Multi-Regional Inoperability Input-Output Modelling using Disaster-REALM

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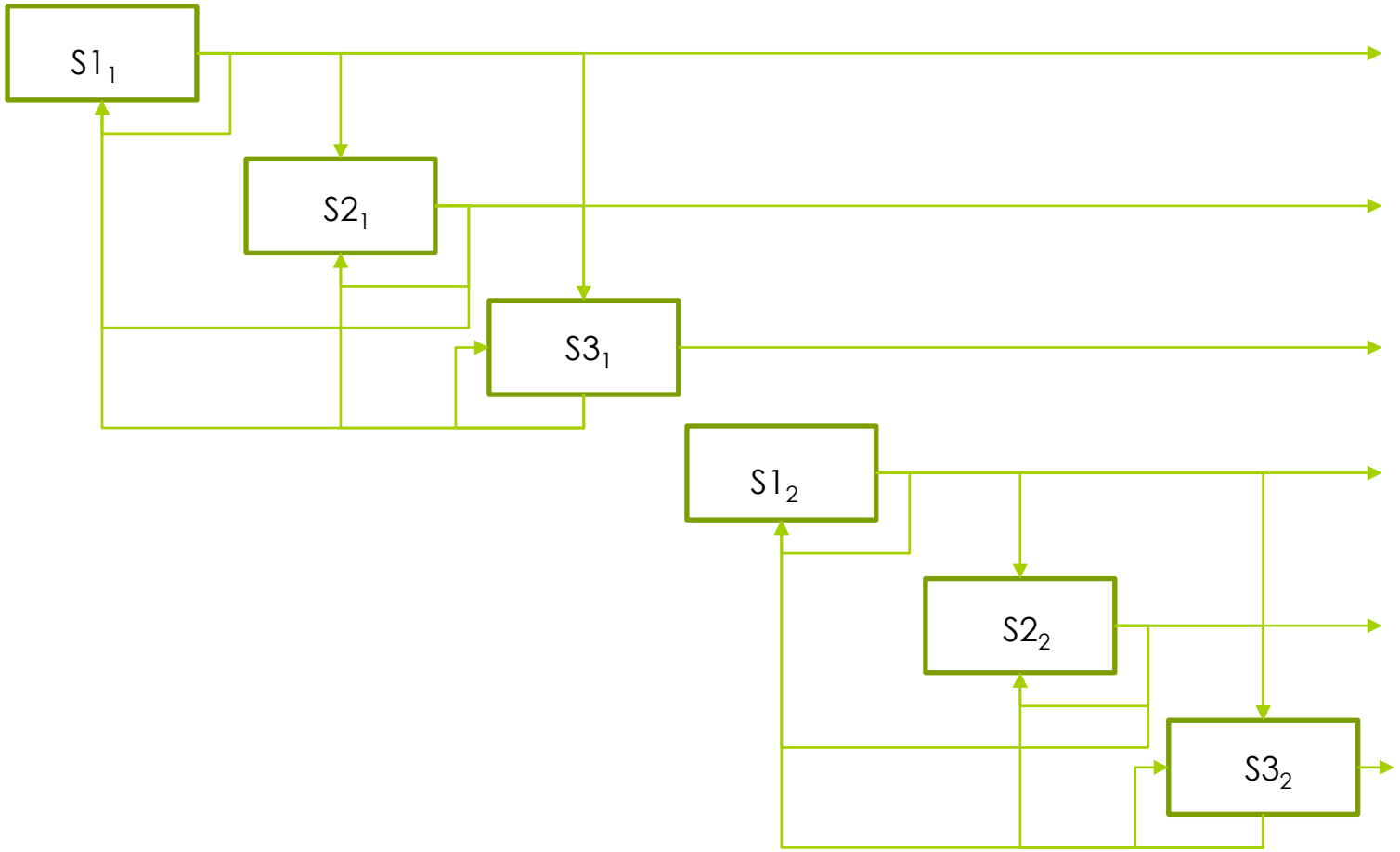
National IO Models vs. Regional IO Models

- National IO Model: Macro view of the entire economy, showing inter-industry transactions on a national scale
- Regional IO Model:
  - Single Region Model: shows the intra-regional flow of transactions, treats all other regions as part of the rest of the world.
  - Inter Regional Input-Output Model (IRIO): Single Region Model with intra-regional transaction flows; Data gathered through survey
  - Multi Regional Input-Output Model (MRIO): Single Region Model with intra-regional transaction flows; Data gathered through non-survey methods or hybrid methods; an estimation of IRIO.

