

JULY 2015

# Food Security in Indonesia

Real-time Food Price Monitoring in West  
Nusa Tenggara Using Innovative Crowd-  
sourcing Approaches: A Pilot Project

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## Executive Summary



CUSTOMER

Pulse Lab Jakarta

PROJECT TIMELINE

February 2015 – June 2015



With thanks for the generous support from the Department of Foreign Affairs and Trade of the Government of Australia

With the support of the Australia-Indonesia Partnership for Decentralisation (AIPD) programme, Pulse Lab Jakarta engaged San Francisco based Premise Data Corporation to evaluate the efficacy of Premise’s distributed monitoring technology in measuring and assessing food security in Indonesia’s rural West Nusa Tenggara (“Nusa Tenggara Barat” or “NTB”) province. The ultimate goal was to provide AIPD with visibility into the extent to which Premise’s technology could be reliably deployed more broadly across food-insecure regions in Indonesia.

The pilot required Premise to deploy its technology platform to monitor pricing of an initial basket of 32 consumer staples, as identified by partners in this project, the UN’s World Food Programme (WFP) and the UN’s Food And Agriculture Organisation (FAO) on an intra-week basis at traditional markets across NTB – including Mataram City, the remaining portion of rural Lombok Island, and the even more rural Sumbawa Island.

From these data points, a number of macro and micro trends became evident, and were made available to the partners via dynamic web-based reporting tools. The macro trends relate to overall price patterns across the islands on which they were being monitored, as well as for the overall basket of items being tracked. The micro trends relate to price patterns for individual products and / or individual markets – the level at which intervention can be directed when situationally appropriate.

For the total basket of surveyed items, the data showed a deflationary trend in food prices during the observation period from April 1 to June 30, 2015. Moreover, and perhaps unsurprisingly, prices were observed to be higher near the urbanized areas of Mataram and Selong and significantly lower

## MACRO TRENDS

**Overall Price Patterns  
across Geography and  
Time**

## MICRO TRENDS

**Prices Patterns for  
Individual Products and  
Markets**

elsewhere. Premise observed a material deflationary trend in the price of rice, the most important food staple in the region, which contributed to the overall decline in food price trends in the index that was developed for this pilot. The decline in rice prices was anecdotally a reflection of prices normalizing downward after an inflationary period prior to the three-month collection timeframe of this pilot. Another product-level observation involved fuel price patterns, which appeared to be significantly higher on the western side of Lombok island, raising interesting secondary questions about the fuel supply chain and market efficiencies in Lombok.

This pilot demonstrated that Premise’s technology is capable of producing representative trend analyses and granular observation data in real-time, including in highly rural and difficult-to-access regions. Premise, WFP, FAO, and Pulse Lab Jakarta are now discussing a potential expansion of the project in Indonesia, including the continuation of the monitoring efforts in NTB as well as an expansion into the even more rural East Nusa Tenggara (“Nusa Tenggara Timur” or “NTT”) province.

Over the course of the pilot, Premise and its partners studied Premise’s approach to overcoming a number of traditional challenges related to technology-based remote monitoring, including issues such as rural network recruitment, fraud detection and data quality, and “bunch” measurement and unit standardization. Refinements to Premise’s methodology based on experience working with the UN partners will be reflected in the next phase of the deployment.

This pilot is part of a series of ongoing assessments Premise is undertaking with global development partners to demonstrate the efficacy of its platform to serve as an early warning system for food security threats around the world. As the project moves beyond the pilot phase in Indonesia, Premise is eager to work with the partners to identify further opportunities to deploy its platform to aid in the fight against world hunger.



## SECTION 1

# Key Findings

# Price Deflation - Lombok Island, ID

PERIOD  
**April 2015 – June 2015**

OVERALL TREND  
**Prices Decreased**

Between April 1 and June 30, 2015, Premise observed a deflationary trend in general food prices on Lombok Island, as shown in Figure 1. Premise identified that this decrease in prices was primarily driven by a decline in the price of low quality rice, as seen in Figure 2.



Figure 1: Premise food price index incorporating all products for Lombok Island, ID.

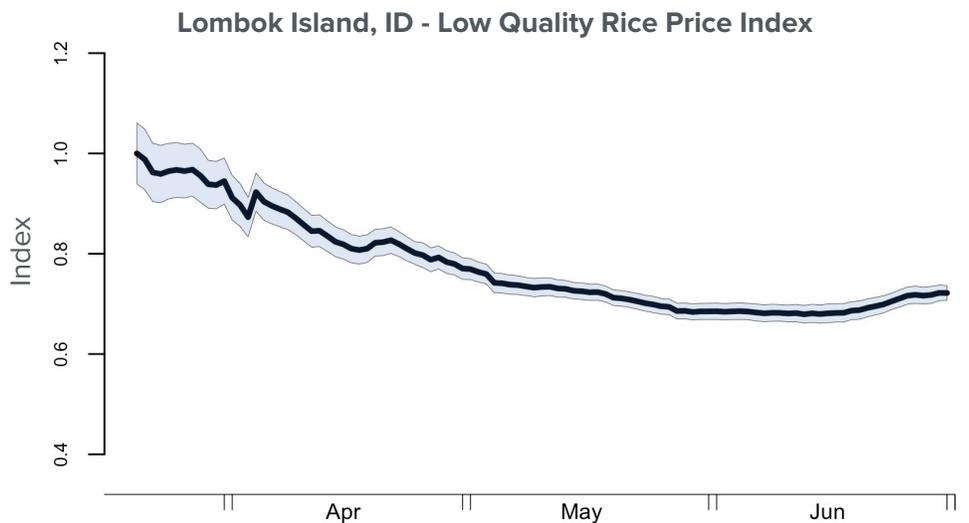


Figure 2: Low quality rice price index for Lombok Island, ID.

# Price Deflation Among Staples - Lombok Island, ID

In addition to low quality rice, Premise saw strong deflationary trends in several other staples, such as flour, sugar, and tofu.

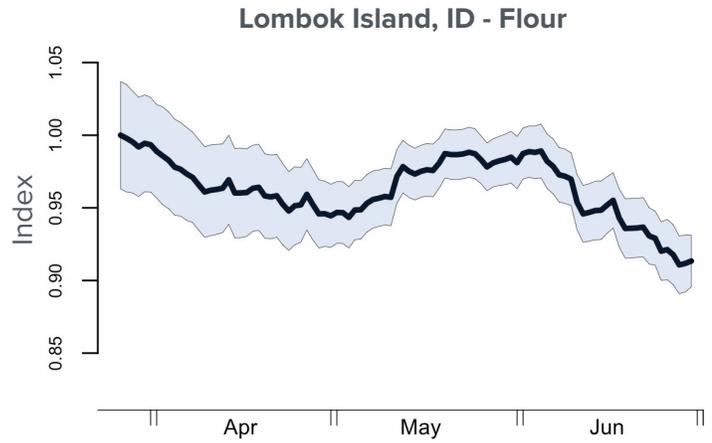


Figure 3: Flour price index for Lombok Island, ID.

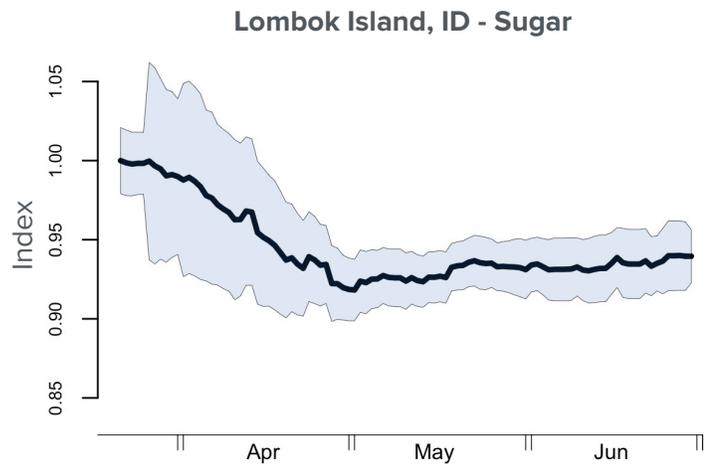


Figure 4: Sugar price index for Lombok Island, ID.

