



vam  
food security analysis

# *Shock Impact Simulation Model (SISMod)*

## *Earthquake Scenario of Kathmandu Valley, Nepal*

November 2013



## Earthquake in Kathmandu Valley (KV)

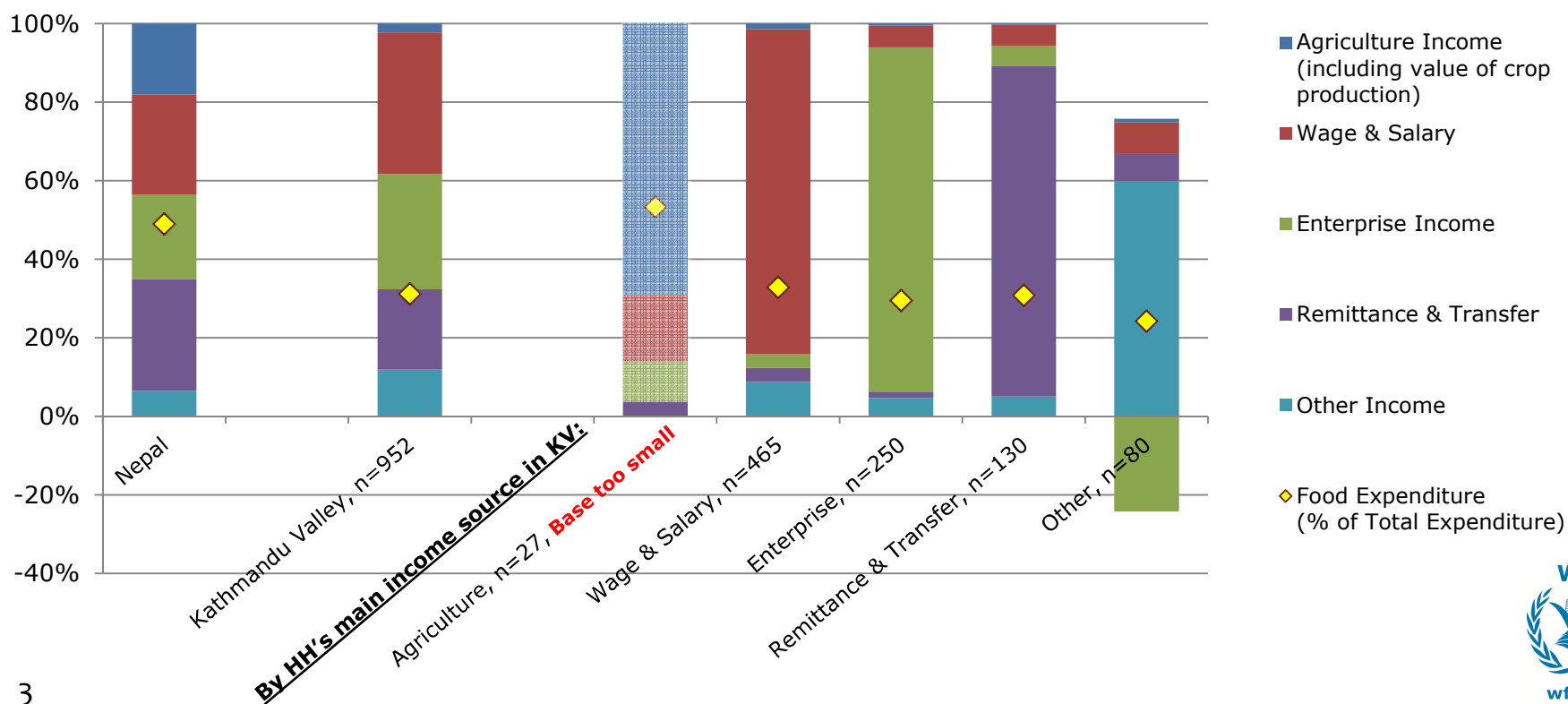
- Nepal is a highly seismic region, lying on top of 92 active faults. Earthquakes of various magnitudes occur almost every year.
- Kathmandu Valley (KV) comprises of three districts, Kathmandu, Lalitpur, and Bhaktapur. The seismic record suggests that major earthquakes like the Great Bihar-Nepal Earthquake in 1934 hit the KV approximately every 75 years, indicating another big earthquake is likely in near future.
- KV is now a densely populated home to almost 2.7 million people, many living and working in non-engineered buildings. Kathmandu was ranked the world's most earthquake-vulnerable city in a GeoHazards International's study. A school child in Kathmandu is 400 times more likely to die in an earthquake than a school child in Kobe, Japan, site of the 1995 Great Hanshin earthquake.
- According to the National Society for Earthquake Technology, an earthquake of magnitude 7.0 Mw or greater today would cause 85,000 deaths and damage 85% of the buildings.