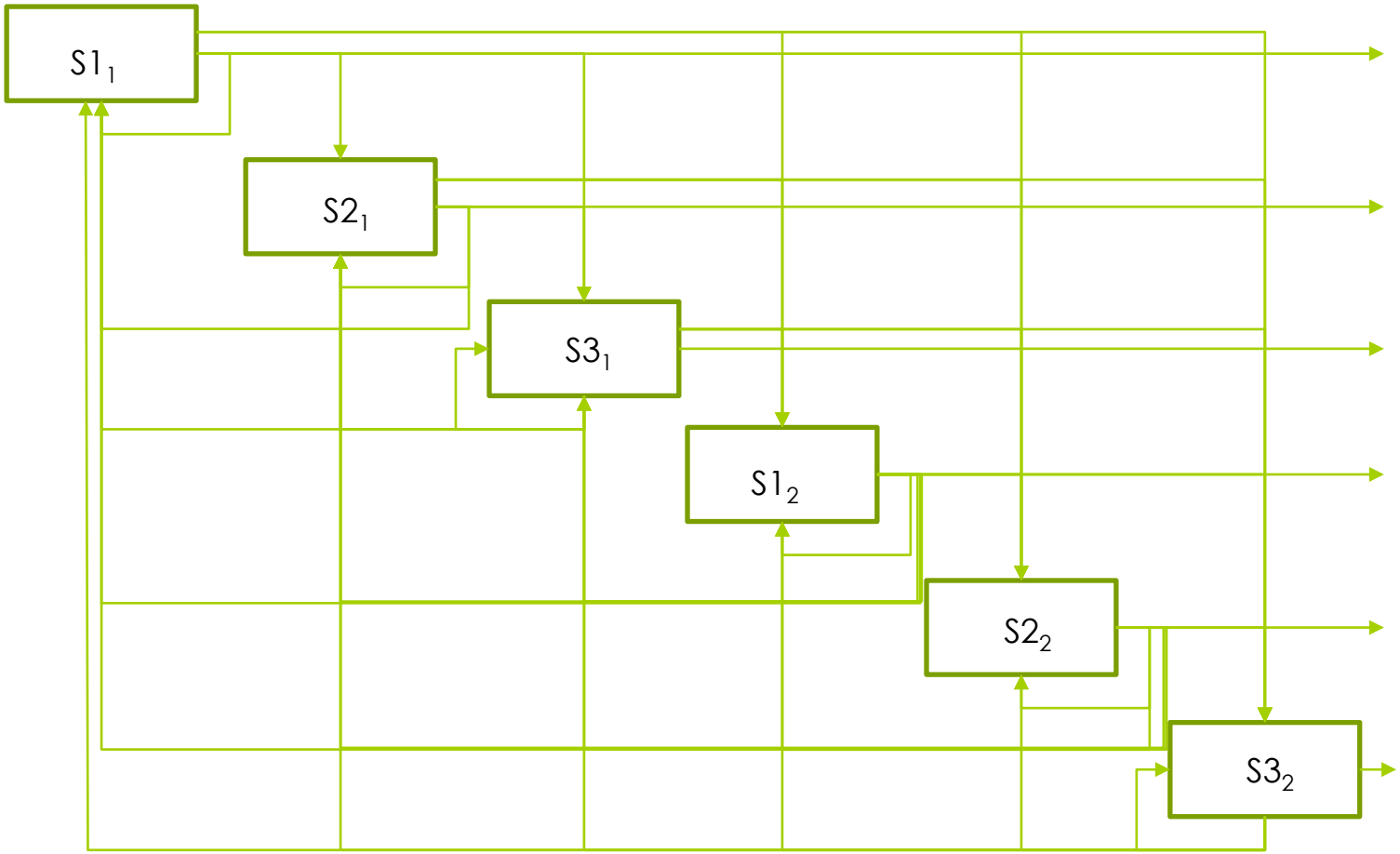
Why Regionalize?

- Technology of production of each region is specific
  - It may be very close or very different from the national table.
- To account for cross-regional interdependencies.
  - Demand footprint – purchasing goods and services from other regions
  - Supply footprint – supplier of goods and services for other regions
- Policymakers can mitigate risks against:
  - Disaster scenarios that produce supply perturbations in their demand footprint
  - Disaster scenarios that produce demand perturbations in their supply footprint

Single Regional IO Model Schematic



Multiregional IO Schematic



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Examples of MRIOs

- Global Models
  - World Input-Output Database (WIOD) –environment and socio-economic indicators
  - Global Trade Analysis Project (GTAP) – focuses on trade
  - OECD – focuses on TiVA more specifically on manufacturing sectors
  - Asian International IO Table (IDE-JETRO) – concentrates on Asian economies with 70 sectors
  - EORA – extensive environmental indicators including 187 countries
  - ADB MRIO- includes 45 economies and 35 sector breakdown
- Country Level
  - Japan
  - China
  - Australia
  - US

Constructing the MRIO

From \ To		Luzon			Visayas			Mindanao			Final Demand	Total Output
		AGR	IND	SRV	AGR	IND	SRV	AGR	IND	SRV		
Luzon	S1	Z_{11}			Z_{12}			Z_{13}			f_1	x_1
	S2											
	S3											
Visayas	S1	Z_{21}			Z_{22}			Z_{23}			f_2	x_2
	S2											
	S3											
Mindanao	S1	Z_{31}			Z_{32}			Z_{33}			f_3	x_3
	S2											
	S3											
Value Added		v_1			v_2			v_3				
Total Input		x_1^T			x_2^T			x_3^T				

Taal Eruption

- Started on January 12, 2020
- Several towns on lockdown
  - Households evacuated
  - Workforce inoperability
- Businesses – hotels, restaurants, farms etc.. shutdown due to ashfall and impending explosive eruption
- Schools converted to evacuation centers