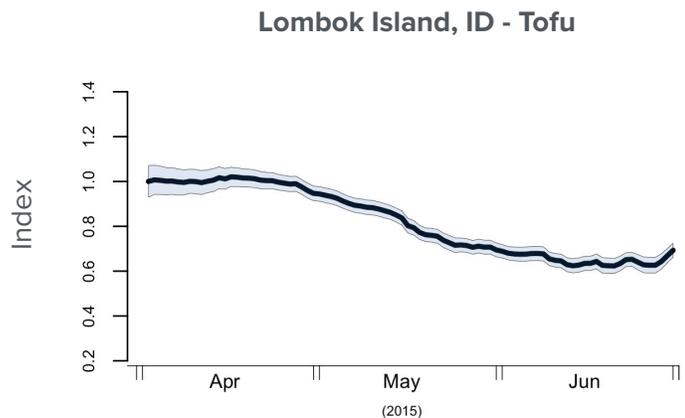


Figure 5: Tofu price index for Lombok Island, ID.

# Counter Trends - Lombok Island, ID

While the overall food price index decreased, Premise did detect increases in the price of several items, including instant noodles, onion, and mackerel.

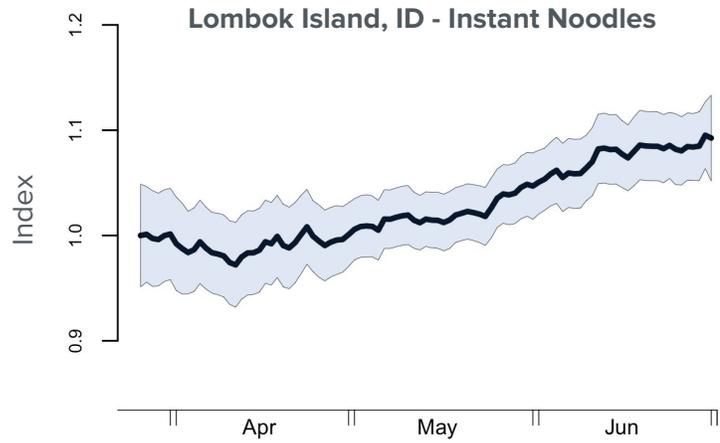


Figure 6: Instant noodles price index for Lombok Island, ID.

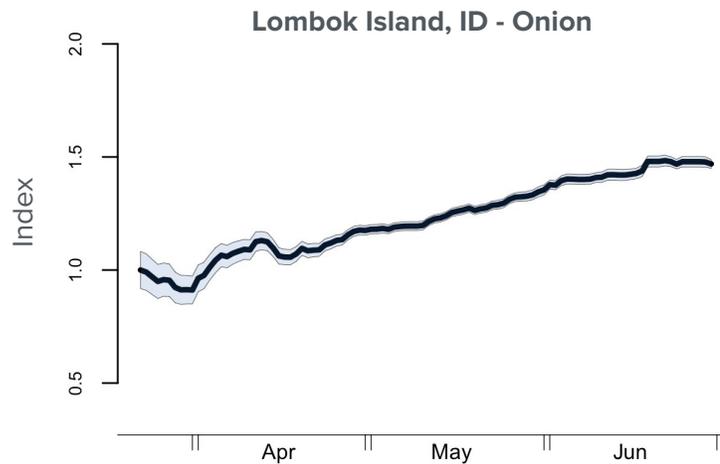


Figure 7: Onion price index for Lombok Island, ID.

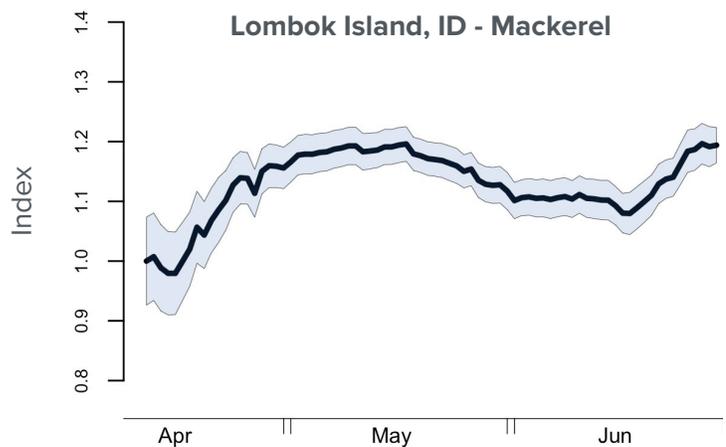


Figure 8: Mackerel price index for Lombok Island, ID.

# Geospatial Trends - Lombok Island, ID

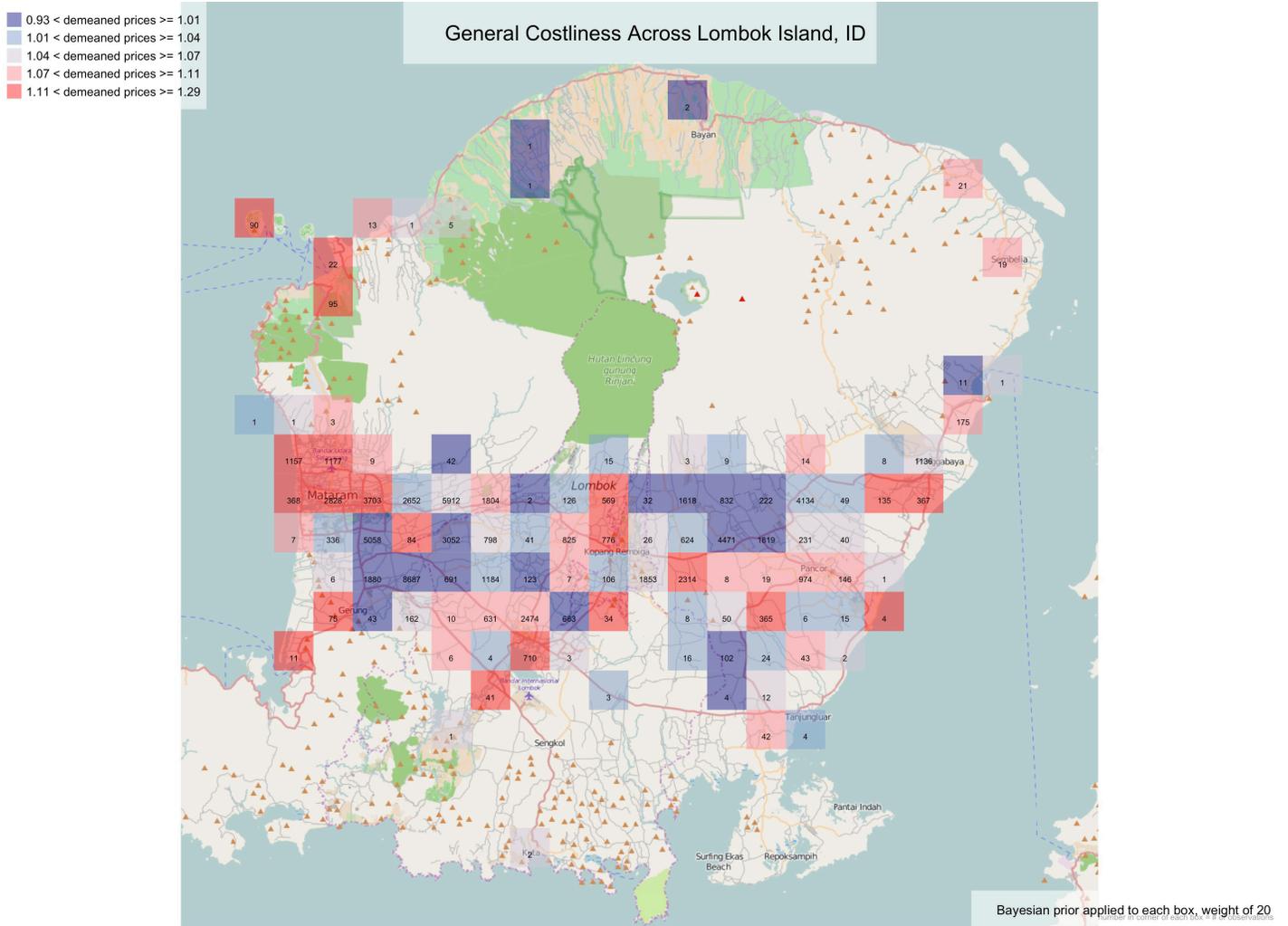


Figure 9: Systematic price differences across Lombok Island taking into account all goods studied.

OVERALL TREND  
**Urban - Rural  
 Price Differentiation**

Premise identified systematic price differences across Lombok Island. In general, prices were, as expected, higher near the urbanized area of Mataram and significantly lower elsewhere.