## HH profile of the baseline year (NLSS 2010)

### Share of Household Income Sources and Expenditure on Food

- KV is the economic center of Nepal. Wage and enterprise are the biggest income sources of HH in KV (37% and 33% respectively). Only 2% of their income is from agriculture, which is so much less than the national average (18%).
- The share of food expenditure is significantly smaller in KV than the national average in Nepal (31% vs. 49%). Within KV, similar pattern is observed among HH groups with wage, enterprise income or remittance as their major income, ranged from 29% to 33%.

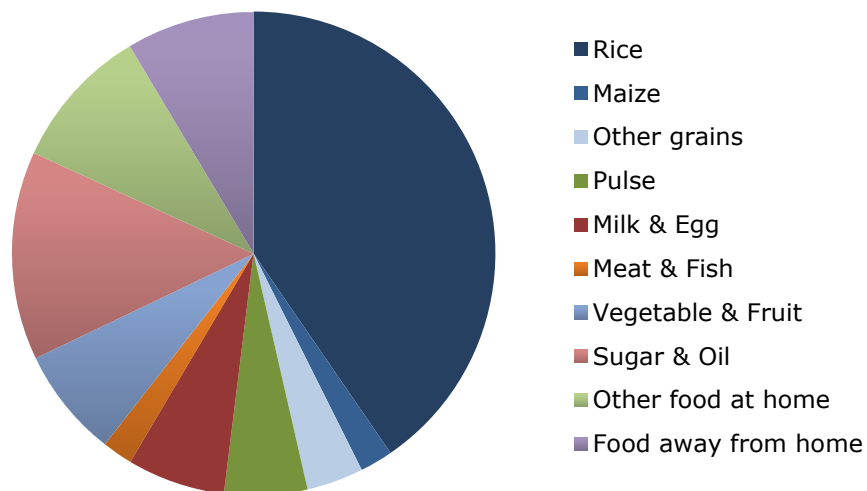




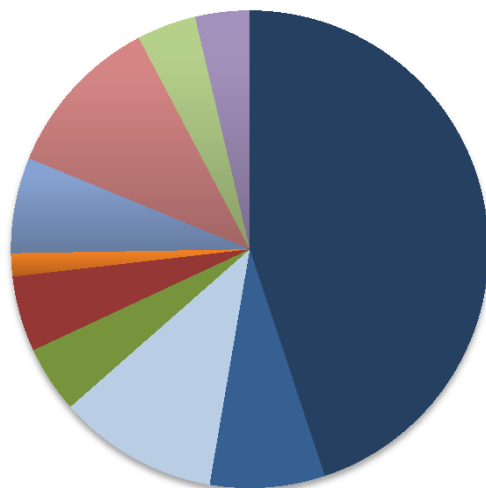
# HH profile of the baseline year (NLSS 2010)

## Per Capita Share of Calorie Consumption of Food Items

### Kathmandu Valley



### Nepal



- For households in KV, of the total calorie consumption, the proportion of rice(39%), maize(2%) and other grains(4%) brought the proportion of total grains to the highest share(45%).
- Comparing to the national average, household in KV had a more diverse diet, with 52% of caloric contribution from food other than grains (vs. 36% in Nepal overall).