Source: ABS-CBN News

Source: UNTV Web

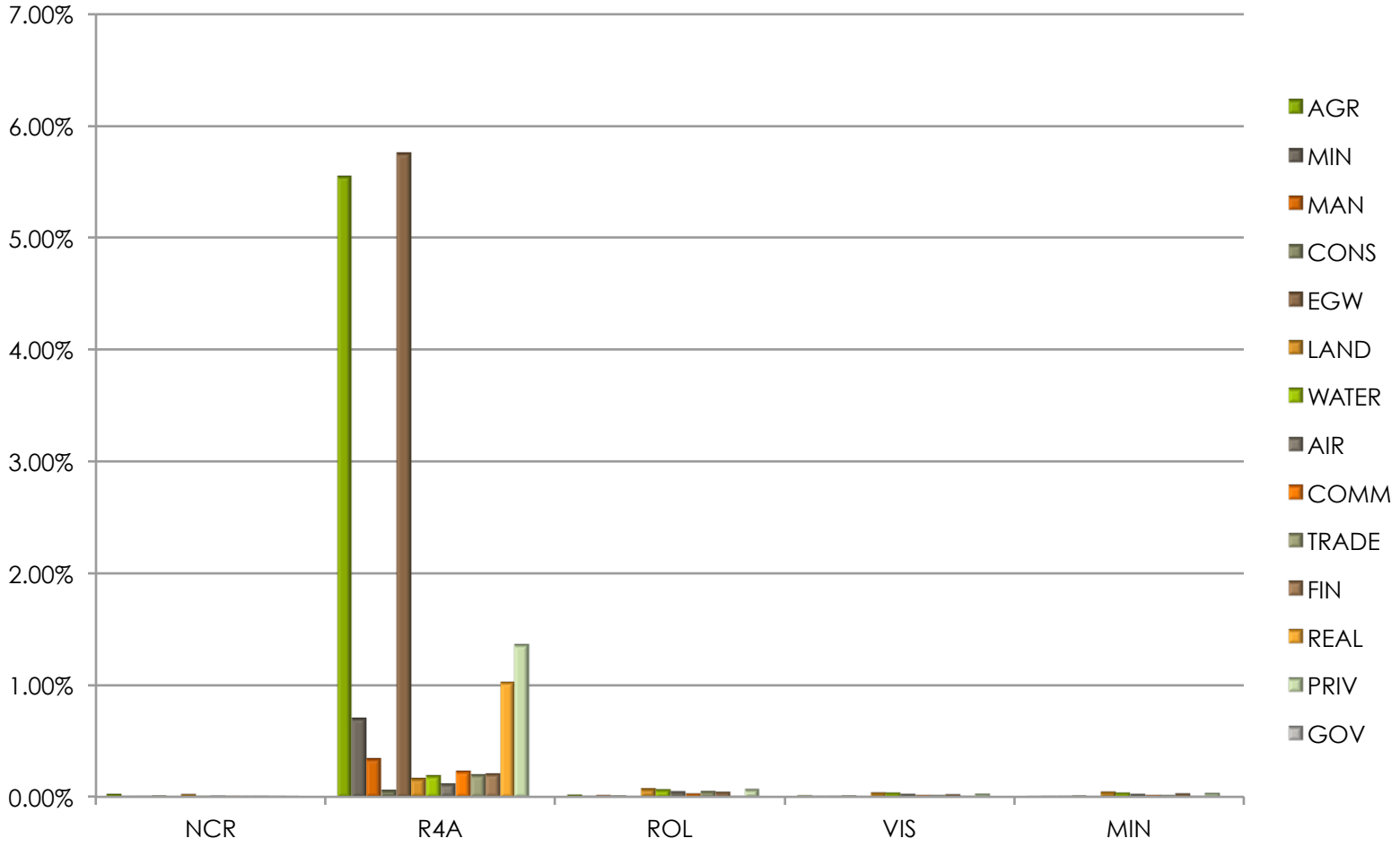
Simulation Considerations

- 5-Region MRIO Table
  - NCR
  - Region 4A
  - Rest of Luzon
  - Visayas
  - Mindanao
- 14 Sectors
  - Agriculture, Fishery and Forestry
  - Mining and Quarrying
  - Manufacturing
  - Construction
  - Electricity, Gas and Water
  - Land Transportation
  - Water Transportation
  - Air Transportation
  - Communication
  - Trade
  - Finance
  - Real Estate and Ownership of Dwelling Places
  - Private Services
  - Government Services

Perturbation Estimates

- Based on NDRRMC's situation reports:
  - Damages to Agriculture and Livestock
  - Power Outages
  - Towns affected
- System perturbations introduced
  - Agriculture, Fishery and Forestry – 5%
  - Electricity, Gas and Water – 5%
  - Real Estate and Ownership of Dwelling Places – 1%
  - Private Services – 1%