# Geospatial Trends - Mackerel - Lombok Island, ID

Premise found that mackerel is more expensive in urban Mataram than elsewhere on Lombok Island.

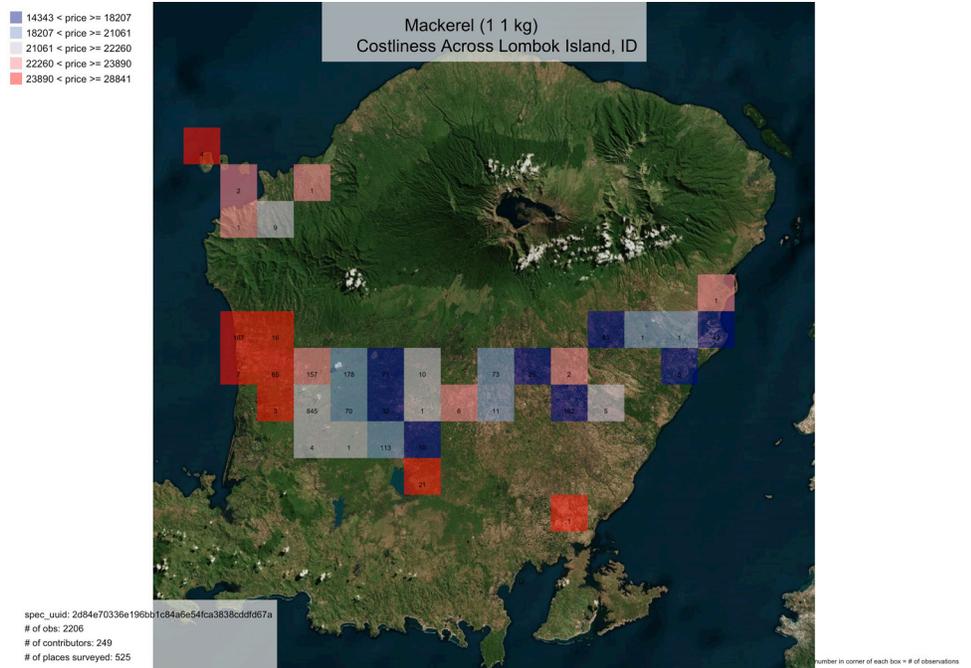


Figure 10: Mackerel prices varied significantly across the island.

At the market level, the urban market of Pasar Umum Kukedini was approximately 50% more expensive than the suburban market of Pasar Umum Pelula.

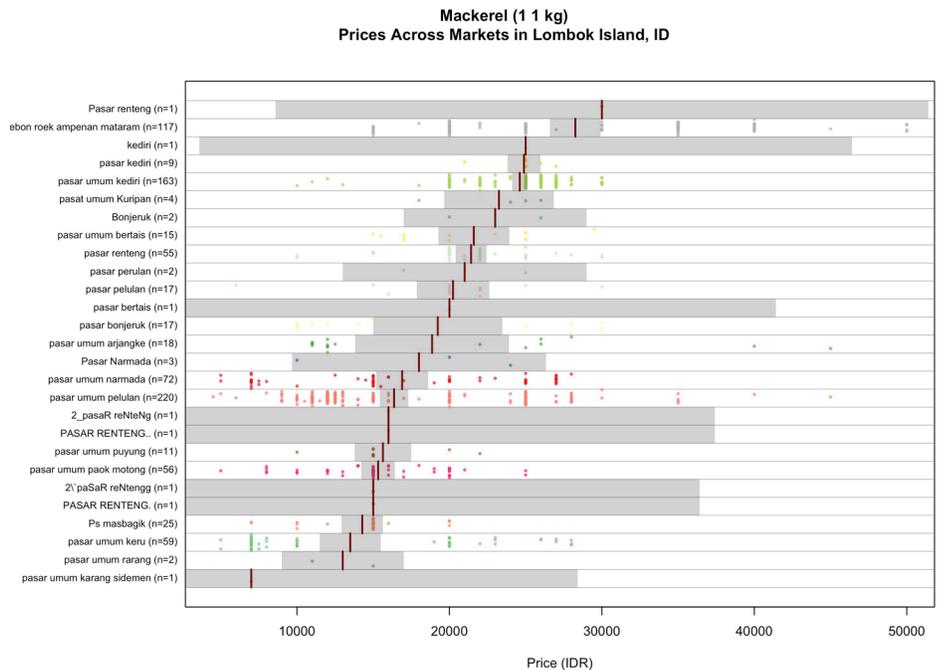


Figure 11: There are clear market price effects for mackerel.

# Market Deep Dive - Pasar Umum Paok Motong

PERIOD  
April 2015 – June 2015

OVERALL TREND  
Prices Decreased

Premise is able to provide visibility at the market / product level. For example, during the course of the study, Premise detected a deflationary trend at the Pasar Umum Paok Motong market in eastern Lombok.



### Pasar Umum Paok Motong Price Index

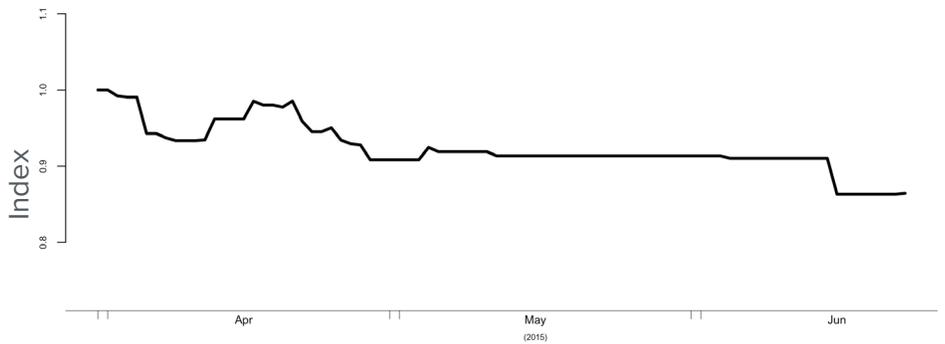


Figure 12: The weighted food price index for Pasar Umum Paok Motong.

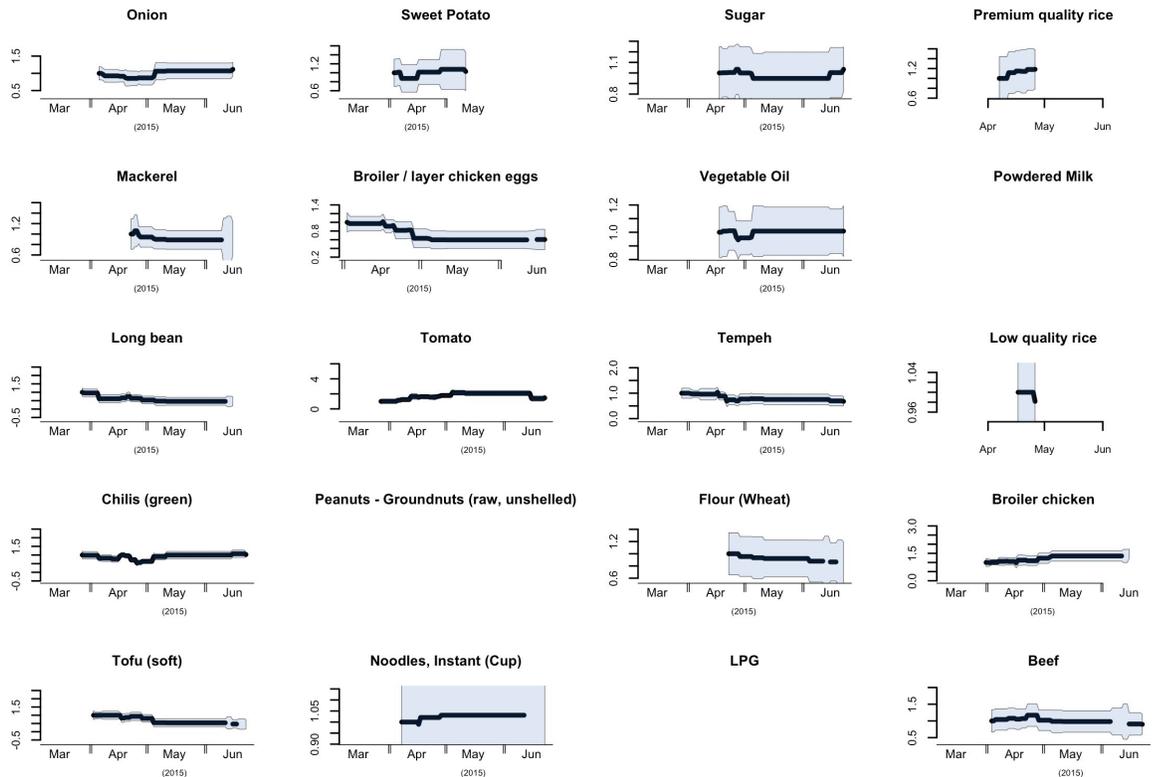


Figure 13: Mean prices over the course of the study by product at Pasar Umum Motong.

