**Product Market Reforms and Technology Adoption by Senegalese Onion Producers**[1]

Tanguy Bernard* Alain de Janvry** Samba Mbaye,*** and Elisabeth Sadoulet****

* International Food Policy Research Institute and University of Bordeaux, t.bernard@cgiar.org

**University of California at Berkeley, alain@are.berkeley.edu

***University Gaston Berger in Saint Louis, sambambayeptci@yahoo.fr

****University of California at Berkeley, esadoulet@are.berkeley.edu

March 16, 2016

**Abstract**

We empirically assess the responsiveness of Senegalese onion producers to significant changes in product market conditions, whereby onions are sold no longer based on volume but on weight and with labeling certifying quality. A village-level randomized information campaign on the upcoming introduction of these market reforms induced significant increase by farmers in the use of quality-enhancing inputs. Delays in the effective introduction of scales enabled us to show positive price returns from these quality-enhancing investments. These results point to the importance of improvements in the functioning of product markets to trigger technology adoption by farmers. Introduction of scales and labels was, however, not sustained as it challenged the market power of wholesale intermediaries. For these reforms to be sustainable, effective market regulation would be necessary.

Keywords: Agricultural technology, Product market, Quality, Sub-Saharan Africa

[1] We are grateful to Assane Sylla and his team for their help in implementing the intervention and ensuring proper data collection. We gratefully acknowledge funding from the Bill and Melinda Gates Foundation through the Agricultural Technology Adoption Initiative.

## 1. Introduction

Use of basic agricultural technologies such as adequate fertilizers and seeds remains low in Sub-Saharan Africa, particularly among smallholder farmers (Gollin, Parente, and Rogerson 2002; World Bank 2007). Lack of access to these technologies, of information about their use, and of financial services all contribute to these low adoption rates (Jack 2011; Karlan et al. 2014). Farmers are further discouraged by limited access to remunerative product markets (Foster and Rosenzweig 2010; Suri 2011). Insufficient roads and communication infrastructures lead to situations of high transaction costs, shallow local markets, and disproportionate capture of surplus by local intermediaries (Fafchamps and Hill 2008; Aker 2010, Goyal 2010). Extensive market failures, in particular associated with the significant market power of intermediaries in remote regions of the country, further contribute to distorted incentives to farmers (Osborne, 2005; Dillon and Dambro, 2016; Porteous, 2016).

This paper provides evidence that small changes in market settings can lead to important production responses by farmers. We rely on a field setting in northern Senegal, where scales were not available for onions to be weighed at time of sale in local collection points.[2] Local consignment agents (coaxers) and authorities argued that these markets were so distant from large consumer markets that the use of scales would discourage traders (banabanas) from traveling the distance and reduce market opportunities for farmers. Thus, onions were sold based on loosely assessed 40 kilogram bags, with preference being given to overfilled ones. Farmers reacted to this perverse incentive by relying on urea-based fertilizer, producing larger although lower-quality (fast deteriorating due to high water content) onions with lower value on consumer markets.

In late 2013, local authorities decided on the introduction of scales and quality labels in the next 2014 season. To assess how this change in market conditions affected farmers' production behavior, we designed an information campaign ahead of the 2014 season, randomly targeted to half of the villages in the vicinity of these markets, and related to the upcoming introduction of scales and labels. Six months later, farmers from these villages were 9 percentage points less likely to have used urea and 27 percentage points more likely to have used a weight- and quality-enhancing fertilizer (10-10-20 nitrogen, phosphorus, potassium) as compared to the control group.

[2] Such scales exist in most other onion markets in the country, including collection points, wholesale markets, and consumer markets.

They were also 7 percentage points more likely to have sorted their onions before taking them to the collection point, a costly measure to enhance quality. In markets, we find that bags originating from villages where information had been provided were 16 percentage point more likely to be of higher quality than those from control villages.

To identify effect on prices, we rely on a naturally occurring time discontinuity. Local authorities did not grant the final formal permission for the scales to be operating until a rather unforeseen date, late in the season. Until then, scale operators could measure weight and quality but were not allowed to reveal this information on a label attached to each bag of onion weighed. We find no effect of the information campaign on the price per kilogram in the few days before labeling was introduced. The price of onions from the targeted villages, however, increased by 9 percent in the very first days following labeling. With imperfect attendance at meetings in treatment villages and information spillovers to control villages, these results are likely conservative.

Information about, and availability of, inputs is not a significant constraint to technology adoption in our study setting. The area has long been the focus of agricultural extension activities, and access to inputs is facilitated by a relatively dense network of private retailers. Liquidity constraints are also unlikely to explain low adoption of improved fertilizers. While more expensive, the added cost of 10-10-20 is negligible compared to the overall cost of onion cultivation. Our results, however, suggest that the functioning of output markets can be a strong impediment to technology adoption. A seemingly small change in the functioning of these markets led to a rapid response by producers, yielding higher-quality onions sold at better prices for producers.

These results are in line with standard theoretical predictions regarding partially observable quality attributes and adoption of quality-enhancing technology. Fafchamps, Hill, and Minten (2008), for instance, show that growers' incentive to engage in quality-enhancing investments decreases as the cost of quality inspection increases. Positive inspection costs lead to under-provision of quality, up to a point when inspection costs are sufficiently high that no quality premium is provided and no farmer engages in quality-enhancing technology. In our context, the introduction of weight and quality labeling significantly reduces the cost of quality inspection. To our knowledge, these results are the first to document the effect of such policy changes in a developing country context.

Our results further contribute to the literature on information asymmetries in agricultural markets of developing countries. The recent literature has in particular focused on the impact of having access to price information through mobile phones and market information services (Jensen 2007; Aker 2010; Aker and Fafchamps 2015, Goyal 2010). This literature notably finds a positive impact of mobile phones on spatial arbitrage but more nuanced effects on those farmers unable to exploit such opportunities. In our case, close to 60 percent of the farmers report knowing market prices per kilogram in main wholesale and consumer markets before taking their onions to collection points. Without scales, however, translation to the price of their own onion production is at best fuzzy, contributing to tensions with local consignment agents. On a broader scale, our results give support to the role of information in increasing the homogeneity of measurement of volumes and qualities along the value chain.

The paper is organized as follows. Section 2 provides background information about production and sales of onions in our study area of the Senegal River Valley in northern Senegal. In section 3, we detail our study design, including the various samples, interventions, and identification strategies. Section 4 presents our results on technology adoption by farmers, while section 5 focuses on market outcomes. Section 6 concludes with an epilogue on the sustainability of the market reforms.

## 2. Study Setting

### 2.1. Context

Onion is used basically every day in every single Senegalese kitchen. For years, the estimated 150,000 tons consumed annually were supplied mostly by imports from the Netherlands. Since the early 2000s, the Senegalese government has attempted to increase incentives for local production through a seven-month ban on onion imports (from February to August), the development of new irrigation schemes, input subsidies, and technical support from national and regional extension agencies (ISRA[3] and SAED[4]). In the Senegal River Valley, onion is now competing with tomatoes as the second most important crop for acreage, after rice.

[3] Institut Sénégalais de Recherche Agricole.
[4] Société Nationale d’Aménagement et d’Exploitation des Terres du Delta du Fleuve Sénégal.

The Podor department, where our study takes place, is several hundred kilometers distant from the main consumer markets in Dakar, Touba, and Saint-Louis (Figure 1). There, onion production covered 350 hectares in 1990 and 3,500 hectares a decade later. Onion is mostly cultivated on irrigated perimeters, with a cycle ranging from 75 to 90 days from transplantation to harvest, depending on varieties, inputs used, and temperature. While relatively straightforward to plant, onion size depends on planting intensity and type of fertilizers used for top-dressing, which in turn affects quality. In particular, SAED (the main extension agency in the Senegal River Valley) recommends four applications of fertilizers: at transplanting time and 20, 40, and 60 days after transplanting. The type of fertilizer recommended includes 1kg of organic fertilizer or urea per square meter, jointly with a cover of 10-10-20 (nitrogen, phosphorus, potassium) mineral fertilizer. Overall, the per-hectare recommendation includes 100kg of Urea and 200kg of 10-10-20 fertilizers (CGERV, November 2014). Studies have however found excessive use of urea by farmers in order to increase yields. In contrast, potassium which is a central element to produce higher quality and lower perishability is largely under-supplied (Duteurtre, Faye and Dièye, 2010).

