Pre-Feasibility: Earthquake Risk and Index Based Insurance for Indonesia [1]

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GlobalAgRisk is a policy-oriented firm with close ties to the University of Kentucky. Our work is supported by international donors who recognize the importance of markets in transferring natural disaster risk as a means for developing and enhancing access to financial service by the productive poor. GlobalAgRisk does not have seismology expertise; rather, our experience has been with index-based insurance for transferring natural disaster risk.

Pre-Feasibility: Earthquake Risk and Index Based Insurance

Introduction

GlobalAgRisk is pleased to present the findings from a pre-feasibility mission to Indonesia to investigate the potential of developing and introducing an earthquake risk insurance product, supported under Ford Grant No. 1100-0121 and IIEF Program No. FF-5H016. The field mission, centering in Jakarta and concluding with a stakeholder seminar at the Ford Foundation offices, took place from 6 November to 17 November 2010. A complete list of individuals and agencies consulted are provided as Annex 1.

A pre-feasibility analysis is a rapid risk, demand, and institutional assessment designed to begin a discussion among potential stakeholders about a proposed innovation. A pre-feasibility is also meant to be a low-cost discovery and decision tool to determine if there is value in the further pursuit of an innovation, given a set of necessary conditions required to support the innovation's development and implementation. The discovery process may lead to modification and refinement of the original concept, incorporating new information of the institutional context, capacities, and a greater understanding of the impact and response to a risk event.

This pre-feasibility focuses on Indonesian earthquake risk and mechanism to transfer this risk. The target population is the productive working poor whose livelihoods are vulnerable to catastrophic shocks that have the potential to drive them into a situation of persistent poverty. This necessarily includes consideration of firms and institutions that serve the poor and who may be likewise exposed to a disruption in services caused by a catastrophic event. The focus of the inquiry is market-based and therefore does not consider potential government financing needs for disaster response nor those with very little ability to participate in a market-based approach such as the poorest of the poor and those who are best served through an appropriate social intervention.

Indonesia is surrounded by multiple tectonic plates causing it to be highly exposed to earthquake risk in both frequency and intensity. Indonesia ranks 11th for its economic exposure to earthquakes, estimated at US $79 billion, and ranks 3rd out of 153 countries for the number of people present in earthquake hazard zones.[2] Overall, approximately 20 percent of the world's damaging earthquakes occur in Indonesia. Earthquake risk is pervasive across the country (figure 1) with more than 14,000 events of magnitude 5 or greater being cataloged between 1897-2009 (Irsyam, M., et al, 2010). As of this writing, the most recent damaging earthquake occurred October 25, 2010, off the western coast of Sumatra, at magnitude 7.7 and generated a tsunami that affected the Mentawai Islands, reportedly killing ~ 435 people and displacing approximately 4,000 households. The devastating December 26, 2004, magnitude 9 earthquake and tsunami occurring off the coast of Northern Indonesia near Aceh brought earthquake risk to the forefront of public policy and has resulted in significant

[2] http://www.preventionweb.net/english/countries/statistics/risk.php?cid=80

investment in natural disaster risk preparedness and response, risk modeling and mapping, and the scheduled placement of new monitoring infrastructure. And yet, despite the apparent risk, market-based financial solutions for earthquake risk transfer are confined to general non-life insurance products whose penetration is extremely low, with earthquake cover being even less. This form of property and causality insurance is the most common insurance for earthquakes. It is generally restricted to compensation for property damage.

Several factors contribute to low earthquake insurance demand, beginning with cost that is driven up by the need for individual loss adjustment and the prevalence of moral hazard associated with the traditional indemnification of losses for perils such as fire. However, earthquake damage is highly correlated regionally among the insured, unlike most fire damage. Such highly correlated risk is uninsurable by local insurers in the classic sense of pooling the premiums of the many to pay the losses of a few. This form of catastrophe risk requires access to global capital and some additional cost to load for the prospects that the severe event can occur early. The relative rarity of severely catastrophic events poses a cognitive challenge in insurance valuation among those exposed who will typically discount heavily low probability events, while ambiguity surrounding the correct probability assessment for low-frequency high-magnitude events compels insurers to heavily load premiums. These factors contribute to a price wedge between supply and demand (Skees and Barnett, 1999; Skees and Hartell, 2006).

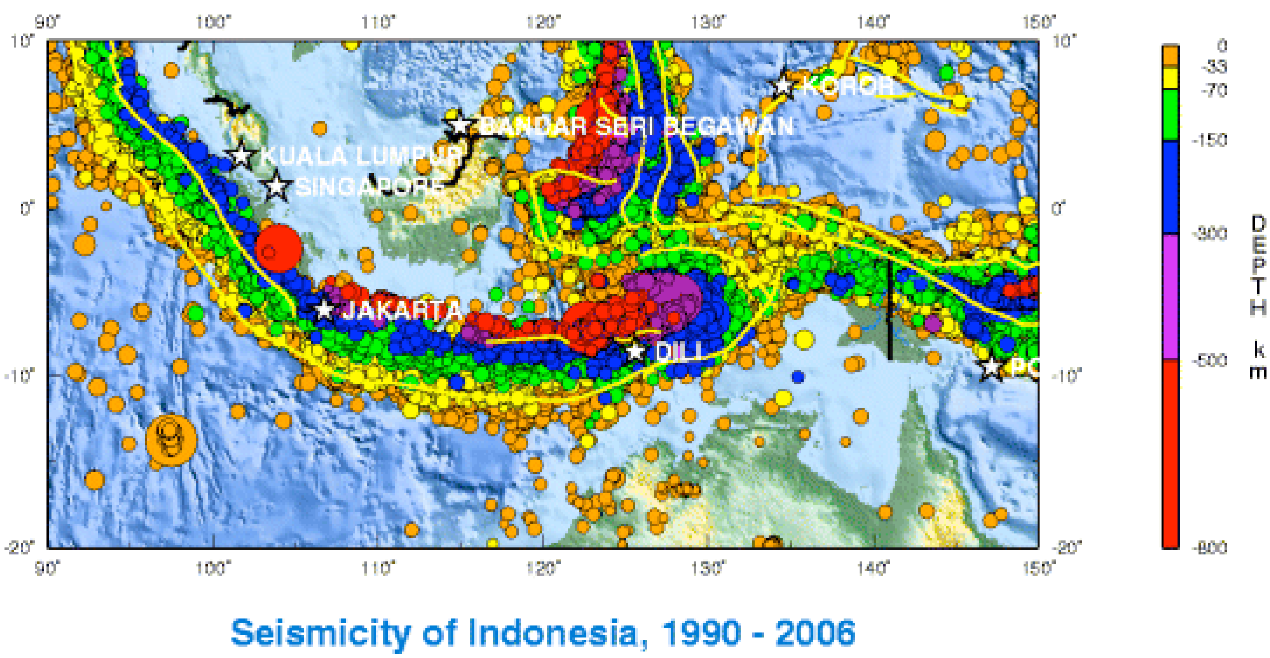


Figure 1: Seismic Activity, Indonesia (USGS).

Index, or parametric, insurance is a financial vehicle specifically designed for managing the correlated nature of catastrophic risk, and is better able to cope with pervasive moral hazard among the insured. In our international work, GlobalAgRisk has positioned index insurance as one component of a household's or firm's overall risk management strategy, including elements of credit and savings/reserves. The motivation is to provide resources for recovery from the largest and most destructive risks while also maintaining affordability. The presence of non-diversifiable catastrophic risk also imposes constraints on other drivers of economic development, such as household asset accumulation and reliable and affordable access to capital. The benefits of index insurance can be delivered in a number of different ways, not only as a stand-alone microinsurance product. The initial concept has been to investigate the potential for bundling earthquake insurance with a savings component that would provide a structured means to address some of the demand issues for more frequent payouts for less severe events while at the same time maintaining affordable catastrophic coverage. This view has evolved to consider more closely the needs of firms, in particular micro-finance organizations, to respond and maintain operations during times of natural disaster, which is precisely the time when the poor need financial access. Bundling of index insurance with other financial services remains a recommended approach for individual products and a couple of noteworthy current examples from Indonesian are highlighted in this report.

Who Absorbs the Cost of Natural Disaster Risk?

Severe earthquakes destroy private property and public infrastructure, and can have a devastating humanitarian impact. In late 2009, the 7.6 and 6.8 earthquakes in West Sumatra alone resulted in 1,300 lives lost and 1,214 persons severely injured. More than 250,000 families (1,250,000 individuals) were affected by a total or partial loss of their homes and livelihoods. Following the events, the government estimated the rehabilitation and reconstruction costs at USD 745 million. Examples of the scope of damage and consequential losses, included:[3]

- The collapse of four hospitals, 12 community health centers, 1,078 schools, 80 percent of government buildings, and the largest university in the region
- Destruction of water and electricity infrastructure, estimated at 170 billion Rph (US $19.13 million), and building losses of up to Rph 8.3 billion (US $933,750)[4]

[3] http://www.thejakartapost.com/news/2009/10/03/earthquakes-rattle-economy-far-and-wide.html; http://en.wikipedia.org/wiki/2009_Sumatra_earthquakes; www.maipark.com; http://www.ifrc.org/docs/appeals/09/MDRID00410-4mthcons.pdf; http://www.usaid.gov/our_work/humanitarian_assistance/disaster_assistance/countries/indonesia/template/fs_sr/fy2010/indonesia_eq_fs08_10-13-2009.pdf

[4] USD 1~Rph 8,888

- Over US $8 million in emergency water, food and shelter supplied by United States Government funds alone
- Disruption of local business operations, ranging from the closure of a cement factory for ten days to 150,000 tons of delayed palm and rubber shipments, and
- Up to 400 commercial and rural bank branches mobilized to restructure small loans

Still even these estimates do not account for the long-term disruptions in business activities and peoples livelihoods that most certainly were part of this event. The costs associated with major earthquakes, and other catastrophic events, are absorbed throughout the economy, often disproportionately by the poor. The World Bank (2009) indicated 40 percent of Indonesia's 230 million citizens live in areas at-risk for multiple hazards, such as earthquakes, tsunamis, volcanic eruptions, floods, landslides, droughts and forest fires.[5] Even before disaster strikes, few low-income households are willing to invest in higher risk, higher return economic activities due to their exposure to these risks. This ex ante behavior severely limits opportunities to break out of a cycle of poverty (Barnett, Barrett, and Skees, 2009). When disaster strikes, the poor pay through direct losses and disruptions to income until productive assets can be recovered and local markets function. In the presence of the constant risk from natural disasters, financial institutions and other creditors, weary of large-scale default, withdraw access to working capital further affecting the ability of local businesses and households to purchase and/or produce needed goods and services.

Governments also incur expenses to coordinate and deliver emergency assistance, and to replace damaged infrastructure. Catastrophic events can quickly overburden government and donor disaster budgets, and can divert resources from other long-term development priorities. Inadequate delivery systems for aid, and complex eligibility and accounting requirements often delay the speed at which public resources can be deployed to assist the economically vulnerable. For example, a government cash grant program to support the reconstruction of private housing for survivors of the Sep/Oct 2009 West Sumatra earthquakes was only launched in mid 2010 and is expected to carry on through 2011. The majority of eligible households are still waiting in temporary housing for the approximate US $1,600 grant to re-establish a permanent home and the confidence to rebuild their lives.

Index Insurance as an Alternative Risk Transfer Innovation

The challenge, given low earthquake insurance uptake that results from the emergence of a demand and supply price wedge, and that the impact of natural disaster risk is absorbed through the economy and disproportionately on the poor, is to design an alternative, efficient and cost-effective catastrophic insurance that facilitates risk transfer to international markets. The structure should also be adaptable for

[5] http://www.thejakartapost.com/news/2010/11/11/managing-exogenous-shocks-indonesia.html

a wide range of risk-exposed stakeholders. Index insurance is one mechanism that has strong potential to meet this challenge.

Index insurance is a different class of risk transfer having unique features that distinguish it from most other forms of insurance. An index is anything that can be measured on a scale having non-random increments. Examples of common insurable indices include directly measured weather variables (e.g., cumulative rainfall, temperature), indices derived from weather variables (e.g., heating and cooling degree days), magnitude-based indices (e.g., maximum flood level or wind speed counts of days with or without rainfall, measures of ground shaking), and indices related to weather and climate (e.g., drought indexes, SST, remotely sensed measures of vegetative health). Index insurance payouts are based on the realized value of the underlying index that is correlated with the losses of the insured, rather than on a direct estimate of ex post losses. This feature negates the need to conduct individual loss assessment and drastically reduces the opportunity for the insured to influence their likelihood of receiving a payment. As a result, index insurance has potentially lower operating costs than traditional, loss-based insurance. Because insurance payments depend only on the value of the index, the amount of payment can be quickly determined and distributed to the insured.

Index insurance products can be classified in two categories: products using indexes that aggregate losses over a group and products with indexes that are event-based. Aggregate loss data describe losses across many individuals, typically in the same geographic region. Examples include a wide range of area-yield programs and the Index-based Livestock Insurance Program in Mongolia, which uses county-level estimates of livestock mortality by species as the index for determining insurance payouts. Event-based indexes use measurements of the insured event, such as a weather variable as the basis for an insurance payment. The index serves as an indicator of the insured risk event itself. The most common example is index-based rainfall insurance, which uses cumulative rainfall measures within a defined time period as an indicator of flood or drought. Satellite data (e.g., NDVI) and sea surface temperatures are also used to provide data for event-based index insurance. Index-based earthquake insurance would also be in the category of event-based indexes. There exists some experience in using various ground motion measures to create catastrophic bonds for earthquakes.

Index insurance is most effective for insuring catastrophic risks as the index is more likely to be representative of individual losses when the triggering event has a widespread homogenous impact; that is, when the losses are highly correlated. This minimizes the potential mismatch between the realized value of an index and the loss experiences of individual policyholders. The lack of perfect correlation between indemnities and losses, basis risk, is one of the limitations of index insurance. One of the advantages of index insurance is that its standardized structure makes it more feasible to pool risk geographically and transfer the financial exposure, via reinsurance or other means, into larger capital markets.