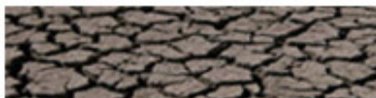
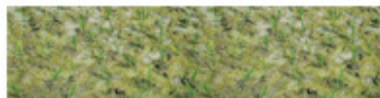


## Formulation of Scenario on Earthquake Impact in Kathmandu Valley in 2013

- Three loss scenarios were created by integrating the estimates from different studies on potential/ 1934 KV's quake, combining the population projection of 2013. The quake brings the lowest damage in the best case, and the highest damage in the worst case.
- 40% to 65% of people will lose their livelihoods due to injury or displacement and 2% to 5% of people will lose their lives.
- The 1934 earthquake led to 20% reductions in GDP, which seems reasonable for such a catastrophic event destroying one fifth of the total income.
- Referring to 2010 Haiti Earthquake, prices of food commodities produced locally are expected to increase by 35% and remittance to increase by 20% in KV.

**Table 1: Loss Estimation, Food Price and Remittance Change for Scenario Earthquake in Kathmandu Valley**

	Best Case		Average Case		Worst Case	
	Population	% of Total	Population	% of Total	Population	% of Total
<b>Death</b>	54,000	2	94,500	3.5	135,000	5
<b>Injured</b>	270,000	10	337,500	12.5	405,000	15
<b>Displaced</b>	810,000	30	1,080,000	40	1,350,000	50
<b>Livelihood lost (injured + displaced):</b>	<b>1,080,000</b>	<b>40</b>	<b>1,417,500</b>	<b>53</b>	<b>1,755,000</b>	<b>65</b>
<b>National GDP lost</b>	15%		20%		25%	
<b>Food price increase</b>	20%		35%		50%	
<b>Remittance increase</b>	10%		20%		30%	

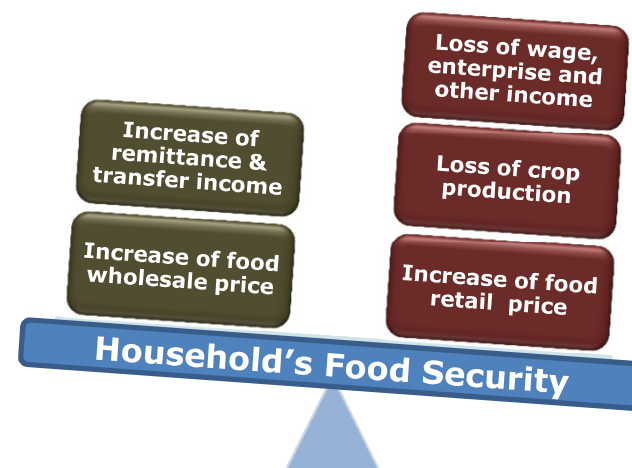


## Assumption of Scenario on Earthquake Impact in Kathmandu Valley in 2013 Q3

- Assumptions are made on top of the already known 2013 Q3 situation to create scenarios of the earthquake in KV.

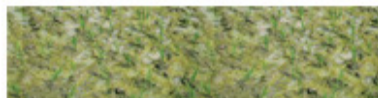
### Assumptions affecting HHs' income in the model:

- Expected proportion of **wage, enterprise and other income** -53% in the best case, -64% in the average case and -75% in the worst case. *(The expected value is calculated as the % of population who lost livelihoods multiplied by -100%, i.e. no income, added % of population maintaining their livelihoods multiplied by -20%, i.e. GDP % change.)*
- Remittance & transfer income** +10% in the best case, +20% in the average case and +30% in the worst case.
- Quantity of **crops production** -50% in the best case, -75% in the average case and -100% in the worst case. *(This will affect income from crop production. Own-consumption is income and expenditure in the model.)*



### Assumptions affecting HHs' income from crop production & expenditure in the model:

- Retail and wholesale **price of all food commodities** +20%, +35% and +50% for the best, average and worst case respectively in KV. For other districts, price % change is discounted according to the correlation and linear regression analysis of rice prices in KV and other local markets. In-depth market integration analysis will be needed for further refinement.



