STORIES OF CHANGE

Haze Gazer & VAMPIRE

SARASWATI development innovation

PULSE LAB JAKARTA

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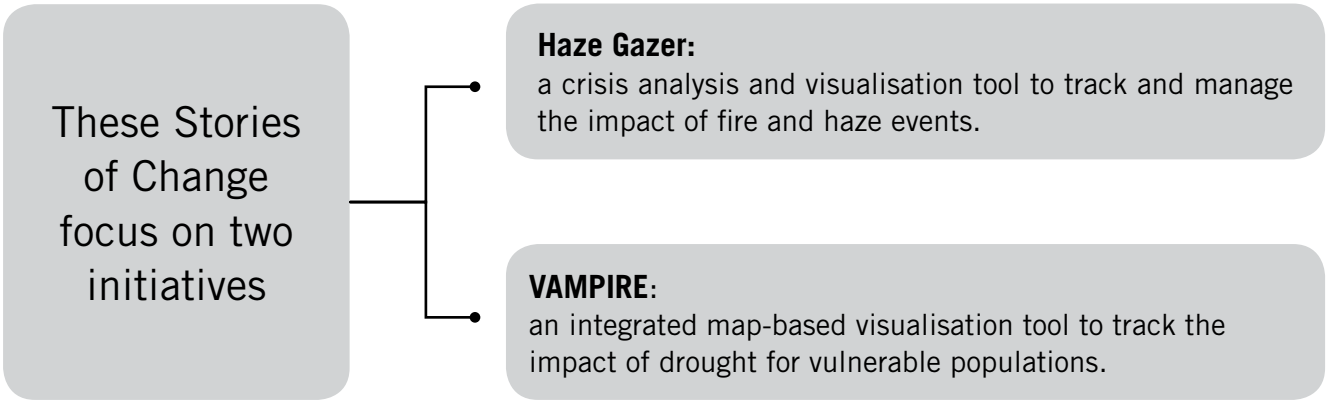
LIST OF ACRONYMS

BAPPENAS	Ministry of National Development and Planning
BMKG	Agency for Meteorology, Climatology and Geophysics
BNPB	National Board for Disaster Management
BPS	National Statistics Agency
ESRI	Environmental Systems Research Institute
EWS	Early Warning System
FAO	United Nations Food and Agriculture Organization
FSVA	Food Security Vulnerability Atlas
GIS	Geographic Information Systems
GSMA	GSM Association
GOI	Government of Indonesia
IPB	Bogor Agricultural Institute
KAIST	Korea Advanced Institute of Science and Technology
KSP	Executive Office of the President of the Republic of Indonesia
LAPAN	National Institute of Aeronautics and Space
LAPOR!	Public Online Complaints and Aspiration Service
NASA	United States National Aeronautics and Space Administration
NOAA	United States National Oceanic and Atmospheric Administration
NTB	Nusa Tenggara Barat
NTT	Nusa Tenggara Timur
PLJ	Pulse Lab Jakarta
PNG	Papua New Guinea
PRISM	Platform for Real-Time Information and Situation Monitoring
RCA	Reality Check Approach
REDD+	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
RPJMN	Indonesian Government's Medium Term Development Plan
SILK	Statistical Iterative Learning of Keywords
SK	Ministerial Directive
SMS	Short Message Service
UI	User Interface
UKCCU	United Kingdom Climate Change Unit
UKP4	President's Delivery Unit for Development Monitoring and Oversight
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UNORCID	United Nations Office for REDD+ Coordination
UNOPS	United Nations Office for Project Services
USAID APIK	United States Agency for International Development's Climate Change Adaptation and Resilience program
UX	User Experience
VAM	Vulnerability Analysis Monitoring
VAMPIRE	Vulnerability Analysis Monitoring Platform for Impact of Regional Events
WFP	World Food Programme

EXECUTIVE SUMMARY

Pulse Lab Jakarta (PLJ) is a joint initiative of the United Nations and the Government of Indonesia, via United Nations Global Pulse and Indonesia's Ministry of National Development and Planning (Bappenas) respectively. Launched in October 2012, PLJ is an innovation lab, which brings together technical experts, government agencies, non-governmental organisations and the private sector to research and facilitate the adoption of new approaches for applying new, digital data sources and real-time analysis techniques to social development.

In February 2018, PLJ commissioned Saraswati to write Stories of Change that document how certain prototypes and approaches developed by PLJ are being used by its government or development partners; what kind of behaviour or policy change they enabled; as well as the factors involved in helping or hindering progress. These Stories aim to complement other knowledge products, such as blogs, reports, policy briefs and other documents already published about these initiatives, by providing a thorough chronology, extensive first-hand testimony based on numerous interviews and analysis on a range of related results.



PLJ endorses a more flexible interpretation of "impact." These Stories of Change confirm that change occurs on many levels and often in unanticipated ways. It is appropriate that PLJ places more emphasis on its contributions towards—rather than its direct impact on—positive change. Through its work and collaborations on VAMPIRE and Haze Gazer, PLJ has made key contributions as follows:

Operational Impact: Both Haze Gazer and VAMPIRE have supported positive change in the way the implementing partners and key stakeholder—the Government of Indonesia (GOI)—work. The Executive Office of the President of the Republic of Indonesia (KSP) adopted these platforms as key building blocks in developing the architecture for its Early Warning System (EWS), which is now a centerpiece of the President's Situation Room; PLJ has learned from and scaled these prototypes, including in developing multi-disaster platforms; and the World Food Programme continues to partner with PLJ in improving the features and accessibility of VAMPIRE while expanding this concept across the Asia Pacific region.

Methodological Impact: Both platforms represent tailored and relevant applications of data science—and provide important lessons from the hits and misses in experimentation along the way. Most significantly, they have contributed to richer and more real-time data that is being used by the GOI for emergency planning, response and evaluation.

Ecosystem Impact: Through collaboration on VAMPIRE, PLJ has benefited from The World Food Programme (WFP) technical collaboration and also supported WFP Indonesia's ability to integrate and promote data innovation.

I.
Introduction

The Vulnerability Analysis Monitoring Platform for Impact of Regional Events (VAMPIRE) and Haze Gazer were conceived and developed in 2014-2015 at an important juncture for its primary collaborators. Pulse Lab Jakarta (PLJ) had recently launched and was actively looking for suitable project partners. The World Food Programme (WFP)—PLJ's primary partner in developing VAMPIRE—was devoting significant regional resources to addressing the consequences on food security of El Niño. And, the new Joko Widodo administration came into office in October 2014 following the July 2014 national presidential election. President Widodo had just been elected on a platform that included promoting both national economic sovereignty and also a more open and accountable government.

THE CHALLENGE OF FOOD SECURITY IN INDONESIA

El Niño - a severe and lengthy climatic event exacerbated by climate change - was predicted to bring oscillating extreme temperatures, an overall suppression of rainfall in Indonesia, and resulting spikes in food prices. This bore out with severe drought in districts across Indonesia, peaking in 2015.

These catastrophic climatic conditions only compounded the fact that Indonesia is under constant threat of food insecurity and resulting malnutrition. More than one-third of Indonesia's children suffer from chronic malnutrition, resulting in what has been described as "alarmingly high" stunting levels. And food security is tied to job security. Over 22 million Indonesians rely on agriculture for their livelihood, according to the UN.

The impetus for the development of VAMPIRE came from El Niño. The WFP in Indonesia, supported by German Government funding via the WFP regional office in Bangkok, was planning drought monitoring and preparedness in response to the impending El Niño in 2014-2015. A look back at the last El Niño —in 1997-1998, directly preceding Indonesia's political *Reformasi*—offered a sobering reminder that drought and the resulting spikes in commodity prices can contribute to popular dissatisfaction with the government. The 2007-2008 food price crisis had further reinforced the need for more timely data analysis.

The WFP had been invited by the new Widodo government to provide technical support to improve food security. According to one WFP official, "*this new government initially saw food security primarily through the lens of rice production and rice stocks,*" consistent with Widodo's campaign focus on national economic sovereignty and the primacy of rice self-sufficiency within this. The WFP saw food prices rising sharply and were focused on how best to advise the new government about appropriate responses. "*They (the GOI) weren't worried because rice sovereignty was the focus and they had enough rice in stock*," another WFP official noted.

"Strong capacity in remote sensing of climatic data via the National Institute of Aeronautics and Space (LAPAN), but [they] were not working with the Ministry of Agriculture, which is responsible for food security. There was not enough emphasis at that time on tech teams within that Ministry." (WFP)

Prior to VAMPIRE, information on drought and food security was either anecdotal or reported manually at the district level. There was no systematic and timely collection of data, and one region could not compare its condition to that of others. For the WFP, it was clear that weather, nutrition, and the price and availability of rice both inside and outside Indonesia were the key factors to focus on. The Government of Indonesia had "*strong capacity in remote sensing of climatic data via the National Institute of Aeronautics and Space (LAPAN), but [they] were not working with the Ministry of Agriculture, which is responsible for food security. There was not enough emphasis at that time on tech teams within that Ministry.*" (WFP)

The WFP recognised that localised crop failures resulting from El Niño were going to have the greatest impact on small and medium scale farmers—and, as such, that impact at the local level needed to be taken more seriously. More granular data than were currently being used would be needed to understand the impact of drought at both national and local levels. Prior to VAMPIRE, WFP was using these data sources and others, such as data from the National Statistics Agency (Statistics Indonesia—BPS), GOI poverty and livelihoods data, and historical reports on disasters from the Indonesian National Board for Disaster Management (BNPB), to produce and disseminate bulletins on food security, but the data analysis was an intensive manual process. It took up to three weeks to process the data in order to produce these, even though the GOI "*wants the information immediately.*" (WFP)

The WFP initially applied its regional funds in support of El Nino preparedness to examine key data that included remote sensing data, socioeconomic vulnerability data, and price data.

Remote sensing data. In collaboration with the Bogor Agricultural Institute (IPB), remote sensing data was employed to provide an indication of the number of days in these areas since the last rainfall. For this, WFP used free rainfall and vegetation data from the US Geological Survey and NASA. These data could be compared against historical data of monthly rainfall over the last 30 years. Collectively, these data were used to provide an indication of the probability of rainfall or continued drought over the following six days. This provided a stronger evidence basis of information on areas that are suffering from drought and food insecurity.

Socioeconomic vulnerability data. WFP then went to the next step of trying to identify people and places that would be most affected. Census data were used to create maps of where vulnerable people are living relative to these weather phenomena. The primary criteria for initial geographic areas of analysis were those areas with small-scale farmers who were living below or close to the poverty line and without irrigation. The WFP then conducted "traditional" ground-truthing to test certain assumptions, which involved a one-time survey involving interviews with approximately 2,000 households in eight of these vulnerable districts. These data helped to inform important food security bulletins.

Price data. When droughts reduce the supply of food, prices usually go up. Since most people in Indonesia, including farmers, purchase their food, prices have a big impact on food security and nutrition. The WFP was interested in exploring price data—as, too, was the Food and Agriculture Organisation (FAO). FAO hired PREMISE, a private company based in San Francisco, to explore price data for several commodities as pilot studies in Nusa Tenggara Barat (NTB) and Nusa Tenggara Timur (NTT) provinces. The FAO collaborated with WFP and PLJ on these pilots, and provided input to determine nine key commodities that were chosen for price monitoring. The pilots required hundreds of local volunteers ("subscribers") to go to the markets, and send price information and photographs for relevant commodities via a dedicated app downloaded onto their cell phones, in return for which the subscribers received cell phone credit.