 **PREMISE****SECTION 2**

# Background on the Project

## Background on the Project

Global Pulse is a flagship initiative of the UN launched in 2009 to foster innovation and advance the discovery, development, and adoption of real-time monitoring and prediction tools for international development and aid programs.

Pulse Lab Jakarta is a joint initiative of the United Nations and the Government of Indonesia, the first innovation lab of its kind in Asia. We bring together experts from United Nations agencies, the Indonesian government, non-governmental organisations and the private sector to research and facilitate the adoption of new approaches to applying digital data sources and real-time analysis techniques for development and humanitarian action”.

PLJ was established in 2012 as a joint initiative of the Government of Indonesia and the United Nations, the first innovation lab of its kind in Asia. The United Nations Global Pulse is headquartered in New York and is an innovation initiative of the Executive Office of the Secretary General. It operates three labs worldwide, one in New York, one in Jakarta – PLJ and one in Kampala, Uganda – PLK.

In December 2014, Pulse Lab Jakarta, in partnership with the Australia Indonesia Partnership for Decentralisation, a programme funded by the Department of Foreign Affairs and Trade of the Government of Australia, sought an innovative and cost effective way to measure and monitor food security in rural Indonesia. Through a competitive tender, Pulse Lab Jakarta “PLJ” ultimately engaged Premise to deploy and evaluate the efficacy of Premise’s distributed monitoring infrastructure in the context of food security in West Nusa Tenggara, one of Indonesia’s more rural provinces.



## SECTION 3

# Introduction to Premise

## Introduction to Premise

Premise is a technology company measuring economic, political, and social developments in real-time.

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Premise combines four key capabilities to facilitate the gathering of on-the-ground high-fidelity data and observations:

**1. Building effective human contributor networks:** These scalable networks of contributors know the local terrain, which allows them to accurately capture everything from large simple observations to complex contextual questions. Premise currently has contributor networks in over 30 countries and 150 municipalities – ranging from megacities to extremely rural areas. Premise's global contributor network has over 16,500 active users.

**2. Highly efficient dynamic tasking:** Utilizing geospatial and temporal technological advances enables Premise's network to complete varying and challenging tasks that may include difficult-to-complete audit-style requirements.

**3. Rigorous data quality assurance:** The Premise application requires contributors to submit multiple forms of proof for each observation. This often includes photographic evidence and GPS data. Premise then applies two layers of quality control to each data point – an automated system that identifies any anomalous captures and a manual review.

Working with customers, Premise deploys its technology to monitor global threats to resource security, emerging trends related to consumer behavior, and development issues such as public health, financial access, and infrastructure.

**4. Data processing and analytics development:** Premise’s data science platform is able to verify the accuracy of submitted observations, dynamically adjusting sampling parameters to minimize collection bias. Additionally, the platform aggregates the underlying data into trend and geospatial analyses, and is able to test specific hypotheses about ground-level developments.

Working with customers, Premise deploys its technology to monitor global threats to resource security, emerging trends related to consumer behavior, and development issues such as public health, financial access, and infrastructure.

In addition to the UN agencies collaborating on this engagement, Premise’s customers include the World Bank, Standard Chartered Bank, governments, corporations, and numerous global investment funds. Premise is active in 30 countries and 150 cities globally with a heavy focus on rapidly developing economies such as China, India, Brazil, Mexico, Indonesia, Turkey, and Nigeria.

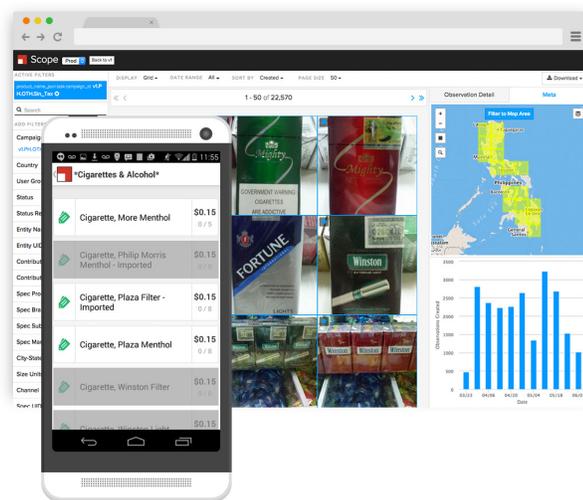


Figure 14: The Premise mobile application tasks people in specific places to collect specific pieces of data.



## SECTION 4

# Project Goals & Scope

## Project Goals & Scope

Prices were collected daily and across a geographic coverage area of almost 20,000 square kilometers.

The coordinating agencies initially set out to answer one primary question: Can Premise’s distributed monitoring technology infrastructure be used as an effective and low-latency means to monitor consumer food staples pricing at traditional markets in the rural areas of West Nusa Tenggara?

Premise collaborated with several teams to define both the geographic areas and market “clusters” for the pilot, as well as the core basket of items to capture. Because of the rural nature of the province, the geographic clusters were comprised almost exclusively of informal, cash-only markets and stalls. The final basket comprised 20 consumer staples, including food items like tofu, tempeh, spinach, mackerel, and eggs, as well as liquefied petroleum gas (“LPG”). Prices were collected daily and across a geographic coverage area of almost 20,000 square kilometers.

The geographic scope of this engagement focused on the three areas identified below, all with relatively low population densities. Mataram City, the most populated of the three areas, is located 35 kilometers from the nearest airport.

LOCATION	APPROXIMATE POPULATION
Lombok Island, excluding Mataram City	653 inhabitants / km
Mataram City	6,563 inhabitants / km
Sumbawa Island	87 inhabitants / km

*Table 1: Population densities of targeted areas.*

Premise was able to build a network of over 500 contributors on Lombok Island who visited over 5,000 unique venues and submitted 66,902 observations.

Success of the deployment was to be primarily judged on:

1. Premise's ability to quickly ramp up a data capture network in Indonesia to provide accurate and frequent price data across a dispersed rural coverage area; and
2. Premise's ability to accurately model price trends in the region across a highly unstructured set of trading outlets.

On both counts, Premise met or exceeded its goals. It was able to build a network of over 500 contributors on Lombok Island who visited over 5,000 unique venues and submitted 66,902 observations. Likewise, in extremely rural Sumbawa, Premise was able to ultimately build a trusted network of 24 contributors who visited nearly 50 unique venues and submitted 757 observations.



## SECTION 5

# The Premise Approach

# The Premise Approach

After six weeks of data capture, the network reached a steady state of growth, supplying almost 8,000 accepted data points each week, far exceeding the target of 1,200 specified in the engagement contract.

## 5.1 Network Recruitment

Based in San Francisco, Premise's Growth Team attempted numerous recruitment methods ranging from Facebook Advertisements and Facebook Messenger to expatriate job boards and university groups before finding strong traction with Blackberry Messenger ("BBM"). Locals began sharing Premise's pin number with numerous university groups and on various blogs, which seeded the initial core group of 50 contributors. A month later, the network of contributors began growing organically by 30% each week and data volume increased, on average, by 40% each week. The network grew so quickly that Premise appointed a local community manager (who began as a Premise contributor) to moderate the Facebook Group where contributors started crowdsourcing answers to each other's questions.

After six weeks of data capture, the network reached a steady state of growth, supplying almost 8,000 accepted data points weekly, far exceeding the target of 1,200 specified in the engagement contract. Premise's Growth Team then calibrated the network to maintain data capture volume at 5,000-6,000 observations per week. Geographic coverage remained strong, and the constant addition of new contributors was responsible for the discovery of over 250 new markets each week, bringing the total to over 5,000 unique markets across Lombok Island.