While onion production receives important support from the Valley's agricultural extension agency (SAED), all actors agree that commercialization remains a major constraint contributing to limited benefits for farmers. Spatial arbitrage opportunities are limited for farmers due to high transport costs.[5] Time arbitrage opportunities are also scarce due to the high perishability of onions produced locally and lack of storage facilities. Once harvested, onions usually need to be sold within the next one or two days.[6] To facilitate exchanges between producers and buyers, commercialization largely rest on the use of consignment agents (*Coaxers*) who sell on behalf of producers to itinerant traders (*banabanas*) without assuming property of the product. Coaxers are resident of local village communities, with knowledge on availability of mature onions amongst local farmers. Historically, *coaxers* would bring *banabanas* to farmers' field for farm-gate transactions. With the increase in local production, *banabanas* are increasingly relying on transport form large trucks with little possibility to reach remote farmers' fields. Instead, 60 to 70 percent of all transactions occur on local collection points where farmers leave their onions on

[5] Transport cost of onion from our study zone to main consumer outlets in Dakar or Touba reaches FCFA 450 to FCFA 500 per 40kg bag – a gross 10% of the sale price at collection points.

[6] Data from the 2013 commercialization season suggests that over 90% of the onions were sold within three days after they were brought to the collection point. By then, the quality of 10% had deteriorated, for an overall 30% of the bags that included some significant amount of rotten onions.

consignment with coaxers, who are remunerated a flat fee per (presumed) 40-kilogram bag upon selling the onions to *banabanas*. There, most farmers complain that prices are highly volatile depending on daily levels of supply and demand (Figure 2), quality is not recognized, coaxers are not providing enough effort (with eventual suspicions of cheating), and the market power of *banabanas* is a source of graft and rent extraction from producers. Although farm-gate commercialization is preferred by the majority of farmers, most are forced to bring their onions to collection points where the probability to sell fast is higher – a point of importance with rapidly degrading production.

Transactions in wholesale and consumer markets (mainly in Dakar, Touba, and Saint-Louis) are organized around criteria of origin, variety, quality, and weight. This is also the case at collection points in production zones closer to wholesale and consumer markets, where each transaction is duly weighed and inspected by the parties. Only in the department of Podor are transactions based on fuzzier assessments. While most onions are of the same variety, there were traditionally no scales to assess the actual weight of each bag. Weight assessment was part of the negotiation process between coaxers and traders, with farmers overfilling their bags in expectation of higher prices and more rapid sales. In our data, the average weight of bags was 42.7 kilograms before the introduction of scales, with close to 90 percent of the bags weighing more than 40 kilograms. Producers have long complained about the absence of scales, but coaxers argued that introducing scales would reduce visits by traders in such distant markets, implicitly acknowledging that traders benefited more from a system without scales.

### 2.2. Intervention and Data

In late 2013, Podor's local authorities decided to introduce scales at local collection points, obtained by the local onion producer association (APOV[7]). Supported by an external development intervention, the scales were to be operational at the beginning of the upcoming 2014 commercialization season. In collaboration with SAED, we organized training sessions for the 34 villages in the area from which farmers brought onions to the three collection points in the previous year. The training focused on quality-enhancing technologies and practices in the cultivation of

[7] Association des Producteurs d'Oignons de la Vallée du Fleuve.

onions, including optimal fertilizer use for quality onions. Although the region is characterized by relatively high access to extension services provided by SAED, this training ensured that all producers in the area had a similar level of information regarding means to produce high-quality onions.

In late January 2014, we randomly chose half of these villages for a follow-up information campaign whereby we informed onion producers about the upcoming introduction of scales at the three local collection points. Given our small sample size, villages were first grouped in quintiles based on the number of onion producers who had participated in the training campaign (a proxy for the total number of producers in the village). In each quintile, half of the villages were allocated the treatment status (a public meeting was organized to provide producers with information about the upcoming system of weight and quality labeling), and the other were kept as controls. Producers in the treatment group were told that at each of the three collection points, scales would be installed early in the season and operated by external agents from the local University Gaston Berger (UGB). These agents would also assess the quality of onions brought to collection points based on the share of good-/medium-/low-quality onions in each bag. Bags would then be labeled with information about weight and quality. Coaxers would still be in charge of sales to traders. This village-level random variation in access to information about the upcoming scales constitutes our main variation, enabling us to assess how farmers' production decisions vary in response to reforms in the market on which they are selling their onions.

By February 2014, eight scales were purchased and placed at the markets, with operators hired and trained by UGB. For the scales to effectively start operating, however, a formal decision by the head of the local administration needed to be taken in a meeting gathering representatives of farmers and coaxers. The meeting was postponed several times until late April 2014, well into the commercialization season. It was then decided that scales would operate but that farmers and coaxers would be free to use them or not.

On May 2, UGB agents started operating the scales and assessing the quality of bags, with a separate group of enumerators collecting information about weight, quality, and price obtained for each transaction. For their first 10 days of operation, the scale operators merely provided the weighing and quality assessment service to farmers upon arrival at the market with their onions to be sold. Starting on the 11th day (May 12, 2014), each onion bag that went through a scale was duly labeled with a tag reporting its weight and its (externally assessed) quality. This time discontinuity in the effective implementation of the market reforms enables us to assess how changes in production strategies by farmers is effectively rewarded through better prices. By the end of May, the season was essentially over, and data collection on markets stopped.

Our final sample includes 533 transactions that occurred during the month of May 2014 in the three collection points of Podor and that went through the weighting and quality-assessment system. For each of these transactions, onion bags were weighed and their quality externally assessed. For 75 percent of them, onions originated from villages targeted by the randomized information campaign of January 2014. As can be seen in Figure 2.3, this imbalance does not seem to vary significantly during the time period considered, in particular before and after introduction of labels on the weighed bags. It is clear, however, that the number of transactions drastically decreases in the second half of May as the season comes to an end.

Figure 4 further illustrates the particularly high instability of prices toward the end of the commercialization season in the Senegal River Valley. Here we report the evolution of prices at the closest collection point to our study sites. This market is more than 50 kilometers away from Podor, on the main road toward major wholesale and consumer markets. There, scales have been operating for several years such that the price level is unlikely to be affected by the introduction of scales in the Podor collection points. If anything, Figure 4 suggests the likely sharp natural rise in prices at the Podor collection points, even without the introduction of scales.

In August 2014, we visited all 200 farmers who had sold their onions in the market during the month of May.[8] Information collected covered issues related to planting, fertilizer, irrigation, and postharvest sorting, along with the recalled dates of these operations. Our sample covered only farmers and coaxers who effectively chose that their onions be weighed and quality assessed. Figure 5 summarizes the various treatment and data collection efforts, along with their corresponding time coverage (see section 6 for a discussion and test of sample selectivity issues).

[8] For about 25 percent of the recorded transactions, onions were owned by coaxers themselves—most of them having purchased these onions from farmers at the farmgate. As they did not specifically engage in production, we did not survey these coaxers.