"The climate threat from such fires is increasing, because the biggest increase in Indonesian forest loss has taken place in swamp forests.... When peat in these swamps burns, it produces more smoke and carbon emissions than do ordinary forest fires." (Belinda Arunarwati Margono via NewsScientist)

PLJ, in collaboration with Bappenas, WFP and the Korea Advanced Institute of Science and Technology (KAIST), also conducted a preliminary study in 2014 on nowcasting (estimating in near real time) food prices using Twitter signals, which was updated and improved upon in 2017. The results of this study, that involved development of a taxonomy to extract prices of four commodities from over 40,000 relevant tweets from July 2012-October 2013 and comparison of these with official prices, confirmed the potential for nowcasting food commodity prices using social media data as a proxy for food price statistics and an early warning mechanism for food price fluctuations. PLJ has also used food price data from Google Trends for the same purpose. Ultimately, none of the nowcasting food prices data was made available on VAMPIRE due to insufficient spatial coverage; the data represented urban areas due to the concentrations of social media users in these areas.

By early 2015, the WFP and the Food Security Agency had just finished the Food Security Vulnerability Atlas (FSVA). An important question that emerged in the words of key WFP staff at that time, was "how can we promote more real time analysis of these important data in order to better evaluate the impact of climate on food security?". Another WFP colleague summarised this as "we need to know where the drought is, what the extent of it is and how it affects people". The FSVA was put online for the first time, with a website designed for easy visualisation of the information.

The WFP wanted to design this dashboard such that it updated automatically –i.e. replaced the current manual system with a system that automated data aggregation and visualisation. Multiple data sources representing different time periods made that challenging. It was at this moment that WFP approached PLJ to collaborate. "*A concept—for what would become VAMPIRE—became clearer, and it also became clear that producing it wasn't going to be that difficult.*" (WFP)

INDONESIA'S HAZE PROBLEM

Indonesia's intermittent haze disasters have national and regional consequences. The haze is caused primarily by slash-and-burn practices conducted by smallholders and more systematically by agro-

industrial land developers. This results in meters of burning peat, which reduces overall water retention in the land. One analysis summarises it as follows: "*The climate threat from such fires is increasing, because the biggest increase in Indonesian forest loss has taken place in swamp forests.... When peat in these swamps burns, it produces more smoke and carbon emissions than do ordinary forest fires.*"

The drought brought by El Niño also exacerbated haze conditions in 2014-2015, resulting in extensive environmental destruction of flora and fauna, health problems, school closures, work disruption and cancelled transportation services. Underlying socio-economic conditions contribute to the problem: people will accept money to burn land when local policies are not pro-poor and economic opportunities as well as resources are scarce.

Local haze thus becomes a sub-national disaster, which typically takes less than 24 hours to become a national disaster. National haze disasters ignore international boundaries and can quickly become a regional disaster. And so when burning peat becomes fire and this leads to a haze disaster, the main questions for the national and local governments are "*what exactly is happening and what can we do*?" (KSP)

Disaster prevention was also not previously based on a timely and accurate reading of layered weather data. Rather, "*the government was focusing on counting hotspots*" according to one WFP official. To do so, it was referring to satellite data, sensors deployed in affected areas and official statistics, such as population density and distribution but not systematically using these data. The Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) was measuring air quality sensors once per day and sending results by SMS or email. Satellite data from the National Institute of Aeronautics and Space (LAPAN) were used by the GOI to identify hotspot locations, but these data were only available every six hours and these could also produce false positives for haze without cross-referencing against other data. And it was not clear how the combination of these data translated into an evidence-based government response.

"We needed tools that allowed us to automatically collect data and monitor various parameters such as wind velocity and direction and haze density. We need to know this in real time so that we can make the right decisions quickly. We are missing information. We have been relying on satellite data, but satellite data is only available every six hours... data from the Indonesian Agency for Meteorology, Climatology and Geophysics is not accessible online yet... It has yet to be integrated with other data sources." (BNPB, as quoted on www.hazegazer.org)

II.
Intervention

VAMPIRE

Collaboration
While the convergence of PLJ, WFP and Government of Indonesia priorities in 2014-2015 set the stage for VAMPIRE, personal initiative was just as much responsible for kick-starting this collaboration.

A new head of the food security team at WFP arrived in Indonesia in 2014. After the Global Pulse launched in New York, he had followed its progress and found a way to work with them on a research project while based in WFP's headquarters in Rome. He arrived in Jakarta "*looking for an opportunity to work with PLJ*". Likewise, the new WFP Indonesia Country Director arrived in Jakarta right on the heels of the inauguration of the new Widodo government. She, too, was aware of Global Pulse, since Global Pulse had been part of the High-Level Task Force on Global Food Security chaired by the UN Secretary General where she worked prior to her Jakarta assignment. Separately, a GIS analyst was in Jakarta and in the process of studying for a Masters degree. As part of her fieldwork, she was looking for an organisation at which she could evaluate and improve GIS processes. PLJ's Head of Office had met this analyst and introduced her to the WFP Indonesia Country Director—who promptly hired her.

The WFP came up with the premise of VAMPIRE as a way to improve the systems and processes for drought monitoring. Knowing PLJ's expertise in data analytics, WFP approached PLJ to collaborate. Not only was this a critical issue with a credible partner, but PLJ's Chief Data Scientist had been experimenting with Twitter data analysis—notably on the Haze Gazer initiative—and saw this as a logical and relevant extension of that work.

Objectives
VAMPIRE was originally designed to better understand the likely impact of weather phenomena on food security. The hope was, in turn, that this would promote better targeted assistance to promote food security for the most vulnerable. From PLJ's own publications, a more thorough theory of change is presented:

THEORY OF CHANGE AS DEFINED BY PULSE LAB JAKARTA: FOOD SECURITY

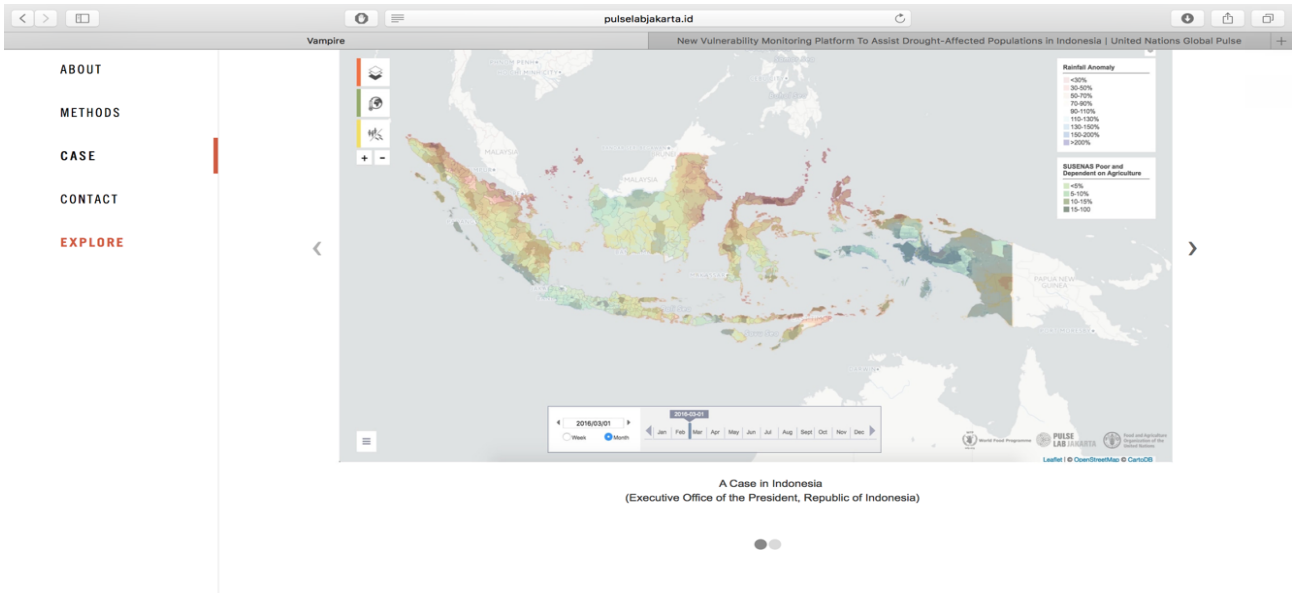
Reduce vulnerabilities to food security	Longest-term
In order to Better manage food security	Longer term
In order to Better target assistance and allocate resources	Medium-term
In order to Identify priority areas for assistance	Short-term
In order to Better understand weather phenomena, extent of drought affected areas, impact on markets, coping strategies and resilience of local communities	Shortest-term

The pink area in the simplified theory of change above represents PLJ's focus, reflecting the shorter-term nature of PLJ influence through contributions to VAMPIRE on the broader issues of food security.

Development

The development of VAMPIRE relied on a combination of engineering, data science and stakeholder engagement. PLJ was responsible for designing much of the back end for the web-based system as well as the entire front end of VAMPIRE. In other words, everything you can see is from PLJ. In the words of PLJ "*we were the engineers and WFP were the analysts*."

Image: Screenshot of VAMPIRE public platform



The WFP technical expertise informed conceptualisation of the platform, including identification of key functions, key questions to be answered by the data and key indicators to use. Representatives of WFP have a similar take to PLJ on the division of labor: "*we had the subject matter expertise. They (PLJ) could rapidly prototype up to proof of concept and scale.*"

"*The biggest benefit in working with PLJ was that there were things we didn't even know we had to learn—those unknown unknowns, such as the data possibilities and how to present those data in a meaningful way to people outside our substantive expertise. We know about food security…much less about how to present that in a useful and persuasive way.*" (WFP)

VAMPIRE: In PLJ's Own Words

VAMPIRE provides integrated map-based visualisations that show the extent of drought affected areas, the impacts on markets, and the coping strategies and resilience of affected populations. (It) is a multi-tier system that fuses several databases. First, it visualises the national socio-economic survey and WFP's household food security surveys. This data provides information on the percentage and distribution of poor, agriculture-dependent populations, as well as food insecure communities.

Second, it analyzes data on rainfall anomalies and the Indonesian Vegetation Health Index. Rainfall anomaly is a measure of the amount of rainfall in a period compared to the long-term average for that time of year while the vegetation index is a proxy for drought. (PLJ blog)

Engagement with the Government of Indonesia

The WFP and PLJ engaged the new Executive Office of the President (*Kantor Staf Presiden* or KSP) on VAMPIRE through a variety of means. Both organisations gave presentations, provided training on VAMPIRE and how to answer questions based on different data sources and attended smaller briefings. PLJ was already known within KSP as a result of its work on Haze Gazer and, prior to that, in support of the GOI's public services complaints platform, LAPOR!.

Later, VAMPIRE was installed in the data bureau of the Ministry of National Development Planning (known as Bappenas) at its request.