The flexible structure of index insurance allows it to be deployed for the needs of a wide range of stakeholders including the provision of contingent financing for disaster relief; protecting financial institutions and other “risk aggregators” from business disruptions when a disaster occurs; and, as a microinsurance product that protects individual households against the financial consequences of catastrophic risks. Of these, microinsurance applications have presented the greatest challenges. While more than 30 index insurance pilot projects have been implemented over the past decade, with the majority targeted at smallholders, few have scaled into self-sustaining insurance markets. The major challenges to the development of index insurance products include:

- Small transactions/low market volume,
- Large initial investment/development cost,
- Not easily replicable—products must be developed in context,
- Tradeoff between transaction costs and basis risk,
- Tradeoff between accessibility and transaction costs,
- Limited data to develop and underwrite products,
- Underdeveloped legal and regulatory systems,
- Extensive capacity building and consumer education needs,
- Frequent need to develop non-traditional delivery channels,
- Achieving market performance and social objectives.

In addressing these hurdles, index-based insurance pilots have required significant investment from donors and governments to provide for development costs since private domestic insurers usually possess neither the human capital nor a willingness to heavily invest in an uncertain innovation. Many index insurance schemes have also relied on premium subsidies to influence demand, which raises doubts about the long-term efficiency and sustainability of these products. Some of these challenges can be met, in part, buy focusing first on risk aggregators, firms and financial services providers to the poor, as a means to improve their resiliency to catastrophic shock and to “jump start” market activity, before innovating for the microinsurance market segment.

A Conceptual Earthquake Index

Several different pieces of information are needed to begin conceptualizing an earthquake index including how seismologists measure the magnitude and ground shaking generated by an earthquake event, and how seismic hazard is modeled to generate probabilistic hazard curves to quantify and communicate risk. This material is drawn in part from BMKG, 2010; Field, 2007; Irsyam et al., 2010; MAIPARK, 2010; McGuire, 1993; USGS, 2010; Wang, 2006; Wang, Woolery and Kiefer, 2003.

Measuring Earthquakes and Ground Motion

The Moment Magnitude Scale (MMS or M_W) is the modern equivalent of the Richter scale (ML, or local magnitude) measurement of the size, or the energy released, of an earthquake rupture at its epicenter. While there are at least eight different magnitude measures, M_W is usually preferred as it is consistent in measurement across most earthquake sizes, those above magnitude 3.5, and can be calculated from data gathered from most types of ground-motion instruments. Regardless of the method used, however, each is designed to yield a single number that is consistent with other methods over their appropriate range. M_W is a function of the stiffness or rigidity of the earth's material at the site of rupture, the area of the rupture, and the average displacement (slip) of the rupture. Magnitude is estimated using ground motion data recorded from seismometer and accelerograph networks. Seismometers are able to detect very slight motion while accelerogaphs record strong ground-motion that causes seismographs to go off scale. These networks of sensors are also used to locate the earthquake's epicenter and estimate its depth. While M_W is dimensionless, it is measured on the logarithmic scale, which implies an exponential increase in energy released as the magnitude of an earthquake becomes larger.

The amount of damage caused by an earthquake, however, is related to the intensity of ground motion at any particular location. Ground shaking intensity is dependent on the energy released at the epicenter of the earthquake (the magnitude), the distance of a particular site from the epicenter because shaking decays with distance, and localized effects such as amplification that are related to the soil topology. Intensity of shaking experienced by an unanchored mass (such as a person or a couch) at a seismic station is commonly reported as peak ground acceleration (PGA) and peak ground velocity (PGV). Peak velocity is the largest measured speed that the ground moves in response to an earthquake ($cm \cdot s^{-1}$). Peak acceleration is the largest measured change in ground motion (velocity) and reported as percent-g, where g is the acceleration force of gravity (981 $cm \cdot s^{-2}$). Both measures are usually reported in terms of horizontal amplitudes with PGA relating better to outcomes experienced due to small to moderate earthquakes while PGV relates better to stronger earthquakes.

An example relationship between earthquake magnitude, distance and PGA, ignoring localized effects, is depicted in figure 2. In the figure, values above 0.05 would be experienced as unpleasant shaking while values above 0.5 imply the destruction of many building types. This relationship is given by an attenuation or ground-motion function that describes how the seismic waves (which are experienced as shaking) generated by an earthquake decrease in size as they move away from the source. Attenuation relationships are estimated from historical earthquake and ground motion records, and are therefore one source of uncertainty in earthquake hazard modeling.

Different levels of ground-motion shaking intensity are related to the human experience of an event using the Modified Mercalli Intensity scale (MMI or I_{MM}), which includes an assessment of damage to buildings and infrastructure. While observed and qualitative, having a systematic means to categorize earthquake impact is important for effective communication of earthquake risk and potential damage to a wide range of stakeholders not having the technical expertise to interpret other measures of ground motion. I_{MM} ranges from Roman numeral I (not felt) to XII (total destruction), though values above X are difficult to distinguish apart and are rarely observed. In the absence of direct verification of experienced shaking intensity, I_{MM} is derived from PGV and PGA data gathered from seismometers and accelerographs using previously estimated regression relationships. Derived I_{MM} is known as "Instrumental Intensity". Table 1 provides descriptions of each category of I_{MM} with correspondence to M_W while an interactive simulation that demonstrates the different degrees of earthquake destruction associate with the Mercalli scale can be accessed at http://elearning.niu.edu/simulations/Mercalli.html (copy-right E-Learning Services, Northern Illinois University, 2006). Finally, table 2 combines these different measures of ground-motion intensity and ranges commonly used to communicate earthquake impact.

Aside from PGV, PGA and I_{MM}, earthquake impact can be characterized by a number of other measures of ground motion or shaking intensity, depending on the capabilities of seismic recording equipment, that provide additional information useful for structural engineering and damage prediction during an event. Spectral acceleration (SA, though sometimes 'response spectra' or 'spectral response') provides information about the frequency content of ground motion and possible amplification effects for anchored structures over specific reference periods. Acceleration time history (sometimes 'acceleration time series') is the sequence of values in earthquake ground-motion over the duration of shaking, measured at a set of fixed times. Other ground motion measures may include cumulative absolute velocities, kinetic energy, or JMA intensities.

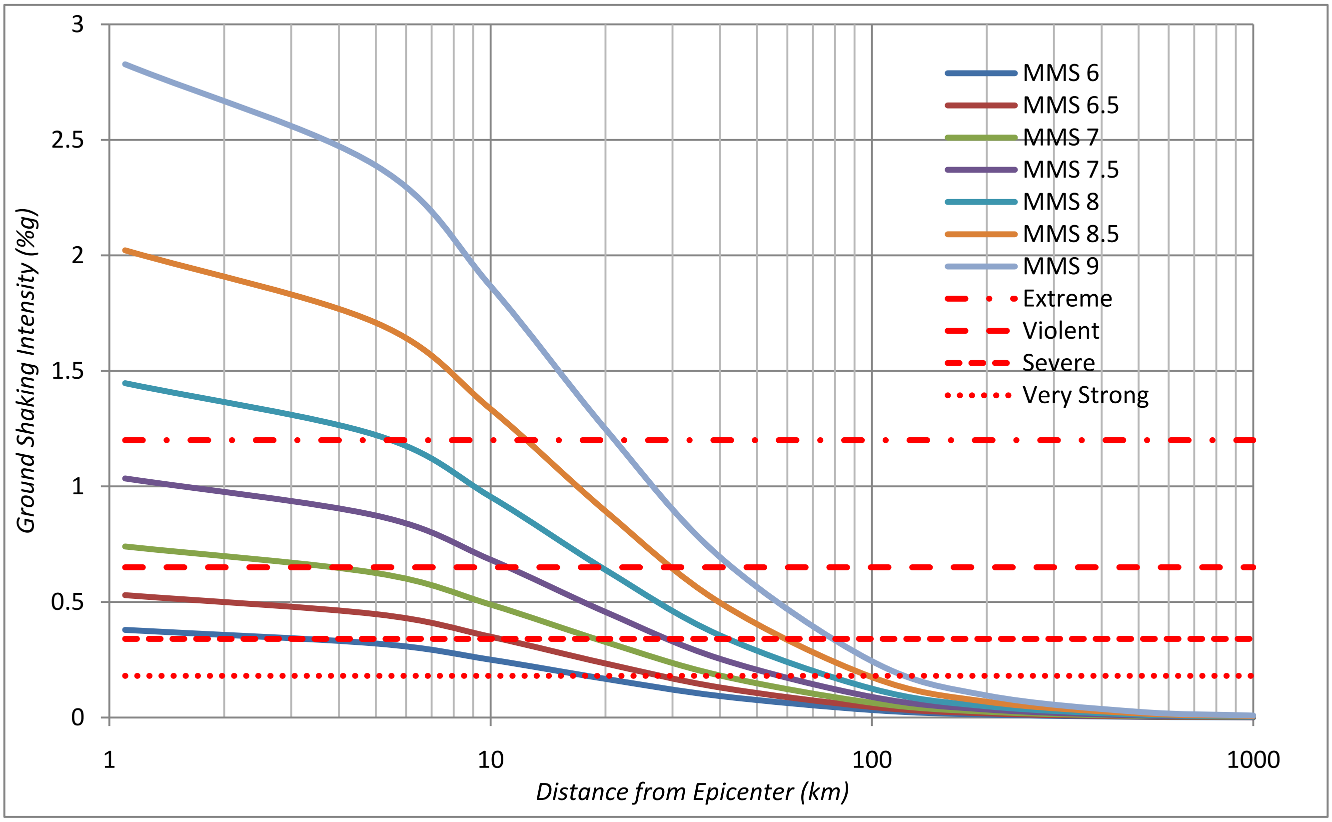


Figure 2: Ground Shaking Intensity over Distance.

Table 1: Modified Mercalli Intensity Scale.

Modified Mercalli Scale		Magnitude Scale
I	Detected only by sensitive instruments	1.5
II	Felt by few persons at rest, especially on upper floors; delicately suspended objects may swing	2
III	Felt noticeably indoors, but not always recognized as earthquake; standing autos rock slightly, vibrations like passing truck	2.5
IV	Felt indoors by many, outdoors by few, at night some awaken; dishes, windows, doors disturbed; standing autos rock noticeably	3
V	Felt by most people; some breakage of dishes, windows, and plaster; disturbance of tall objects	3.5 4
VI	Felt by all, many frightened and run outdoors; falling plaster and chimneys, damage small	4.5
VII	Everybody runs outdoors; damage to buildings varies depending on quality of construction; noticed by drivers of autos	5
VIII	Panel walls thrown out of frames; walls, monuments, chimneys fall; sand and mud ejected; drivers of autos disturbed	5.5
IX	Buildings shifted off foundations, cracked, thrown out of plumb; ground cracked; underground pipes broken	6 6.5
X	Most masonry and frame structures destroyed; ground cracked, rails bent, landslides	7
XI	Few structures remain standing; bridges destroyed, fissures in ground, pipes broken, landslides, rails bent	7.5
XII	Damage total; waves seen on ground surface, lines of sight and level distorted, objects thrown up into air	8

Source: Ohio Seismic Network, http://www.dnr.state.oh.us/OhioSeis/

Table 2: Commonly Reported Ground-Motion Parameters and Ranges

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Source: Irsyam et al, 2010.

Mapping Earthquake Impact

Part of the challenge in designing and index-based earthquake insurance is to accurately depict where potentially damaging ground-motion has occurred following a major earthquake without having to physically assess damage. Maps of ground-shaking intensity produced by the USGS, shake maps, are the means to depict the distribution of earthquake ground-shaking intensity over geographic space. Using the attenuation relationships demonstrated in figure 2, a modeled shake map can be generated for any earthquake of known location and magnitude, as demonstrate in figure 3 for the magnitude 7.7 Mentawai earthquake. It is common practice for the default map coding to be of instrumental intensities from the I_{MM} scale, but PGA and PGV maps can also be generated. Patterns of shaking intensities, however, do not uniformly radiate from the origin, and are influenced significantly, even over short distances, by complex geological formations, characteristics of the faulting, and the magnitude of the event. In practice, patterns of shaking intensity are derived from the network of seismometers and accelerometers, with interpolation/prediction methods used for the space between seismic recording stations. Hence, the density of recording stations will importantly influence the degree of basis risk that exits between experienced shaking intensity and what is depicted in a shake map.

The Indonesian seismic network, operated and maintained by the Agency for Meteorology, Climatology, and Geophysics (BMKG), is undergoing significant expansion of its land-based seismic monitoring capabilities. The capabilities and infrastructure includes 160 seismometers (52 maintained by foreign agencies) and 500 accelerometers that will be networked through ten regional centers to the national operational center where the seismic data is processed in near real time. It is at the national center where earthquake time, magnitude, depth, and location is determined (within 3 minutes of the event), data gathered for shake map generation, and for rapid assessment of the need for tsunami warnings when the earthquake occurs off-shore (within 5 minutes). Figure 4 shows the individual sensor locations of the seismic monitoring network (seismometers), having spacing between sensors in the range of 100 km.

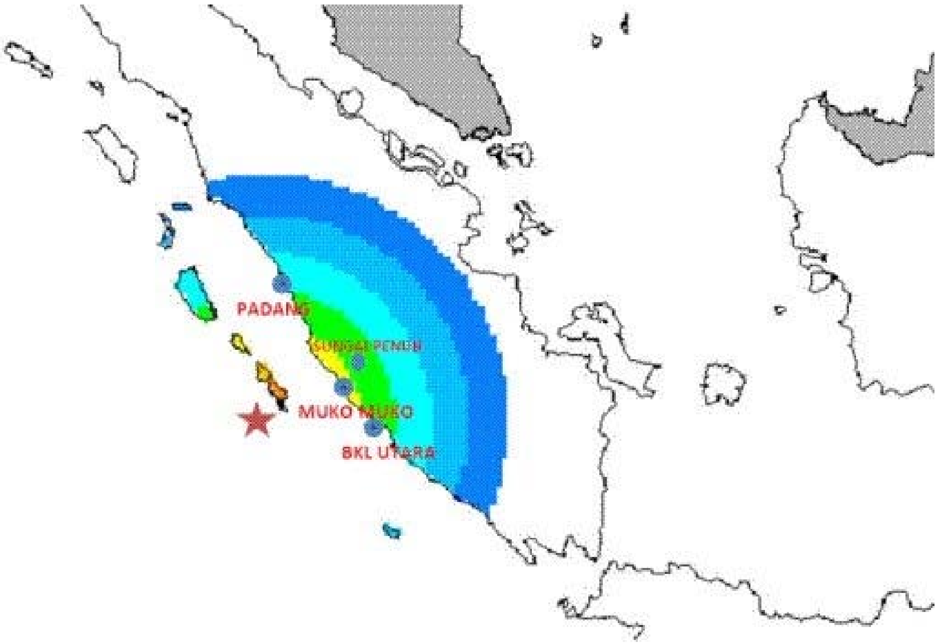


Figure 3: Modeled Shake Map, Mentawai Earthquake (MAIPARK, 2010).