## 2.3.Experimental Integrity

This section reports on implementation of the information campaign and validates the experimental design. At the producer level, Table 1 reports on producers' knowledge of the scales and labels intervention. By the time we conducted the survey (August 2014, that is, well after the end of the season), virtually everyone knew about the introduction of scales and labels in both targeted and non-targeted villages. Yet one finds clear differences in the sources of this information and the timing when it was made available to farmers in the treatment and control villages. In treatment villages, 53 percent of respondents report learning about the scales and labels through the information campaign, which occurred at the end of January. This is confirmed by a similar proportion (51 percent) reporting learning about the change in January.[9] In comparison, 18 percent in non-targeted villages learned about it through the campaign, and thus most learned about it later during the year—42 percent found out about the existence of scales and labels upon delivering their onions.

This difference in timing has some implications for farmers' production decisions. According to farmers themselves, less than 25 percent in control villages changed their production decisions in response to this information, compared to 79 percent in treatment villages – a preliminary indication of the impact of the information campaign. Among those who changed, 48 percent revised their use of fertilizers (often referred to as "moving out of urea"), 52 percent say that they sorted their onions better, 13 percent say they used better irrigation, and 2 percent say they used better seeds. Overall, we find a fairly high level of compliance with treatment allocation: high and timely awareness of the introduction of scales and labels in treatment villages and comparatively much lower and later access to this information in control villages.

Next we assess the similarity of farmers' characteristics and production choices before the information campaign. Planting-related decisions are unlikely to be affected by the information campaign, as most planting occurs from November to January and the information related to scales and labels came only at the end of January (in our data, 95 percent of the plots were planted before the date of the information campaign). As reported in Table 2, we do not find significant differences between treatment and control villages related to the number of plots, total area planted

[9] The slight discrepancy between the two numbers is likely due to individuals' not remembering precisely the day of the campaign, which occurred in late January.

with onions, or date of planting. We further assess whether farmers from treatment and control villages started with the same initial level of knowledge about onion production. The extension campaign reached only about one in three farmers in both treatment and control villages. Asked about key aspects of this training, farmers in treatment and control villages gave similar answers on average, with the exception of whether one should harvest onions with or without their leaves. Last, we find that a large proportion of farmers in both treatment and control villages have a good idea of onion prices in Dakar before they bring their own to the local collection points. Overall, we do not find evidence of systematic differences between producers in treatment and control villages in pre-treatment behavior or in characteristics that are unlikely to be affected by treatment.

## 3. Information and Producers' Behavior

As shown in Table 1, 79 percent of the farmers in treatment villages reported that knowing about the upcoming introduction of scales and labels affected their production decisions. In most cases, these changes related to the type of fertilizer used and whether they would sort their onions before bringing them to the collection points. This section further explores the magnitude of these effects. We rely on ordinary least squares–based intent-to-treat estimates, where the dependent variable is regressed on village-level treatment allocation. Treatment being allocated at the village level, standard errors are correspondingly clustered at this level. The data in this section exclusively rely on the August 2014 survey of the 200 farmers who transacted on the three collection points in May and whose onions were weighed with the scales.

In Table 3 we first report the means and standard deviations of the variables used later on in this section for the control group. Accordingly, we find that the average planting date lies far ahead of the information campaign. In our sample, 95 percent of the fields were planted before January 23, limiting the scope for any impact of the information campaign on production decisions. On average, onions were ready to be harvested on April 2, 2014. Onions do not need to be harvested right away, however, and can stay in the field for an additional one to three weeks without much degradation. The rate of degradation accelerates a lot once the onion is picked from the field. Still, with the average onion plot being harvested in mid-April, the effective introduction of labels on May 12 did miss most of the season's production.

Table 3 further indicates high levels of fertilizer application. In effect, we did not survey a single producer who had not used at least one type of fertilizer in his or her onion field. Urea is by far the most commonly used, followed by 9-23-30. The use of 10-10-20 fertilizer, which is the number one recommendation by SAED for top-dressing, is comparatively very low in terms of both occurrence and volume (extensive and intensive margins). Last, a very high proportion of farmers reported sorting their onion harvests before bringing them into the local collection points. Accordingly, for 92 percent of the transactions originating from farmers in the control group, onions had been sorted before being brought to the consignment agent. Clearly, however, this binary variable could mask important heterogeneity in the extent of sorting.

In Tables 4, 5, and 6, we report estimates of the impact of living in a village chosen to receive information about the upcoming scales and labels in late January 2014. We first assess whether farmers revised their planting plans. In Table 2 we did not find that farmers from these villages differed in terms of the number and size of plots allocated to onion production. In Table 4, we do not uncover further evidence that information has affected decisions about when to plant fields.

In contrast, Table 5 reports a significant effect of the information campaign on the use of fertilizers. Two-thirds of fertilizer applications in control villages occurred after the date of the information campaign. Overall, fertilizer applications were more likely to be affected by treatment than were planting decisions. We find that treatment is associated with a 9 percentage point decrease in the likelihood that a household used urea as a fertilizer, although we do not find a clear effect on the quantity of urea used. In contrast, our results show a large increase in of the likelihood of using 10-10-20 fertilizer. Farmers in treatment villages are 27 percentage points more likely to have used such a type of fertilizer (a close to 100 percent increase from the control group), and there was a 116 kilogram per hectare increase in the quantity of this fertilizer that is used (a more than 250 percent increase). We do not find any meaningful effect of the information campaign on the use of 9-23-30. This result on the shift in fertilizer use from urea (good for yields) to 10-20-30 (good for quality) is a major indication of the channel through which quality response has been achieved.

Last, Table 6 reports estimates of the extent to which farmers increased their sorting of onions before bringing them to collection points. As discussed above, the initial level is very high to start with, likely due to a broad assessment of what sorting entailed. While the initial objective was to capture whether farmers gathered high, medium, and low quality into separate bags, it is likely that this question was understood as farmers merely removing overly rotten onions and foreign matter from the bags. Nevertheless, Table 6 suggests a positive increase in the sorting of onions among farmers in treatment villages. Important to note, this effect is limited to the month of May, when scales and labeling were effectively operating. In effect, farmers typically call up their coaxers before bringing their onions to market. Those informed about the upcoming scales may have asked whether the scales were in place and only if so engaged in further sorting of their onions. Without this information, or without higher-quality onions derived from enhanced use of appropriate fertilizer, farmers in control villages had a lower incentive to increase sorting of their onions during the month of May 2014.

Overall, results in this section point to a rapid and meaningful reaction of farmers to the information they received about installation of scales and quality labeling at local collection points. Despite a relatively small sample and a one-time-only information campaign, we find clear evidence that farmers have changed their production behavior in response to incentives to quality through use of dedicated fertilizer and sorting of onions. These results are reinforced by the fact that impact is not observed for decisions that could not be affected by the campaign (planting time) or when scales were not yet active (sorting).

## 4. Information and Market Outcome

As established in the previous section, the treatment-induced changes in producers' behavior are mainly driven by changes in the type and quantity of fertilizer used. Increased use of 10-10-20 and decreased use of urea are supposed to generate higher-quality, denser, heavier-per-volume, though less voluminous onions. We assess the extent to which changes in producers' behavior translates into higher prices for their produce. We rely on data collected at the scale and transaction level on the three collection points. Each transaction was matched with the producer's village of origin, which enables us to assess the effect of the information campaign on market outcomes. Results are reported in Table 7.

We first assess whether onions brought to collection points by producers from treatment villages were in effect of higher quality than those originating from control villages. Scale operators were trained by SAED to measure onion quality by emptying one in every five bags, separating the bag's content into high- and low-quality onions, and assessing the respective proportions within the bag. If the proportion of high-quality onions surpassed an established threshold, the bag was deemed of good quality as well as the next four bags of the same producer.[10] If not, it was assessed of low quality as were the next four bags. This exogenous quality measurement, independent from ongoing negotiations between producers, coaxers, and traders, enables us to trace producers' decisions to the quality of their onions in the market. Results in the first column indicate a 16 percentage point added chance of onions' being of good quality if originating from a treatment village (from a level of 8 percent in the control villages). Thus, there is clear traceability of farmers' production choices on the quality of their onions. Results in the second column show that once labels have been introduced, one-third (though not significant) of the treatment effect is accounted for by the realization of labeling. This likely comes from additional sorting once scales and labels were in place.