## Assumption on Price Shock Transmission due to the Earthquake in Kathmandu Valley in 2013 Q3

**Table 2. Correlation and Linear Regression Analysis of Rice Price in KV vs. Other Local Markets**

Region	Belt	Market	Correlation Coefficient	Regression Coefficient (log-transformed)
Eastern	Terai	Jhapa	0.76*	0.63*
Eastern	Terai	Morang	0.77*	0.76*
Eastern	Hill	Ilam	0.81*	0.65*
Eastern	Hill	Dhankuta	0.81*	0.79*
Eastern	Hill	Bhojpur	0.56*	0.51*
Central	Terai	Dhanusha	0.82*	0.71*
Central	Terai	Parsa	0.75*	0.93*
Central	Terai	Chitwan	0.48*	0.78*
Central	Hill	Ramechhap	0.53*	0.26*
Central	Hill	Nuwakot	0.78*	0.48*
Western	Terai	Rupandehi	0.78*	0.66*
Western	Hill	Kaski	0.82*	1.01*
Western	Hill	Palpa	0.75*	0.41*
Mid Western	Terai	Banke	0.77*	0.79*
Mid Western	Hill	Rolpa	0.68*	0.80*
Mid Western	Hill	Surkhet	0.70*	0.47*
Mid Western	Mountain	Jumla	-0.04	(No linear correlation)
Far Western	Terai	Kailali	0.68*	0.83*
Far Western	Hill	Achham	0.72*	0.62*
Far Western	Hill	Doti	0.56*	0.45*

*The asterisk \* indicates that the coefficient is statistically significant at 5%.*

- The correlation coefficients indicate most local markets have a moderate (>0.5) to strong (>0.7) positive relationship with KV market, except Jumla, which is located in the Mid-Western mountain area.
- The regression coefficients show % change of rice price in the local markets when rice price in KV increase by 1%.
- For other districts without price data, the price % change will be calculated as the average of the regression coefficients by region and belt multiplied by the price % change in KV. Price in the mountain areas will not be affected by the price change in KV.