Inoperability levels



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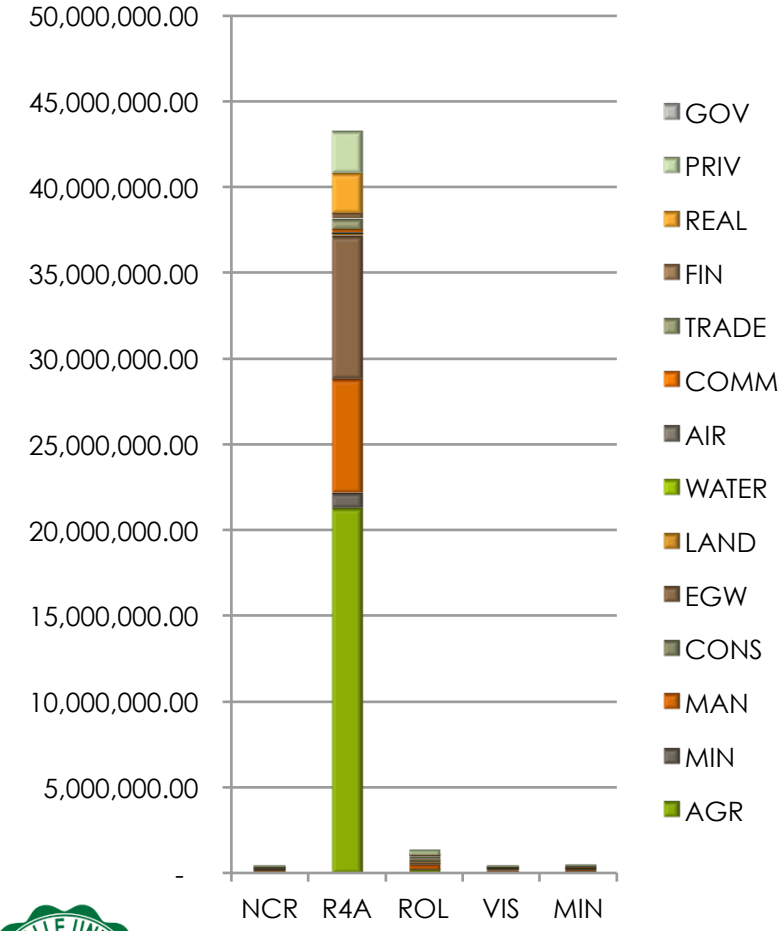
Economic Losses



	NCR	R4A	ROL	VIS	MIN
AGR	56,259.57	21,217,561.90	204,072.80	63,956.00	81,533.57
MIN	5,496.91	864,342.17	18,282.79	6,982.92	7,627.91
MAN	101,968.43	6,628,098.48	284,282.47	108,729.71	119,074.20
CONS	7,184.37	67,382.26	22,477.33	7,201.73	7,606.20
EGW	8,023.30	8,303,496.19	23,587.07	8,793.49	8,954.54
LAND	39,016.40	114,307.80	101,494.40	33,795.32	37,036.60
WATER	8,944.66	36,311.38	22,508.43	8,188.74	8,846.07
AIR	9,452.72	30,842.76	24,508.74	8,649.21	8,924.96
COMM	16,440.26	191,492.02	50,407.03	16,924.77	17,776.16
TRADE	58,876.81	638,110.57	189,859.64	66,461.33	71,866.13
FIN	39,477.25	273,235.39	119,868.51	40,106.65	43,767.20
REAL	12,590.08	2,373,248.27	31,855.33	11,399.59	10,683.67
PRIV	95,696.28	2,421,086.58	297,978.30	99,002.68	104,875.81
GOV	-	-	-	-	-
Total	459,427.03	43,159,515.77	1,391,182.84	480,192.13	528,573.01