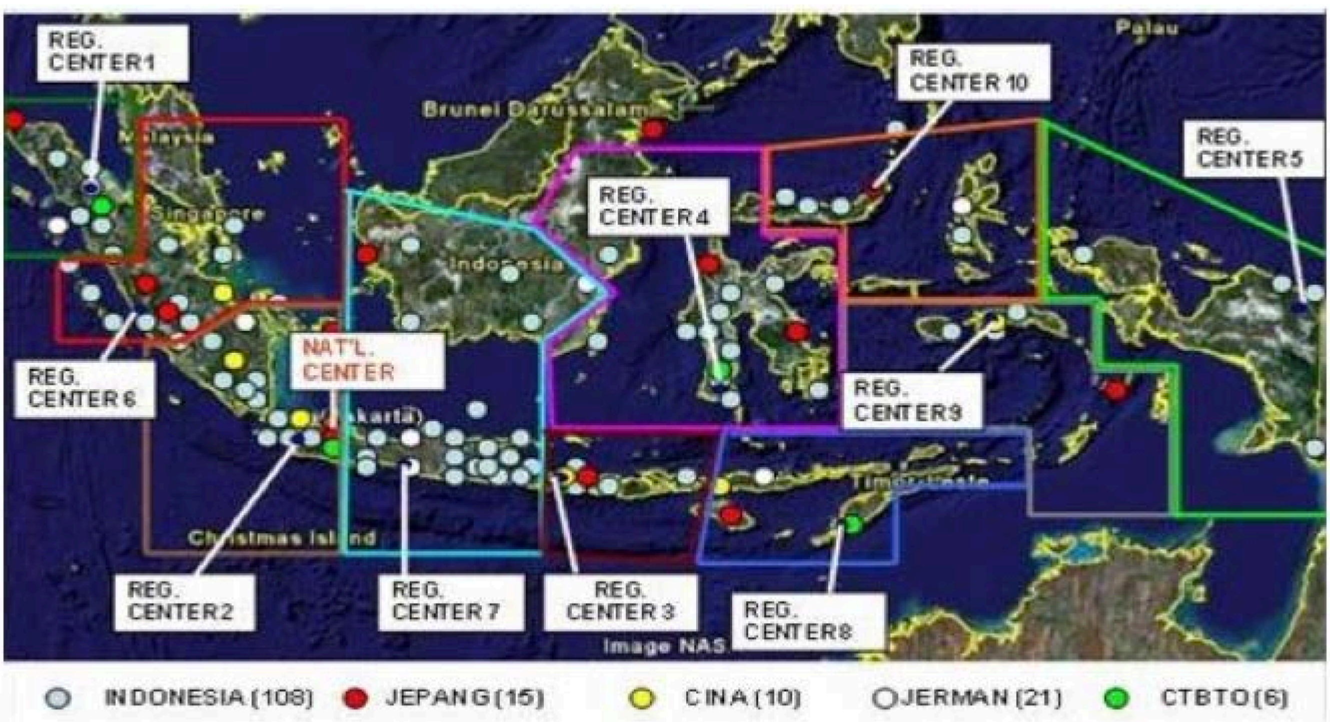


Figure 4: Indonesian Seismometer and Accelerometer Network (BMKG, 2010).

While a mapping of instrumental intensities is useful for depicting the general impact of an earthquake over geographic space, acceleration and velocity maps (also possibly spectral response maps) have a closer physical relationship to potential earthquake damage and therefore may be more appropriate for an index insurance application. When combined with other applicable GIS information such rated risk zones and the location of the insured's, shake maps can provide the basis for the identification of areas meeting the threshold for loss payment and rapid settlement. The following sequence of shake maps depicting the September 30, 2009 M_W 7.7 earthquake in Southern Sumatra, near Padang where the reported shaking intensity reach VII on the I_{MM} scale. Fatalities during that event reach 1,117 and with at least 2650 structures reportedly damaged. Each shows that how the geographical distribution of ground shaking is uneven, responding to structural geological features, and demonstrates the higher resolution of contours available with PGA and PGV maps. Figures 5 and 6 show how GIS or topographic information can be combined with seismic information. Note how that the contour pattern of velocity and acceleration is more variable than derived instrumental intensities and differ from each other. Generally, PGV maps display less variability than PGA maps and are often more closely related to structural damage for moderate to large events, which makes it a good candidate for an index insurance application.

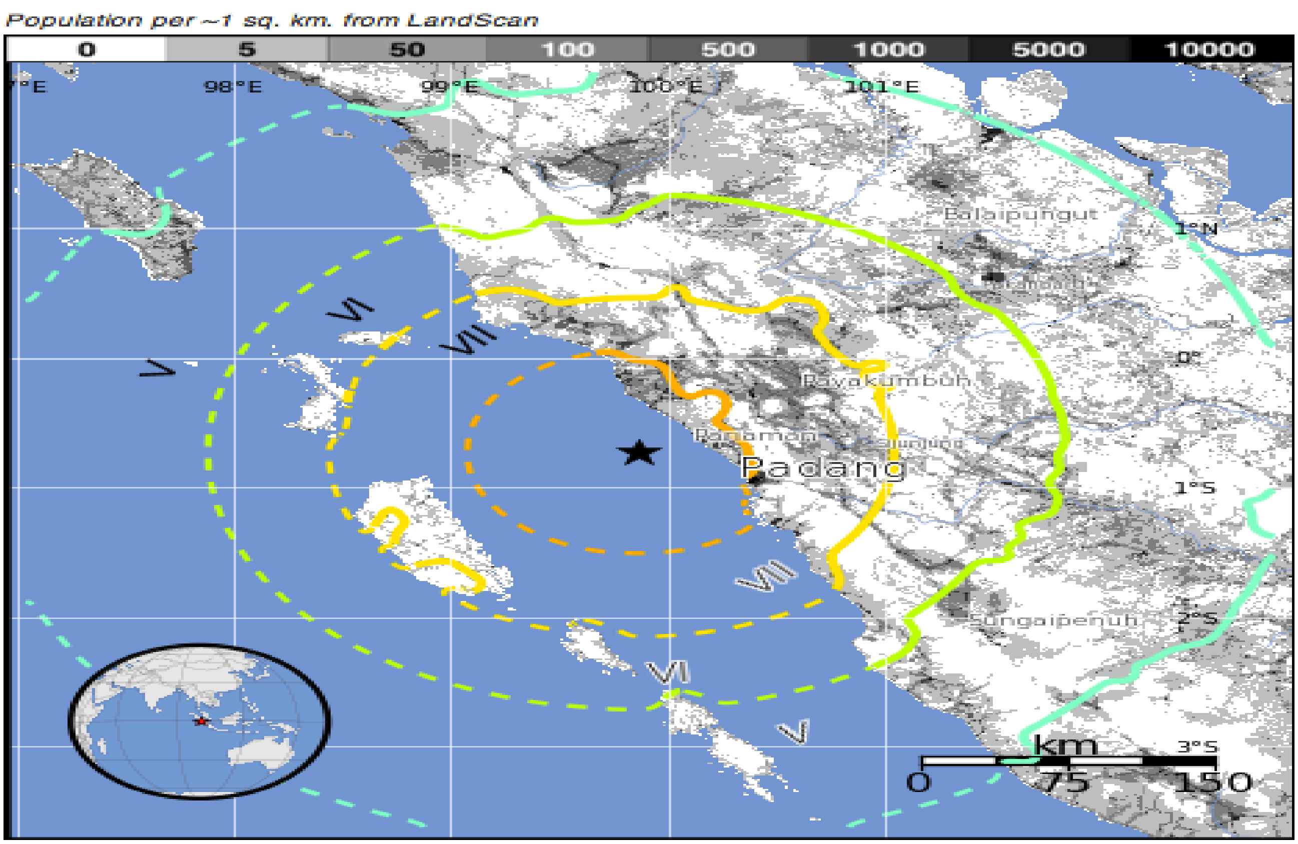
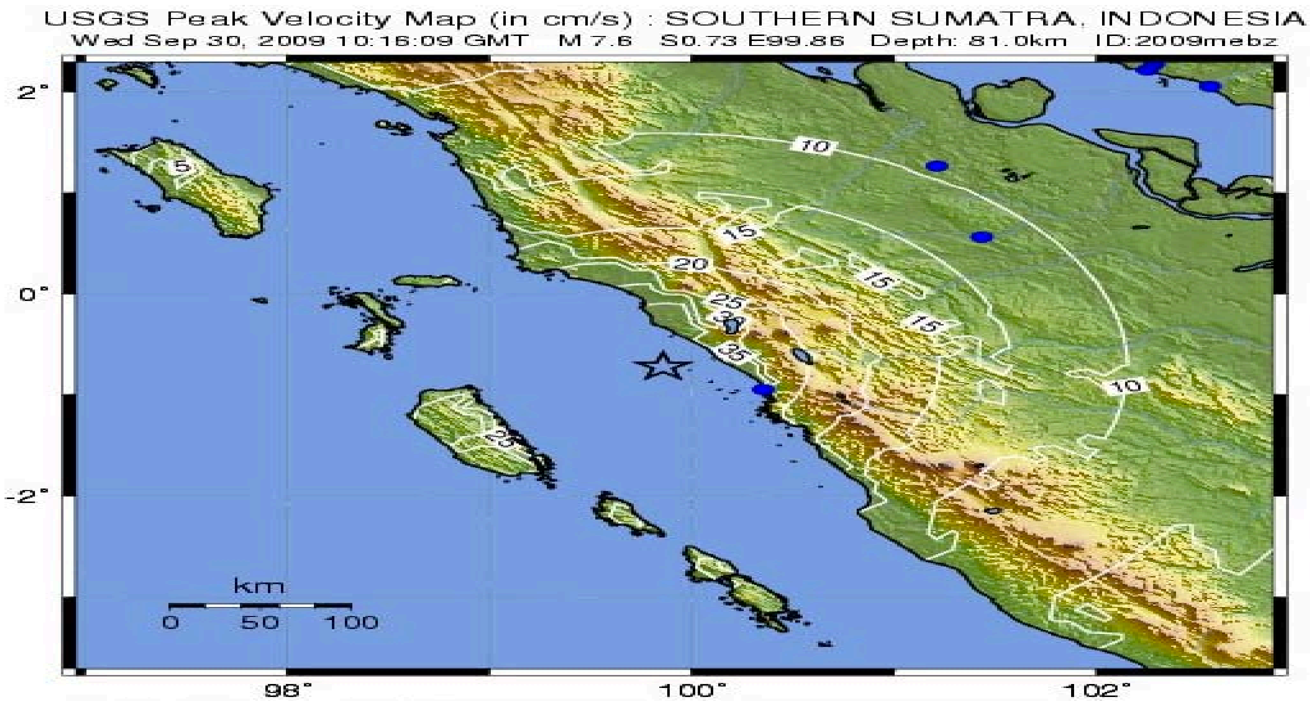


Figure 5: Population Exposure with I_{MM} Contours, Padang 7.6 M_W Earthquake, 8/30/2009 (USGS).



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
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PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
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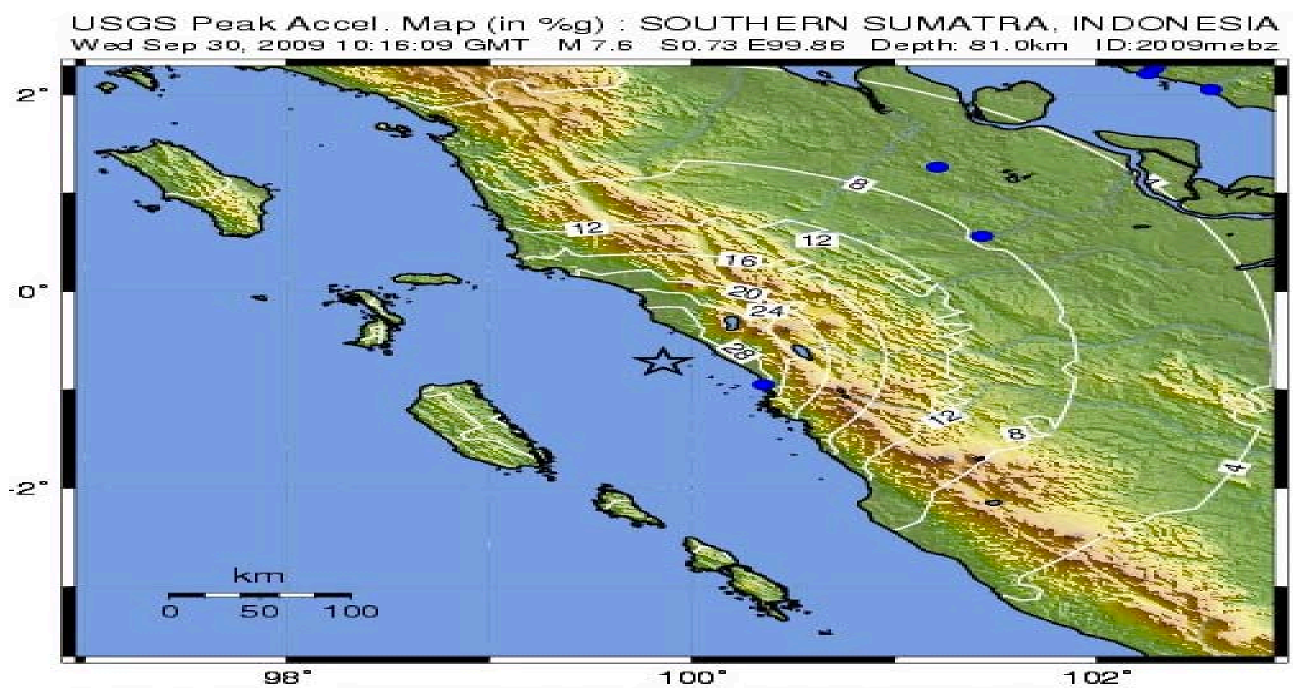

Figure 6: PGV and PGA Shake Maps, Padang 7.6 M_W Earthquake, 8/30/2009 (USGS).