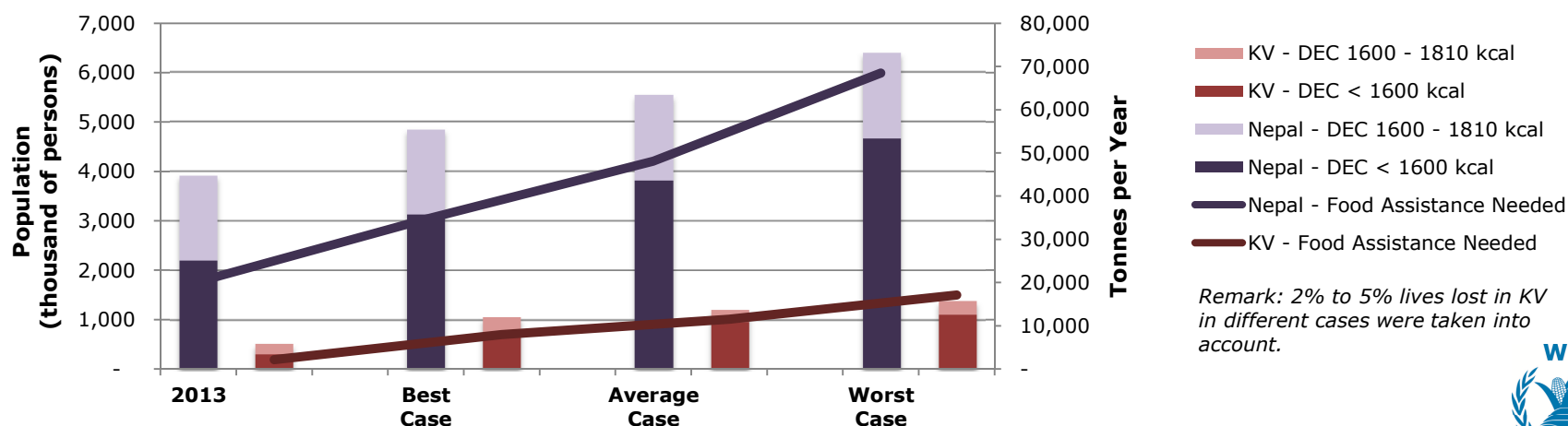


## Simulation Outputs of Scenario on Earthquake Impact in Kathmandu Valley in 2013

- Food security situation in KV will be significantly aggravated by the earthquake. Even in the best case scenario, food energy deficient population in KV would be double, compared to the 2013 annual average (37.6% vs. 14.3%).
- In the worst case, around half of the population in KV and one fourth in Nepal would become food deficient, i.e. below 1810 kcal.

Proportion of Food Energy Deficient Population	2013 (All shock factors)	Scenario Earthquake in Kathmandu Valley		
		Best Case	Average Case	Worst Case
Nepal	14.3%	18.8%	22.3%	26.9%
Kathmandu Valley	19.1%	37.6%	45.4%	53.0%

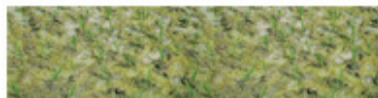
**Breakdown of Food Energy Deficient Population and  
Total Food Assistance Needed to Meet MDEC 1810 kcal**



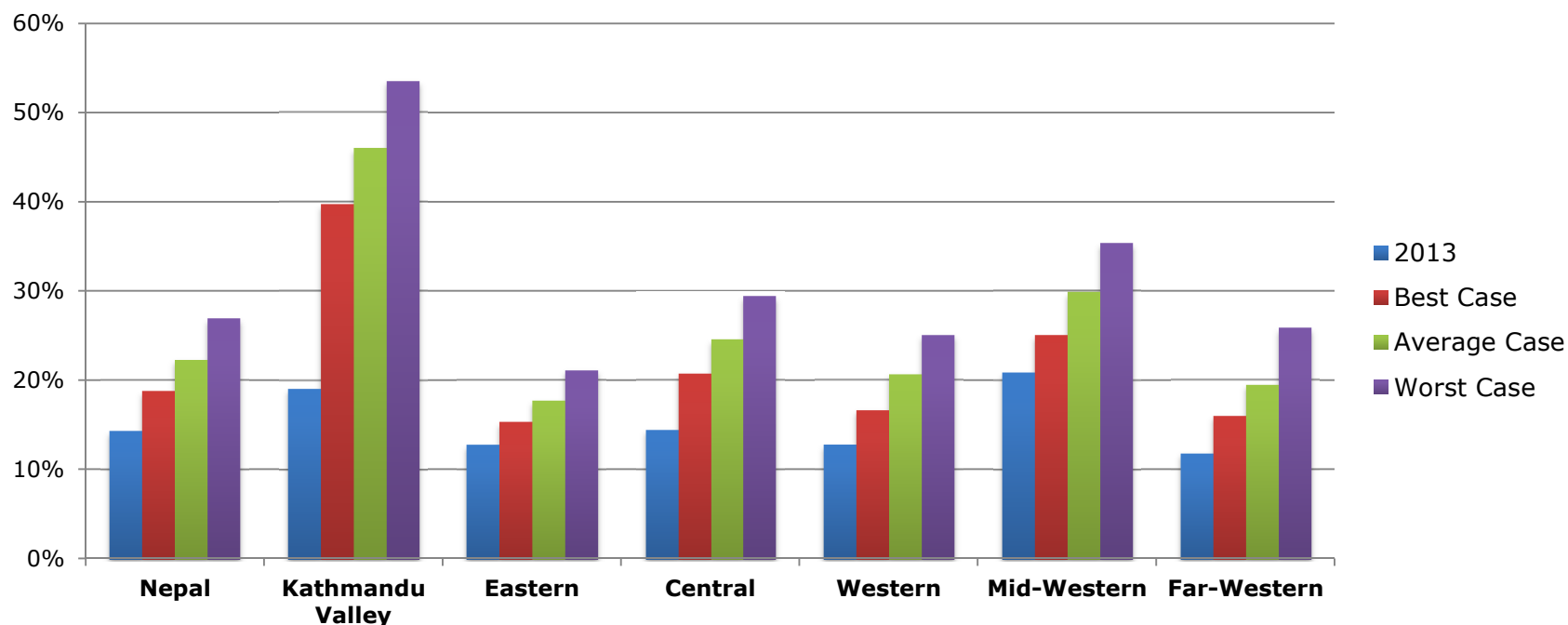
*Remark: 2% to 5% lives lost in KV in different cases were taken into account.*