In thousand PhP

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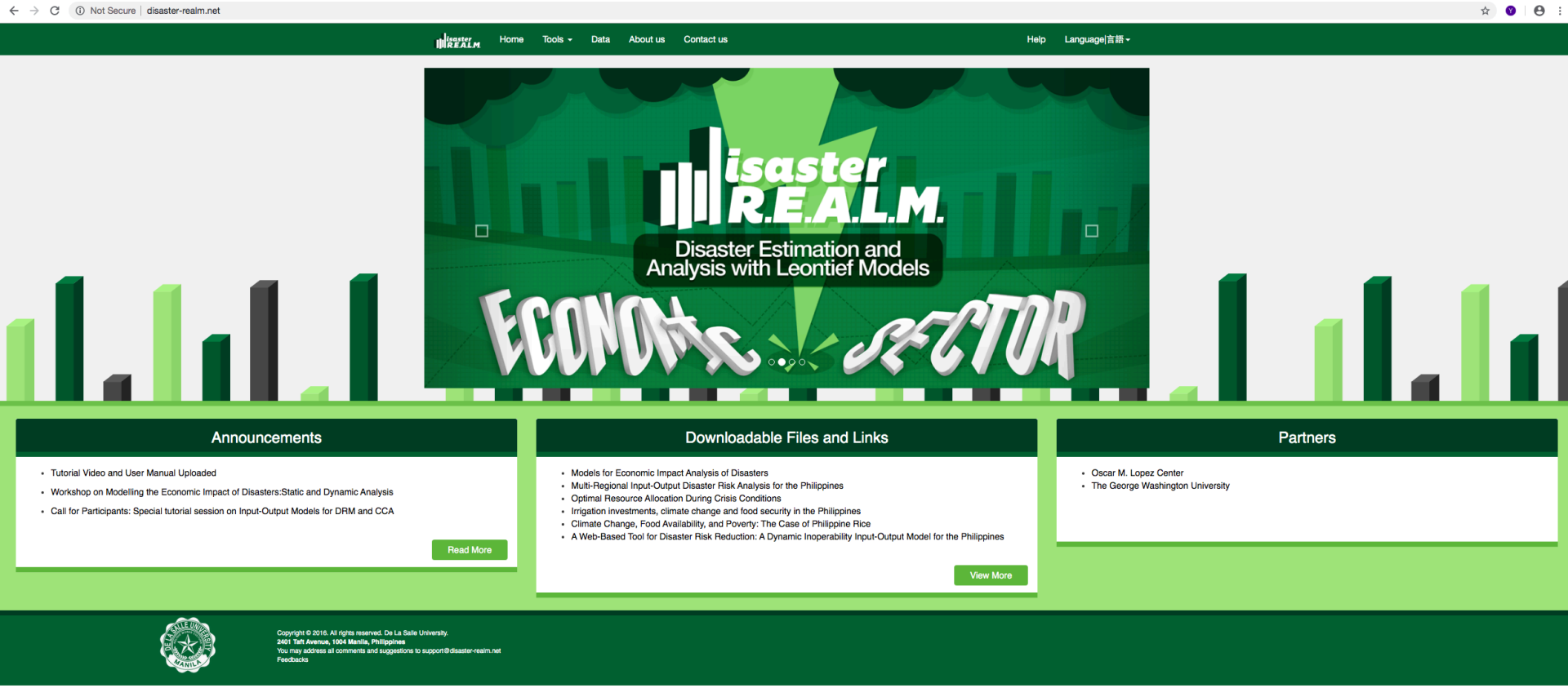
Disaster-REALM Freeware



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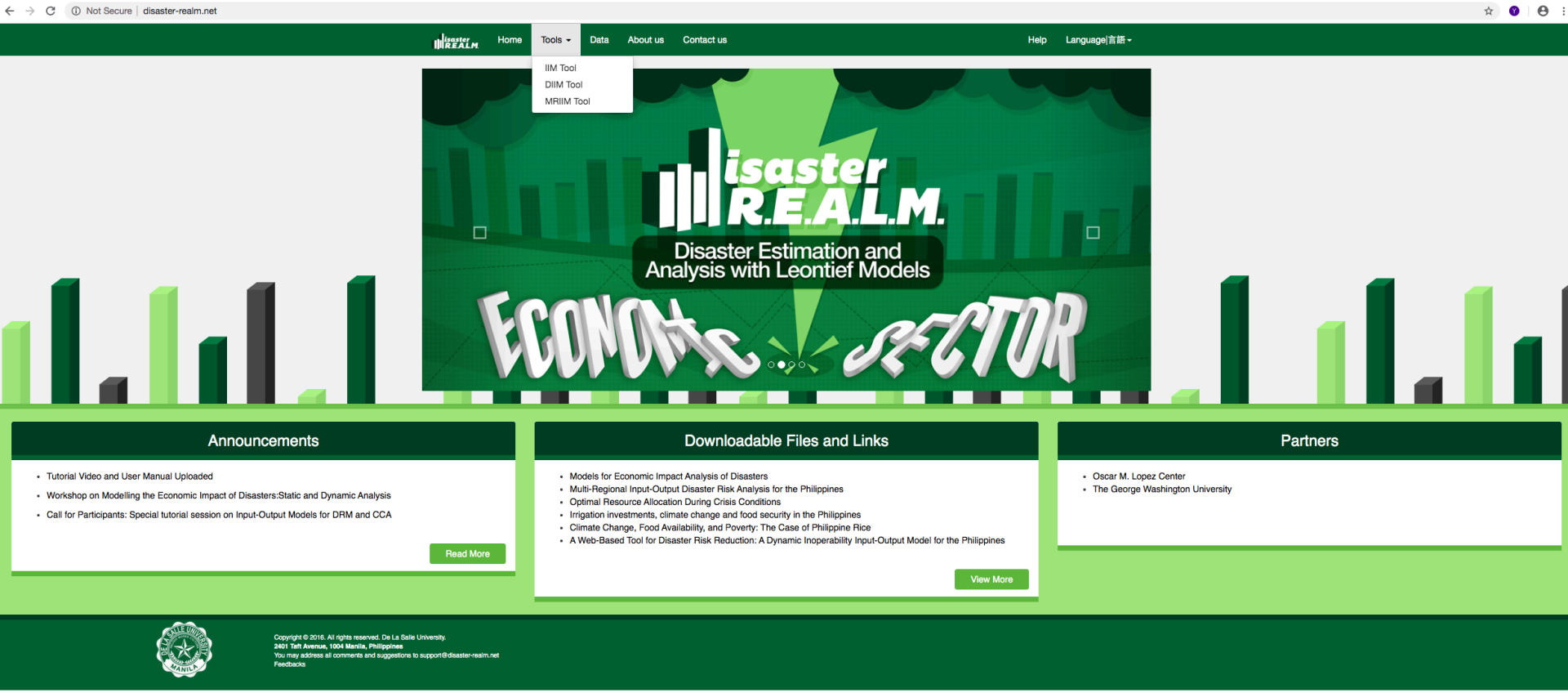