VAMPIRE: Key Outputs

The VAMPIRE platform (open platform).

Blogs: A New Tool for Assisting Vulnerable Populations During Droughts, Scaling Up Our Drought Impact Tracker, and Fusing Datasets to Track the Impact of Disasters in Indonesia and Beyond: VAMPIRE Is On It.

Academic paper: "VAMPIRE and PRISM - New Vulnerability Monitoring Platforms on Food and Livelihood Security in Indonesia and Sri Lanka" - 3rd Conference on Data for Policy conference (2017) (paper not available yet).

HAZE GAZER

Collaboration

"*It was we who approached PLJ first. Our relationship extended beyond this or that office. I knew (a PLJ staff) before…and we had many discussions, especially around evidenced based policy making. So, when we in government were forced to be more responsive to key challenges, it was good to be able to approach a partner like PLJ.*" (KSP)

While the KSP invited PLJ to consider developing a response to haze, the UN Office for REDD+ Coordination (UNORCID) was PLJ's primary partner in conceiving Haze Gazer. UNORCID was the first to propose haze as a focus and helped PLJ to understand information needs and shared technical advice on the nature of fire and haze events. It was also the first to propose using social media as data sources on this platform to explore the dynamics of haze. Specifically, UNORCID staff proposed to PLJ to test analysis of tweets on health, economy, and mobility for their relevance.

While the GOI was interested in peat fires, the angle for PLJ was a little different: "*we were interested in haze and not just hotspots*." PLJ was interested to focus on the haze problem for a few reasons beyond the initial nudge from KSP and UNORCID: this was a prominent and recurring issue of broad (and national political) interest; haze, as a focus, was conducive for new prototyping that would entail experimentation—since it was a *slow moving* development issue; and PLJ had already been experimenting with Twitter data analysis and saw great potential in the applications of this into platforms like Haze Gazer and VAMPIRE.

THEORY OF CHANGE AS DEFINED BY PULSE LAB JAKARTA: HAZE GAZER

Improve regional resilience to haze and other types of disasters	Longest-term
In order to Improve community resilience	Longer term
In order to Empower citizens	Medium-term
In order to Increase citizen engagement / support government to target interventions aligned with affected populations	Short-term
In order to Gather and combine numerous data sources and analyses	Shortest-term

Objectives

Haze Gazer was designed to provide more integrated data and information and enhanced data visualisation by complementing traditional data sources already employed by the GOI—such as satellite and meteorological data—with relevant social media and other mobile data. In using social media, PLJ was hoping to tap into another sustainable source of data, since these were available for access. The overall data analytics were intended to be more systematic. And the original plan was to not only build Haze Gazer for the government but also as a public platform, since improving public education about haze and public action in response to haze were considered important objectives. As such PLJ was testing the relationship between an important real-world issue (haze) and social media content—with the hope of demonstrating how social media could be one source of data relevant for peat fire management.

Once again, the pink area in the simplified theory of change above represents the shorter-term nature of PLJ's focus, this time through its contributions to Haze Gazer in support of haze monitoring and management.

Development

Unlike with VAMPIRE, PLJ developed Haze Gazer in house, with little external guidance or direction. PLJ staff provided the data science and system development expertise and led the process of posing challenges and then iterating towards solutions. PLJ technical staff do join routine (typically monthly or bi-monthly) global research calls that involve up to 30 in-house staff from among the three technical teams (Global Pulse in New York, Pulse Lab Kampala and Pulse Lab Jakarta) in the pulse lab network. These research calls involved frequent discussions on the development of both Haze Gazer and VAMPIRE. These calls also supported transfer of knowledge from Jakarta—for example, with Haze Gazer experience informing Global Pulse development of social media mining on immunizations.

Meanwhile, in trying to understand and anticipate haze, the GOI had only been relying on satellite data, sensors deployed in affected areas and official statistics, such as population density and distribution. With Indonesia having over 20 million Twitter users at the time of PLJ's initial experimentation, there was a wealth of Twitter data with the potential to provide near real-time insights on public sentiment about haze and peat fires. While censuses and surveys help governments follow long-term trends, these cannot provide real-time snapshots. Twitter and other social media data were considered by PLJ and UNORCID, in particular, to have potential in supporting immediate government action on issues affecting the public through *timely* and *frequent* data updates.

And so, one of the early questions was how hotspots could be identified and better understood using social media data. Another starting point was that when it comes to haze, "*everything is based on the weather. You have to listen to the weather map.*" (WFP) Haze Gazer was designed to use satellite and sensor data as well as baseline population data and layer this with citizen-generated data.

In 2014, PLJ conducted a feasibility study, in collaboration with UNORCID, on the correlation between Twitter communication trends and on-the-ground forest and peat fire haze events. For this initial proof of concept, DataSift provided access to the social media datasets, and the data was collected, stored and classified by a social media analytics company called Crimson Hexagon.

Based on this initial proof of concept, in 2015 PLJ conducted more detailed research—this time using 29 million tweets as opposed to 113,000 for the feasibility study—regarding how movement patterns can be understood from Twitter metadata. The results were outlined in a research paper. Mobility patterns change at times of extreme haze—some people evacuate, for example—and this can be seen from their

tweets. Tweets can also capture emotions in response to haze. Adding Twitter data to assess citizen needs, opinion, and behaviour was also considered useful in providing ground-truthing from citizen perspectives.

Crimson Hexagon was ultimately seen by PLJ as an unsustainable service, given its cost and the fact that it did not support behavioral analysis since it does not provide access to raw data sets. In devising a solution, PLJ used the help of a domain expert from the KAIST to develop its own Natural Language Processing Toolkit. This included development of the taxonomy (keywords) that was related to haze. This "Statistical Iterative Learning of Keywords", branded (SILK), represented one significant innovation in support of the development of Haze Gazer. From these sorted tweets, PLJ could capture relevant messages from the data as a whole. In turn, PLJ captured user mobility using geo-stamped tweets. Since these early days, PLJ has further developed natural language processing, and is now applying machine learning to determine keywords related to haze.

Government partners "*then developed the concept further by identifying other data sources that could offer insights on haze event dynamics, which included the identification of the need for data visualisation.*" (PLJ) BNPB asked PLJ for data on visibility rates during haze. In response, PLJ explored analysing photos posted by people on Twitter in haze-afflicted areas, enriching the data sources for Haze Gazer. The amount of photos correlated with the severity of the haze, and so PLJ has kept this as one information canal in Haze Gazer. These visuals can help BNPB make decisions, such as whether to close schools and airports.

"*Most efforts to use online media, especially social media, to inform public policy have focused on text mining. This project looked at multimedia sources, including image, video and audio-based inputs. The partners have found that these other information sources are a useful complement to text-based inputs.*" (PLJ)

Innovation involves hits and misses, and not all of the experiments with incorporating multimedia into Haze Gazer were successful. PLJ tried soliciting public videos via YouTube, but there was not much direct engagement from citizens with the platform. That said, the quality of information in video is considered by PLJ to be much "richer" than other media, such as photographs, and so this feature has been retained despite little video content being uploaded by the public.

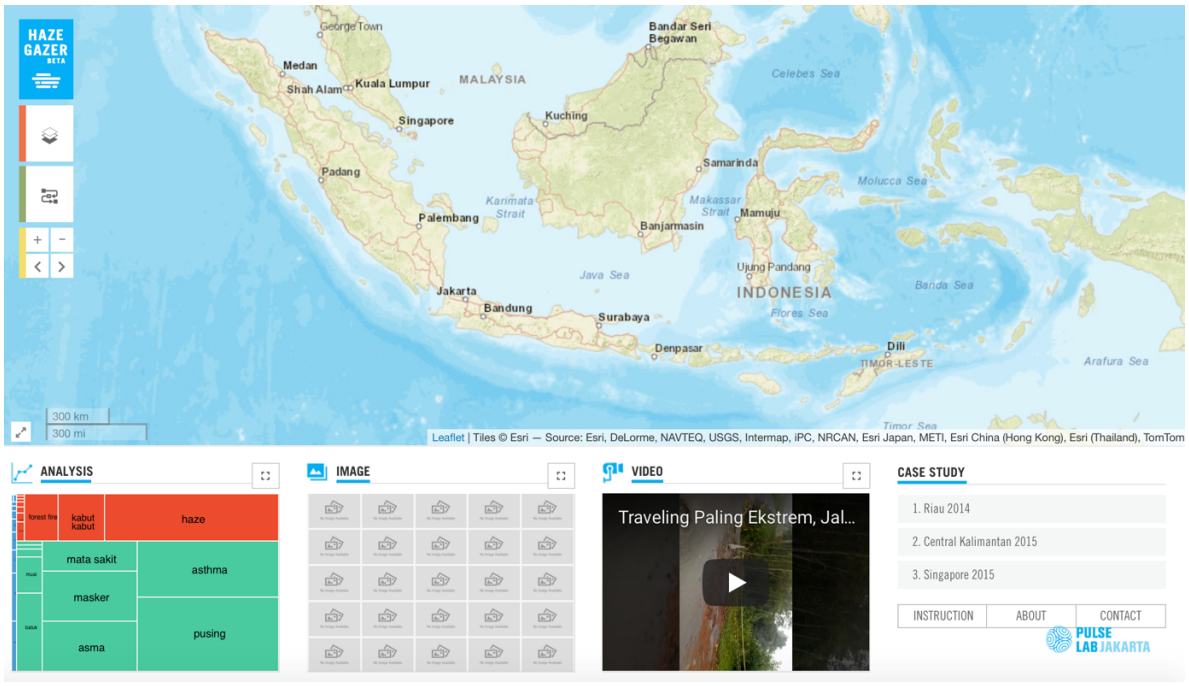
Haze Gazer: In PLJ's Own Words

Haze Gazer *is a crisis analysis and visualisation tool that provides real-time situational information from various data sources to enhance disaster management efforts. The prototype ... provid(es) real-time insights on the locations of fire and haze hotspots; the strength of haze in population centres; the locations of the most vulnerable cohorts of the population; and most importantly, the response strategies of affected populations, including movement patterns and in-situ behavioural changes.*

Haze Gazer uses advanced data analytics and data science to mine open data, such as fire hotspot information from satellites and baseline information on population density and distribution, as well as citizen-generated data, including the national complaint system in Indonesia called LAPOR!, citizen journalism video uploads to an online news channel, and real-time big data such as text-, image- and video-oriented social media. (PLJ blog)

PLJ collaborated with one of the largest national private radio networks, Elshinta, to try and incorporate relevant audio content into Haze Gazer using Google's speech to text. This was also informed by prior work on speech to text in Pulse Lab Kampala. However, this data platform was, in the words of PLJ, "unreliable", and PLJ did not itself have the bandwidth to resolve these problems and incorporate this content into Haze Gazer. PLJ had also wanted to use CCTV footage from Riau, Kalimantan and elsewhere in Sumatra, but this video footage was not streamed over the web and therefore not accessible.

Image: Screenshot from www.hazegazer.org



Engagement with the Government of Indonesia

Haze Gazer was developed at PLJ and "*brought to KSP nearly at the end.*" (PLJ) Once Haze Gazer was almost fully developed, PLJ presented it to KSP. PLJ offered to provide some modifications to the Haze Gazer design but there was no follow up to this offer from KSP. KSP did not ask for specific extra data, but only asked "*what can these data do*?" After handover, there was no further engagement by KSP with PLJ on Haze Gazer.