Premise’s flexible global payment system is adaptive to the regulatory and technological constraints of a particular market and accommodative to each contributor’s preferred method of payment.

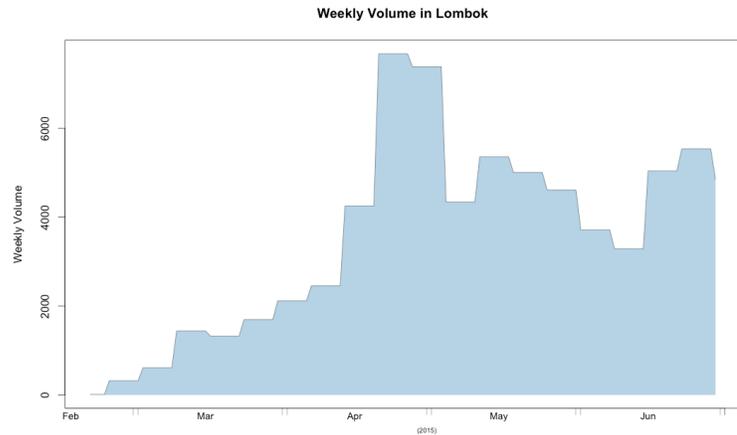


Figure 15: Weekly data volumes for Lombok Island (including Mataram City).

## 5.2 Network Engagement & Incentivization

The success of Premise’s network recruitment and engagement model hinges on its ability to build and maintain strong relationships with contributors. Trust is essential to any relationship, and for Premise, trust is primarily fostered through a relentless emphasis on ensuring that contributors are compensated for their contributions promptly and reliably. Premise’s flexible global payment system is adaptive to the regulatory and technological constraints of a particular market and accommodative to each contributor’s preferred method of payment – which can include, among others, online cash transfers, mobile money, grocery vouchers, bitcoin, and gift cards. In Indonesia, the most common chosen payment method is PayPal (accounting for over 93% of payments by value), which allowed contributors to directly receive monetary compensation for their work. However, mobile top-up and grocery vouchers were also options available to them. Using PayPal, contributors could directly cash out within the Premise smartphone application without having to speak to Premise personnel to request payment.

Premise recognizes the importance of maintaining an ongoing dialogue with contributors. The company places emphasis on being accessible and responsive.

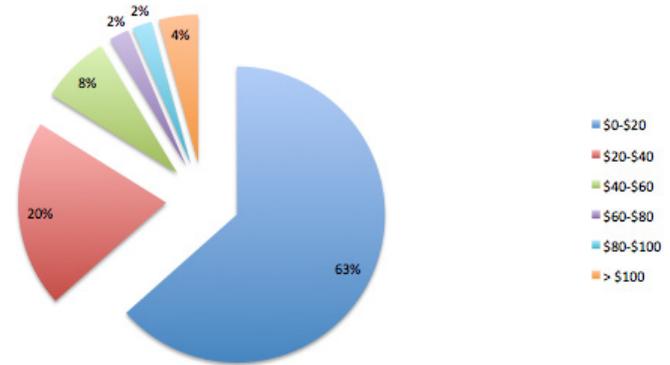


Figure 16: Distribution of NTB contributors according to weekly earnings (week of April 27, 2015).

In addition to a reliable and convenient payment regime, Premise also cultivates network engagement through a personalized onboarding and training program that every new contributor is taken through. After the onboarding phase, Premise recognizes the importance of maintaining an ongoing dialogue with contributors. Since Premise manages the network remotely from its San Francisco headquarters, the company places emphasis on being accessible and responsive. To that end, Premise’s Growth Team utilizes a range of instant messaging tools to address user questions and provide technical support. To complement the efforts of the Growth Team, Premise also employs on-the-ground community managers as local touchpoints for contributors. Finally, Premise conducts regular contributor surveys to gauge network engagement and collect user feedback. All of these efforts are essential to building an engaged and supportive contributor community, which ultimately results in higher data quality.

While ramping up a network in a new geography, Premise offers weekly volume bonuses to early contributors. Contributors quickly learn that collecting data with Premise is easy and

Cultivating super-users is an essential part of the network launch process as they become the local, on-the-ground Premise advocates.

flexible, and as little as an hour of collection work per day has the potential to match their current incomes. Another method used to incentivize users is referral bonuses, paid in two parts: the first portion is awarded when a referred friend downloads the Premise application, and the second portion is awarded if the friend submits 20 accepted photos within one week of sign-up. This bonus structure results in not only volume, but also quality, improvements, as existing contributors are incentivized to share best practices for accurate data collection. In the case of Indonesia, the referral bonus proved particularly popular with university students aged 18 to 25.

### 5.3 “Super-users”

Super-users are defined as contributors who rely on Premise as a regular source of income, are committed to regularly submitting high volumes of high quality data, provide feedback on how to improve the in-app user experience, and actively communicate their belief in the mission of Premise. During the two-week period from June 15 to 29, Premise gathered 15,605 data points from 234 unique users. 11% of these users are considered super-users and collected 35% of this total data volume.

Cultivating super-users is an essential part of the network launch process as they become the local, on-the-ground Premise advocates. Given the high level of commitment to and trust of Premise these contributors develop, they are willing to expand their travel radius to capture additional data. Premise is able to deploy new application features and tasks for testing, and gain cultural insights to improve overall accuracy and efficiency.

In Indonesia, super-users have also taken on management roles in the online community to grow the network and increase data

In Indonesia, super-users have also taken on management roles in the online community to grow the network and increase data quality across the board.

quality across the board. Currently, Premise’s Facebook Group in Indonesia, which is moderated by super-users, has over 400 members and averages seven posts per day and dozens of comments per post, in which members help answer each other’s questions about the Premise smartphone application and data collection process.

**5.4 Choice of Locations**

The Premise platform is capable of operating in two modes: discovery and place-directed. In discovery mode, Premise contributors are encouraged to visit any location that they feel is appropriate and submit a capture. They are also asked to name the market. In place-directed mode, contributors are instructed to go to specific places. For this pilot phase, the Premise platform operated in discovery mode. As a result, over 5,000 unique markets were discovered by contributors. In the next phase, the platform will be switched to place-directed mode, and the 16 most prominent markets will be revisited on a frequent basis.

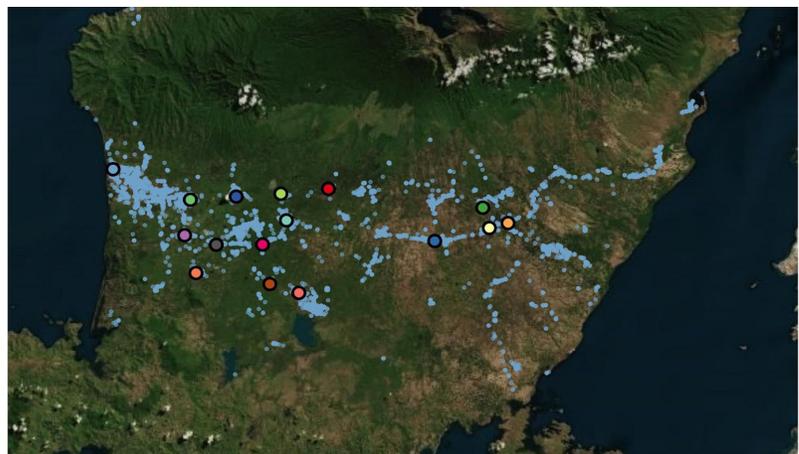


Figure 17: The range of places on Lombok Island visited by contributors. The brightly colored dots are the sixteen most prominent markets.

Premise and WFP collaborated on refining the basket, with a focus on ensuring accurate representation of primary food staples for the region as well as data integrity.

### 5.5 Choice of Commodities

Premise began with a list of 32 food staples provided by the Jakarta-based WFP team. Contractually obligated to collect data for 20 of these items, Premise tasked its contributors to collect data for the full list for an initial eight weeks. After analyzing the initial results, Premise and WFP collaborated on refining the basket, with a focus on ensuring accurate representation of primary food staples for the region as well as data integrity. Below is the list of initial and final specifications, with the final 20 items selected identified in bold.