In the third column, we assess the extent to which such quality increases translated into price increases over the entire month of May. With the naturally occurring variation in prices in the second half of the month (cf. Figure 4), we control for the transaction's date with linear and quadratic terms. We do not find a clear effect of the information campaign on prices received by producers throughout the period.

Recall that although operating from May 2, scale agents did not start labeling bags with weight and quality information until May 12. Until then, traders did not access weight and quality measures, and onions were sold by the bag as previously in the season. If, as believed by producers, scales would lead to more remunerative quality-enhancing investments, one should have observed these effects after labels were properly introduced. We test for this effect in columns 4 to 7, with a difference-in-differences approach where the interacted term between the use of labels and being from a treatment village gives the effect of introducing scales and labels on the collection points, inclusive of producers' behavioral responses to these changes.

In column 4, we first assess whether in effect there was no premium to the higher quality of onions from treatment markets ahead of the introduction of labels. We do so with a test of parallel trends on the period before the introduction of labels. Taking as a placebo the label introduction date in

[10] Although the UGB agents were trained (by SAED) on evaluating three levels of quality, only two (medium and low) were reported in the data. In what follows, we use this distinction as a binary variable indicating whether the bags were of higher or lower quality.

the middle of the period (day –4), we do not find any evidence of differentially evolving price trends between onions in treatment and control villages.

In columns 5 to 7, we assess the effect of duly introduced labels on May 12. In column 5, a bandwidth of +/– 4 days from May 12 yields the minimum mean square error and is thus considered optimal. We test for the robustness of these results with half and double bandwidths in columns 6 and 7, respectively. We find clear evidence of the combined effect of labeling and the information campaign. In the four days following the introduction of labels, farmers from treatment villages received an average extra FCFA 10.6 for each kilogram of onion. This corresponds to a 9 percent increase from the overall per-kilogram price.

The same results hold when considering a smaller bandwidth in column 6. Results are, however, lower in magnitude in column 7, when the bandwidth considered runs from –8 to +8 days around May 12. Together these results suggest that quality premiums are lower toward the end of the season when the growing scarcity of supply becomes the main driver of prices.

We further verify that the external assessment of quality as reported in labeling, with classification of bags into three categories from best to worst, corresponds to what wholesale agents are looking for in their transactions. In Table 8, we correlate the external quality indicator with banabanas' own quality assessments of the same bags. Results show that label categories have strong predictive power of banabanas' own quality assessment, with categories 2 and 3 in banabanas' assessment scoring increasingly lower on UGB agents' quality assessment. As column 2 suggests, this correspondence in quality assessment is fully conveyed by the introduction of labels. Last, we further verify the relationship between externally assessed quality and price and the role that labels have in transmitting this information. In Table 9, we see that externally assessed quality is positively correlated with price. As column 2 shows, this price effect is mainly the result of the introduction of labels.

## 5. Costs and Benefits

With onions of potentially smaller size, it is unclear whether the FCFA 10 premium per kilogram measured in Table 7 is sufficient to cover the costs of investing in the technology. The (subsidized) price of urea in the area is FCFA 167 per kilogram, while each kilogram of 10-10-20 costs FCFA 200—a 19 percent difference. However, the unsubsidized price of urea in the region is FCFA 240 per kilogram, 20 percent higher than the cost of 10-10-20. In the following estimates, we assume that all farmers have access to the subsidized price and discuss the implication of subsidies at the end of the section. Using results from column 4 in Table 5, this represents a FCFA 4,408 increase in production cost per hectare.

On the side of harvest, the increase in quality may, however, come at the cost of lower overall quantity harvested. Our survey setting did not allow for the weighing of farmers' total harvest, nor did we measure the volume of each bag. Although these bags are standard, farmers decide whether to overfill them or not. From casual observations, we did not observe that bags of onions from treatment villages—of higher quality on average—were less filled than bags from control villages. Furthermore, with a fixed price per bag and payment by kilogram, farmers in treatment villages had no incentive to decrease their filling of bags. Thus, we hypothesize a homogeneous volume of bags between treatment and control villages.

Using information collected about markets, we estimate in Table 10 the relationship between quality and weight (column 1) and the impact of the information campaign on the weight of each bag (column 2). Results are consistent with agronomic predictions in that bags of higher-quality onions weigh more than bags of lower-quality onions. The magnitude is, however, relatively small: bags of 42 kilograms on average for the lower-quality type are only 0.86 kilogram heavier when filled with onions of better quality (a mere 2 percent difference in weight). Results in column 2 are consistent in sign and magnitude with bags from treatment villages weighing slightly more than those coming from control villages, although the coefficient is less precisely estimated.

Turning to production levels, we assess in Table 11 the changes induced by the information campaign in the quantity of onions harvested per hectare, at the plot level, relying on recall data from farmers and measured in number of bags. Our results show no overall effect of the information campaign on the farmers' overall harvest (columns 1 and 2) or yields per hectare (columns 3, 4, and 5).

Assuming other production costs are constant across treatment and control villages (we did not, for instance, find impact on the number of irrigation rounds per plot), one may use the above numbers to assess the overall impact of the information campaign on farmers' onion revenues. The average farmer produced 239 bags of onions per hectare in both control and treatment villages. The average bag in control villages weighed 42.2 kilograms, giving a total harvest of 239 × 42.2

= 10,086 kilograms per hectare in the control group and 239 × (42.2 + 0.68) = 10,248 kilograms per hectare in the treatment group. Farmers in treatment villages invested FCFA 4,408 more per hectare in 10-10-20 than did those in control villages, that is, $4408/10{,}248 = \text{FCFA}\ 0.43$ per kilogram harvested. On selling in markets with operating scales, onions from treatment villages were priced FCFA 10.6 higher than those from control villages for which the average price was FCFA 115 per kilogram at the time the scales were introduced.

Overall, the difference in revenues per hectare between farmers in treatment and control groups is given by $(10{,}248 \times (114 + 10.6 - 0.42)) - 10{,}086 \times 114 = \text{ FCFA}\ 122{,}793$ (a 10.7 percent increase in income per hectare compared to the control group), although there is a likely smaller increase in benefits per hectare once the costs of other inputs are subtracted.

## 6. Selection Issues

Our sample of transactions and of producers undertaking these transactions is not representative of the overall population selling onions at the collection points considered. A significant number of producers did not use the scales to weigh and eventually label their onions and are therefore not recorded in our dataset. Anecdotal evidence suggests that on being offered the opportunity of using the scale, producers with lower-quality onions decided to sell directly to banabanas on the basis of volume. Furthermore, a number of consignment agents—in charge of selling on behalf of farmers—boycotted the use of scales for all the onions for which they were responsible.

If true, this self-selection issue implies that our analysis compares farmers producing the best-quality onions in villages targeted by the information campaign to the best-quality producers in control villages. Using the list of 2,430 producers who sold their onions at collection points in the 2013 season, we find that 71 percent originated from treatment villages, while 29 percent originated from control villages. In contrast, the sample of producers using scales in the 2014 season is further skewed, with 19 percent of producers from control villages. If anything, this selection suggests that part of the recorded producers from the treatment villages would have produced lower-quality onions than those from control villages, had they not had access to the information campaign. Comparison of recorded producers between treatment and control groups would thus produce a downward bias on our estimate of prices obtained on the markets.

We assess the extent to which selection issues may bias our results using data from the previous campaign on the same markets—a campaign wherein no scales were introduced on the market. At the same time, we recorded basic characteristics of farmers selling at collection points, including the number of bags sold on a given transaction, the price obtained, whether the producer had sorted his or her onions for quality, as well as his or her phone number. Telephone numbers were also recorded in the dataset used in this paper, enabling a matching of our sample of producers with the larger sample of producers who sold on the market in the previous year. This enables us to compare the characteristics of producers using the scales when they became available to the characteristics of those who decided not to use them.