The GOI did conduct its own rapid assessment—including of social media activity—in nine provinces deemed especially critical for the impact of haze. Of these, there was negligible or no Twitter activity in two, although Facebook was popular in all. The KSP continues to consider online news media as important sources of information and data, and suggest they need more data from community radio to inform overall analytics on peat fires and haze. The KSP "*added 600 or so more features to the Haze Gazer algorithm, including those relating to online news.*" (KSP)

[16] http://hazegazer.org
[17] https://www.unglobalpulse.org/blog/haze-gazer-crisis-analysis-tool

HAZE GAZER: Key Outputs

The Haze Gazer platform for the GOI combined big data, citizen generated data, and open data. The public online platform for Haze Gazer, www.hazegazer.org was officially launched in January 2017 at the UN World Data Forum. The "news" and "report" features of this platform have not been updated since 2016. But other more up-to-date data are available. Analytics provided by PLJ shows that the platform has received over 23,000 page views to date. Almost half of all users originate in the U.S. but users in Indonesia and Singapore spend the longest and view the most pages.

Scientific papers. Through the development process of Haze Gazer, PLJ produced and published five scientific papers of note. To PLJ, this was an important corollary to development of the platform in that these papers contributed to the overall "*enhancement of knowledge*".

Case studies. PLJ also produced three case studies on Haze Gazer, which are available via www.hazegazer.org. PLJ considers these case studies as a means to demonstrate value and also as a useful tool to support discussions on Haze Gazer at the policy level.

- **Blogs:** Haze Gazer: A Crisis Analysis Tool, and Scaling Up Haze Gazer.

VAMPIRE AND HAZE GAZER: **FIT FOR PURPOSE?**

FIT FOR THE GOVERNMENT OF INDONESIA

VAMPIRE addressed a more policy-oriented need of the new Indonesian government. By 2015, the GOI was advising the WFP that it wanted "knowledge and capacity support as well as specific technical advice – and not simply food projects any more." (WFP) VAMPIRE was one response to this request, and a reflection of WFP Indonesia's emphasis on supporting national government priorities and not bringing in pre-baked interventions.

Promoting Legacy Systems. The National Disaster Management Agency (BNPB) was intimately involved in the design of Haze Gazer by contributing insights on existing government systems, and testing of the tool. Early in the development of Haze Gazer, PLJ met with representatives of the Indonesian Forestry Ministry and the BNPB. This allowed PLJ's data scientists and engineer to examine the systems already being used by these government departments. In developing Haze Gazer and then VAMPIRE, PLJ emphasized replication and, to some extent, upgrade of these existing systems in order to promote sustainability.

Haze Gazer continues to provide the functions of the legacy system, while at the same time offering new insights based on public discourse on multimedia platforms. "By having an interface that government knows and understands, you are not reinventing the wheel. We could layer on other data and they (government counterparts) would be more willing to absorb these." (PLJ) For handover, PLJ only needed to provide training on how to use Haze Gazer data, where the data came from, and why these data were selected. PLJ also used open source tools and made VAMPIRE and Haze Gazer web-based for easy access.

FIT FOR THE INDONESIAN PUBLIC

Haze Gazer was public and designed with citizen "resilience" in mind, but there was little direct input solicited from citizens at the beginning and no thorough Human-Centred Design process prior to development. Rather, PLJ applied the "common sense approach" (PLJ) in developing the platform. The Pulse Story Hazed and Confused, offering a citizen-based take on haze, was published in tandem with production of Haze Gazer.

PLJ acknowledges that the Haze Gazer platform should be simpler than the current look if the intention is to promote more public engagement. The Haze Gazer dashboard was not primarily designed for the public but rather for the President's situation room, which resulted in the boxy look and complicated data representations. There is some interest within PLJ to produce two dashboards—one for the President's situation room featuring raw data and the other public facing and featuring key insights only—but PLJ has had neither the time to commit nor personnel to produce both dashboards.

A more intuitive Haze Gazer mobile may be more suitable for the public. A mobile version of Haze Gazer was developed and briefly field tested in 2016 with underwhelming results. The intent behind the mobile version was to encourage input from and engagement with local residents. However, by PLJ's own admission, there was no thorough process undertaken to promote this mobile version—not least since there have been no major haze events since 2014.

III.
Impact

Pulse Lab Jakarta endorses a more flexible interpretation of "impact". Objectives can (and, often, should) change over time. Proponents of "Doing Development Differently" stress the importance of iteration and adaptation as well as the complexity of genuine development progress. Concrete impact often occurs over the longer-term, which can exceed project cycles, key personnel postings, or even government terms. Recognising this, PLJ defines its contributions and influence in terms of:

Operational Impact – the effect that PLJ prototypes or analytics have on the ways that partners, clients and key stakeholders work. This includes the adoption of data driven approaches.

Methodological Impact – the promotion and practice of new and relevant applications of data science.

Ecosystem Impact – contributions in support of the broader and complex ecosystem of data innovation, not only in Indonesia but also regionally and globally. This includes contributions to key stakeholders participating differently within this ecosystem.

This more inclusive categorisation is compatible with broader definitions of policy change, which reflect incremental shifts that include not only changes in regulations and legislation, but also changes in the level of knowledge among key policymakers on an issue and changes in attitudes among these policymakers towards data and other evidence.

OPERATIONAL IMPACT

The WFP and PLJ agree that VAMPIRE is *primarily* for the Government of Indonesia—as is Haze Gazer. There is broad agreement that it is more important to be able to identify how the government is using these and less important to establish firm links between the dashboards as originally designed and specific policy decisions. PLJ representatives admit that "*we don't really know how they are using Vampire and Haze Gazer*." WFP representatives interviewed, likewise, did not know how exactly how the KSP is using VAMPIRE or the data analytics it yields. "*KSP has been a little bit of a black box*." But this was not a concern: "*The beauty is that VAMPIRE has been swallowed up by the government's Early Warning System. It is great they are adapting this. I'd be surprised if we recognized VAMPIRE within the GOI*."

The WFP sees KSP using VAMPIRE in a broader sense. Their understanding is that KSP is looking at the historical record on disasters as well as current disasters—especially for drought—and then trying to

[22] https://www.unglobalpulse.org/how-we-define-impact-our-data-innovation-lab
[23] http://doingdevelopmentdifferently.com

understand how local governments are addressing the sustained high incidence of drought. "*KSP wants to understand where the investment into disasters has gone, and how subnational governments are using information they have to address these issues.*"

Informing development of the government's Early Warning System

VAMPIRE and Haze Gazer were critical in the government's open data architecture. KSP officials cite three 'building blocks' for Indonesia's Early Warning System (EWS): the Food Security Vulnerability Atlas, VAMPIRE, and Haze Gazer. KSP officials confirm that the Early Warning System dashboard still uses VAMPIRE's actual look, enriched with substantially more data on food prices. However, from Haze Gazer the dashboard only incorporates the Twitter information channel, enhanced with data from the Facebook newsfeed and online newspapers for areas where social media are less used, such as Aceh.

"*Haze Gazer and VAMPIRE provided us with new insights as to what the Early Warning System could be. Before, the EWS was more on natural disasters and commodity prices…but not very integrated at first. Even now, it is not effective enough. But in some sectors this is getting better—for example in food security and health. Forest fire prevention is much better.*" (KSP)

"*Haze Gazer is pretty awesome.*" (KSP)

VAMPIRE and Haze Gazer are two examples through which the Indonesian government confirms that it is able to promote the notion that strong and timely data can establish a pattern for response.

"*These platforms are instruments to be used for government business processes. We have tweaked the functions and use these for political means—as evidence to engage with different line ministries. Our Early Warning System is confirming the beginning of a hypothesis on funds poorly allocated, less than optimal coordination, etc.*" (KSP)

And so, it is not possible, and—arguably—not relevant, to determine the impact of Haze Gazer and VAMPIRE on precise elements of policy decision-making at the level of the GOI for a couple of reasons:

"These platforms are instruments to be used for government business processes. We have tweaked the functions and use these for political means—as evidence to engage with different line ministries. Our Early Warning System is confirming the beginning of a hypothesis on funds poorly allocated, less than optimal coordination, etc." (KSP)

Both Haze Gazer and VAMPIRE have been subsumed into a much larger Early Warning System funded by the government and housed in the President's situation room that includes classified information and data. For example, while VAMPIRE provided a snapshot test of PREMISE price data on nine basic commodities, the Government's EWS "*tracks all basic commodities.*" (KSP)

Extrapolation and analysis of Haze Gaze and other data is done separately outside of direct management of the KSP, and the decision making based on analytics from this system are a matter of national security and, therefore, not public. Officials from Indonesia's intelligence agencies, including the new Cyber Encryption Agency, are also involved in analysing data from the President's situation room.

Supporting the government's open data agenda

A broader perspective on policy change is relevant in this case. One longer-term legacy inherited by the current Indonesian government is one of a lack of reliable and robust data. The current government's promotion of One Data (*Satu Data*) is towards defining and institutionalising a structure for the use and sharing of data. Since the beginning of his administration, the current president has demanded KSP to be one step ahead in disaster management and that data across ministries should be synchronised and not contradictory. This has enabled KSP to push innovative ideas, including inviting VAMPIRE and Haze Gazer to inspire development of the Early Warning System, as part of the government's broader open data agenda.

Promoting more effective government response

The EWS, in which VAMPIRE and Haze Gazer are integral, has assisted the Government in improving its disaster response. In the event of haze, the information canal captures tweets from people around the area, informing any actions taken by either local authorities or communities, such as the military and police, special rangers from the Forestry Ministry (*Manggala Api*), or citizens' forest monitoring groups (*Masyarakat Pemantau Hutan*). In areas with no related tweets, there are two possibilities: 1) the area has not been addressed by any local authorities; or 2) the local government has not put enough investment in disaster management. In the first case, KSP can channel the information to the BNPB. In the second case, KSP can advise the central government to conduct a performance evaluation, checking local government budgeting versus actual spending on disaster management, allowing more effective monitoring and response from the central government.

"*The first time I saw Haze Gazer, I said we should use it. We now use it in the President's situation room, so that we can have more accurate predictions. It helps us to use our limited budget to prevent forest fires… Since then, the President established better coordination for prevention. And we took the lead.*" (KSP)

The incorporation of Haze Gazer into the EWS "*allows KSP to direct political attention where it is needed the most… We overlay Haze Gazer with 3 satellites—NOAA, Terra, and Aqua. When all triangulate, we can conclude that is the location of the hotspot.*" (KSP) KSP is by their own admission using the data from Haze Gazer to support enforcement. There are many actors involved, from forest rangers, the military, police, central government logistics, subnational logistics, and village logistics. "*The GOI's EWS is telling us now how even villages are experiencing fire and responding to fire. Sub-national government needs advice on how to pool resources and these data help us to provide that.*" And this has real world as well as very personal consequences: The President has told the heads of police and the military in areas prone to forest fires that if these break out, they are out of a job.