- |  |                                     |                          |
|--|-------------------------------------|--------------------------|
| 1. <b>Beef</b>                         | 12. Green Mustard                   | 25. Soybean              |
| 2. Cassava                             | <b>13. Liquefied Petroleum Gas</b>  | 26. Spinach              |
| 3. Chicken ("Village")                 | <b>14. Long Bean</b>                | <b>27. Sugar</b>         |
| <b>4. Chicken (Broiler)</b>            | <b>15. Mackerel</b>                 | <b>28. Sweet Potato</b>  |
| 5. Chicken Eggs ("Village")            | 16. Maize                           | <b>29. Tempeh</b>        |
|  | 17. Milk (Fresh)                    | <b>30. Tofu (Soft)</b>   |
| <b>6. Chicken Eggs (Broiler/Layer)</b> | <b>18. Milk (Powdered)</b>          | <b>31. Tomato</b>        |
| <b>7. Chilis (Green)</b>               | <b>19. Noodles (Instant)</b>        | <b>32. Vegetable Oil</b> |
| 8. Chilis (Red)                        | <b>20. Onion</b>                    |                          |
| 9. Duck (Whole)                        | <b>21. Peanuts (Raw, Unshelled)</b> |                          |
| <b>10. Flour (Wheat)</b>               | <b>22. Rice (Low Quality)</b>       |                          |
| 11. Green Bean                         | 23. Rice (Medium Quality)           |                          |
|  | <b>24. Rice (Premium Quality)</b>   |                          |

Table 2: The original list of 32 staples and the final list 20 staples (in bold).

### 5.6 Survey Refinement

With the final specifications list agreed upon, Premise began additional user communications to correct common mistakes discovered during the initial period of data capture. These communications included sending photos to explain the difference between onion and garlic, sweet potato and cassava, fresh and

Scope is a visualization tool for navigating, filtering, and reviewing the raw underlying data collected during a deployment.

flavored milk, and green beans and green lentils. The result of this effort is evidenced by the higher data quality observed amongst the finalized specifications list. Before the finalized list was adopted and the corrective measures were taken, rejection for incorrect product was the most common rejection reason, accounting for 41% of all rejections. This measure fell to 22% after the corrective measures were taken. The total breakdown of rejection by status is listed in the table below.

REJECTION REASON	PERCENTAGE OF REJECTIONS
Duplicate-observation	32%
Other-against-policy	22%
Incorrect-product	22%
Incorrect-packaging	9%
Incorrect-price	7%
Other	8%

*Table 3: Reasons for rejection of observations.*

## 5.7 Real-Time Data & Analytics

Premise provided the project partners with access to two of its platform reporting tools: Scope and Iris.

### 5.7.1 Scope

Scope is a visualization tool for navigating, filtering, and reviewing the raw underlying data collected during a deployment like the one in NTB. Premise uses Scope to review, and accept or reject observations after they are submitted by contributors. Project partners can use the tool to sort and filter for specific subsets of the data, as well as to view the geospatial representation of the data. They can also review rejected data to understand sources of fraud and user error.

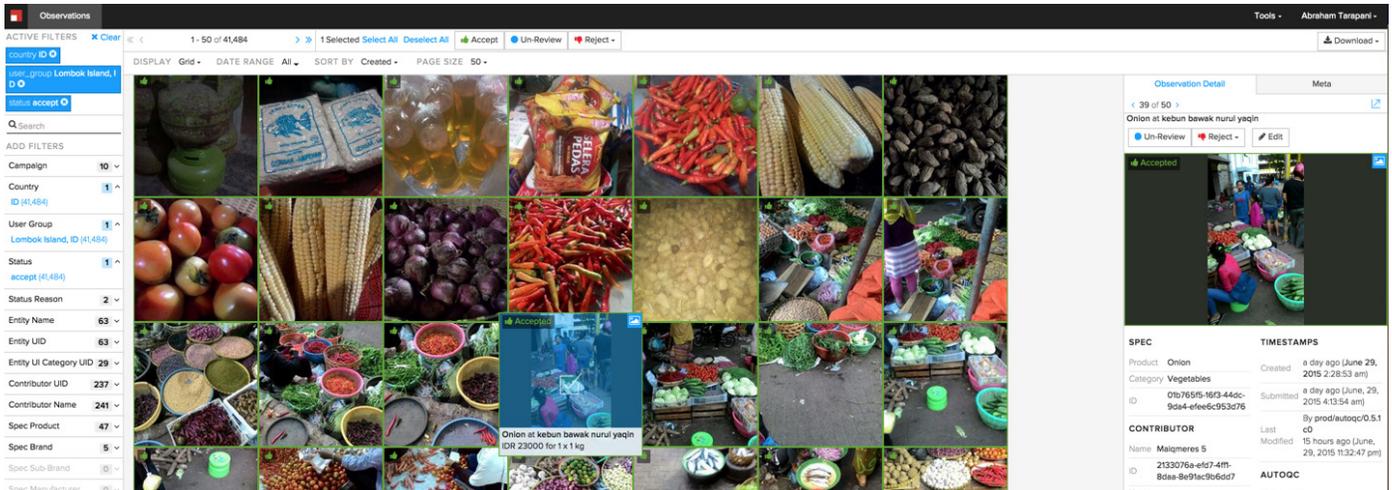


Figure 18: Using Scope filters (on the left of the page) to review specific subsets of the data; reviewing micro-data for specific observations on the right.

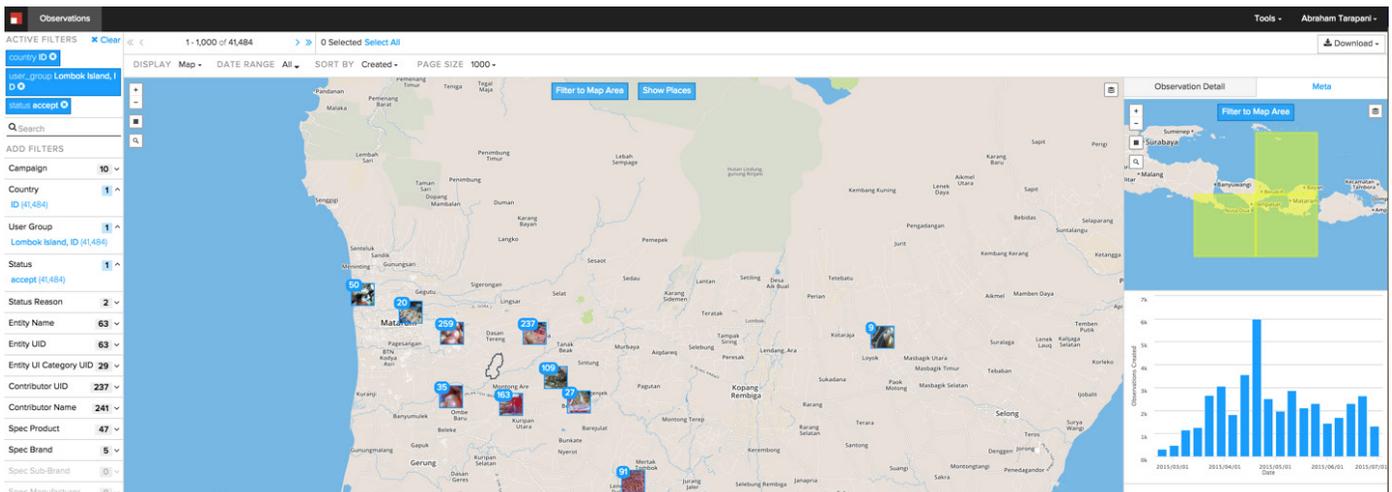


Figure 19: Using Scope to review geospatial positioning of specific observations (most recent 1,000 accepted observations in Lombok shown above).

### 5.7.2 Iris

Iris is a tool used to review macro trends derived from the underlying data. In the case of this project, Iris provided trends on the pricing of the headline basket of consumer staples over time as well as a drill-down on the pricing of each staple. Regional drill-

downs are also enabled. The system allows for day-on-day review of trends, typically with as low of a latency as 72 hours from the day of reference.