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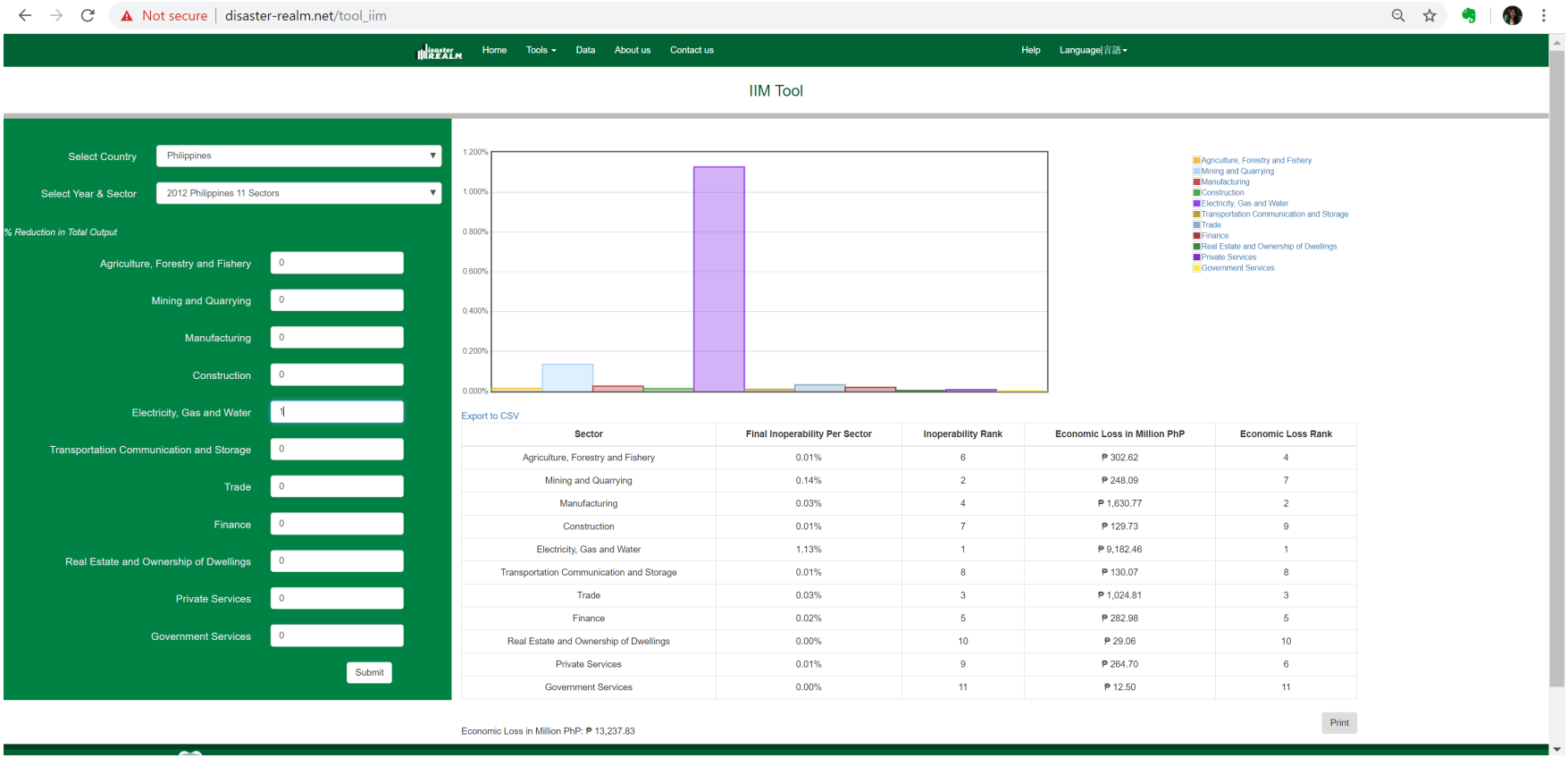
IIM Tool



Sector	Final Inoperability Per Sector	Inoperability Rank	Economic Loss in Million PhP	Economic Loss Rank
Agriculture, Forestry and Fishery	0.01%	6	₱ 302.62	4
Mining and Quarrying	0.14%	2	₱ 248.09	7
Manufacturing	0.03%	4	₱ 1,630.77	2
Construction	0.01%	7	₱ 129.73	9
Electricity, Gas and Water	1.13%	1	₱ 9,182.46	1
Transportation Communication and Storage	0.01%	8	₱ 130.07	8
Trade	0.03%	3	₱ 1,024.81	3
Finance	0.02%	5	₱ 282.98	5
Real Estate and Ownership of Dwellings	0.00%	10	₱ 29.06	10
Private Services	0.01%	9	₱ 264.70	6
Government Services	0.00%	11	₱ 12.50	11