In addition, VAMPIRE data informs the Government about the severe impact of drought on food production and farmers. As a response, the GOI through the Ministry of Agriculture provides aid to help farmers following disaster. This cycle did not previously exist. While VAMPIRE is not solely credited with promoting this, the platform has nevertheless showcased "slow-burn" progress on data-driven policy making, particularly in the event of crisis.

Informing government analysis

VAMPIRE has now been institutionalised as one of the data and information sources that informs the routine working groups meetings joined by BMKG, LAPAN, the Ministry of Agriculture's Food Security Agency and others that produce the quarterly food security bulletins. The Indonesian government has produced a Ministerial Directive (SK) that specifies VAMPIRE as one information sources for related agencies to refer to. The most recent annual SK to this effect has just been renewed.

Supporting external advice to government
VAMPIRE has supported the WFP in advising the government: "*VAMPIRE is the go-to source on looking forward as to what food security is going to be doing… which is particularly helpful when we know that the weather is less predictable than it used to be. It is useful in a programmatic sense for us when we advise the Ministry of Agriculture and the Coordinating Ministry of the Economy in what factors are likely to impact good production and prices and poverty*." (WFP)

Promoting data literacy
VAMPIRE not only presented data, but promoted further exploration based on the derived analytics and visualisations. The various institutions brought together in the technical working group to produce the food security bulletins—which provide information for early warning and timely response planning—including the Geophysics, Climate and Meteorological Body (BMKG), the Ministry of Agriculture's Food Security Agency, the National Institute of Aeronautics and Space (LAPAN) and the Bogor Agricultural Institute (IPB), frequently debated VAMPIRE data in the process of producing these bulletins.

Promotion of Haze Gazer and VAMPIRE have also contributed to important conversations more broadly within government about data quality and data credibility. The Ministry of Agriculture was interested enough to conduct a verification mission from WFP's food security bulletins in the field to test the validity of the data. To PLJ and WFP, this reflects a positive appreciation of the accuracy of data and what is riding on this.

METHODOLOGICAL IMPACT

WFP acknowledged that "*we had the data…but needed the engineering. The data exists but we need to make these more beneficial for development*." VAMPIRE brings together the various data sources that WFP was already accessing and analysing in manual form, and created an *automated system* that provided *near real-time data updates* via a dashboard that features *user-friendly and interactive maps and visualisations*. It combines near real-time data with the traditional static data. "*It cut the time from weeks to hours to answer the two most fundamental questions: extent of drought, and the impact of drought on the most vulnerable*." (WFP) To the extent that it greatly reduced the time of providing more varied data in more valuable visualisations Vampire reflects better use of data and digital data sources—and three primary data sources in particular: remote sensing data, price data and household data.

As a result, WFP was able to create profiles of which districts would be most likely to be drought affected. "*Now we could show that these are the areas in drought, these are the populations in areas in drought, and so these are the impacts of drought*." (WFP)

VAMPIRE is just one product of overall work on food security monitoring, but a significant initiative from the perspective of WFP. "*The great data benefit of VAMPIRE was it previously took us weeks to download satellite data…and by then these were old. We managed to automate that with Vampire. We could then spend less time on manual stuff and more time on analysis. That was extraordinary*." (WFP)

Meanwhile, Haze Gazer—in PLJ's own analysis[24]—has been determined to enhance disaster management efforts by providing real-time insights on: "*locations of fire and haze hotspots; the strength of haze in population centres; locations of the most vulnerable cohorts of the population; and response strategies of affected populations, including movement patterns and in-situ behavioural changes*." Much of these

[24] https://www.unglobalpulse.org/projects/haze-gazer-a-crisis-analysis-tool

data were already available—for example data on fire and locations of the most vulnerable populations—but the *technical achievement* of Haze Gazer was in demonstrating that multiple data sources can be combined in near real time to produce valuable and actionable information.

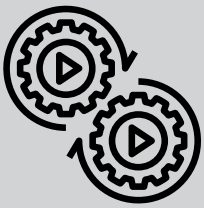
Analysis of Twitter data provided "*more timely insights to enhance evidence-based decision making*" and "*showed that temporal correlations were observed between the number of peat fire hotspots and number of tweets*." With its layers of data, Haze Gazer could help to "*highlight where things are working and not working*." (PLJ)

Analysis of Twitter data provided "more timely insights to enhance evidence-based decision making" and "showed that temporal correlations were observed between the number of peat fire hotspots and number of tweets." With its layers of data, Haze Gazer could help to "highlight where things are working and not working." (PLJ)

For a self-described innovation lab, PLJ is increasingly ambivalent about promoting innovation for the sake of it. "*VAMPIRE is semi-innovative…a new paradigm." (PLJ)*

"*I'm proud of what we accomplished. But we were not the first to do this. Many projects are like this and have done these overlays. We were well positioned with strong relationships. We could deploy quickly and this was particularly relevant during El Niño. But we didn't invent anything that hadn't been done before*." (WFP)

VAMPIRE was for the *first time in Indonesia* providing a variety of relevant drought-related data in near-real time and via appealing visualisations. And this platform is one example of how "innovation" is perhaps best in the eye of the beholder: in 2017, VAMPIRE won the WFP Innovation Award.



KEEPING IT REAL

The VAMPIRE platform provides integrated map-based visualisations that show the extent of drought affected areas, the impacts on markets, and the coping strategies and resilience of affected populations. Users can view where food-insecure and agriculture-dependent communities live; data on rainfall anomalies and vegetation health; and crowd sourced prices of staple foods in these areas. (PLJ Blog)

These claims are a little over-stated. In practice, VAMPIRE did incorporate a few months' worth of data on the impacts of markets. But, as already explained, these were not continued. WFP also tried streaming Ministry of Finance price data for a while but this proved not to be viable given the lack of standard formatting of these data. The one-time WFP household survey did produce data on the impact of drought on vulnerable populations. These data "*were useful at that time. These narrowed down the areas most affected and provided in-depth household information. Perhaps vulnerability of affected populations is a better word than resilience—since we were looking at how conditions of vulnerability have changed in households facing the most chronic food security*." (WFP) But this is a static layer of data from that one snapshot in time.

ECOSYSTEM IMPACT

Public access

PLJ has received occasional requests asking for data and interviews concerning big data for sustainable development—mostly from overseas. Usually the focus of these is on stories and impact, and less about technical questions. Occasionally, researchers have used Haze Gazer as part of their research. To date, there has been no offer for collaboration—despite the solicitation for partnerships both on the Haze Gazer website and in related blogs. One PLJ staff remarked that Haze Gazer has been more popular within the development sector than among the broader technology community.

International uptake and recognition

The United Kingdom Climate Change Unit (UKCCU) is concerned about fire and haze for a number of reasons: deforestation, land degradation, greenhouse gas emissions, and the social and economic impacts. They have a number of programmes which support Indonesian institutions to reduce the risks and impacts of fire in Indonesia. Similarly, they have requirements to report on the risks and impact of fire to their networks, particularly the UK Government. UKCCU has made use of Haze Gazer in doing so: "*We use a number of sources to check stats and relevant policy impact (e.g. the success of the fire ban in Jambi province)… we use the WRI's global fire watch data, government stats and Haze Gazer to cross reference information, monitor and report on our programmes and policy analysis*."

The Government of Sri Lanka, via WFP Sri Lanka, requested that a platform like VAMPIRE be developed for its Disaster Management Ministry to deal with drought and floods. PLJ and WFP Indonesia deployed to Colombo to help the Sri Lankan team to set it up.

VAMPIRE has received significant internal recognition within the WFP. Winning the WFP's 2017 Innovation Award provided more than just kudos. WFP's own Innovation Accelerator had repeatedly expressed doubts about VAMPIRE during the early stages of development. "*The innovation award focused attention on how much further WFP Indonesia is ahead on the development scale. It also highlighted how we here are very un-traditional in what we are doing here*." It was also noted that the recent WFP innovation award for VAMPIRE "*does help and raises the visibility of this model with the regional head*." And WFP Indonesia claim that based on the success with VAMPIRE "*we get more requests now from people within WFP to produce things*."

In 2016, Haze Gazer was shortlisted for the *Harnessing Data for Resilience Recognition award* by the US Agency for International Development as one of five finalists in the early innovation category.

> *"We use a number of sources to check stats and relevant policy impact (e.g. the success of the fire ban in Jambi province)… we use the WRI's global fire watch data, government stats and Haze Gazer to cross reference information, monitor and report on our programmes and policy analysis." (UKCCU)*

IV.
Findings

CHALLENGES TO POSITIVE CHANGE

Crossed Lines of Political Authority

Every ministry has their own dashboard and different mandate. In managing haze, the Ministry of Forestry has the mandate to monitor conditions before haze disasters erupt. The mandate for the National Board for Disaster Management (BNPB) is after a disaster happens. Meanwhile, Haze Gazer is more about monitoring during the event. Cooperation with the appropriate government department is key in addressing food security. "*The Ministry of Social Welfare has responsibility for delivering important assistance. WFP had tried to engage them on drought impact, but the Ministry of Agriculture took over responsibilities.*" (WFP) There are also the inevitable political frictions between the central and local governments that distort the gravity of local conditions—with local governments trying to elevate their concerns to a national issue so that the national government will take care of it. With these various overlapping interests, it has been more strategic for PLJ and WFP to engage with KSP because this Office is aligned with the president's agenda and can inform the work of all related line ministries.

Navigating Data Sovereignty

One challenge in designing Haze Gazer outside of government but for government beyond that of securing funding and political commitment to continue is in the *political acceptability* of data represented. Some Indonesian government agencies are not allowed to make decisions based on "unreliable sources of data"—interpreted in this context as data sourced from outside of the government. For example, a challenge faced by PLJ in engaging with the BNPB is that data should be from LAPAN. The National Board for Disaster Management BNPB has made frequent requests—for example, for wind data and rainfall data—but these data should come from BMKG. However, BMKG does not have a mechanism for sharing data automatically. They still share data using email. The USAID APIK programme is helping them to share their data but this is not yet completed. PLJ has even used Haze Gazer data to inform a Data Dive and invited BNPB officials to this. While BNPB officials have shown great interest in Haze Gazer data, they could not officially use it. To tackle this challenge, PLJ tried to facilitate incorporation of all "reliable (Indonesian government sourced) data". However, as an external platform, PLJ is still using some external data sources, including NASA and Twitter data.

The KSP is not as rigid in excluding sources of data in its decision making considerations. "*We are different to BNPB. The source of data is not an issue here in this office. Now, for example we have developed our own geo-spatial map, and so we will stop using Google. But that is because we have developed our own tool. For decision making we often refer to external sources of data—for example from the World Bank. The problem is that we cannot refer to these external sources in public.*" (KSP)

Access to Twitter Data

Twitter data involved a similar wrinkle but from the PLJ side. Raw Twitter data cannot be shared with any party outside of UN given PLJ's agreement with Twitter over the use of its data. However, since the platform is public, KSP has been able to benefit from the publicly accessible analytics to overcome this issue.