Seismic Hazard Risk Analysis

Seismic risk analysis is focused on modeling and quantifying the probabilities of ground shaking intensity (seismic hazard) caused by earthquakes for a defined time period. These probabilities can then be combined with models of structural response for the purpose of developing earthquake resistant building recommendations and codes. With traditional earthquake insurance purposes, the risk analysis is combined with damage simulation given characteristics of the built inventory to form an aggregate loss distribution in order to derive premium rates. For an application to index insurance, the modeled probabilities are combined with a proposed insurance payout structure to generate a loss distribution and the pure risk premium. It is because of this need for an assessment of potential damage, and the uncertainty surrounding the loss estimates, that traditional insurance is expected to be more heavily loaded than index insurance. Otherwise, both forms of insurance are subject to the same sources of uncertainty that emerge during a seismic hazard risk analysis.

The summary output of most seismic hazard risk analysis is an earthquake *hazard curve* that shows the annual frequency that different levels of a ground motion parameter, such as PGA, will be exceeded at a location of interest. Seismic hazard analysis can be either probabilistic or deterministic, though in principle the two types can be used to help check the results of the other. Deterministic hazard analysis is location specific and assumes a single scenario, such as the effects of the largest possible earthquake on the building site of a critical structure, and is used as part of the design criteria. In this analysis, the distance to potential earthquake sources and magnitudes are fixed parameters and which makes it difficult to incorporate uncertainty. Probabilistic seismic hazard analysis (PSHA), also sometimes termed the deductive method, which treats the sources, locations, distances, time of occurrence, and magnitudes as random variables, is the standard method for estimating probabilities. By considering all possible levels and combinations, PSHA is able to explicitly incorporate uncertainty in rates, location and magnitude in a way that enables construction of standard confidence intervals around the hazard curve output.

A fundamental and prerequisite input into an application of PSHA is a processed (cleaned and standardized) earthquake catalog that contains the locations, times of occurrence, and size of historical earthquakes. The procedure for computing hazard curves then follows four standard steps:

1. Identify the size and distance distribution of all seismic sources (e.g., active faults or areal sources) to a location of interest, described geometrically in three dimensions.
2. Characterize the seismic hazard source model or models to determine the frequency distribution of earthquake occurrence, usually described as a Poisson process, and the distribution of magnitudes for each previously specified seismic source.

3. Specify the attenuation model, such as that exemplified in figure 2, specific to or adapted to local geological conditions, and find the distribution of possible ground motion values at the location of interest.
4. Calculate the probabilities and plot the hazard curve through a triple integration over all possible sizes and locations, ground motions, and occurrence frequencies of earthquakes impacting a specific location.

Seismic hazard risk analysis recognized two main sources of uncertainty, epistemic and aleatory, and treats each differently in the probabilistic analysis. Epistemic uncertainty results from incomplete knowledge most obviously reflected in modeling and statistical relationships. Epistemic uncertainty can be reduced with additional data and advances in modeling and incorporated into the analysis through the generation of a family of hazard curves. Aleatory uncertainty results from the intrinsic variability or randomness of natural processes and cannot be reduced. Aleatory uncertainty is incorporated in the analysis via the probability distributions and standard error of the key variables, which are averaged when computing the exceedance rates. This uncertainty is expressed through the probabilistic nature of the hazard curve itself as well as by the construction of confidence intervals. Again, the sources of uncertainty lie in the inherent variability of earthquake hazard:

- Location (source-site distance)
- Size (magnitude)
- Effects (attenuation relationships)
- Timing (temporal uncertainty)

Figure 7 demonstrates an example of a standard hazard curve with PGA on the horizontal-axis, the mean annual frequency of exceedance on the vertical-axis, and the return period in years on the secondary vertical-axis (the secondary axis is not always included). Given that the hazard curve is the purpose of the PSHA exercise, it is worth reviewing its interpretation and use.

Working from the curve, one is able to identify the annual frequency of exceedance (also λ, annual rate of exceedance, annual number of events) for a maximum ground-motion event. The return period (T_R, recurrence interval) is the average time between large earthquakes at a particular site and is the reciprocal of the annual frequency of exceedance ($1/\lambda$). Then, the *probability* of exceeding a ground motion parameter value in a given period of time (*t*) is given by the equation $P_E = 1 - e^{(-\lambda t)}$. Referring to the grey dotted lines in figure 7, one finds the probability of exceeding a PGA of 0.3 in 50 years by referencing the corresponding value of annual frequency and solving P_E = 1-exp[-(.005)(50)] = 22.1 percent. That is, there is a 22.1 percent chance of exceeding a PGA value of 0.3 in 50 years. Conversely, if one wants to find the value of PGA corresponding to a 2 percent probability of exceedance in 50 years then solve for λ = - log(1-P)/t = -log(.98)/50 = 0.0004 and from the curve find the PGA of ~0.6 having a return period of 7,000 years. If the time interval is held constant, the familiar plot of probability of exceedance against PGA can be produced for each value of the hazard curve. Using t = 50 years, figure 8 confirms that for a PGA value of 0.3 there is about a 22 percent probability of exceedance.

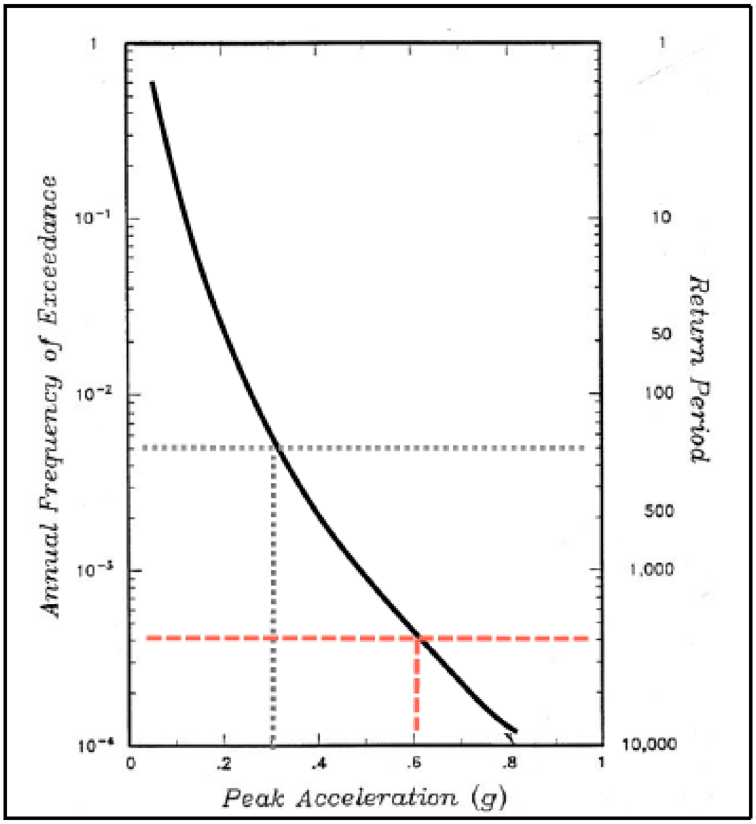

Figure 7: Example Seismic Hazard Curve.

Hazard curves developed from PSHA can also be used to produce maps of seismic hazard from earthquakes. In a probabilistic hazard map, areas of equal seismic hazard are identified ('rating territories' for insurance purposes) with the ground motion parameter indicated for each area, given *x*-percent probability of exceedance in *t* years. That is, each uniform area represents a single point on a hazard curve. Seismic hazard risk maps can be produced for many different configurations of probability exceedance and time period. Common formats for engineering purposes include:

- 10 percent probability of exceedance in 50 years
    - 500 year earthquake (return interval)
- 5 percent probability of exceedance in 50 years
    - 1000 year earthquake
- 2 percent probability of exceedance in 50 years
    - 2500 year earthquake

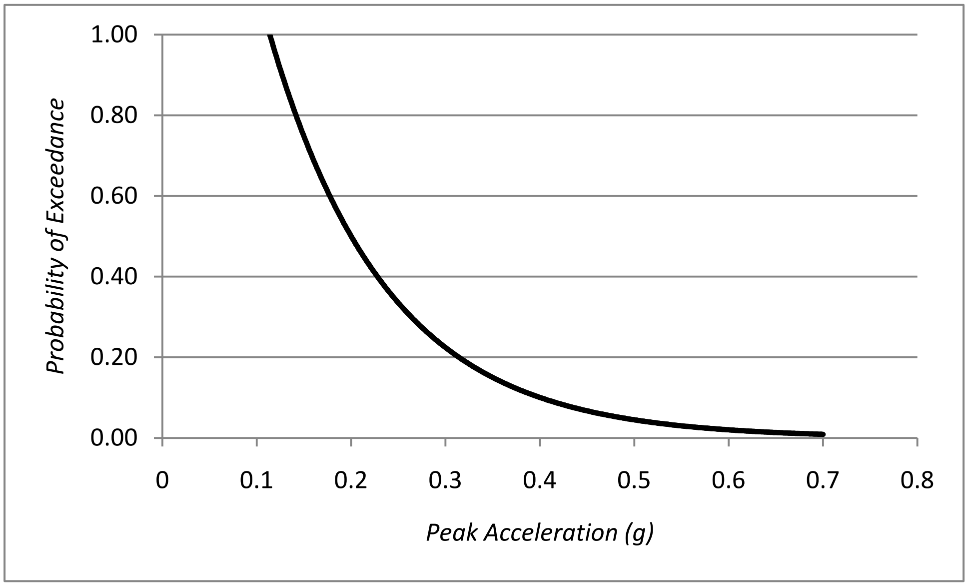

Figure 8: Example Seismic Probability Plot for 50-Year Interval.

Indonesian Seismic Hazard Maps

Since the Aceh earthquake and tsunami of 2009, considerable new investment has been placed in both upgrading the seismic hazard-monitoring network as well as in mapping seismic hazard risk for building code recommendations and for disaster preparedness. Prior to that, the most recent officially released national earthquake hazard map dated from 2002, and underpinned the Indonesian Seismic Building Code, SNI-03-1726-2002.

The 2002 hazard map has recently been revised by the Team for Revision of Seismic Hazard Maps of Indonesia as part of a collaborative effort between numerous Government of Indonesia agencies (Ministry of Public Works, Indonesian National Disaster Management Agency [BNPB], BNKG, and others) and external donors, notably the Australia-Indonesia Facility for Disaster Reduction (AIFDR). The overall effort not only updated the hazard map with the main purposes of contributing to building code revision and enabling better informed disaster preparedness decisions, but to strengthen national capacity in seismic hazard analysis. The PSHA generated three PGA contour maps at 10 and 2 percent probability of exceedance in 50 years and the 10 percent probability of exceedance in 100 years. The analysis also produced a series of spectral acceleration maps. The first of the PGA maps is reproduced here as figure 9. Noteworthy about this PSHA effort is that it began by constructing what is probably the most complete earthquake catalog to date while at the same time acknowledging that faulting some regions have not yet been well studied. The mapping effort has a high degree of spatial specificity, reflecting the detailed knowledge of faulting in the better-studied areas. In addition, the methods and models used in the analysis are transparent and well documented. The summary report can be accessed from the AIFDR host at the following link:

http://www.aifdr.org/products/Irsyametal2010IndonesianNationalEarthquakeHazardMapSummaryReportEnglish.pdf

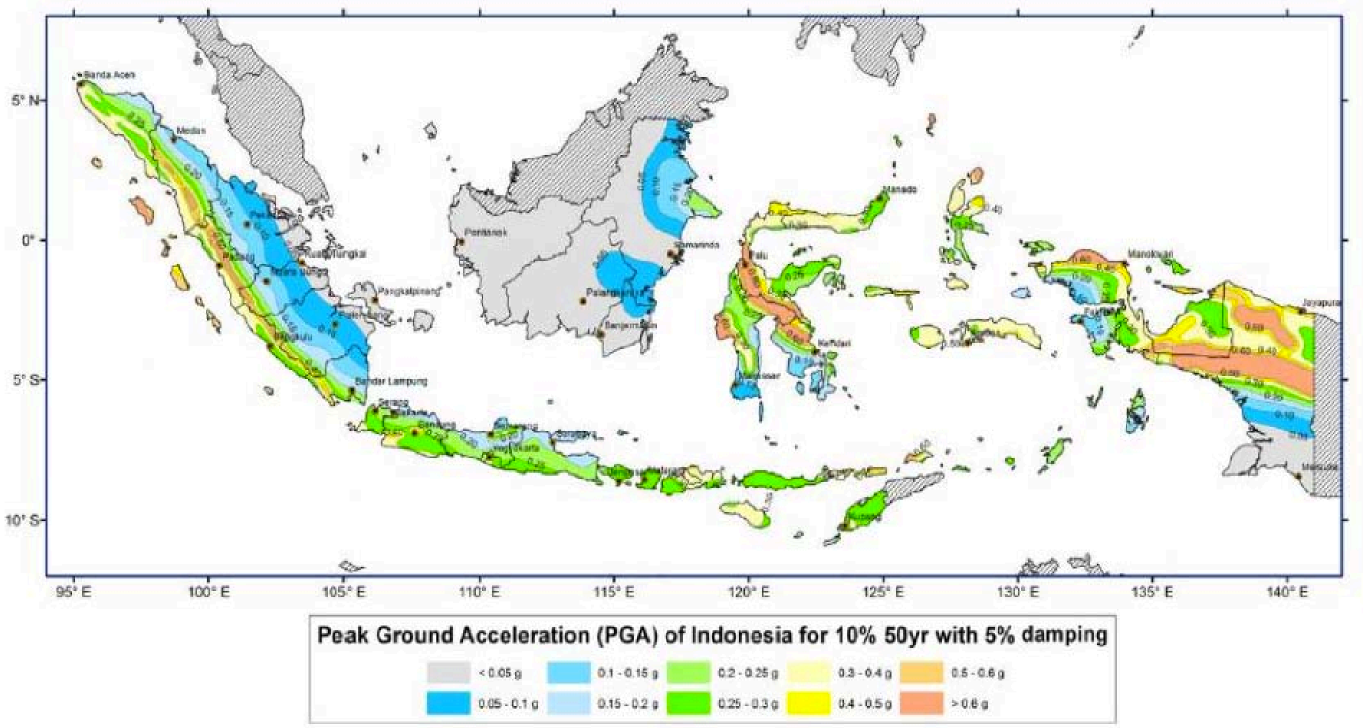

Figure 9: National Seismic Risk Map for Indonesia (Irsyam et al, 2010).