## Simulation of the Proportion of Food Energy Deficient Population (<MEDC 1810 kcal)

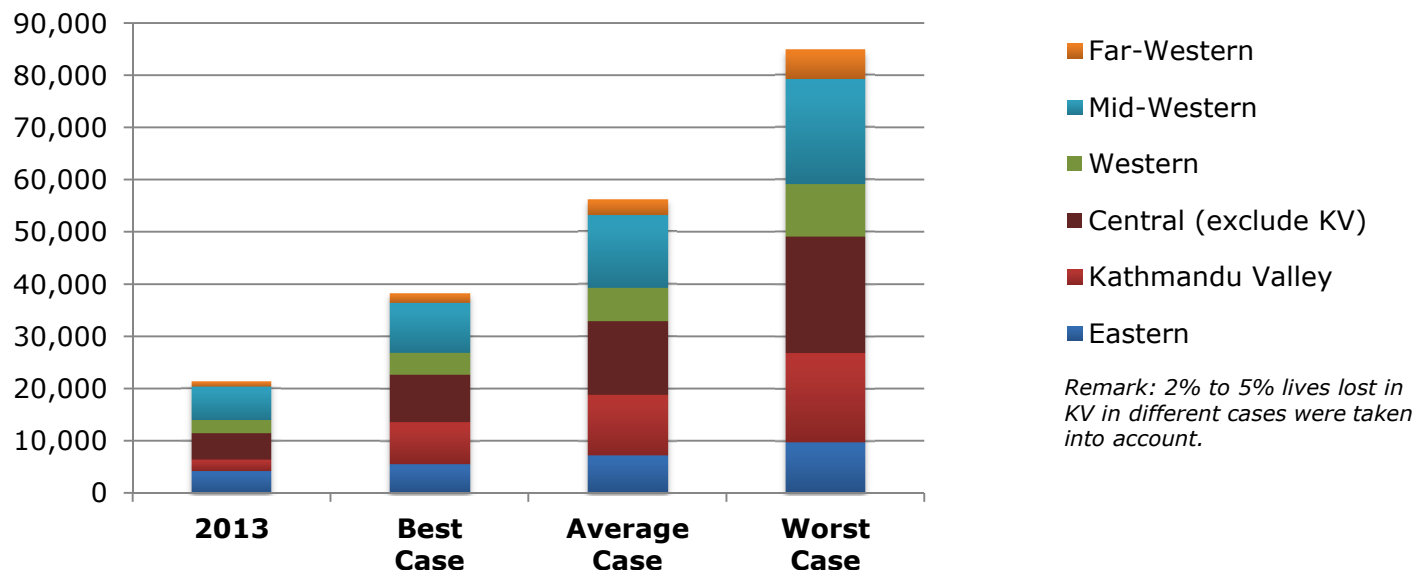


- To simulate the earthquake impact in other regions, it was assumed that food prices in all regions would follow the trend of KV.
- Among 5 regions, Mid-Western has the highest proportion of food energy deficient people in all scenarios.
- In the best and average case, impact of the earthquake is most visible in Central, proportion of food deficient population increased by 1.4 times and 1.7 times respectively. In the worst case, the most affected region is Far-Western the proportion increased by 2.2 times (vs. 2 times in Central).