Sourcing Commodity Price Data

Government-business processes

The experiment in collaborating with PREMISE to use crowdsourcing via a mobile phone app for monitoring food prices did not gain traction for a couple of reasons. First, in implementing this pilot "*we forgot about government-business processes*." (WFP) The GOI needs long-term data to monitor prices, and using an expensive vendor such as PREMISE for this was ultimately considered unsustainable. Also, the Ministry of Finance does not consider rural price information as particularly relevant for monitoring inflation. Provincial level price setting is a more important indicator. According to WFP, "*stronger earlier conceptualisation of this pilot would have identified this as a challenge*."

Obfuscation in access to data

Our funding was to develop capacity on remote sensing within this Disaster Management Agency… but in the end they refused due to red tape. They wanted formalised agreements, etc. They were far more bureaucratic. Also, government tends to be risk averse. They want to know how data will be used." (WFP)

Technical challenges in accessing price data

The WFP tried to include other sources of data for food prices but ran into technical problems. The GOI food data is produced by the Bureau of Statistics, Ministry of Finance, Ministry of Trade, and the Ministry of Agriculture. Their data have slightly different results and it is hard to say which data are the most reliable. Furthermore, the Finance Ministry is not consistent in the formatting of their price data, so it is difficult to integrate these. BPS still publishes data in pdf, making the data harder to scrape and sort. Bank Indonesia now has its own map-based food price system called *Harga Pangan*. The WFP is currently exploring how to incorporate data from *Harga Pangan* into VAMPIRE.

The Politics of Haze Management

Not all national government response is based solely on climatic considerations. Government action on haze is best directed at the local level, but then local politics also plays a crucial role. The reality—as defined by KSP officials themselves—is that political attention is more likely to be directed at local regions in which the local political leadership are politically allied with the administration. Government action is partly determined through a simple analysis matrix of "*mampu*" (are regions capable of using funds for prevention and action?) and "*mau*" (do regions have leadership with the political will to act?). If answers to both of these are yes (for example, in South Sumatra), then these regions are considered political allies and are more likely to receive resources and assistance.

Making Data Analysis Actionable by Local Communities

Haze Gazer and VAMPIRE support data analysis at the most central level of government. While policy and decision making at the national level can alleviate food insecurity, this remains primarily a local issue—dependent on local conditions and local responses. One WFP official acknowledged a missing link between research, analysis and monitoring on the one hand and timely as well as informed implementation at the local level on the other hand: "*National statistics are fine—but there are issues at the local level. In theory, what you would want is to create something actionable around data. District officers should be getting timely information that they can bring to farmers. Farmers should be getting good information about when to plant and harvest—but still follow traditional approaches. It would have been cool to get*

more community engagement to understand what the data are telling them and what actions they could take… unfortunately, this is still missing." (WFP).

Greater community engagement also relies on local government action. Relationships between development partners and the government as well as between government departments are stronger in Jakarta but much of the work is at district level. The WFP had offices in Kupang, Jayapura, and other regional centers and was working with district officials, "*but their incentives were not always aligned with what is happening centrally.*" (WFP)

ENABLING FACTORS FOR POSITIVE CHANGE

Government Engagement — The Right Way

PLJ's approach to working with government is multi-faceted: it has leveraged established personal relationships; it is a relationship over the longer-term and not project based—one that has spanned support for LAPOR!, the Open Government Partnership, co-development of the One Data Toolkit, Haze Gaze and VAMPIRE; it reflects a shared commitment to making government more open and support for evidence based policy; and it is based on PLJ providing the government what it needs, when it needs it, and how it needs it.

Prior to the development of Haze Gazer and VAMPIRE, PLJ had already demonstrated a willingness and ability to engage with senior Government of Indonesia representatives, including in the KSP and its predecessor, UKP4. This successful approach to "working politically" was acknowledged not only by GOI officials but also by WFP representatives as one of the significant pull factors in their efforts to promote collaboration with PLJ: "*I see PLJ as a service—they don't have subject matter expertise, but they have great ability to engage across the private and public sectors. They have that advantage. Other UN agencies are not as successful with this.*" (WFP)

From the GOI side, PLJ was considered to understand how government works, and how to engage within the various nuances and politics. "*They (PLJ) work within existing channels and understand that a "yes" from government officials doesn't always mean yes.*"(KSP)

"*The PLJ approach in general was excellent. One of the most, if not the most, helpful among the UN agencies… I cannot thank them more.*" (KSP)

"*We need more like PLJ to help—or force, if you like—government. For now, the approach of PLJ is smart. Have a product. Show the product and demonstrate how if you implement this product then this is going to be the result. Going the other route of building capacity within government with this type of bureaucracy is not really effective unless you are going to change civil service recruitment in general. There is little meritocracy and personnel move.*" (KSP)

WFP Indonesia has also been actively engaging government, and sees itself as helping the GOI with what it says it needs. "*The government's medium-term development plan (RPJMN) tells us what is needed. The President wants an EWS and a situation room to host. This is our justification for supporting VAMPIRE. The RPJMN also specifically mentions improving food security and preventing the impact of disasters on food security and crops—again, that is our justification.*" WFP also cites the importance of form along with substance. "*The GOI appreciates that we can say things more directly than they could to one another.*" VAMPIRE—not least through its clear data visualisations—is a tool that informs such direct advice.

This focus on government ownership applies to other related information products. "*We want to revise the methodology of the Food Security Vulnerability Atlas…but this is not a government priority and that's ok for now. It's still their product. We can't push for something they are not ready for.*" (WFP)

Availability of Good Quality Data

Haze Gazer and VAMPIRE, as with other similar platforms, are only as good as the data available. Access to an array of datasets by PLJ was central to the depth of insights available on Haze Gazer and VAMPIRE and to the success of the initiatives.

Growing Awareness of the Importance of Data in Governance

"*There is a new wave of feeling about the importance of data. This is coming from the top but ministries are also seeing that an evidence basis is better for them. Government is better informed, and there is growing awareness about the importance of this. Government is punched here and there….and so it is good to refer to accurate data in response. Change is not only from the supply side but also the demand side. The need for data is growing and I have not seen this in the past—that the government has to have data.*" (KSP)

PLJ Human and Financial Resources

Much of PLJ's work has been project-based and/or one-time research. But PLJ management credits its core funding and the lack of a project deadline for allowing PLJ to experiment and iterate in the development of Haze Gaze and Vampire while also engaging government around this within a timeframe that suited key government counterparts themselves. This is very much the product of PLJ's relationship with its primary funder, the Australian Department of Foreign Affairs and Trade (DFAT), which has provided funding that is more flexible than for most other DFAT-funded projects in Indonesia. That said, time and the relevant financial resources alone were necessary but not sufficient. The final key ingredient was in having expert in-house political knowledge, that facilitated government engagement, and technical knowledge, including web development and data science skills, throughout implementation.

Aligning Focus with Government Priorities

Haze Gazer and VAMPIRE were not products developed on the outside and pitched to the GOI. They directly addressed issues that had already been identified by the GOI itself as national priorities. PLJ and WFP (for VAMPIRE) allowed development of these tools to be problem-driven.

Providing Value Added

In addition to addressing key government priorities in a manner consistent with the culture of the GOI, PLJ also gained political capital by proving its value added. Not only were the tools presented by PLJ relevant for addressing critical national priorities, but the PLJ team—and PLJ's Chief Data Scientist, in particular—were cited by one KSP official as being particularly valuable.

The Role of Government Champions

While strong engagement with the Indonesian government by PLJ and WFP was one factor, the receptivity of the GOI to these approaches was equally important. Principal representatives of the GOI were open to discussion on these new data sources. They recognised the need for data on localised issues. "*In the President's office, there was a young guy who thinks differently. He sees things in a more progressive way. He wants to see innovation used nationally by government. He was a champion. He recognised they weren't getting the full picture (i.e. the Ministry of Agriculture's argument at that time that rice production was sufficient). He wanted us to present the case that he could bring to his bosses." (WFP)*

Political Leadership
Both PLJ and KSP acknowledge that political leadership was necessary for the integration and uptake of the tool within the public administration. "*Even when we talk about evidence based policy, we need political support. Without this, I don't believe it will work*." (KSP)

Complementarity in Collaboration
Supportive management
VAMPIRE represents a significant departure from usual WFP initiatives. WFP's Indonesia Country Director was, in the words of colleagues, "*very open minded and forward thinking*." Likewise, the PLJ Head of Office was credited with pursuing genuine collaboration. "*Having (the Head of Office), who is happy to push support and give us free access to PLJ, has been fantastic*." (WFP) Mutual respect and a genuine commitment to collaborate facilitated the working relationships.

This strong collaboration goes beyond Indonesia. Global Pulse characterises the relationship as follows: "*We have had an incredible relationship with WFP for eight years…very operational, straightforward. We continue to support them in any way we can… with each iteration, our role is more advisory and less on implementation. We will not re-implement with us in the lead and in project management. We will build their capacity, and we can advise them on how to partner with a particular company, on data privacy or things like data visualisation*."

The WFP has picked its internal champions: "*There are people who get it and people who don't internally within WFP. There are those that see value in something new without needing to know all the details…our regional office has been a terrific champion. The VAM unit in the WFP headquarters was, understandably, focused on multiple Level 3 emergencies at that time. However, the Climate unit have seen the value. They have provided us with significant technical input*." (WFP)

Compatibility of skills
The WFP had subject matter expertise and PLJ could rapidly prototype and provide proof of concept and scale. The WFP also relied on strong local partners, such as IPB, in developing the methodology behind VAMPIRE and in ensuring that data analytics were presented in a timely and appropriate way for government via the food security bulletins. Both WFP and PLJ prioritise supporting the GOI. PLJ had funding and the capacity to take on risk. The WFP solicited funding and brought an equal appetite to experiment. A WFP official summarises the collaboration as follows: "*We've all known our place with VAMPIRE. This linking of subject expertise with technical expertise needs to happen more*."

A Product of Its Time
In the case of Haze Gazer and VAMPIRE, PLJ "*developed these platforms until we had a viable prototype and then we handed them over to the government*." But this was in the early days of PLJ—a lab that is quickly evolving based on its internal learning and the demand for its services. It is unlikely that PLJ could undertake development of projects on this scale now. "*We don't have the capacity or resources now for follow on*." (PLJ)

Serendipity
As much as supportive management is important, there is a human element of serendipity that supported effective collaboration in the case of VAMPIRE. Despite all of the supporting circumstances and personal contributions outlined in this document, the WFP Indonesia Country Head admitted, "*we were lucky to have (the GIS analyst). I'm not sure we'd have done this without her*."

SCALE AND FUTURE USE

"*Getting to scale within government is an important focus of our work in Indonesia.*" (UN Global Pulse)

Haze Gazer and VAMPIRE are open source tools, which reduce the financial burden of scale and promote broader compatibility. After Haze Gazer and VAMPIRE, there was an increased interest within PLJ to explore the possibilities and impact of such dashboards. PLJ has been committed to promoting open sourcing in general, and is currently considering strategies to be even stronger in pushing open source. It was after the development of Haze Gazer and VAMPIRE that PLJ started to think about scalability—both vertical, in terms of expanding the user base and horizontal, in terms of adding features—and sustainability.