Multi-Regional Inoperability Input-Output Modelling using Disaster-Realm

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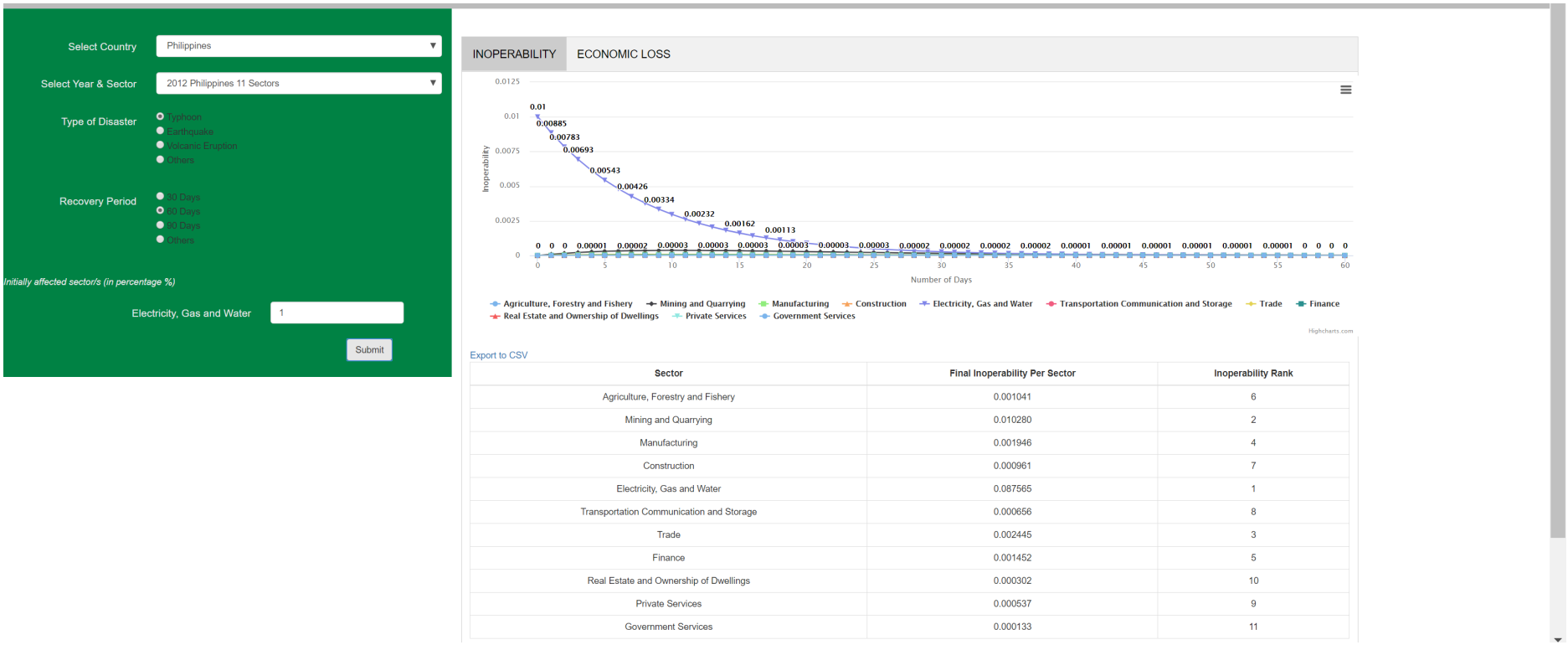

Sector	Final Inoperability Per Sector	Inoperability Rank
Agriculture, Forestry and Fishery	0.001041	6
Mining and Quarrying	0.010280	2
Manufacturing	0.001946	4
Construction	0.000961	7
Electricity, Gas and Water	0.087565	1
Transportation Communication and Storage	0.000656	8
Trade	0.002445	3
Finance	0.001452	5
Real Estate and Ownership of Dwellings	0.000302	10
Private Services	0.000537	9
Government Services	0.000133	11

DIIM Tool

Select Country: Philippines

Select Year & Sector: 2012 Philippines 11 Sectors

Type of Disaster
- Typhoon
- Earthquake
- Volcanic Eruption
- Others

Recovery Period
- 30 Days
- 60 Days
- 90 Days
- Others

Initially affected sector/s (in percentage %)

Electricity, Gas and Water: 1

Submit

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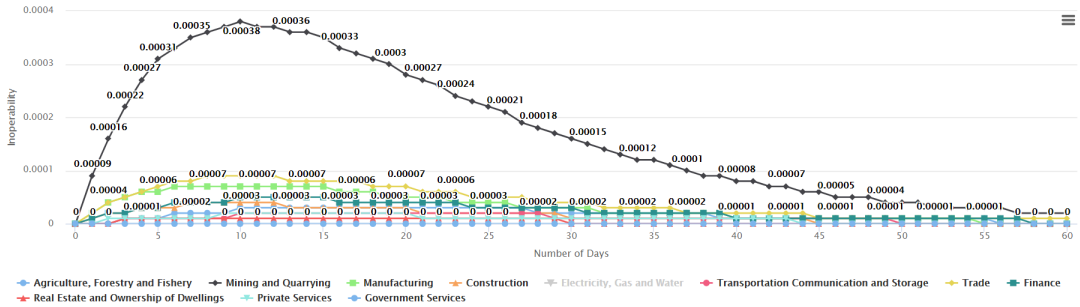