Results are presented in Table 12. We do not uncover any clear evidence of selection in column 1 or in column 2 upon adding coaxer fixed effects. If anything, results suggest that those who sorted their onions based on quality in 2013 are 3 percent more likely to have used the scales in 2014. Coaxer fixed effects (not reported here) are in large part highly significant, further suggesting that the choice of using scales was in fact largely decided by coaxers, some of whom simply decided to boycott the scheme. Results in column 3 indicate an overrepresentation of treatment producers in our sample as compared to controls, although we did not uncover clear evidence that this selection is based on the farmer characteristics that we rely upon here, as shown in columns 4 and 5.

## 7. Epilogue

Scales and quality labeling were introduced in 2014 at the Podor onion collection points to make those engaging in transactions better informed and transactions more transparent. We used a field experiment to assess producers' responses to quality recognition in market transactions. Results show that it created significant gains for producers as weighing and labeling induced higher quality that was rewarded by higher price. Producers responded to quality recognition by using more quality-enhancing, instead of volume-enhancing, fertilizers and engaging in more sorting of onions to grade bags by quality level. Higher prices with no declines in yields led to significant income gains for farmers. This indicates that African smallholder farmers, although generally illiterate and poorly informed, can respond to price incentives by adjusting both their production and their marketing practices.

With these positive results creating efficiency and equity gains, it should come as a surprise that the process of weighing and labeling was abandoned in the following cropping season. Understanding why this happened requires assessing the political economy of relationships between the four categories of agents involved in the onion value chain: producers, coaxers, banabanas, and local development agencies. A survey of opinions revealed the following responses to the experiment.

Producers indicated strong appreciation for the initiative. Weighing was seen as important to them because they knew that there was extensive cheating by banabanas, with presumed 40-kilogram bags needing to be overfilled to be sold and reaching on average an extra unremunerated 7 percent. Quality recognition was also important to them as a source of additional revenue, especially through labeling endorsed by third-party verification, in this case our research team overseeing the labeling process.

Coaxers were divided about the issue due to fears of free riding creating advantage for some of them over others. Coaxers' main concern is being able to sell rapidly to banabanas the onion bags on consignment with them. Their concern is to deter banabanas from exercising their fallback options, namely, buying at the farmgate instead of the collection point, shifting their purchases to other collection points, or buying from coaxers who do not use scales. Typical of a prisoner's dilemma situation, each of them has more to gain from defaulting until a regulatory authority can impose respect for the new system on all coaxers. Survey of opinions thus found some coaxers agreeing with the system and others categorically rejecting it.

Banabanas are the ones with market power in these distant markets, and they are the main losers from greater market transparency. They voiced quasi-unanimous opposition to the system. They were able to exercise enough pressure on coaxers and regional authorities to make sure that the system would be discontinued and not universally extended to all collection points.

Local development agencies have been shown to be effective in delivering technical assistance to farmers. They were able to gather farmers and work with their local organizations to deliver training in quality response and storage. They were, however, not able to intervene in regulating markets and imposing new rules to coordinate agents on behalf of the collective good. This is in part due to the fact that national markets remain highly unstable with erratic government interventions on import policies that undermine price expectations on local markets. This also derives from lack of political representation of farmers' interests that the local agencies could use to press for policy reforms.

In the end, what we see is that market reforms can be effective in inducing technology adoption by smallholder farmers but that they need effective regulatory power to be implemented. To exercise power, local regulatory authorities need to be backed up by political will, transparent national policies, and organized popular support. The sad lesson from this experiment is that large sums of money can be left on the table, with well-recognized efficiency and equity-promoting reforms remaining unimplemented, until state interventions in markets become better codified and farmers achieve enough political power to exercise their rights over these reforms.

References

Aker, J. 2010. "Information from Markets Near and Far: The Impact of Mobile Phones on Grain Markets in Niger." *American Economic Journal: Applied Economics* 2 (1): 46–59.

Aker, J., and M. Fafchamps. 2015. "Mobile Phone Coverage and Producer Markets: Evidence from West Africa." *World Bank Economic Review* 29 (2): 262–292.

Dillon, B., and C. Dambro. 2016. "How competitive are food crop markets in sub-Saharan Africa? A review of the evidence." Working paper, Evans School of Public Policy and Governance, University of Washington

Duteurtre, G, M. D Faye, and P. Dièye. 2010. *L'agriculture sénégalaise à l'épreuve du marché*. Paris: Karthala Editions.

Fafchamps, M., and R. Hill. 2008. "Price Transmission and Trader Entry in Domestic Commodity Markets." *Economic Development and Cultural Change* 56 (4): 729–766.

Fafchamps, M, R. Vargas Hill, and B. Minten. 2008. "Quality control in nonstaple food markets: evidence from India." *Agricultural Economics* 38 (3): 251-266.

Foster, A., and M. Rosenzweig. 2010. "Microeconomics of Technology Adoption." *Annual Review of Economics* 2:395–342.

Gollin, D., S. Parente, and R. Rogerson. 2002. "The Role of Agriculture in Development." *American Economic Review* 92 (2): 160–164.

Goyal, Aparajita. 2010. "Information, Direct Access to Farmers, and Rural Market Performance in Central India." *American Economic Journal: Applied Economics*, 2(3): 22-45.

Jack, K. 2011. “Market Inefficiencies and the Adoption of Agricultural Technologies in Developing Countries.” White paper prepared for the Agricultural Technology Adoption Initiative, J-PAL (MIT)/CEGA (Berkeley). http://sites.tufts.edu/kjack/files/2011/08/ATAI-white-paper-12102011.pdf

Jensen, R. 2007. “The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector.” *Quarterly Journal of Economics* 122 (3): 879–924.

Karlan, D., R. Darko Osei, I. Osei-Akoto, and C. Udry. 2014. “Agricultural Decisions after Relaxing Credit and Risk Constraints.” *Quarterly Journal of Economics* 129 (2): 597–652.

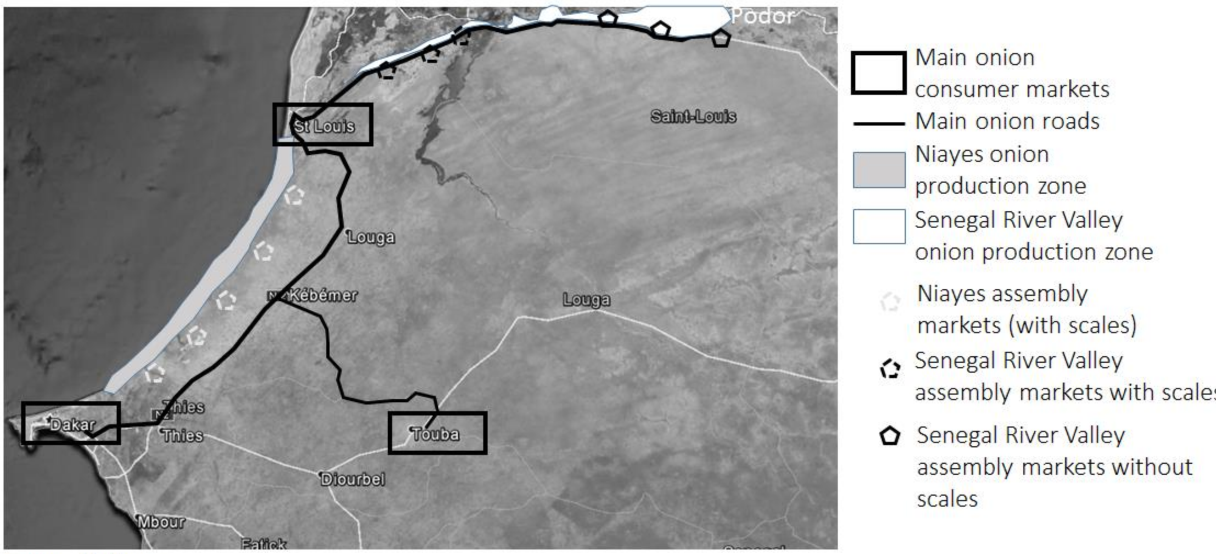
Osborne, Theresa. 2005. “Imperfect Competition in Agricultural Markets: Evidence from Ethiopia.” *Journal of Development Economics* 76(2): 405–428.