Other organizations are also studying seismic hazards in Indonesia but with a focus on catastrophic insurance applications. PT Asuransi MAIPARK Indonesia is the successor organization and public liability company of Pool Reasuransi Gempa Bumi Indonesia (PRGBI), or Indonesian Earthquake Reinsurance Pool, that was formed as a result of government regulation requiring all general insurance and reinsurance companies to participate in sharing of catastrophic risks, including earthquake risk. MAIPARK serves as the reinsurer and earthquake risk clearing-house on behalf of its members, advocates for natural disaster education and preparedness, and supports the improvement of the earthquake monitoring network and capacity. MAIPARK also invests in its own capacity for research, modeling and quantifying seismic hazard risk that is used to help properly price Indonesian earthquake risk. Figure 10 provides a map of insurance rating territories produced by MAIPARK. These territories, or premium zones, are the result of a PSHA combined with loss estimation models to develop rates for different types of insured structures. The graphic also includes an identification of the earthquake sources used in the analysis, a hazard map for PGA (though the probability of exceedance and time period is not identified), and a map of I_{MM} estimated from the PGA values. This map can be accessed at: http://www.maipark.com/content/display/tariff.

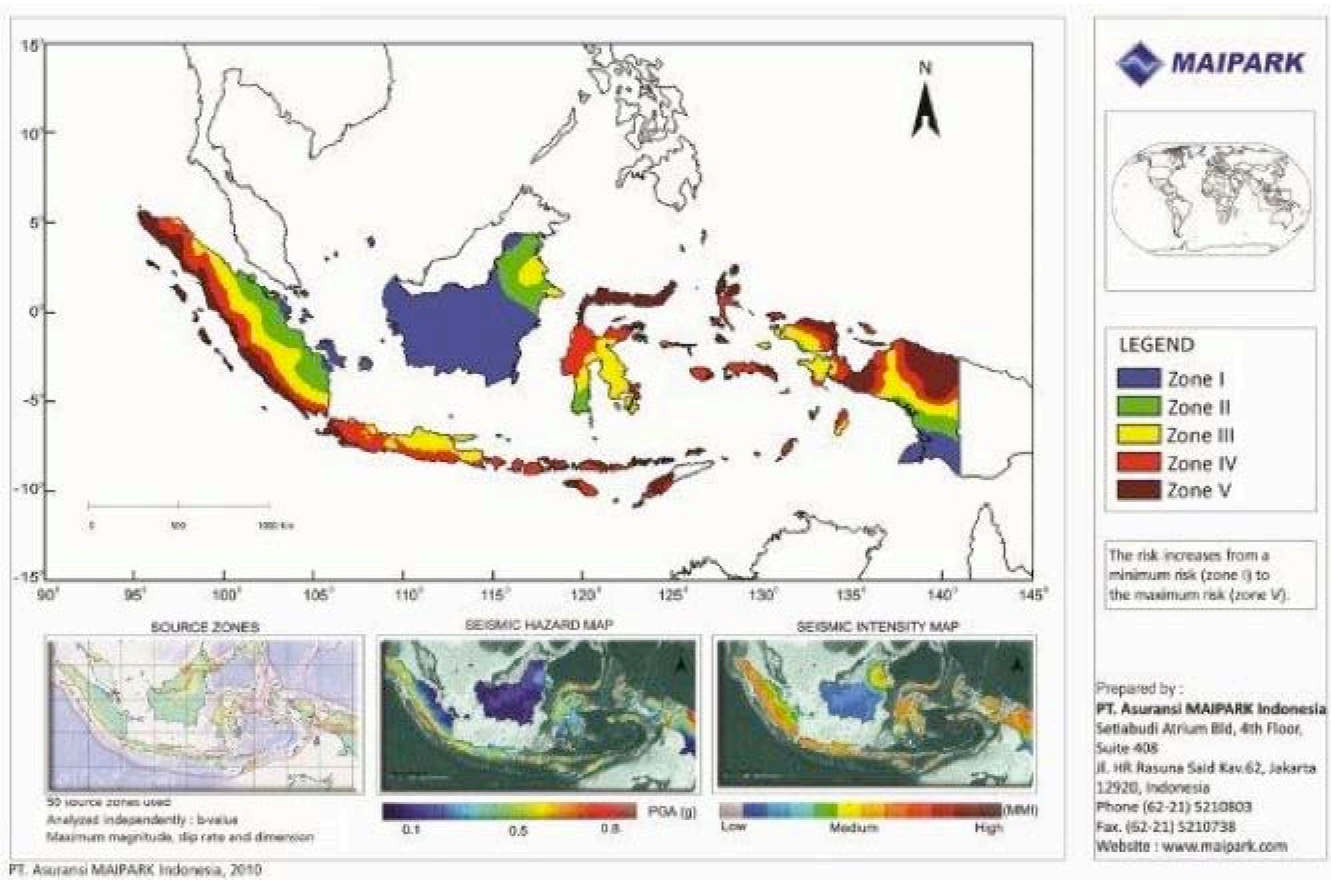

Figure 10: Earthquake Risk Zone Map of Indonesia, (MAIPARK 2010).

Immediately clear from examining figures 9 and 10 is that the risk (premium) zones are fewer than the possible categories of PGA values and that considerable possible detail is lost in aggregation. This is not necessarily a shortcoming for insurance purposes as long as the intervals of PGA appropriately reflect meaningful differences in relative risk. Fewer risk zones have the advantage of lending greater simplicity to earthquake insurance sales and administrative activities. It is clear from the above referenced material, however, that within Indonesia there is already a good and growing capacity to model, assess, and to deploy the results from seismic hazard risk. From the perspective of considering the market development for index insurance, this suggests that there exists a good foundation in domestic human and technical capacity to support such a scheme.

A Simple Index Insurance Structure

Seismic hazard mapping is used to depict the rating territories of an insurance product that takes into account the relative earthquake risk across geography. As with any index insurance product, the sole means of determining whether a payout occurs, where it occurs, and at what level is the applicable index. For this proposed product, the index is one of several different ground-motion parameters, using

PGA as the example index. Shake map generation combined with applicable GIS information can be used to spatially identify the locations of ground-motion intensity (PGA values) used to trigger an index insurance payout following an earthquake event.

An index payout structure can range from highly specific to something quite parsimonious. Most product structures are variation of a simple linear function of the index value such that the higher the index (greater incidence of the hazard) the greater the payout, up to some limit. In other words, the payout structure should bear some resemblance to the level of losses or costs experienced by the insured corresponding to the severity of the event. It is sometimes tempting to estimate a payout structure that very closely matches the loss experience of a representative or average consumer of insurance, usually in an attempt to approximate an individual loss assessment. These efforts are more likely to lead to overconfidence in the appropriateness of the product and, ultimately, in dissatisfaction by consumers who may fail to fully understand the payout structure and whose individual experience differs from the average. In effect, additional basis risk is created by the complexity of the structure itself. In addition, index payout structures that are tied to one measure of loss experience (e.g., such as yields) may fail to fully capture the range of losses and costs experienced by the insured. An index payout structure that relates simply but meaningfully a basic relationship between hazard intensity and payout levels is more likely to be understood by consumers who then can more accurately judge whether the product, and what level of coverage, is appropriate for their risk management needs.

Linear and near continuous payout functions are common in index insurance but presume that small changes in an index value relate meaningfully to the incremental changes in the payout level. Often, a payout structure that varies over discrete ranges of the hazard index, a step function, is more applicable, especially if those ranges correspond to broadly recognized differences in severity, and thus loss experience. In particular, the correlation exhibited between ground motion and potential damage is not exact and depends on many localized seismic behaviors and characteristics of the infrastructure at risk. Thus, structuring payouts on ranges of ground motion values is the approach proposed for index-based earthquake insurance in Indonesia.

Earlier discussion of the measurement and communication of ground shaking intensities, especially the relationship between I_{MM} and PGA, is the basis for initially identifying the following index value ranges and payment categories shown in table 3. Recalling that each value on the magnitude scale corresponds to a ten-fold increase in energy released by an earthquake, it is reasonable that payment rates should increase rapidly past a certain threshold. Note that the I_{MM} values approximately relate to those identified in table 2 which are estimates based on the experiences in Indonesia as reported in shake maps of the region's recent earthquakes. Corresponding In addition, PGA values corresponding to certain I_{MM} thresholds may be lower than anticipated when compared to regions due to differences in construction methods and standards. This payout structure is shown graphically in figure 11. Given this proposed structure, payments to the insured are just the payout rate (identified using shake maps) multiplied by the chosen sum insured.

It must be emphasized that this structure is provisional and meant as a demonstration of what is possible. The input of a diverse stakeholder group, including the expert input of seismologists and disaster response experts, is necessary to ensure that the scales and categories are appropriate for Indonesia.

Table 3: Proposed Payout Rate per PGA Value Range.

PGA (g)	~ I_{MM}	Payout rate
< 0.092	≤ V	0
0.1–0.19	VI	.2
0.2–0.349	VII	.6
≥ 0.35	≥ VIII	1

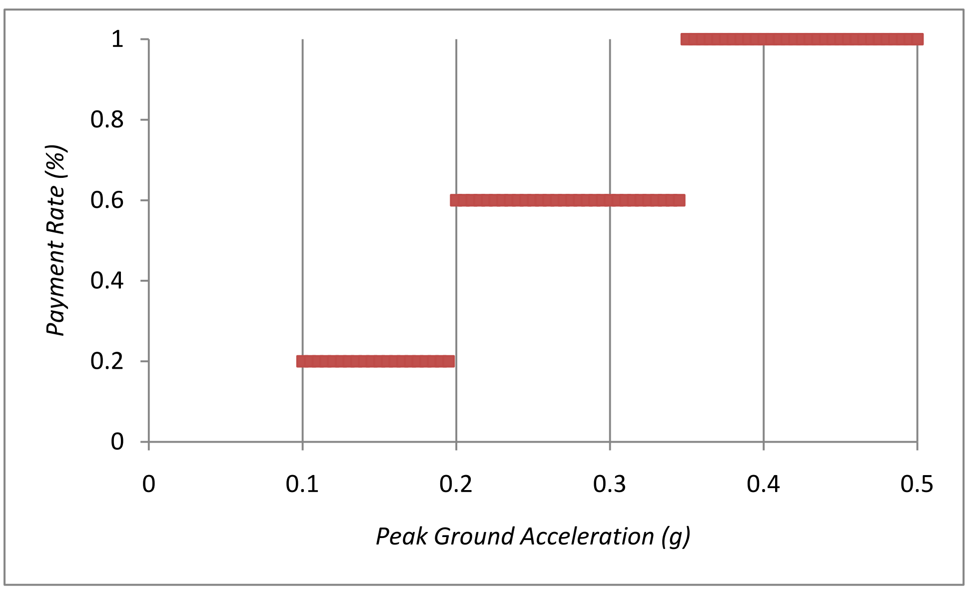

Figure 11: Provisional Payment Rate vs. Peak Ground Acceleration.

A Market Development Perspective

The development experience of GlobalAgRisk has been with index-based insurance market development for transferring natural disaster risk, primarily weather related risk. The lessons we have drawn from this work differ in some respects from many index-based insurance initiatives, namely a singular focus on individual household (micro) products as the primary vehicle to protect assets and livelihoods during natural disaster events. There are many significant hurdles associated with this approach which include, among others:

- The enormous educational effort that must be conducted down to the household level for there to be any informed demand for a completely new type of product;
- Daunting issues concerning basis risk stemming from the need to assess disaster impacts at a small scale where the monitoring infrastructure is often sparse or non-existent;
- The need to identify or develop an efficient distribution channel in order to keep administrative costs as low as possible;
- A difficulty in securing and holding the interest of domestic and international risk holders for small market volumes that inevitably accompany micro-level products;
- Regulatory considerations that must be properly dealt with, especially when considering the protection of household consumers, in order to avoid misunderstandings that could lead to a mistrust of the index-based approach at the regulatory level.

Practitioners have addressed these difficulties in many different and often innovative ways and with different degrees of success. One notable problem, however, is that the expense of these efforts, in terms of external support for administrative systems and for premium subsidies, is often quite large and ongoing. Low individual household demand is at the same time addressed with higher payment frequency that begins to substitute for the role of household savings for small and moderate risk. One wonders, therefore, if this is the right starting point for creating sustainable and eventually scalable risk transfer systems. These concerns are equally valid when considering index-based earthquake insurance.

The ultimate goal of our business model, as for most practitioners of index-based insurance, is to facilitate poverty alleviation, contribute to economic growth, and to improve the lives of the working poor through natural disaster risk transfer. Our experience suggests that the starting point for such efforts may often be:

- At a greater aggregate level than individual households (though explore broadly for opportunities).
- The risk level addressed should be truly catastrophic (leaving a role for savings and credit).
- Insurance is better targeted to a range of business and livelihood interruptions than a single metric of loss.

The term ‘risk aggregator’ is meant to mean a business that serves the working poor and in doing so is exposed to the same risk as are the households. This includes bank and microfinance organizations that are exposed to default risk through the exposure of household to catastrophic risk. It can also include a variety of supply chain businesses with whom households trade. These financial institutions and other businesses may have their own direct exposure to the consequences of earthquake hazard. The purpose of focusing on these types of entities is to ensure their resiliency and capacity to continue service to households during and after a natural disaster. Ready and affordable access to financial services for coping and recovery are especially important in the immediate aftermath of an earthquake. Financial lenders will find it difficult, unless they are geographically diversified and well reserved, to extend additional loans when faced with the high likelihood of payment delay and default in an affected region while at the same time having deposits withdrawn by households. Consequently, a risk management strategy for exposed risk aggregators is one important step toward managing risk for households. Often such a strategy and the development of financial products to protect against the business interruption costs of risk aggregators can be achieved and delivered more quickly and at less initial cost than when starting at the household level. In doing so, a minimum scale of transaction can be reached more quickly which will help sustain market development activity on the part of profit-orientated insurance and reinsurance providers.

Risk aggregators are may already be sophisticated in their conceptualization and assessment of their exposure to catastrophic risk. This lessens the initial extend and scope of the insurance education and financial literacy efforts needed to introduce a completely new risk management tool into the financial market place. It also lessons the cost of product delivery, as risk aggregators are far fewer than there are individual households, while contract size will be larger. All these factors mean the possibility of more rapid recovery of up-front product investment costs of the insurer and a higher probability of sustainability. But this is not only a matter of cherry-picking; important initial capacity building on the part of insurers, product development teams, the regulator, and other institutions involved in the operation of an index insurance can be achieved in a more controlled environment. Greater domestic capacity translates into a greater ability of all stakeholders to innovate for household products. At the same time, however, the practitioner should keep abreast of possible opportunities to more quickly advance index products to the household level. Very often this is possible via bundling of the insurance with banking services or as a rider to existing insurance products, where distribution channels are already well developed and where demand can be more easily assessed. Several of these possibilities are explored for Indonesia.