## Simulation of Total Food Assistance Needed to Meet the Needs at MDEC 1810 kcal (in tonnes/year)

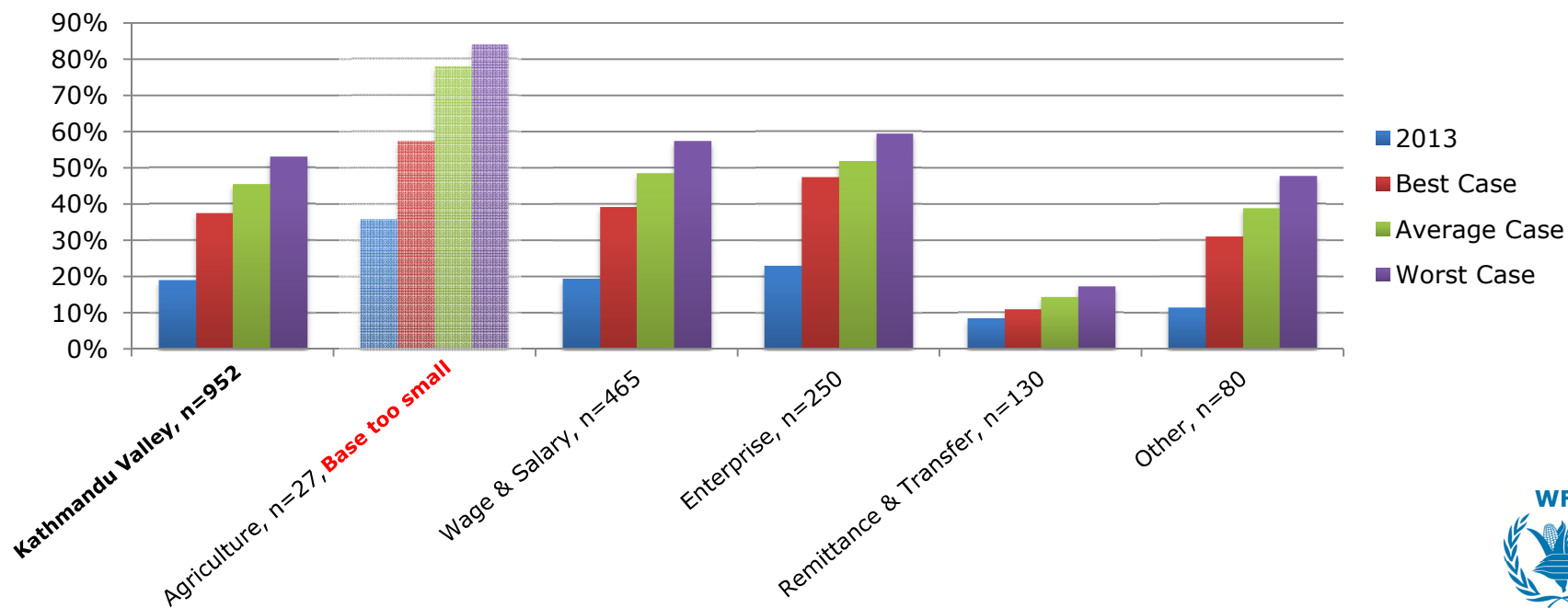
- Nationwide, the overall tonnage of food requirement to make up the food energy deficiency would increase by 85% after the quake even in the best case and would triple in the worst case.
- Food requirement of KV would increase from 2177MT to 7942MT the best case, 11542MT the average case and 17120MT the worst case. The increase in KV made the Central region become the region most in need, taking over the Mid-Western region.
- Although Far-Western accounted for little proportion of the total food requirement (roughly 5% of total), it has the second largest increase, from 1026MT to 1927MT the best case, 3080MT the average case and 5675MT the worst case.