Porteous, Obie. 2016. “High Trade Costs and Their Consequences: An Estimated Dynamic Model of African Agricultural Storage and Trade.” Working paper. Department of Agricultural and Resource Economics, University of California at Berkeley.

Suri, T. 2011. “Selection and Comparative Advantage in Technology Adoption.” *Econometrica* 79 (1): 159–209.

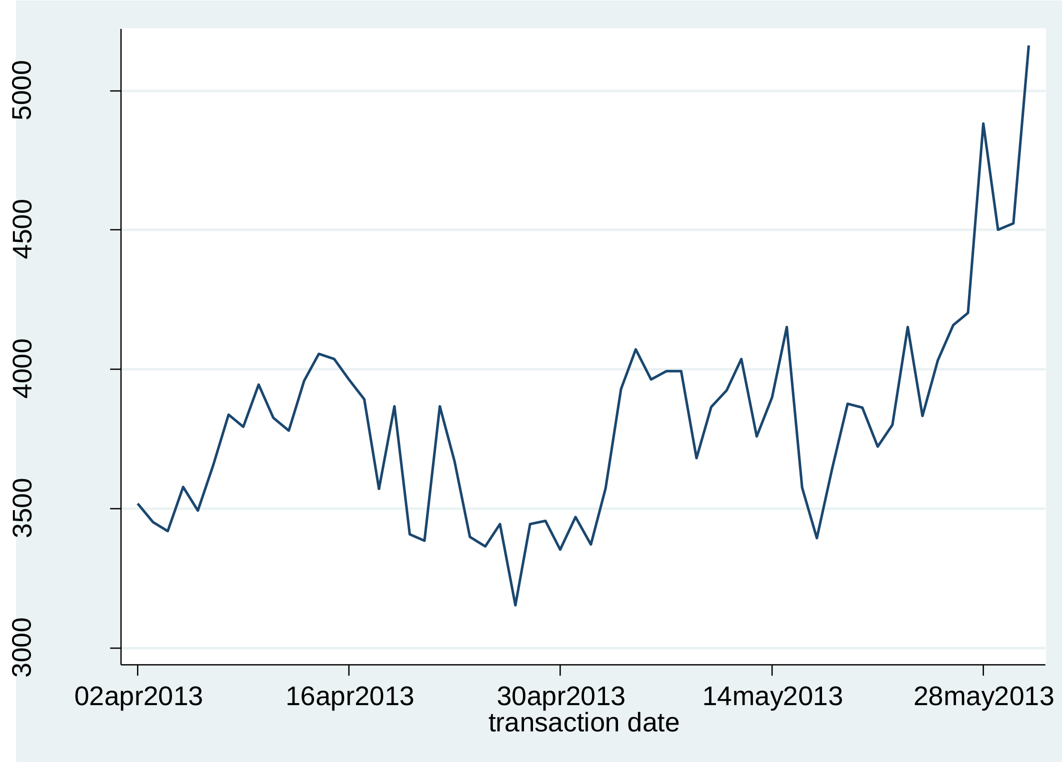
World Bank. 2007. *Agriculture for Development.* World Development Report 2008. Washington, DC.

Figure 1. Study zone




Source: Authors

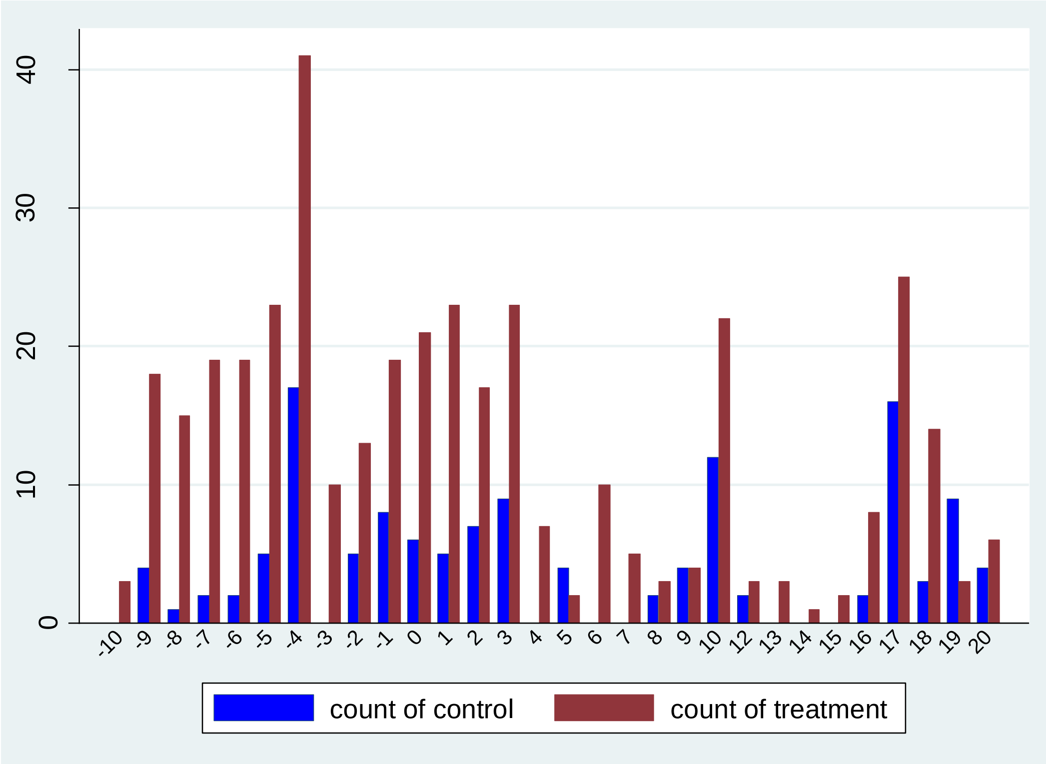
Figure 2. Evolution of mean price on Podor collection points in the 2013 season




Source: Price data collected by authors in the 2013 onion commercialization season
(one year prior to the current study)