Insurance lies at the end of the continuum of financial services for risk management: savings and credit are properly used for small and intermediate risk coping while insurance is used to recover from infrequent catastrophic losses. Insurance never returns its expected value and so the cost of high frequency payouts quickly becomes uneconomical relative to borrowing, savings, diversification, and risk mitigation. This is particularly the case for index insurance meant to address covariate risk which cannot be easily pooled and where ambiguity regarding the extremes of a loss distribution compel insurers and reinsurers to heavily load premiums. A second reason to focus squarely on catastrophic events for index insurance is precisely because households and firms have the most difficulty coping with this type of risk. That is, risk pooling or diversification at a local or even regional level breaks down when everybody is negatively impacted at the same time. Earthquake risk may be even a better example of this condition than serious flooding, which not only disrupts economic activity but also destroys assets and infrastructure. Finally, a focus on catastrophic events can help to reduce the incidence of basis risk for both risk aggregators and households in that the unevenness of impact declines as an event become more severe when compared to moderate loss levels.

The payout structure of many (weather) index-based insurance schemes is typically linked to a single metric of loss, such as crop yields. However, several recent applications of index insurance for both households (drought insurance for coffee producers in Vietnam) and risk aggregators (flood risk for banks in Vietnam and el Niño insurance in Peru) recognizes the concept of business or livelihood interruption for consequential loss, which allows for the inclusion of multiple losses and costs that accrue when individuals work to overcome the impact of a catastrophic event. In our experience, when households or firms talk about financial impacts of natural disasters, the discussion extends beyond a single activity to the multiple causes of reduced income, increased expenses, and asset destruction. Further, if it is true that the covariance of returns across different activities is greater for more extreme events and that steps to diversity a portfolio by investing in several activities is ineffective, then index insurance should explicitly account for the multiple consequences of loss that stem from catastrophic events. In doing so, the consequential loss framework should be more attractive from a demand perspective than index-insurance approaches keyed to a single loss metric. This approach also helps to preserve economic incentives for the insured to undertake risk mitigation and aggressive coping activities.

A related concept emerging in the field of index-based risk transfer is that of contingent insurance, where it is the burden of the insured to select the level of sum insured that suites their individual risk profile given an exposure to catastrophic risk. Payments are contingent on the index thresholds being exceeded. Index-based earthquake insurance may very well fit into the category of contingent insurance where it will be otherwise very difficult to sensibly assess the maximum insurable sum which will vary widely among insurance participants.

This section has briefly touched on the core principles of our business model that have, in part, guided this pre-feasibility activity for index-based earthquake insurance in Indonesia. It is based on our evolving experience developing index-based natural disaster risk transfer markets and from reviewing the experiences of others. This background should help clarify the reasons for the path of the analysis and the recommendations. To illustrate these ideas in practice, the following example is given of ongoing market development of El Nino insurance in Peru, a GlobalAgRisk, Inc. activity.

Example: Index-based El Niño Insurance in Peru

In Peru, the risk of concern is El Niño, which can bring catastrophic rainfall and flooding to the coastal regions of Peru, particularly in the north. The past two severe El Niño events resulted in rainfall more than 40 times the normal amount for January through April. The initiative to develop weather insurance in Peru began with a focus on protecting microfinance institutions from the risk of loan defaults and other problems resulting from extreme El Niño events, with the goal of stimulating an increase agricultural lending to smallholder farmers. Feasibility work identified El Niño as the driver of catastrophic rainfall and flooding in the province of Piura, and found a strong correlation between SSTs in the Pacific, which are measured as indicators of El Niño Southern Oscillation (ENSO) cycles. As a result, an index-based El Niño Insurance product has been developed which uses measures of the average November and December SST for ENSO region 1.2 from NOAA as an indicator of a severe El Niño.

During product development the initial focus expanded beyond insuring the agricultural lending portfolio of lenders in recognition of the different ways financial institutions and other enterprises are affected by catastrophic El Niño. Extreme rainfall and flooding from past events has resulted in many significant problems in Piura — lost or damaged crops and fruit trees, erosion of soils and riverbanks, a break down in transportation due to damaged roads and bridges, increased incidences of disease (e.g., malaria), and disruptions in commerce. When individuals and local markets suffer in this fashion, it is expected that many in the agricultural value chain and other sectors will also suffer. For example, by early 1998 there was clear indication that a strong El Niño was coming and thus, many farmers simply did not plant their crops which resulted in a 27 percent drop in fertilizer sales in northern Peru (Skees, 2010). These insights led us to position El Niño Insurance in a different way to account for the variety of different ways that risk aggregators in the region may suffer from El Niño risk.

The El Niño Insurance product was presented to the Peruvian regulator as a form of business interruption insurance designed to pay for consequential losses that are linked to extreme flooding that is highly correlated with a severe El Niño. Furthermore, given that high ENSO measures in November and December are such a strong signal of catastrophic rainfall to come between February and April, the regulator also accepted that exposed firms would be incurring additional expenses even before the onset of the disaster (Skees, 2010). Thus, the design of the El Niño Insurance enables the insured to receive a payout as early as January, allowing time to use the funds to implement disaster preparation activities if possible or to have funds available in the immediate aftermath of the disaster.

For microfinance institutions in the region, an insurance payout would be treated as new equity on their balance sheets, bolstering their capital adequacy ratio during a time when delinquent or defaulted loans and savings withdrawals could bring it down. Figure 12 illustrates a model of the effects of an El Niño disaster on the capital adequacy ratio of an MFI with (“con seguros”) and without (“sin seguros) the use of insurance. As the figure shows, an insured institution would be in a stronger position following El Niño to make new loans and investments for years afterwards in comparison to an institution without insurance. The spike for the insured institution is a result of the insurance payout with a decline afterwards representing equity outflows in the form of new loans. To achieve this buffer against equity losses, the MFI need only to insure a portion of their lending portfolio to offset some of their risk exposure. In the risk assessment model used to support the results shown in figure 12, the optimal sum insured was in the range of 5 percent of the lending portfolio (Collier and Skees, 2010).

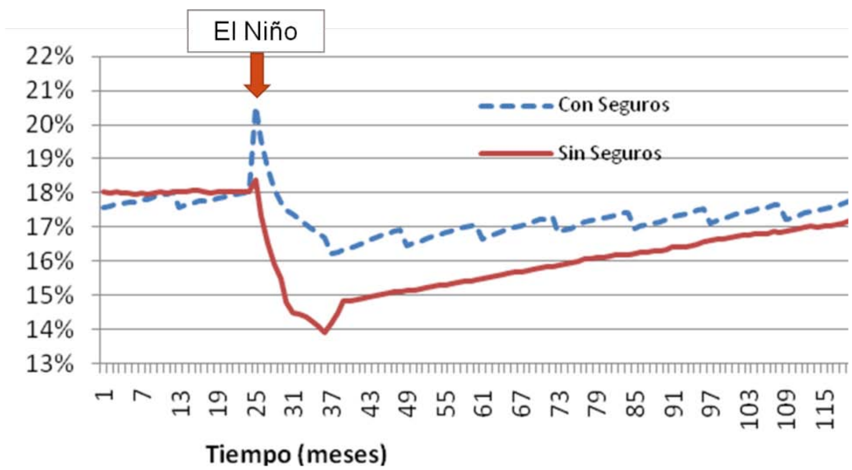

Figure 12: Effects of El Nino on Capital Adequacy Ratio with and without Insurance (Collier and Skees, 2010).

The analysis resulted from one-on-one risk assessments with some of the MFIs in Piura to gain a clearer understanding of the different ways in which El Niño affects their operations and to help them evaluate an optimal level of sum insured to support resiliency and return to normal operations after a catastrophic event. While such detailed research could not be conducted with each potential consumer, the analysis gives credence to the idea of El Niño Insurance as business interruption insurance by illustrating how insurance can be used to offset the long-term consequences of catastrophic weather risk. These concepts are relevant to other financial institutions and businesses that experience problems from El Niño even though their exposure and needs may be different.

Indonesia: Stakeholder Input on Demand

During the pre-feasibility mission, the GlobalAgRisk team engaged professionals from insurance companies, banks and microfinance institutions, development organizations, and donor agencies, and academics, scientists, and regulators. Through 19 meetings and a one-half day seminar with 50 participants, stakeholders across the fields of financial services, development and disaster preparedness, and public policy provided early input into three key questions:

- What sectors do stakeholders view as appropriate targets for index-based earthquake insurance, and what is their exposure?
- What are some of the existing risk management and risk transfer strategies that potential users have in place to cope with the economic impact and consequential losses associated with earthquakes?
- And, what are some of the demand-side conditions and considerations that may influence the design and uptake of an index-based disaster insurance product.

Index insurance is new to many stakeholders in Indonesia. However, in general, the concept of an earthquake index insurance product was well-received as one potential way to round out the insurance market and broaden what is now a severely limited set of available financial risk management and transfer mechanisms. Stakeholders acknowledged that severe earthquakes pose a significant risk to almost every sector of Indonesian society, most of whose physical and human assets remain uninsured, and threaten the continuity of government and business operations, the production and distribution of critical goods and services, and the welfare and resiliency of households. Figure 13 categorizes the range of potential users, identified by stakeholders, who may benefit from an index-based earthquake insurance product.

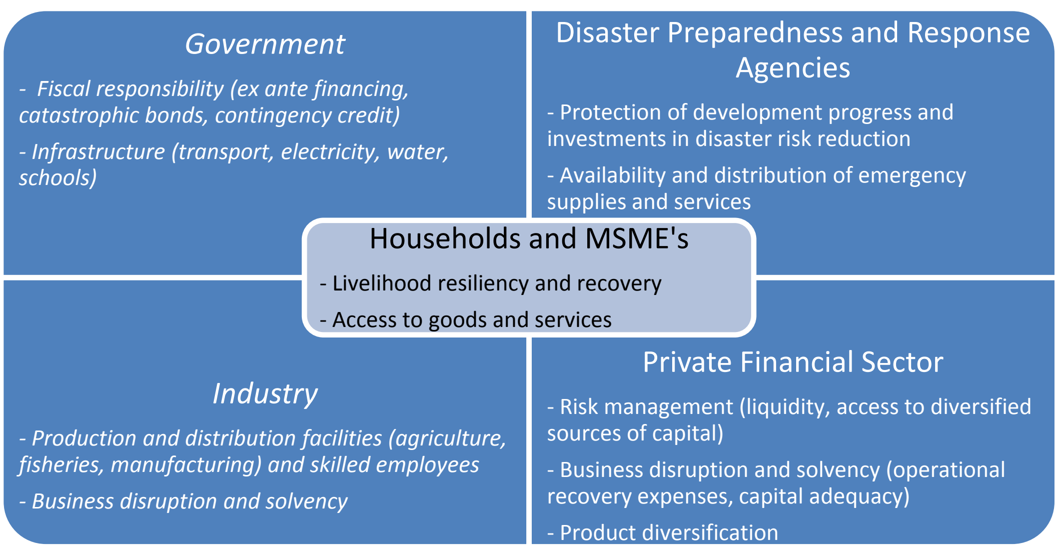

Figure 13: Potential User Interests Map

The discussion below, focuses on information and insights related specifically to *Households and MSME's*, and the *Private Financial Sector* and *Disaster Preparedness and Response Agencies* that serve them.

Disaster Preparedness and Response Agencies

Disaster risk management is a growing national priority. Policy and program efforts are gradually moving the country from having a predominantly reactive emergency response and recovery stance towards disasters, to one emphasizing prevention and mitigation. Following the Indian Ocean earthquake and tsunami in 2004, Indonesia and 167 other states renewed their commitment to Disaster Risk Reduction (DRR) with the Hyogo Framework for Action 2005-2015. The Hyogo Framework seeks “the substantial reduction of disaster losses, in lives as well as the social, economic and environmental assets of communities and countries”.

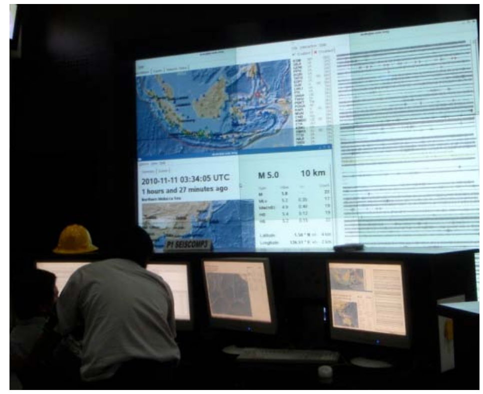

Figure 14: BMKG’s Early Warning Center.

In line with the priority areas for action under the Hyogo Framework, significant investment has been made in Indonesia to improve disaster risk management at the national and local level. The Government of Indonesia enacted a new legislative framework (Law on Disaster Management 24/2007), launched a state-of-the-art Early Warning System, and created the National Disaster Management Agency (BNBP) solely dedicated to dealing with disasters. BNBP works with an extensive network of government entities and the United Nations, which coordinates donor and NGO engagement. Local governments and civil society are working together to educate communities on sources of disasters and mobilize them to identify ways to save lives and mitigate the loss of critical infrastructure and livelihood assets. Disaster risk reduction education has been adopted as part of the national curriculum. Additional disaster risk management strategies are being mainstreamed into regular development programs, with increased attention on social and economic mechanisms that increase community and household resilience, to avoid the reversal of development gains over the past several decades.

The Hyogo Framework also calls for the development of financial instruments that create opportunities for private sector involvement in disaster risk management to help transfer risk, incentivize disaster planning and mitigation, and overcome the limitations of disaster aid and government budgets. The Government of Indonesia is working with the World Bank and IFC to develop a comprehensive catastrophic risk-financing framework and to structure financing mechanisms, such as disaster insurance and contingent credit, to reduce the fiscal burden of disasters on public resources. Figure 15 illustrates the quadrupling of the Government’s disaster-related expenditures in recent years. [6] The calculations include allocations for rehabilitation and reconstruction. Figure 16 is one estimate of rehabilitation and

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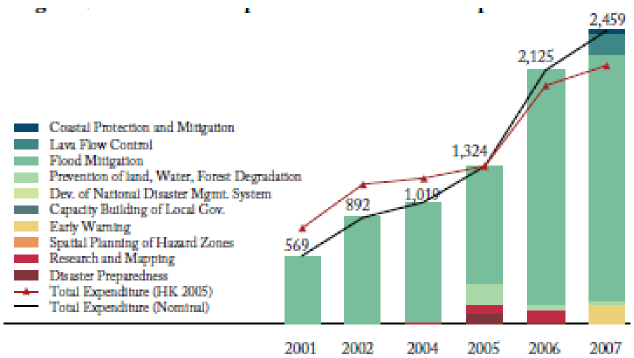
[6] Data from the Government Budget Disbursement Database (World Bank 2010).

reconstruction costs associated with earthquake disasters alone.[7] Disaster insurance, including an earthquake index-based product, may also have a role in protecting both public and private emergency response supplies to ensure that affected assets and inventories can be rapidly replaced and deployed.