Haze Gazer and VAMPIRE are the result of significant collaboration between three principal stakeholders: Government of Indonesia, WFP (in the case of VAMPIRE) and PLJ. The GOI is scaling Haze Gazer and VAMPIRE through continual upgrades to its EWS, which has incorporated these platforms. The WFP, with PLJ technical assistance, is scaling VAMPIRE by improving the platform in Indonesia and supporting development of similar platforms elsewhere in Asia and the Pacific. And PLJ is adapting and iterating the Haze Gazer and VAMPIRE designs in support of larger-scale disaster response and air quality monitoring.

As such, the Stories of Change for Haze Gazer and VAMPIRE have no definitive end. PLJ's contributions to each of these have inspired not only scaling but also broader evolution of other related initiatives.

SUPPORTING THE GOVERNMENT OF INDONESIA

One critique of scalability when working in collaboration with the KSP is that the KSP itself operates at the whim and mercy of the current administration. But some within the KSP see themselves as more agile drivers and implementers of innovation vis-à-vis the more permanent but bureaucratic line ministries. "*I get to hide behind innovation. We need to unplug innovation from the civil service to support sustainability.*" (KSP)

However, there is acknowledgment even within the KSP that it may only have one more year of operation—given the 2019 elections. "*Look at history of UKP4. It was strong—who would have thought it would disappear? But overnight the whole office was gone. My worry is whether we can leave a strong legacy—something that cannot be turned back with any new administration. We need to institutionalise the changes. Without that, I don't know how the bureaucracy will continue carrying the torch.*" (KSP)

As such, scaling of VAMPIRE and Haze Gazer within the government's EWS is less dependent on the KSP itself and more on the institutionalisation of using these data to inform government response. Such institutionalisation, from a public policy perspective, depends on the regulatory framework and the institutional architecture of government. Regulatory entrenchment started with the One Map (*Satu Peta*) policy, which is now supported by a presidential regulation This includes the Government's geospatial map (*Peta Kita*)—which includes data from Haze Gazer and VAMPIRE as part of the thematic data on disasters—which has already been well institutionalised: 19 ministries are among those that refer to 85 thematic maps from which they are required to report progress every three months.

Engagement with Other Government Bodies

There have been informal requests to PLJ from BNPB and BMKG, asking for the follow up of Haze Gazer. For its part, PLJ is interested to encourage BNPB to use the dashboard to provide real-time citizen voices to enhance the government's EWS. PLJ has also been encouraging the disaster management authorities to publish their operational practices, since combining these with data from Haze Gazer would provide insights on operational haze crisis dynamics.

EXPANDING THE VAMPIRE COVEN

Scaling within Indonesia

Within Indonesia, the WFP is continuing to customise VAMPIRE. Scaling of VAMPIRE is currently on four paths:

- Price data—WFP hopes to include Bank Indonesia's *Harga Pangan* price data on VAMPIRE within the coming year;
- Expand the focus of VAMPIRE to include landslides, in addition to drought and flood;
- More directly connect early warning with early action—in other words, how information generated drives disaster responsiveness by core stakeholders. For this, WFP will examine floods and droughts in East Java and test that when an alert declares that there is a flood/drought coming at a particular level of severity and affecting a specific number of people, a particular action should be taken; and
- Include more UX (user experience) and UI (user interface) testing to make sure VAMPIRE looks better and has a more intuitive and user-friendly interface.

One application that WFP is interested to explore in building off of VAMPIRE is **weather risk insurance**. Crop risk policies are usually heavily government subsidised. Some policies kick in when crops fail, others are based on weather information and trigger in a way that if rainfall falls below a certain amount the policy pays farmers anyway. In other words, some policies are based on weather and not just crop loss. VAMPIRE could be an extremely useful tool if governments wanted to implement weather risk insurance policies such as this—since these would also benefit from historical weather data. This is a complex process, though. It took WFP five years to launch a similar sovereign risk insurance scheme in Africa.

Development of an Adaptable Regional Model

Building on the momentum generated from a positive longer-term relationship not only with PLJ but also Global Pulse, and also the growing recognition within WFP about the merits of the VAMPIRE model, the WFP has been actively promoting a regional model for VAMPIRE with other governments within Asia and the Pacific, including Sri Lanka, Papua New Guinea, Cambodia and Fiji. The summary *modus operandi* is: build it, demonstrate the value of the data and information, and slowly over time hope it gets taken on by government partners.

"*Direct promotion of VAMPIRE has been hard since you really need a screen to showcase its merits. But there has been plenty of internal promotion. For example, I was in Panama just last month and talking about this.*" (WFP) A few months ago, WFP convened a meeting in Phnom Penh, Cambodia, to discuss the regional experiences with VAMPIRE and its spin-offs. The result of this has been that other country programs are interested to develop similar platforms, and regional organisations—notably the South Asia Regional Cooperation forum—are interested to learn more.

For future regional and international promotion, VAMPIRE will be turned into a basic GIS that could be used for any purpose and that will also be refined to include forecasting, whereas at present the data focus on current conditions. The WFP has secured funding to collaborate with PLJ to adapt and customise VAMPIRE in this way. "*We have to start at the technical level to prepare this tool for expansion so that any country that wants this tool transferred can easily use this regional core and customise it.*" (WFP)

Sri Lanka: PRISM
Sri Lanka offers a concrete national example of how VAMPIRE was adopted and adapted.

"This wasn't just a one-way transfer of tech: in contextualising the tool to Sri Lanka, we made improvements which will inform the development of the Indonesian version." (WFP)

Engagement began with a requirements analysis. Sri Lanka had a lot of reporting needs, but they were not generating data-driven reports. The WFP helped to develop this capability for Sri Lanka for the front end of their PRISM platform. On the technical side, Sri Lanka offered a different challenge for implementation since "*it is so much smaller. We needed to look at whether indicators used in Indonesia are applicable. And we are using data at different resolutions there given the scale*." (WFP)

Scaling the VAMPIRE model in Sri Lanka has also highlighted differences on the political side. While the KSP in Indonesia has taken the platform and integrated it according to its needs with little systematic feedback to PLJ and WFP, there has been more routine engagement with the government in Sri Lanka. According to one WFP official, "*the Sri Lankan government were open about integrating data, and the Sri Lankan Ministry of Disaster Management has been more openly engaged. This openness has allowed the front end of PRISM to evolve, since it has been easier for us to figure out the needs*."

The priority now in Sri Lanka is expanding the data on PRISM from just drought to drought and floods—as was done in Indonesia last year. "*PRISM in Sri Lanka has garnered lots of regional attention within WFP—especially among those who determine what happens next*." (WFP)

Cambodia: PRISM
The PRISM platform developed by WFP in Cambodia will also be merged into the regional model. Once again, though, PRISM in Cambodia is different to PRISM in Sri Lanka. "*PRISM in Cambodia has none of the sexy algorithmic analysis and data science. It is focused more on visualisations*." (WFP) As such, the Cambodia platform more closely resembles the VAMPIRE platform in Indonesia.

Papua New Guinea
In PNG, the significant challenge has been the lack of available data—which is of particular relevance in times of national disaster, such as for the drought conditions wrought by El Niño over the last couple of years as well as following the recent earthquake. To address this data drought, WFP has been running mobile phone surveys in collaboration with PLJ and Digicel trying to get insights on food security issues in PNG. The mobile phone surveys—four have been conducted to date—have, according to one WFP analyst, been very useful for many agencies there.

Recently Digicel, WFP and PLJ was awarded funding from the UK's Department for International Development via the GSM Association (GSMA) to explore what they hope is the new wave of VAMPIRE: the decentralisation of data-driven insights. This work will involve analysis of the interplay of satellite, census and mobile data in order to derive insights on disasters that can inform push alerts via SMS to provincial and other local governments as well as farmers and other vulnerable citizens. In this way, it

is hoped that VAMPIRE will deliver key data and look at climate analysis—to also inform understand of, and responses to, food security.

The hope going forward is that this model promotes action. "*We built a prototype and it became a system. It needs to become an operational tool again*." Looking forward, the WFP wants to integrate a 72-hour food security assessment following major events, such as the recent earthquake in PNG. This would involve quickly gathering all data possible. "*If we could automate this, then we could have this food security estimate out within hours." (WFP)*

However, political uptake is not a given. WFP representatives admit they are "*not sure how this will happen. We will build VAMPIRE and host it on a remote server and make it available to the government. We hope they will see benefit as these data are not political*." They acknowledge that the PNG Government has little capacity to work on this there and, therefore, expect no change over the medium term. "*Ideally you would want to build capacity in government*." But, in the words of another WFP official, "*this is a good starting point since PNG needs this information. For now, we are producing PNG reports here in Indonesia and that is not sustainable*."

Financing Scaling

Scalability of VAMPIRE/PRISM will, according to WFP representatives interviewed, need a "*decent investment*." WFP staff are in the process of drafting and submitting proposals to fund scaling. The WFP will be relying on domestic budgets or traditional funding sources in social protection and agriculture to scale VAMPIRE. *"(Bill) Gates tweeted yesterday on the importance of data in a 10-year agriculture project. That's the kind of time horizon for funding that we need!*" (WFP)

PLJ'S DESIGNS FOR MULTI-DISASTER RESPONSE PLATFORMS

The underlying mechanism of Haze Gazer and VAMPIRE can be applied to other types of disasters or sustainable development themes. And for PLJ, "*Haze Gazer is the basis of other systems – through this experience we learned how to fuse the data*." Since PLJ's engineering team is small, they have placed an emphasis on recycling previous platforms. CycloMon (Cyclone Monitoring) and the under-production DisasterMon (Disaster Monitoring) are developed from Haze Gazer in that they use the same system architecture technology.

CycloMon allows users to monitor cyclones within a certain timeframe and for certain countries. It also provides detailed information—such as trajectory and wind speed—on cyclones taking place. DisasterMon is still in the prototype stage. While DisasterMon uses Haze Gazer technology, DisasterMon will paint on a much broader canvas, incorporating data related to other major natural disasters such as earthquakes, landslides, volcanic eruptions, and cyclones. This will involve a different interface and is being designed with global reach in mind. To promote uptake among the most relevant stakeholders, PLJ will need to establish connections with relevant regional disaster management offices.

Air Quality Monitoring

Haze Gazer can scale in terms of insights, based on the integration of richer and related data sources. A prime example of this is that Haze Gazer is one avenue for monitoring air quality and crowdsourcing data around this issue. Air quality is currently on the PLJ agenda, with PLJ testing assumptions before engaging in development of a related platform. As an expansion of experimentation conducted in the development of Haze Gazer, PLJ is now exploring the extent that social media data are relevant not just

for reporting on air quality but also in assisting with the detecting of air quality—i.e. can air quality be inferred from social media data analytics?

PLJ is also further exploring social media and crowdsourcing, since ground-truthing remains "*a big thing*." This represents a broader push within PLJ to explore richer insights into "the crowd…" The focus to date has been on bringing data "up" to policy decision makers—for example with Haze Gazer and VAMPIRE or in the pushing of data to the public—for example in ensuring farmers receive weather and crop related information. The greater challenge to PLJ is in sourcing and representing data in a way to get people to act and in promoting that as a continuous loop of information.