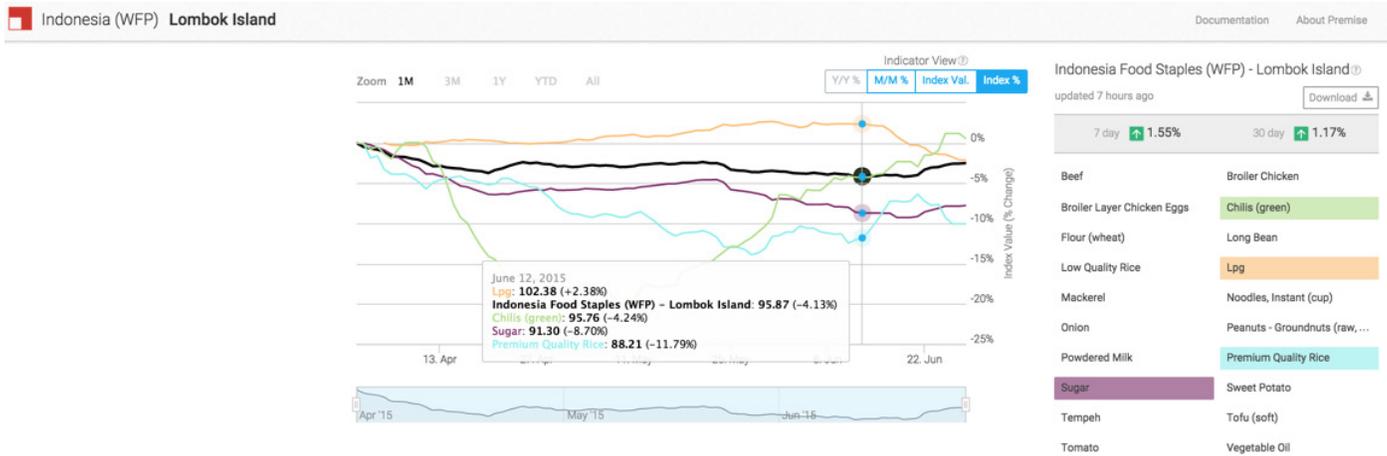


Figure 20: Viewing daily trend information for the headline index as well as each product being monitored in the basket.

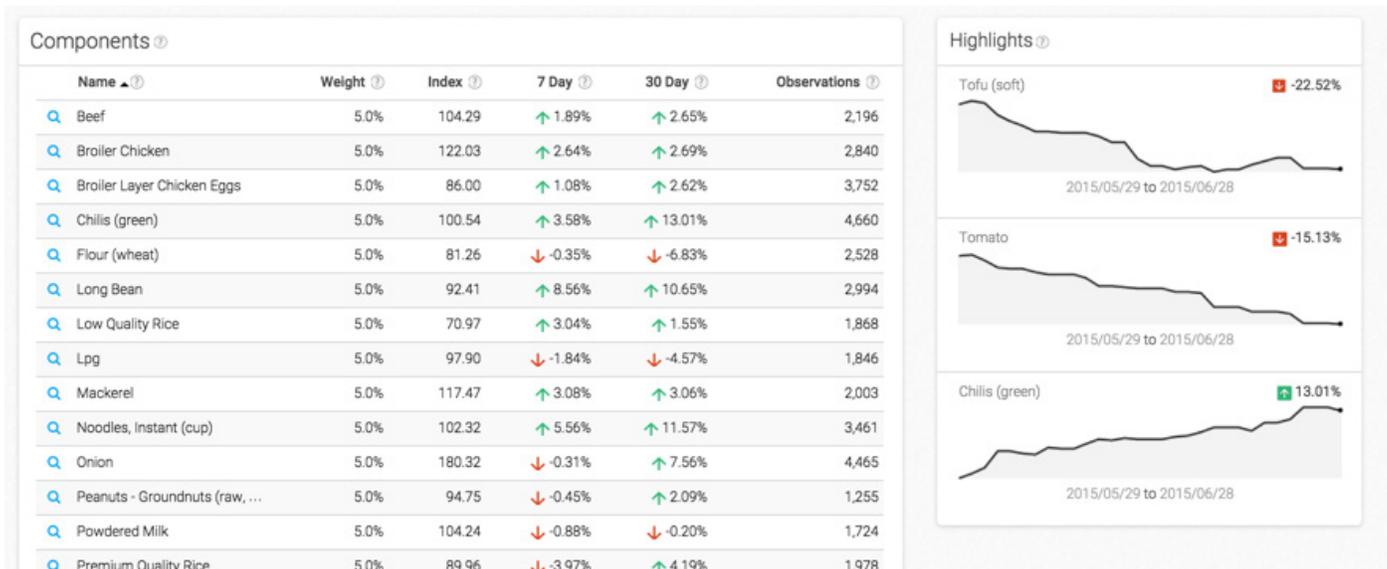


Figure 21: Viewing information about the weighting each component in the basket, as well as index values and trend information. The right-hand panel highlights products with especially strong volatility.



## SECTION 6

# Key Challenges & Lessons

# Key Challenges & Lessons

BBM proved effective because of its interactive nature. Instead of filling out a multi-step form, prospective contributors could dialogue directly with Premise's Growth Team.

## 6.1 Rural Recruitment

Premise's initial rural recruitment strategy relied heavily on Facebook Advertisements that led to online sign-up forms, which lacked reach, proved impersonal, and failed to inspire trust on the part of potential contributors. Respondents to the Facebook Advertisements provided false contact information, which prevented them from receiving the introductory email that explained the payment process and application instructions.

Premise's Growth Team quickly revamped its outreach strategy after identifying Blackberry Messenger as the most popular electronic communication application in the region. The Premise BBM pin was disseminated on popular job boards and community forums, allowing those interested to reach out to Premise directly and quickly become active users. BBM proved effective because of its interactive nature. Instead of filling out a multi-step form, prospective contributors could dialogue directly with Premise's Growth Team. Through BBM, the Premise team shared examples of accepted photos and built trust with prospective contributors, who quickly learned that their time was not being wasted with a "Western scam".

Using BBM as the primary methodology for recruitment allowed Premise to effectively expand geographic coverage from the more urban Mataram City to the rest of rural Lombok Island and, to a more limited degree, the even more rural Sumbawa Island. Within the first month of BBM use, lead generation increased from ten respondents per day to over 50 per day. Within two months, lead-to-active contributor conversion rate increased from 11% to 57%



The automated quality control process can detect group collaboration behavior by detecting if the same product was being submitted by more than one user in a narrowly defined period of time.

In the past, Premise’s quality control process has identified four main types of fraud:

**6.2.1 Profile Fraud**

User creates multiple profiles on multiple phones. This gives the illusion that all observations are from different users with unique user IDs, when in actuality they are duplicates. This is tracked by checking Android push tokens that overlap with several different accounts and / or phones. The automated quality control process is also capable of flagging when a user is using a different device than the one on which the account was created.

49526	6420526d-0f22-4fec-833f-63a0c50c4f09	FaTra	Anggriawan
49511	5589276b-963b-4257-9a3e-d65c4f0fb34d	fatria	anggriawan
53421	5eb6e764-994d-4a0f-8c66-8c5b0254a9c0	Fatria	Anggriawan
54105	839ae828-f108-4753-a089-38b53efb3de7	Fatra	Anggriawan
54417	421a49a5-e8a3-422a-b39d-1d87e1f925e2	Fatra	Anggriawan
56370	2fa6e8d7-c88f-4643-9649-b70ebfbd0af9	Fatra	Anggriawan
58695	ee120495-4f97-454d-abe6-9e26c4642513	fatra	anggriawan
58718	a176f598-3866-4242-89f0-0174a4fe69ff	fatra	anggriawan
58952	51b5c76a-bf7e-4165-819c-639cfc3504c3	fatra	anggriawan

Figure 23: Analytic example of profile fraud.

**6.2.2 Group Collaboration Fraud**

Users travel together to the same markets and submit the same items. This gives the false impression of a broad sampling base. The automated quality control process can detect this behavior by detecting if the same product was being submitted by more than one user during a narrowly defined period of time.

Group collaboration fraud can be visualized by creating a distance matrix amongst all contributors, where distance is defined by the percentage of observations whose geographical area, hour, and day overlap.



Figure 24: Photographic example of group collaboration fraud.

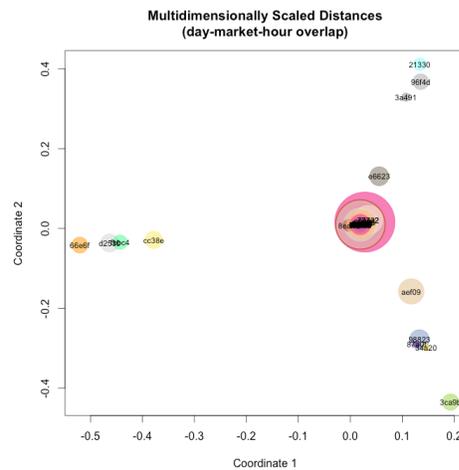


Figure 25: Analytic example of group collaboration fraud.