Source: Budget Disbursement Database, MoF

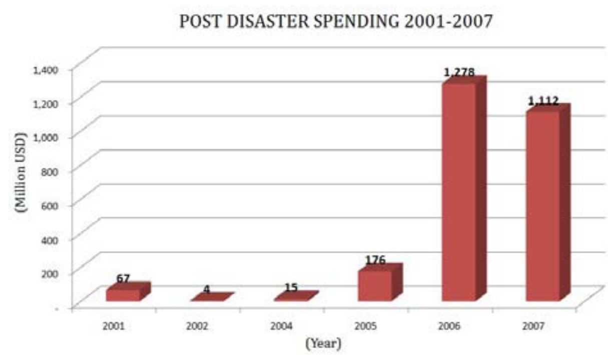


Figure 15: Total Government Disaster-related Expenditures

Figure 16: Government Expenditure on Rehabilitation and Reconstruction due to Earthquakes

The imperative to develop financial mechanisms that enable local organizations and households better financially prepare for, react to, and recover from disasters is also needed as responsibility for response and recovery is increasingly decentralized. Development efforts that raise the capabilities of local organizations and households to adopt sound disaster risk management practices will contribute to improving the demand-side conditions for market-based disaster insurance products at the meso (e.g. microfinance providers and SME's) and the micro level (e.g. microenterprises and households).

Private Financial Sector

Financial services for low-income households and micro, small, and medium-sized enterprises (MSMEs) in Indonesia are supplied by a complex and fragmented market of regulated and non-regulated, and public and private providers. The Government supports a network of public regional banks. Commercial banks and BPR's (privately-owned People's Credit Banks, introduced by Bank Indonesia) are regulated. Unregulated providers include NGO's, Savings and Lending Cooperatives, and various village-based models that generally serve lower income segments with smaller loan sizes. There are also traditional rotating savings and credit groups, known as *Arisans*, which are used widely across poor and wealthy income segments for their social capital value.

Most microfinance providers have a concentrated geographic operating area and serve, on average, only a few thousand clients. The geographic concentration of individual providers leaves them

[7] Estimates provided in communications with Prof. Zen.

highly exposed to correlated catastrophic events, such as earthquakes. When clients are affected by disaster, default rates increase, savings are withdrawn, and costly adjustments are needed to restructure loans. These factors can threaten the liquidity and solvency of microfinance providers at the moment clients most need their services. Indonesia witnessed this vulnerability when a number of microfinance providers in Aceh went out of business following the 2004 9.0 Indian Ocean earthquake that triggered the tsunami. More recent disasters, such as the 2009 earthquakes in West Sumatra and the 2010 volcanic eruption of Mirapi, continue to alarm microfinance managers who are concerned as to whether existing risk management strategies, such as provisioning and loan restructuring, are adequate to cope with the portion of clients suddenly unable to repay their loans, and the uncertainty around how long it take for clients to rebuild their livelihoods.

Not all microfinance providers have the same access to risk management and transfer mechanisms to cope with severe affects of an earthquake on operational costs, liquidity, and solvency. Private microfinance institutions are the least prepared to deal with a major disaster. To date, public microfinance institutions have been well-protected by the Government's *Kredit Usaha Rakyat* People's Credit for Businessprogram. The program collateralizes up to 80 percent of all micro and small loans under Rph 20 million (US $2,250). For commercial banks, microfinance is one business line among many through which exposure to a range of risks is diversified. In fact, as a result of the resiliency demonstrated by the microfinance sector during the recent financial crises, a number of Indonesia's banks are investing in the growth of their microfinance portfolio as a diversification strategy. Growth investments include expansion of microfinance product lines, which is spurring interest in retailing newly developed micro-insurance products for low-income markets.

One commercial bank reported purchasing business interruption policies to transfer loan loss risk associated with microenterprise borrowers affected by disasters, such as fire, flood, and earthquake. Further analysis would be needed to assess the cost-benefit of using earthquake index insurance as a partial substitute or as complementary coverage for consequential losses and extra costs, as used in Peru.

In addition to private microfinance providers that are geographically concentrated, those that have an undiversified capital base or inefficient reserve levels are most in need of more sophisticated risk management practices. Among Savings and Lending Cooperatives, an estimated 90 percent of their capital is mobilized through member savings, leaving them highly exposed to massive credit default and runs on savings following a disaster. Many NGO providers, including a newly created wholesale lender, Bank Andara, are funded by international donor funds and social investors. Their business continuity, in the face of a catastrophic event, would be dependent on the willingness of backers to re-capitalize the institutions.

Improving the risk management capabilities of microfinance providers is a priority need for the development of the microfinance sector in Indonesia, to ensure healthy growth and sustainability. Local capacity building institutions, established by the international development community, such as BISMA and MICRA[8], are working to strengthen private providers of various institutional types and stages of development. Priority capacity building areas include new product development, facilitating access to external sources of capital, and risk management, which broadly incorporates operational policies and procedures, portfolio and product diversification, and efficient resource allocation (i.e., capital allocation and liquidity to manage shocks). As the organizational capacity of providers evolve, competition for new sources of capital to finance growth will also increase. In turn, a more prudent and sophisticated mix of risk management strategies may be sought to attract lenders. The opportunity to improve institutional ratings, used by lenders to evaluate investment opportunities, may be one way to incentivize uptake of disaster insurance. The potential affect on improved capital access may also minimize the perceived opportunity cost of making premium payments, which enter the balance sheet as an asset and increase the institution's equity base. In addition, the opportunity to leverage disaster insurance as a mitigant for credit risk exposure (like collateral and guarantees) to lower capital adequacy requirements would be another potential avenue to motivate demand. The government has begun to institute more stringent financial control and transparency requirements. A number of the weakest institutions have been shut down and capital adequacy requirements are potentially on the rise.

Households and Microenterprises

The introduction of microinsurance in Indonesia is relatively recent. The range and penetration of available products targeted to households and microenterprises remains limited. Early promoters have had mixed results. The insurance company Allianz launched its microinsurance program in 2006. It has recorded considerable growth, reaching 440,000 customers and Rp 9.5 (US $1.07 million) in premiums in 2010.[9] It distributes credit-life, personal accident, and business interruption coverage through its own agents and 30 microfinance providers (BPR's, Cooperatives, and Banks). A local organization, Takmin, operates as a sales and servicing agent between insurance companies and microfinance institutions. It introduced a Shariah-compliant credit-life insurance product (*MicroSakinah*) in 2008. As of mid 2010, Takmin was working with 44 microfinance providers , but had only reached 11,749 customers and a total sum insured value of US $2.5 million.[10] The small average outreach of microfinance providers and limited capacity to adopt even basic entry-level products, such as credit-life, are viewed as significant

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[8] BISMA, founded by CARE, delivers financial and technical services to microfinance institutions with limited technical capacity and/or access for funding. MICRA, founded by Mercy Corps, works to build the institutional strength and outreach of the Indonesian microfinance sector, by providing a full range of technical inputs and support to all industry stakeholders, in a sustainable and demand-driven manner.

[9] http://www.thejakartapost.com/news/2010/10/21/allianz-plans-microinsurance-push.html

[10] Presentation made by Agus Haryadi of Takmin at the 4th International MicroInsurance Summit, September 30, 2010, CrownePlaza Hotel, London.

hurdles to accelerating the penetration of microinsurance, despite reports of high demand for 'off-the-shelf' products. With support from BISMA and the MicroInsurance Centre, additional efforts are underway to bring international standard trainings to microfinance managers to raise their capacity in managing microinsurance products.

Experience with index-based micro-insurance products in Indonesia is far more limited. A couple of pilot efforts have been conceived, but either did not get off the ground or failed. In 2006, Allianz, CARE, and IRI worked to develop a weather index insurance product. Due to unforeseen complexities in coordination, the product was never launched. In 2009, GTZ and MunichRe developed an index-based flood product, but fewer than 50 policies sold. This latest endeavor highlights the difficulty in overcoming cognitive failure among households to prioritize expenditures on catastrophic disaster insurance, and in finding an acceptable premium:payout ratio. The lack of demand was attributed to an inadequate understanding of client's perceptions of the value of paying a small premium for a payout that is triggered only in the case of low-frequency, extreme flood levels.

Stakeholders consistently emphasized the challenges of marketing any insurance product to low-income households, noting limited experience with insurance and competing demands on scarce resources to cope with more frequently felt crises. Recommendations for a set of minimum requirements for an index-based earthquake insurance product targeted to the working poor included:[11]

- Aggressive awareness building and education
- Simple enrollment, payment, and claim processes
- Transparent, easily understood payout trigger, and reasonably useful payout sum
- A focus on delivery in high-density areas and low-income communities.

Recent innovations in non index-based products in Indonesia provide additional insights into the characteristics of products that may be easily understood and attractive for low-income households. Allianz, in partnership with a local microfinance institution, World Vision Fund, launched an educational endowment product at the time of this mission. The product seeks to address pressing and immediate concerns facing low-income households – children's education and its financial dependency on the health of household income earners. The product, *TAMADERA*, enables clients to regularly put aside small sums (10,000 Rph per week) to accumulate up to Rph 2,500,000 (US $281) over five years for a child's education. In the event of the policyholder's death or critical illness, an automatic payout of the full Rph 2,500,000 sum is triggered. Should the client lapse in making regular payments or voluntarily cancel the policy, the difference between the sum of payments made and a penalty is returned to the policyholder. In the first week of the pilot test, a significant portion (estimated at 30 to 50

[11] There is a general view that most financial products can be adapted to meet Shariah principles, thus is not considered a minimum requirement.

percent) of clients offered *TAMADERA* opted to purchase the product. It is envisioned that, over time, the endowment product could take-on additional riders, such as hospitalization coverage and disaster protection, to provide more comprehensive coverage at a marginal additional cost to clients. It is also anticipated that the product can be pushed through other market channels, such as employers in any sector seeking to offer low and middle income employees new financial ways to protect their children's education. Interestingly, despite undergoing rigorous market research and underwriting to inform the product's design, Allianz found it difficult to find microfinance providers willing to participate in a pilot launch. The challenge was attributed, in large part, to reservations among deposit-taking providers who feared that the small endowment payments would compete with their efforts to collect savings. Similar reservations among this segment of providers could be anticipated with the introduction of an earthquake disaster product.

A second recent product innovation to highlight is ACA Asuransi's introduction of DEMAM BERDAH in 2010, which provides insurance coverage for dengue fever. As a result of public health and education campaigns, the cause of dengue fever, preventative measures, and testing and treatment are now more widely understood among lower-income populations. The average cost of dengue fever treatment in Indonesia is Rph 3,500,000 (US $394). ACA has made DEMAM BERDAH available via scratch cards that are offered through a network of retail shops. One scratch card, priced at Rph 50,000 (US $5.62), provides up to Rph 2,000,000 (US $225) of coverage. One individual can purchase up to five scratch cards for a maximum payout of Rph 10,000,000 (US $1,125). Since the launch of the product in May 2010, over 12,000 policies have been sold. The product's success followed significant institutional commitment and persistence through a lengthy process of trial and error. Over several years, ACA developed and tested a number of alternative delivery channels, such as ATM's, to reach low-income market segments with its insurance products and had limited success. ACA now has a five-person team focused solely on the development, underwriting, and sales of retail micro-insurance products.

Small and Medium Enterprises

Little information was uncovered during the mission about the particular demand context and conditions for an earthquake disaster insurance product targeted at Small and Medium Enterprises. This market segment is still largely underserved by banks and microfinance providers in Indonesia due to the mismatch between the demand for larger loan sizes and SME's inability to meet the collateral requirements of formal financial service providers. Most capital is likely to be accessed through trader credit made available by input suppliers and buyers in the value chain. In principle, SME's serve as risk aggregators, much like microfinance providers, but they consist of a group of enterprise value chain actors, including input suppliers, output processors, transporters, etc). A meso-level earthquake index product could serve to protect SME's against direct losses, loss of future business revenues and added recovery costs to accelerate the speed at which their business operations can resume. Households could directly and indirectly benefit from market actors that recover quickly, such as SME's, which play an integral role in facilitating access to goods and services, and provide employment to low-income households. Insurance coverage may also improve SME's competitiveness and access to capital at more favorable terms (Skees et al 2010).

In conclusion, a number of demand-side conditions identified during the mission point favorably towards the need - and the motivation of stakeholders - to further invest in advancing the market development process of an earthquake index product, namely:

- Catastrophic disaster insurance fits well into Indonesia's national poverty reduction policy and disaster risk reduction plans
- There are a broad range of potential users to optimize the returns on public and private investments in market development and product design activities at the meso and macro level
- Commercial banks have already identified the need to protect their institutional interests from disasters, and would like to explore opportunities for retailing disaster insurance to micro-enterprise clients
- Local microfinance institutions, in partnership with technical assistance providers, are working to improve risk management practices, gain access to new sources of capital, and diversify the products that they offer low-income clients. The introduction of meso- and micro level disaster products appear to align with these priorities and present mutually supporting incentives.
- SME's represent a second set of risk aggregators that could be protected with a meso-level index based product to accelerate the recovery of markets and access to goods, services, and employment for affected households
- The capacity of local organizations, businesses, and households to assess their exposure to disaster risks and invest in mitigation strategies to cope with moderate disasters are improving with support from disaster risk reduction education and livelihood development programs

Regulatory Considerations

One critical element of any index-based insurance initiative is the early involvement of the insurance regulator. As with any type of insurance, index-based insurance must be based on a legal and regulatory framework that ensures contract performance. The introduction of index insurance also raises a unique set of legal, regulatory, and supervisory challenges. While some may classify index-based risk transfer as derivative securities, it is best in an emerging economy setting for it to be recognized properly as insurance and follow insurance principles. One significant reason is for the protection of the consumer, and in many emerging economies the insurance regulator is often much better equipped to provide this oversight than are other market regulators. Lack of clarity regarding the regulatory status of risk transfer instrument also creates a business risk for insurers and reinsurers, potentially undermining their interest in participating in a pilot demonstration project. It is not recommended that initial piloting activity become involved with the re-writing or creation of new regulation. Rather, efforts should be made to identify the relevant laws and regulations that support index-based insurance and ensure that its fits within the existing framework. The regulator should be invited to actively participate in this review from the very beginning of product development to avoid unanticipated delays or future problems that could prevent a pilot from reaching meaningful scale. This will be particularly important should a pilot advance non-traditional types of insurance contracts, such as consequential loss and contingent insurance.