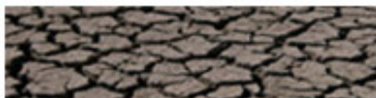




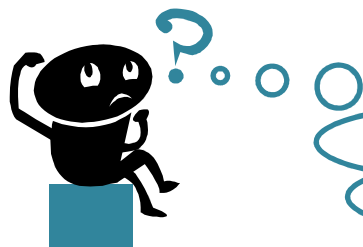
## Simulation of the Proportion of Food Energy Deficient Population (<MEDC 1810 kcal) by HH's main income source in KV

- HHs' with remittance & transfer as main income source are most resilient to the earthquake, proportion of food deficient population would increase from 8% to 12% in the best case and 21% in the worst case.
- Looking at the two biggest groups, wage and enterprise, the impact of the quake would be significantly high compared to 2013. HHs dependent on wage with food deficiency would increase by 20, 29 and 38 percentage points respectively in the best, average and worst case, while HHs dependent on enterprise with food deficiency would increase 24, 29 and 36 percentage points.
- HHs dependent on wage would be more affected compared to HHs dependent on enterprise, with the increase of 2.5 times (vs. 2.3 times of enterprise group) in the average case and increase of 2.9 times (vs. 2.6 times of enterprise group) in the worst case. In the best case, both groups would increase 2 times.





## Simulation Outputs of Scenario on Earthquake Impact in Kathmandu Valley in 2013



*It is often difficult to obtain accurate real-time population figures right after the earthquake. With limited information, can SISMod simulate the shock impact?*

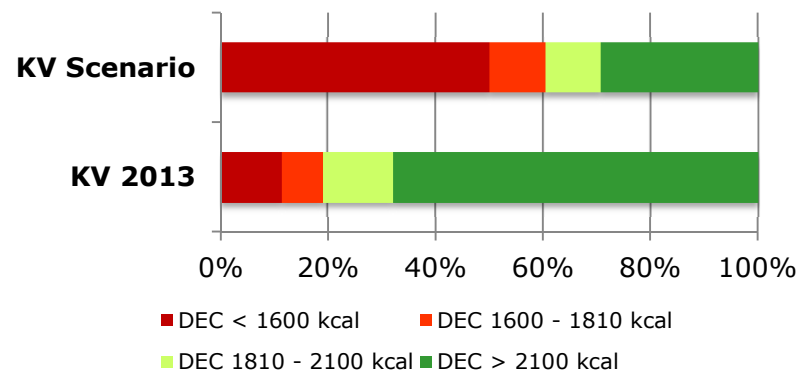
**Scenario:** Imagine the earthquake occurred, there are many uncertainties going-on and the only thing we observed is the food price has increased by 50%.

**Assumption:**

- (1) Both retail and wholesale food prices in KV +50%
- (2) HH's income -100% because the economic activities have grounded to a halt in KV.

**Result:**

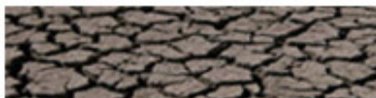
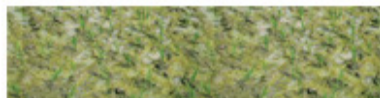
- In this scenario case, the food deficient population in KV would increase from 19% to 60%. The difference, i.e. 41% is representing 1.1 million of population.
- In other words, 1.1 million people would be affected by the earthquake (through income loss and food price increase) and would require food assistance.





## Lessons Learnt

- The simulation results provide estimates on the extend to which the population would be affected by the earthquake in terms of food assistance needs.
- Not only the direct impact in the quake regions but also the ripple effect across the nation can be simulated through local price shock.
- It is very important to validate the assumptions, shock factors and the results with local experts who have good understanding of the local changes.
- The more knowledge of changes in shock factors, the more shock scenarios refined to derive impacts (e.g. price change in other region).
- SISMod results should be interpreted with caution when considering different sub-groups: representativeness could be lost.



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*Thank You*