An analytic visualization of group collaboration fraud is seen above. A distance matrix is created amongst all contributors, where distance is defined by the percentage of observations whose geographical area, hour, and day overlap. Contributors who all tended to capture data at the same places at the same times have low distance scores. This  $n \times n$  matrix (n contributors)

The automated quality control system can detect different locations / place IDs accompanied with the same latitude and longitude coordinates.

is projected onto two dimensions ('Coordinate 1' and 'Coordinate 2' in the plot) via principal coordinates analysis (multidimensional scaling of a data matrix), so the network can be visualized. The cluster in the center of the plot above is an example of a cluster of contributors who tended to capture observations together.

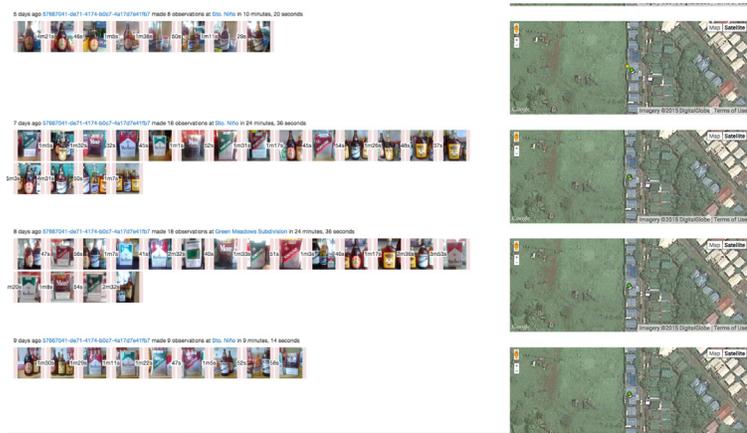


Figure 26: Analytic example of location fraud.

### 6.2.3 Location Fraud

Users attempt to submit observations from one location as sourced from multiple locations by manually changing the store name. However, metadata associated with each submission reveals that these photos share the same latitude and longitude coordinates. The automated quality control system can detect different locations and place IDs accompanied with the same latitude and longitude coordinates.

### 6.2.4 Duplicate Data Fraud

Users attempt to submit the same products multiple times, often by changing the price for each submission. The automated quality control system flags observations submitted as the same specification within one place ID. These are then typically rejected after review by the Quality Control Team.

Since WFP needs to benchmark pricing across locations – and often countries – the absence of normalized units of measurement presents challenges.



Figure 27: Photographic example of duplicate data fraud.

### 6.3 “Bunch” Measurement

Many items in rural markets are priced on a “per piece” basis, rather than based on a normalized unit of measurement (e.g., price per kg or price per liter). When indexing prices to identify changes over time, this can be overcome through structured measurement and place revisits. However, since WFP needs to benchmark pricing across locations – and often countries – the absence of normalized units of measurement presents challenges. Currently, Premise contributors are instructed to ask shopkeepers for the equivalent price per unit. However, this request is not always possible or acknowledged. The following table shows products which in NTB had a high degree of pricing on a “per piece” structure.

Premise is working through a number of analytic and methodological solutions to overcome this challenge. The analytical solutions involve using image analysis along with benchmark reference items to assess relative size and / or

Premise is working through a number of analytic and methodological solutions to overcome the challenge presented by “bunch” measurement.

weight of an item. The methodological solutions involve asking contributors to bring rulers and / or scales with them to the market, as a trained enumerator would, in order to conduct their own measurement of these items.

PRODUCT	COUNT BY PIECE	COUNT BY gm	COUNT BY kg	% OF PIECE PRICING
Tempeh	1855	125	137	<b>88%</b>
Tofu	1247	139	85	<b>85%</b>
Spinach	1903	86	424	<b>78%</b>
Long Bean	1292	23	618	<b>67%</b>
Green Mustard	1007	25	302	<b>75%</b>
Maize	572	82	1109	<b>32%</b>

Table 4: Top staples where pricing was measured “per piece”. Data as of May 5, 2015.

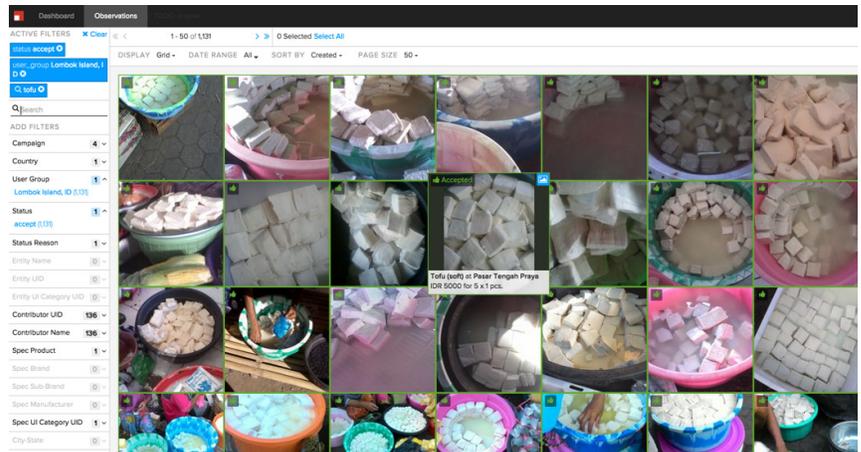


Figure 28: Tofu priced on a “per piece” basis.



## SECTION 7

# Implications for Future Work

## Implications for Future Work

Premise's technology produced representative trend analyses and granular observation data in real-time.

This pilot project was designed as a means for PLJ and its coordinating partners to evaluate Premise's technology, effectively stress testing the infrastructure's ability to capture high-frequency data at low latency in a highly rural region where traditional survey methods can be costly and difficult to implement.

This effort is part of a series of ongoing assessments that Premise is undertaking with development partners to demonstrate the efficacy of its platform to serve as an early warning system for food security threats around the world.

Premise's technology produced representative trend analyses and granular observation data in real-time. Premise, PLJ, WFP, and FAO are now in discussion about potential expansion of the monitoring effort in Indonesia to continue to deploy the platform in difficult-to-reach provinces in Indonesia. The following section describes how the second phase of the monitoring effort is anticipated to be structured for NTB, as well as a new province to be added: East Nusa Tenggara.

### 7.1 NTB Continuation

The primary intent of the NTB expansion will be to continue to observe the sustainability of the Premise network over a longer duration capture program. This phase is expected to last six months, meaning that by its conclusion, some of Premise's contributors will have been active on the network for close to nine months.

The primary intent of the NTT expansion is to continue to demonstrate Premise's ability to operate in increasingly remote locations.

Using the data captured during the pilot phase, Premise will narrow down the list of covered locations from over 5,000 to 16 of the major markets on Lombok Island. A reduced network of contributors will be tasked to continue the ongoing monitoring of these markets, and analysis will be designed to integrate with WFP and FAO's market-level monitoring operations. The desired outcome is that WFP and FAO can use Premise's market-level analysis as a core input into market threat analysis as well as aid and logistics optimization.

## 7.2 NTT Expansion

The primary intent of the NTT expansion is to continue to demonstrate Premise's ability to operate in increasingly remote locations, while capturing rigorous weekly data on market price trends.

In preparation for the NTT expansion, Premise has begun initial recruitment in the more urban areas on NTT. Premise's network is now active across Kupang City, with 12 contributors having submitted over 2,600 observations to-date. Premise's Growth Team has utilized these active contributors for referrals to gain initial leads in the rural Timor West region, which has resulted in over 100 observations in one week. Blackberry Messenger and Facebook Groups have again proven successful in rural Flores, Sumba, and Rote Island, where leads are becoming active contributors as they complete the Premise onboarding and training process. The strong online community and Facebook Group with over 400 active Indonesian contributors has been tasked with helping new members become familiar with the application. In order to ramp these areas as quickly as possible, Premise hopes to partner with local WFP offices to jumpstart the relationship building process.

In preparation for the NTT expansion, Premise has begun initial recruitment in the more urban areas on NTT. Premise's network is now active across Kupang City, with 12 contributors having submitted over 2,600 observations to-date.

In contrast to the experience with NTB, where contributors were allowed to freely "discover" trading outlets selling relevant products in the targeted basket, in NTT, contributors will be given clear direction to only visit the major markets on the islands mentioned above and to conduct structured re-visits on a weekly basis (with redundancy of contributors still factored in to ensure high quality data).