The Head of the Indonesian Insurance Bureau for non-life insurance, Mr. Isa Rachmatarwata, is well respected and reportedly well aware of index insurance developments in the industry. The Insurance Bureau is a part of the Ministry of Finance and housed in the Capital Markets and Financial Institutions Supervisory Agency. Unfortunately, Mr. Isa was not available to meet during the week of the in-country pre-feasibility for index-based earthquake insurance. However, a consulting team for a recent International Finance Corporation (IFC) feasibility study of weather index insurance in Indonesia did meet with the regulator to discuss the basic regulatory environment and issues of product introduction (IFC, 2010). While a crop specific weather index and earthquake index insurance will differ in several important ways, the basic findings reported by the team are generally relevant for any index insurance product. These findings are reproduced and paraphrased here:

> Law Number 2 of 1992 regulates insurance business activities, the agreements that emerge as the result of an insurance contract are regulated separately in the Commercial Code (KUHD). The requirements for marketing a new insurance product are specified in Article 3 of MoF Decree No. 422/ KMK.06/2003, which stipulates that a new insurance product, when submitted for registration to the regulator shall be accompanied by the following supporting documents:
>
> - Specimen of insurance policy;
> - Statement from insurance expert on the description and basis for the calculation of premium rate and technical provisions, along with supporting assumptions and data;
> - Underwriting projection for the next 3 years;
> - Reinsurance support for the insurance product;
> - Description of marketing technique and sample of brochure that will be used;
> - Legal agreement document if the insurance product is being marketed together with another party.
>
> In principle, the Insurance Bureau did not foresee an obstacle to the development of index insurance in Indonesia. In order authorize the retail distribution of weather index insurance products, however, the Insurance Bureau needs to be provided with clear evidence that the product complies with the indications of the above-reference Ministerial decree and that a number

of related legal issues that must be clarified. Insurers need to make sure that any policy introduced has standard, concise and understandable language. Farmers need to be able to understand the coverage. Policy wording is very important and is one of the key criteria upon which product approval will be based. In addition, the weather index and premium rate presented in the policy must be supported by robust statistics.

Recommendations: Two Avenues for Impact

The pre-feasibility mission sought to identify ways to introduce a market-based index product for earthquake risk that would protect the asset accumulation and access to financial services for Indonesia's working poor. The mission also attempted to broadly examine whether there exists the basic elements necessary to support an index-based product's development and implementation.

In the context of current demand and supply conditions, we recommend a sequenced, two-avenue approach to early market development and product design efforts. The first avenue pursues a *risk aggregator strategy* to initially develop a meso-level product that targets microfinance providers and SME's that serve the poor. The second avenue pursues a *household-level resiliency strategy,* which builds upon the initial groundwork pursued in the first avenue to adapt and bundle an earthquake index contract with existing microfinance products targeted directly to low-income consumers.

Key observations that support starting with a risk aggregator strategy include:

- Microfinance providers and SME's play a critical role in household resiliency and recovery by providing access to capital, secure savings, and goods, services, and employment for households to restart their livelihoods after a major disaster. The impact of a household micro-insurance product will also be greatest in markets that can recover quickly and minimize short-term post-disaster inflationary effects on effective payout values.
- Catastrophic insurance is only one component of an overall risk management strategy and best serves customers who can mitigate the impacts of more frequent small and intermediate risks. Risk aggregators are a relatively more homogenous group than households in this regard. For example, microfinance providers generally adhere to a minimum set of capital adequacy and loan loss provisioning requirements, and other loan restructuring and portfolio diversification policies.
- Risk aggregators can be engaged in more sophisticated discussions on insurance valuation in light of an assessment of their un-diversifiable exposure and the cognitive challenges associated with relatively infrequent, catastrophic events.
- Stand-alone micro-insurance, of any type, has yet to overcome provider capacity and product delivery constraints to penetrate the lower-income market in Indonesia to a significant extent. Low market volume (total premium income and value insured) and slow uptake will threaten the scale and sustainability of any new product. The potential broader application of a higher market

volume meso-level disaster product that can be applied to businesses across sectors is more likely to sustain private sector interest during the development process. Once a scientific and regulatory platform and product proof of concept is established, the relative outlay for further investment in adaptation for the household market will be significantly reduced.

- Navigating the regulatory aspects of composite financial products for the household-level will take time. However, bundling financial instruments provides the opportunity to expand the value proposition of disaster insurance by simultaneously improving the resiliency of households and their means to manage other more immediate financial risks, such as illness, education, poor harvests, death of a relative, and social obligations.[12] Transaction costs can also be reduced through economies in financial education, and product marketing and delivery.

The following are recommendations for actions that can be taken in the interim to improve the environment for a household-level resiliency product to be successfully introduced. These foundational activities seek to assist households to assess their financial exposure to disaster and other risks, adopt financial and non-financial ways to mitigate those risks, and raise their willingness and ability to pay for catastrophic protection. These include:

- Mobilizing communities and local organizations to assist households to assess their exposure to disaster risks, identify risk mitigation strategies (diversification, land and property management, emergency provisions, etc) and develop business continuity plans
- Improve the livelihood opportunities for poor households to accumulate assets and raise their purchasing power through improved access to information, markets, and productivity enhancing technologies
- Expand the reach of informal and formal financial services, including savings and credit and insurance (e.g. health, life, accident), to enable households to access more cost-effective ways to manage small and moderate losses, and build social capital.
- Raise financial literacy levels of individuals to improve household budgeting, reinforce positive saving and credit habits, and introduce the basic concepts of insurance (solidarity, risk pooling and transfer, etc) in locally meaningful ways
- Ground truth community and individual perceptions of micro-insurance to inform educational and marketing materials, and monitor outcomes from new financial product innovations.

From a product platform standpoint, our tentative observations are that Indonesia has rapidly developed the technical capacity in seismic monitoring and reporting at a spatial scale that would most likely support a meso-level application in its current form. Micro-level applications require answering

[12] These five priorities were identified in by an extensive market research study, MicroInsurance Demand and Market Prospects, conducted by Allianz, GTZ, and UNDP in Indonesia in 2006.

questions about the degree of meaningful basis risk between station interpolations to determine an appropriate level of geographic specificity. Both of these statements are made with the understanding that a more thorough analysis and demonstration of capabilities is required to be definitive regarding the seismology network's ability to monitor a ground-motion index. Similarly, probabilistic earthquake hazard analysis and associated hazard mapping has advanced significantly in recent years. Actuarial analysis is already being practiced using local capacities and so the main task will be to combine the multiple sources of knowledge into a rating model that is transparent and gains the confidence of underwriters, including those of reinsurers to help reduce the degree of ambiguity loading on any possible insurance product.

Any index-based insurance product must properly exist inside a regulatory framework for the protection of consumers and insurers alike. Product development and regulatory guidance should proceed in tandem so that developers and the regulator benefit from each other's insights, and to avoid misunderstanding and delay. Should product development be pursued, it is strongly recommended that a thorough legal and regulatory review be undertaken early in the project cycle. This function is necessary for the correct formulation of index-based contracts that are unfamiliar to many insurance market participants and who may be tempted to otherwise adapt existing types of policies to fit the circumstance. Furthermore, presenting the idea of index insurance as business interruption, consequential loss and/or contingent insurance to the insurance regulator must be well supported and justified within the regulatory framework, and occur well before the submission of the final product documentation for approval. At the micro-level, the possibility of bundled or composite (non-life) index insurance with types of life products may also involve meeting certain regulatory requirements—items that should be approached during an initial review.

Opportunities and Challenges

The concept of developing an index-based earthquake insurance at either the meso- or micro-level that features consequential loss and contingent aspects contains in it the possibility of being at once context specific but with global scalability. One main advantage is that the approach disconnects loss estimation of the build infrastructure, which involves considerable modeling effort, from the insurance. This removes one source of uncertainty that is built into traditional earthquake insurance pricing. While this approach is not a replacement for traditional earthquake insurance for many property owners, it creates the possibility of making earthquake insurance accessible to a wide range of stakeholders in a form that can be used to transfer many consequences of the risk and at potentially reasonable cost. Context is provided by the geographic specificity of the seismic monitoring of ground-motion that determines the location and value of the index.

Challenges abound including significant legal and regulatory effort tied to the formulation and approval of consequential loss and contingent insurance. Among the consumer level concerns is begin able to effectively communicate the product and risk exposure in such a way that a potential purchaser can make an informed decision regarding an appropriate sum ensured. This task is made difficult when considering low probability, high consequence events that are often difficult to conceptualize. This education is vital since there is no physical loss adjustment and could lead to substantial unmet expectations in the absence of a proper understanding of the product. This is one reason why focusing on risk aggregators first is a recommended strategy. Bundling some level of earthquake coverage with simpler triggering conditions with certain classes of household level insurance products could be an initial entry point into that market. This could help avoid some issues of basis risk while being able to offer a product of value to the productive working poor.

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Annex 1: List of Stakeholder Consultations

Organization	Stakeholder Category	Representative Name(s) A: Meeting Participant(s) B: Discussion Participant(s)	A	B
ACA Asuransi	Insurance Group	Teddy Hailamsah, President Director Tommy N. Barus, PA to Pres Director Jakub Nugraha, Sr Asst Vice President Micro Insurance	x	x
Agency for Meteorology Climatology and Geophysics (BKMG)	Science and Disaster Preparedness	Dr. Andi Eka Sakya, Executive Secretary Dr. P.J. Prih Harjadi, Deputy Dir General for Geophysics	x	
Allianz	Insurance Group	Martin Hintz, Victor Sandjaja, Technical Director/Vice President Director Yosephina Elliana, Micro Business	x	x
ASDFI	Life Insurance	Andhika Syahrial Sakni		x
Australian-Indonesia Facility for Disaster Reduction (AIFDR)	Science and Disaster Preparedness	Dr Trevor Dhu, Risk and Vulnerability Manager	x	
AVRIST	Life Insurance	Masdar		x
Bank Andara	Microfinance Wholesale Lender	Numan R. Manaf, Task Force & Fee Based Business Manager	x	x
Bank Danamon	Commercial Bank	Tantrie Soetjipto, Snr VP Financial Institution Division	x	
BISMA/CARE	Microfinance Capacity Building	Margaretha Ari Widowati, BISMA Director of BISMA and CARE/CIPSED Microfinance Program Coordinator Agus Munawar, BISMA Investment Manager	x	x
Child Fund	Development and Disaster Preparedness and Response NGO	Sharon Thangadurai, National Director	x	
CSRC, Universitas Islam Negeri Syarif Hidayatullah	University Center (Islamic coops/health savings)	Emilia Fauzi Emi		x
DeTara Foundation	Environmental NGO	Nita Nuryanthy		x
GERHATI	Microenterprise Development	Leonardus Sutedjo		x
Grameen Foundation	Social Finance	Thilma Komaling Bnyuputro, Social Enterprise and Technology Consultant		x
HOPE Worldwide	Development and Disaster Preparedness and Response NGO	Charles M. Ham, Country Director Lambok Hutagalung		x
IFC	Financial Sector Development	Grace Retnowati, Access to Finance Tom Moyers, Access to Finance Earnest Bethe	x	

ILO	Social Finance	Virginia Bethe, Microinsurance Innovation Facility	x	x
Induk Koperasi Simpam Pinjam – Raden Saleh	Credit Cooperative	Agus Prayoga		x
Institut Teknologi Bandung	Science	Prof. Mudaham Taufick Zen	x	
Jaya Proteksi Takaful	General Insurance	Yudha Pratama		x
KONSEPI	Environmental NGO	Rahmat Sabani		x
Koperasi Mitra Duafa	Microfinance Institution	Slamet Riyadi		x
LEMBAGA EKOLABEL	Environmental NGO			x
MAIPARK	Insurance (catastrophic risk transfer)	Bintoro Wisnu, Corporate Secretary Bisma Subrata, Director Prof. Mudaham Taufick Zen, VP R&D Andriansyah, Seismologist Ruben Damanik, Earthquake Risk Analyst Haikal Sedayo, Volcano Risk Analyst	x	
Mercy Corps	Development and Disaster Preparedness and Response NGO	Sean Granville Ross, Country Director Eky Amrullah	x	x
MICRA	Microfinance Capacity Building	Nagwa Kamal, CEO Erlyn Shukmadewi, Senior Researcher Pritta Basuki Rini P Radikun Andriyani Hapsari Indra Alfonso	x	x
Ministry of Cooperatives and SME's	Government	IR Agus Muharram, Deputy Minister for Human Resource Development	x	
PPSW	Microfinance Capacity Building (women's savings groups and coops)	Astried Adhania Tri Endang Sulistyowati Yayah Sobariyah Endang Sulfiana		x
Save the Children	Development and Disaster Preparedness and Response NGO	Delailah Borja, Country Director Mara Hardjoko, Emergency Director Livelihoods Manager	x	x
Surya Kencana	Industry?	Vonny Contessa Milla Feryanti Putu Surya		x
Syariah BNI Life	Life Insurance	Ike		x
Takmin WG/PERAMU	Microinsurance Intermediary	Agus Haryadi, Chairman WG/PERAMU Ihsan Arkam, WG Mulyadih, PERAMU Muhammad Asadullah, PERAMU Khafidzin, PERAMU	x	x
Tanaoba Lais Manekat (TLM)	Microfinance Institution (Timor)	Rozali		x

Ukabima	Microfinance Group (BPR's)	Nurbbiyantoni Wisjnu Radji		x
World Bank	Financial Sector Development	Djauhari Sitorus, Financial Sector Neni Lestari, Research analyst	x	
World Vision/ Vision Fund	Development and Disaster Preparedness and Response NGO/Microfinance Institution	Glenn Jimmy, WV Market Specialist Hendrik Riwu Kore, Director Vision Fund	x	