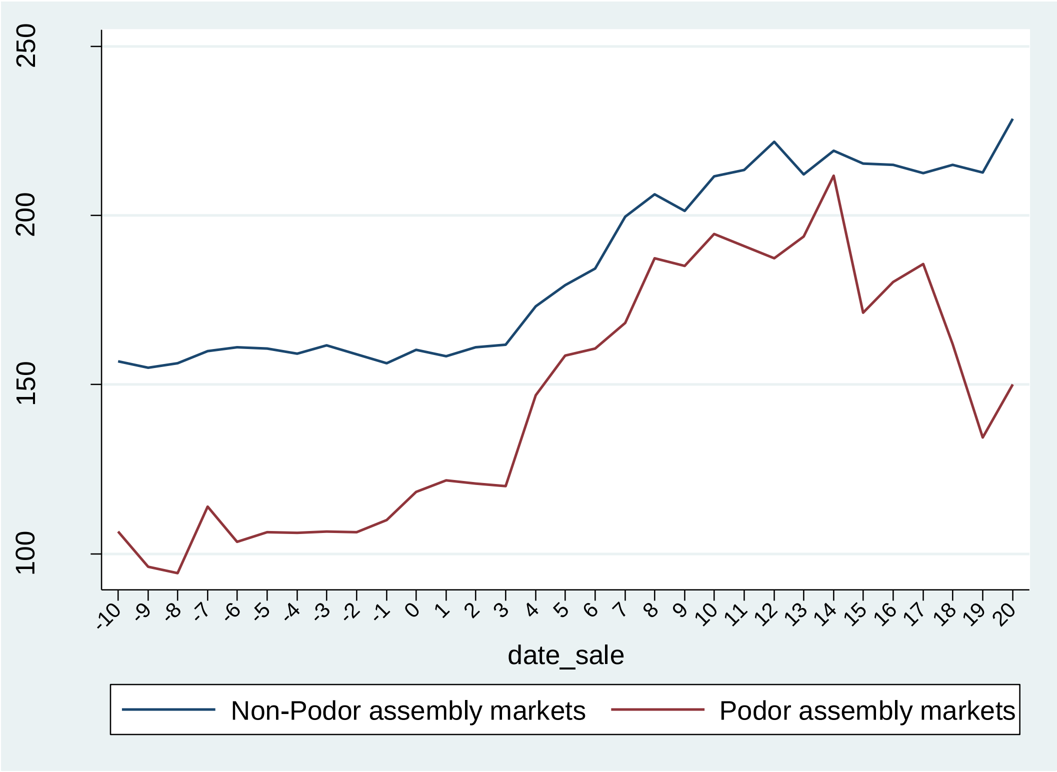
Note: apr = April; may = May.

Figure 3. Number of transactions recorded per treatment arm during May



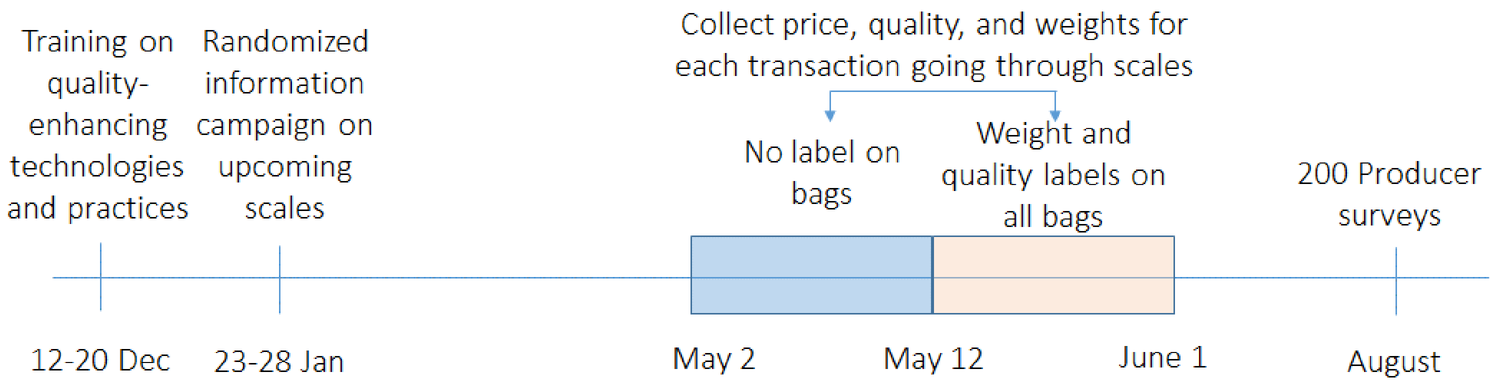

Note: Dates are centralized around May 12, when labels were introduced on bags. Spikes (–4, 3, 10, and 17) correspond to one of the collection points being a weekly market.

Figure 4. End-of-season evolution of prices




Note: Data are from the collection point closest to the study site. Dates are centralized around May 12, when labels were introduced on bags.

Figure 5. Study timeline




Note: Dec = December; Jan = January.

Table 1. Access to information about the introduction of scales, by treatment and control villages

| Information | Control villages | Treatment villages |
|---|---|---|
| % who know about introduction of scales | 97.44 | 98.75 |
| % who learned about it through | | |
| Information campaign | 18.42 | 53.46 |
| Friends/relatives | 23.68 | 11.32 |
| Coaxer | 15.79 | 13.21 |
| On delivery | 42.11 | 20.75 |
| Other | 0.00 | 1.26 |
| % who learned about it in the month of | | |
| January | 21.05 | 50.94 |
| February | 13.16 | 3.14 |
| March | 5.26 | 2.52 |
| April | 47.37 | 32.70 |
| May | 13.16 | 9.43 |
| Doesn’t know | 0.00 | 0.63 |
| % who changed production behavior since learned about scales | 23.08 | 78.80 |
| *n* | 39 | 161 |

Table 2. Tests of balance (household level)

| | *n* | Mean treatment | Mean control | Difference: *p* value |
|---|---|---|---|---|
| Total area cultivated in onions (hectares) | 198 | 0.67 | 0.58 | .58 |
| Number of plots cultivated in onions | 200 | 1.51 | 1.52 | .99 |
| | | | | |
| Respondent attended training on quality | 199 | 0.33 | 0.29 | .67 |
| Respondent's knowledge about means to enhance onion quality | | | | |
| - One should use herbicides | 165 | 1.00 | 0.98 | .12 |
| - One should harvest with leaves | 200 | 0.54 | 0.84 | .00 |
| - Kilograms of base fertilizer to use per hectare | 175 | 206.76 | 205.07 | .85 |
| - Number of weeks after planting to start irrigation | 200 | 17.23 | 16.44 | .54 |
| - Number of weeks after planting to apply first fertilizer | 199 | 20.03 | 19.74 | .82 |
| - Recommended number of fertilizer applications | 200 | 3.08 | 3.22 | .43 |
| - Number of days before harvest for last irrigation | 200 | 20.00 | 19.07 | .53 |
| - One should use mostly urea as fertilizer (%) | 200 | 5.13 | 3.73 | .71 |
| - One should use mostly 10-10-20 as fertilizer (%) | 200 | 30.77 | 34.78 | .55 |
| - One should use mostly 9-23-30 as fertilizer (%) | 200 | 51.28 | 46.58 | .57 |
| | | | | |
| Respondent generally knows prices in consumer markets (%) | 200 | 0.54 | 0.65 | .23 |

Table 3. Mean of dependent variables in control group

| | Mean | Standard deviation |
|---|---|---|
| Date planted | December 16, 2013 | 27 days |
| Date ready to harvest | April 2, 2014 | 24 days |
| Use urea (0/1) | 0.95 | 0.22 |
| Kilograms of urea per hectare | 218.01 | 145.56 |
| Use 10-10-20 (0/1) | 0.28 | 0.45 |
| Kilograms of 10-10-20 per hectare | 43.34 | 96.15 |
| Use 9-23-30 (0/1) | 0.64 | 0.48 |
| Kilograms of 9-23-30 per hectare | 211.87 | 268.41 |
| Sorted onions | 0.92 | 0.26 |

Table 4. Effect of information campaign on planting and harvesting time (plot level)

| | Date planted | Date harvested |
|---|---|---|
| Treatment village | 6.706 | 3.598 |
| | (4.296) | (4.079) |
| Constant | December 16, 2013 | April 2, 2014 |
| | (3.558)*** | (3.566)*** |
| $R^2$ | .01 | .00 |
| *N* | 303 | 303 |

Note: Standard errors are clustered at the village level. ***$p < .01$.