In the case of the air quality work, the challenge with this has been in finding a crowd to provide the content to support ground truthing of data on the strength of haze. Simply put, the idea has been to source photographs (from Instagram and Twitter) from the same locations at the same time of day and from the same devices over an extended period to be able to predict air quality. The critical element is to control as many variables as possible in order to produce better data for a better training data set that will lead to a better model.

To promote crowdsourced data, PLJ has approached ride sharing companies (with the intention of incentivising drivers to provide data by making payments via these companies' online payment services) and the UN Office for Project Services (UNOPS) in order to capitalise on UNOPS' network of civil society organisations.

PLJ's air quality work is also directly informing Global Pulse's work. Global Pulse is aiming to replicate PLJ's use of artificial intelligence to mine images for air pollution for a global platform on communicable diseases that is currently being developed in collaboration with the World Health Organisation (Global Pulse).

Informing and Integrating with PLJ's Human Centered Design Work

Haze Gazer was not PLJ's only response to the haze crisis. PLJ had been looking at ways to combine data science with ethnography in order to apply a more human-centered design approach. In tandem with design of the Haze Gazer platform, PLJ produced its first Pulse Story, Hazed and Confused. This provided a local community perspective from Pontianak, West Kalimantan, on perceptions of haze and the impact of haze at the local level.

PLJ was building its relationship with Reality Check Approach (RCA) at that time, and through this collaboration one PLJ staff person was trained by RCA and brought into their haze-related research for UNICEF. To draw on lessons from this research and discussions around Haze Gazer, and to contribute to the process of defining some possible solutions, PLJ organised Co-design for Change, a 2-day workshop to better understand the impact and possible response strategies for haze in 2016. The workshop was conducted by PLJ, UNICEF and Reality Check Approach. PLJ's hope for this workshop was to provide more detailed contextual understanding to explain some of the key analytics as well as trends and behavior derived from Haze Gazer and other tools. And interesting examples of this did emerge: lagging—whereby Twitter comments from haze areas peaked a day or two after the hotspot emerged—was explained by the gradual affect of haze on populations as opposed to the near-real time satellite hotspot data; and why was it that people were seen to be moving *into* severe haze areas, for example from Riau to Kampar?

Citizen input suggested that in times of haze many people seek out family, even if this means having to suffer the haze together.

The report from this workshop contains detailed recommendations on how citizens can help themselves during haze crises, give citizens small wins, and help them believe they can overcome the haze crisis, but has yet to be published. One of the collaborators, Bali-based Kopernik, is currently exploring funding opportunities to follow up on the recommendations.

Regional Scaling

While PLJ originally conceived Haze Gazer as a national platform for Indonesia, scaling using Indonesia-specific data has been hampered by the fact that this particular initiative is not only dependent on relevant data and stakeholder engagement, but it also relies on haze. In 2016, PLJ received Twitter's permission via an agreement with Twitter in New York to use real-time tweet data. However, in 2016 and 2017 there was no significant haze and so PLJ could not test the effectiveness of this social media in supporting Haze Gazer.

As such, PLJ has been looking beyond Indonesia to for opportunities to scale. There has been interest to expand this concept within Southeast Asia, given the fact that haze is a recurring cross-border issue of concern. In 2017, there was a challenge from DataSpark, the "mobility intelligence company" that is part of the SingTel Group in Singapore, who was willing to open their data - seeing people's mobility data to check the severity of haze and extent that people heeded government advice about staying stationary during haze. PLJ submitted a research paper and was one of the winners of this challenge. Fortunately for the region and unfortunately for this data experiment, there was no haze during the period that data were made available, and so PLJ was unable to test this. Expanding Haze Gazer to Singapore and Malaysia has been explored from a technical perspective ("*it would be straightforward to create a taxonomy in order to collect keywords from those countries*" (PLJ)) but there has been no significant engagement by PLJ with these governments on this—once again, since haze has not been a dominant issue for the past four years. Singapore's government has had its own haze platform since 2013 managed by the National Environment Agency, and would, in PLJ's opinion, likely be reluctant to install a system developed in Indonesia.

Further afield, UNDP in Nepal has expressed interest in building off of the Haze Gazer experience in Indonesia—as, too, has the Association of Southeast Asian Nations Coordinating Centre for Humanitarian Assistance on Disaster Management, following a series of meetings. But there has been no follow up from either of these to date.

PARTNER AND STAKEHOLDER CAPACITY

Each of the three primary stakeholders for VAMPIRE and Haze Gazer have demonstrated significant capacity to produce, adapt and scale the original designs.

GOI

As noted elsewhere, the demand from and engagement by KSP officials was critical to the successful integration of VAMPIRE and Haze Gazer into the Early Warning System. As for capacity, "*their technical people are good*." (PLJ) One of the KSP staff who has been a strong proponent of VAMPIRE had previously worked with the World Bank. But as he notes "*we have 16 people who work on policy, but*

only two with public sector experience. We focus on advocating similar thinking within KSP and trying to educate those around us."

PLJ

PLJ's internal human resources were, arguably, the most important factor in successful development of Haze Gazer and VAMPIRE. But before developing VAMPIRE, PLJ had not experimented with overlaying information. Most of the work had been front end. For VAMPIRE, the back end, particularly relating to geo-spatial information, is particularly important. By their own admission PLJ learned a lot about open sourcing GIS information through this process, and particularly from the WFP GIS specialist who had access to ESRI data. PLJ staff were also learning about Human-Centered Design and co-design via these collaborations: "*I really liked the development process of Haze Gazer: I got lots of input from different stakeholders, for example in understanding the nine priority provinces asked by the government*". (PLJ)

WFP

WFP was not only a technical partner to PLJ in developing VAMPIRE but also contributed to upgrades after the initial launch. In 2017, WFP identified the need to improve VAMPIRE and initiated the technical process for doing so. "*Our mandate is providing relevant data to optimise policies to promote food security, and we included flood data to support this. To improve the impact assessment—meaning the impact of drought and now floods on crops—we have also added a feature that enables users to access and visualise data in a non-map basis*." (WFP) WFP developed this upgrade with PLJ. Once again, WFP did the methodological and conceptualisation groundwork and PLJ supported front end development. "*PLJ are very innovative. We were incorporating not only different data but different data in different time frames. We didn't know how to present such data on a daily and monthly basis but PLJ helped with that*." (WFP)

Development of VAMPIRE also helped WFP Indonesia to test the technical capacity and appetite for experimentation within WFP itself: "*We were surprised by how much of a difference we could make. And we were surprised by the level of tech use within WFP at the time. WFP openness to take on something outside of its usual work was fantastic*."

WFP has also supported related government capacity by providing trainings on data for policy decision-making to the GOI. "*We do not deal with the price data people much and so we have focused this support on the socio-economic survey folks*." These informal trainings have focused on how to gather data and how to translate technical data for policy audiences. WFP notes improvements in data analytics and visualisations (for example, in improved infographics) in the socio-economic reporting resulting from these trainings.

V.

Lessons Learned & Recommendations

The importance of strong conceptualisation
The experience of working with PREMISE on commodity price monitoring reinforces something instinctively understood in development practice but occasionally overlooked in the rush to pilot: the importance of strong initial conceptualisation. New technology may offer data solutions, but a critical component in success at a policy level is in determining and providing data that suit the appetites and political expediencies of key government counterparts.

"*The PREMISE work was technically very exciting. We were hoping that through this platform, this would exist over longer term. Once we got all the information, we could measure resilience. Data that would be needed for this include social media data. The systems are built to be able to add new data sets. However, the right questions were not asked at beginning in conceptualisation. We need to look at the methodology for sustainability of food security interventions.*" (WFP)

The importance of strong contextualisation
In developing Haze Gazer and VAMPIRE, PLJ was less concerned about "innovating" and more interested in applying approaches that could be contextualised for the particular circumstances and conditions. The principal motivations were to experiment with a variety of data sources in order to produce a more timely source of information and analytics that had relevance for policymakers in addressing priority issues. This combining of data was not new—but it had not previously been applied in this way in Indonesia or by the WFP (in the case of VAMPIRE).

Be open-minded in defining impact
The experiences of Haze Gazer and VAMPIRE—and the approach taken in this story of change—make the argument for not defining key ingredients of impact, such as ***scale,*** in too linear a fashion. Pull the thread of these initiatives and you find that related adaptations are taking place in many different directions, including those not anticipated at the outset. Likewise, approaches to defining ***policy change*** should be flexible and realistic. With a partner such as the Indonesian government, which collaborates around open data but is shielded in how it uses data, it is not possible to determine the precise input of certain data analytics to certain decisions—especially when applied to initiatives that focus on the complex layering of data. The original design of VAMPIRE and Haze Gazer is less relevant than how the government has taken ownership of these and adapted them to suit its needs. They provided a working prototype for the government and helped government officials question what data and evidence could be relevant for action on key issues.

Data visualisation is important
It is clichéd to argue that platforms such as VAMPIRE and Haze Gazer are only as good as the data. But there is also an argument that these platforms are only as good as the data *they represent.* Complex and

layered data are not instinctively meaningful to all policy decision makers (or institutional colleagues on whose support future funding rests). As such, data visualisation is essential in promoting the value of these platforms: "*Visual communication is essential for decision makers who need dense information in a digestible way. With good visualisation, everyone understands what the data mean.*" (WFP)

Work politically

In interview, one KSP official offered the following concise advice in engaging with government for sustainable change: "*Use your resources to develop a product and sell this to opinion leaders within government. Change in government takes place at two levels: the technical ministries and local government. Forge a strategic link with certain ministries—for example, Bappenas and The Ministry of Communication and Information. Showcase the importance of data. Go to local governments too! PLJ has not done this. Pick two or three local governments that have a commitment to implement policy on an evidence base so PLJ can have a real life lab.*"

Government officials themselves, as noted elsewhere in this document, caution against spending too much time developing the data skills of their government colleagues. For example, the President's situation room is populated by numerous analysts, including from the intelligence agencies, and these staff routinely rotate—meaning that it is more strategic to strengthen the tools they access than their skills in access. However, there is acknowledgment within the GOI that data literacy training is of greater value when focused on the *producers* rather than the *users* of data.

Promote new data avenues

From its outset, there was significant demand on and within PLJ to explore Twitter sentiment analysis. Concurrently, PLJ acknowledges that "*people were arguing about the credibility of data we are getting from social media.*" Concerns centered around the representativeness and validity of social media when used as the *primary* source in data analysis. But PLJ has demonstrated that Twitter can be used to *complement* existing traditional data such as surveys and the national census—despite challenges in developing algorithms that cater to the Indonesian language. These data are not just limited to what people say but also have value in demonstrating what people do, providing related data on location, time and other variables. While Twitter has quantity on its side, the challenge for PLJ going forward is in further exploring "thick data"—i.e. the qualitative insights derived from user research that ground-truths the intentions behind what people say and do and thereby augments findings from big data and open data.

Collaboration is just as much personal as institutional

In the experience of both Haze Gazer and VAMPIRE, it was not institutions that drove initial collaboration but rather the sum of personal initiatives and engagement. Specific lessons deriving from this are hard to pin-point, but they should include: hiring well, capitalising on personal connections, and embracing outward-looking management that is open to opportunistic co-experimentation with partners demonstrating compatible skills.

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