Table 5. Effect of information on overall fertilizer use (household level)

| | Use urea (0/1) | Kilograms of urea per hectare | Use 10-10-20 (0/1) | Kilograms of 10-10-20 per hectare | Use 9-23-30 (0/1) | Kilograms of 9-23-30 per hectare |
|---|---|---|---|---|---|---|
| Treatment village | –0.092 | 45.217 | 0.271 | 116.431 | –0.014 | –0.649 |
| | (0.051)* | (63.187) | (0.118)** | (27.871)*** | (0.074) | (50.059) |
| Constant | 0.949 | 218.012 | 0.282 | 43.344 | 0.641 | 211.870 |
| | (0.033)*** | (28.845)*** | (0.102)** | (18.404)** | (0.069)*** | (41.403)*** |
| $R^2$ | .01 | .00 | .05 | .05 | .00 | .00 |
| *n* | 200 | 198 | 200 | 198 | 200 | 198 |
| Mean of control group | 0.95 | 218.01 | 0.28 | 43.34 | 0.64 | 211.87 |

Note: Standard errors are clustered at the village level. *$p < .1$. **$p < .05$. ***$p < .01$.

Table 6. Effect of information on sorting of onions (transaction level)

| | Producer reports having sorted onions before sales | | |
|---|---|---|---|
| Treatment village | 0.028 | 0.026 | 0.009 |
| | (0.049) | (0.048) | (0.076) |
| Transaction occurred in May | | 0.047 | 0.032 |
| | | (0.020)** | (0.033) |
| Treatment Village × Transaction Occurred in May | | | 0.076 |
| | | | (0.049) |
| Constant | 0.925 | 0.901 | 0.864 |
| | (0.047)*** | (0.046)*** | (0.066)*** |
| $R^2$ | .00 | .01 | .04 |
| *n* | 602 | 602 | 602 |

Note: Standard errors are clustered at the village level. **$p < .05$. ***$p < .01$.

Table 7. Market-level impact of the information campaign

| | Quality | Quality | Price | Price | Price | Price | Price |
|---|---|---|---|---|---|---|---|
| | (full sample) | (full sample) | (full sample) | ]–8,0[ days | ]–4,+4[ days | ]–2,+2[ days | ]–8,+8[ days |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Treatment village | 0.164 | 0.110 | 6.509 | –1.399 | –4.172 | –3.936 | –4.831 |
| | (0.056)*** | (0.069) | (5.181) | (3.572) | (3.837) | (3.387) | (2.469)* |
| Treatment Village × Labels Introduced | | 0.082 | | | 10.643 | 10.438 | 6.827 |
| | | (0.055) | | | (4.492)** | (4.603)** | (3.100)** |
| Treatment Village × Placebo date for label introduction | | | | –2.145 | | | |
| | | | | (4.064) | | | |
| Constant | –0.254 | –0.179 | 77.376 | 97.905 | 99.102 | 37.346 | 140.054 |
| | (0.094)** | (0.115) | (7.307)*** | (7.286)*** | (39.455)** | (84.079) | (3.717)*** |
| $R^2$ | .12 | .12 | .61 | .08 | .15 | .14 | .49 |
| *n* | 543 | 543 | 533 | 223 | 165 | 123 | 320 |
| Mean of control group | 0.08 | 0.08 | 141.51 | 106.77 | 114.02 | 113.9 | 114.94 |

Note: Standard errors are clustered at the village level. All estimates include market dummies, date, and date² terms. *$p < .1$. **$p < .05$. ***$p < .01$.

Data contains 543 measurement of quality (columns 1 and 2), but only 533 for price paid (column 3): 10 bundles of bags were not recovered upon following them at time of transanction. Discrepancy with column 3 is because we are missing information on price for 10 transactions (quality was assessed for all bags going through the scales, but prices were obtained by tracking down these bags for later transactions on the market).

Table 8. Test of recognition of externally-assessed and banabana-assessed quality

| | Onions are evaluated as higher quality by University of Saint-Louis agents | |
|---|---|---|
| Excluded: higher quality as assessed by banabanas | | |
| Medium quality | –0.177 | –0.037 |
| | (0.051)** | (0.112) |
| Lower quality | –0.320 | –0.096 |
| | (0.065)*** | (0.119) |
| Transaction Occurred after Introduction of Labels × | | |
| Medium Quality | | –0.177 |
| | | (0.122) |
| Lower Quality | | –0.333 |
| | | (0.121)*** |
| Constant | 0.111 | –0.040 |
| | (0.091) | (0.142) |
| $R^2$ | .16 | .18 |
| *n* | 476 | 476 |

Note: Standard errors are clustered at the village level.

All estimates include market dummies, date, and date² terms.

***p* < .05. ****p* < .01.

Table 9 Impact on price of externally assessed quality and role of labels

| Variable | Price per kilogram | |
|---|---|---|
| Higher quality | 23.415 | 4.775 |
| | (7.341)*** | (2.786)* |
| Post-treatment Date × Higher Quality | | 27.763 |
| | | (7.965)*** |
| Constant | 85.785 | 90.726 |
| | (4.089)*** | (4.237)*** |
| $R^2$ | .65 | .67 |
| *n* | 533 | 533 |

Note: Standard errors are clustered at the village level.

All estimates include market dummies, date, and date² terms.

**p* < .1. ****p* < .01.

Table 10. Impact of information on weight of bags

| Variable | Kilograms per bag | Kilograms per bag |
|---|---|---|
| Higher quality | 0.804 | |
| | (0.411)* | |
| Treatment village | | 0.688 |
| | | (0.524) |
| Constant | 42.544 | 42.190 |
| | (0.236)*** | (0.445)*** |
| $R^2$ | .02 | .02 |
| *n* | 536 | 536 |

Note: Standard errors are clustered at the village level. *$p < .1$. ***$p < .01$.

Table 11. Impact of information campaign on volumes harvested

| | Number of bags harvested | Number of bags harvested | Bags per hectare | Bags per hectare | Bags per hectare |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Treatment village | –31.224 | –15.449 | 22.651 | 26.858 | 28.38 |
| | (54.268) | (45.033) | (27.01) | (26.363) | (26.096) |
| Constant | 177.974 | 161.414 | 239.159 | 212.307 | 215.368 |
| | (49.873)*** | (60.967)** | (22.983)*** | (43.650)*** | (42.030)*** |
| *n* | 199 | 199 | 302 | 302 | 302 |
| Mean control group | 177.97 | 177.97 | 239.16 | 239.16 | 239.16 |
| Month fixed effects | No | Yes | No | Yes | Yes |
| Household fixed effects. | | | No | No | Yes |

Note: Standard errors are clustered at the village level. **$p < .05$. ***$p < .01$.

Table 12. Issues of selection, using previous year's data

| | Used scale in 2014 season | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Number of bags sold in 2013 (000) | -0.070 | 0.002 | | -0.360 | -0.055 |
| | (0.050) | (0.072) | | (0.178)* | (0.222) |
| Price per bag sold in 2013 (000) | -0.001 | 0.005 | | -0.001 | 0.001 |
| | (0.010) | (0.010) | | (0.006) | (0.007) |
| Sorted onions before sale in 2013 | 0.032 | 0.033 | | 0.042 | 0.041 |
| | (0.028) | (0.020) | | (0.039) | (0.041) |
| Treatment village | | | 0.097 | 0.095 | 0.043 |
| | | | (0.050)* | (0.055) | (0.066) |
| Treatment Village × | | | | | |
| Number of Bags Sold in 2013 (000) | | | | 0.320 | 0.059 |
| | | | | (0.185) | (0.234) |
| Sorted Onions before Sale in 2013 | | | | -0.027 | -0.015 |
| | | | | (0.051) | (0.047) |
| Price per Bag Sold in 2013 (000) | | | | 0.000 | 0.005 |
| | | | | (0.018) | (0.018) |
| Constant | 0.130 | 0.200 | 0.072 | 0.067 | 0.153 |
| | (0.039)*** | (0.058)*** | (0.016)*** | (0.025)** | (0.035)*** |
| *n* | 1,509 | 1,509 | 1,510 | 1,509 | 1,509 |
| Coaxer f.e. | No | Yes | No | No | Yes |

Note: Standard errors are clustered at the village level. *$p < .1$. ***$p < .01$.