Export to CSV

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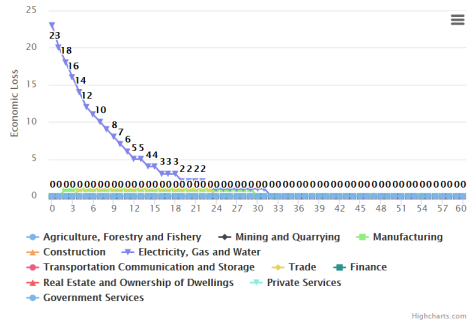

Export to CSV

Sector	Economic Loss in Million PhP	Economic Loss Rank
Agriculture, Forestry and Fishery	₱ 6.22	4
Mining and Quarrying	₱ 5.24	7
Manufacturing	₱ 34.48	2
Construction	₱ 2.74	8
Electricity, Gas and Water	₱ 198.27	1
Transportation Communication and Storage	₱ 2.66	9
Trade	₱ 21.54	3
Finance	₱ 5.88	5
Real Estate and Ownership of Dwellings	₱ 0.61	10
Private Services	₱ 5.47	6
Government Services	₱ 0.25	11

Total Economic Loss in Million PhP: ₱ 283.39

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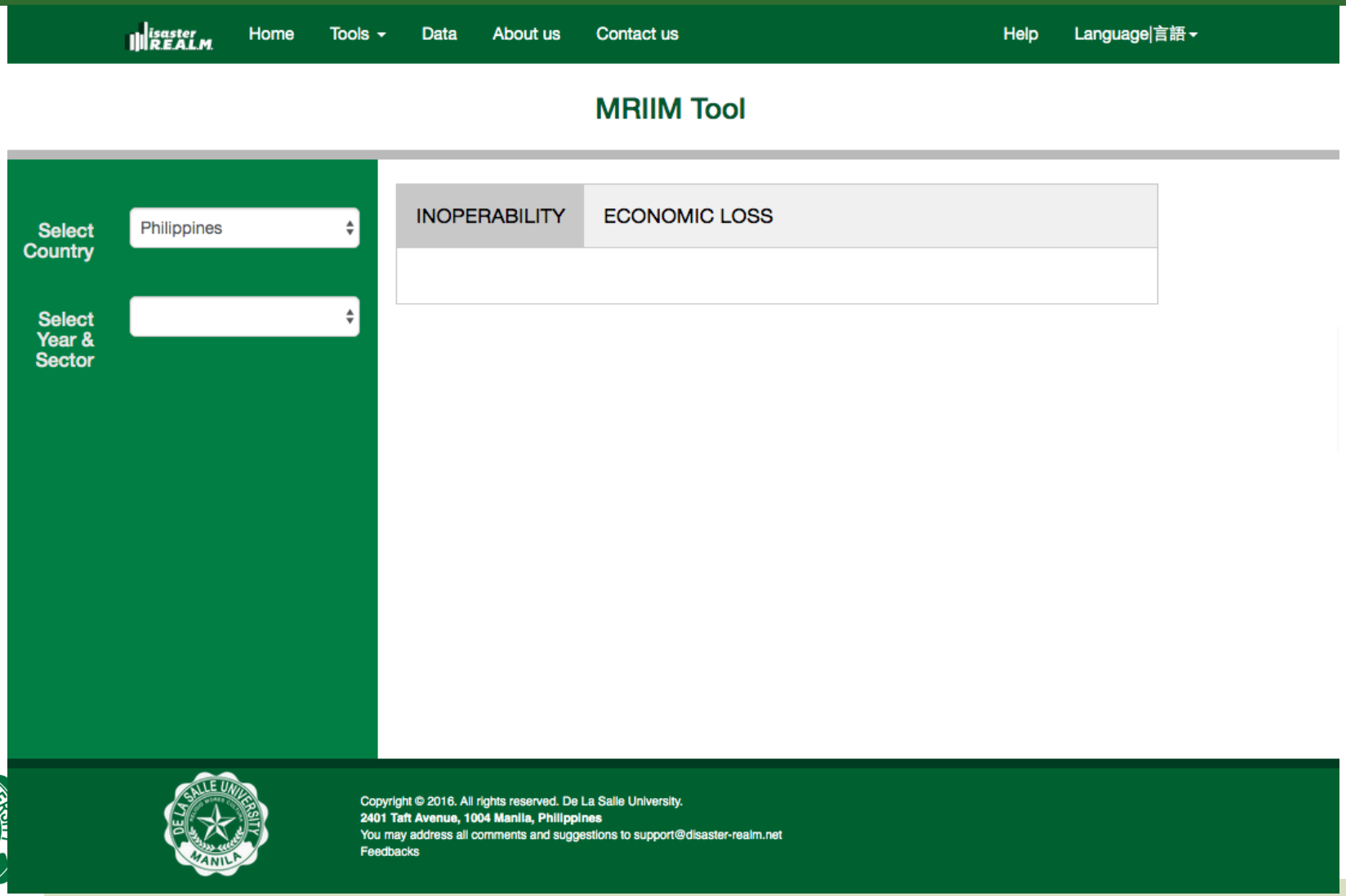
MRIIM Tool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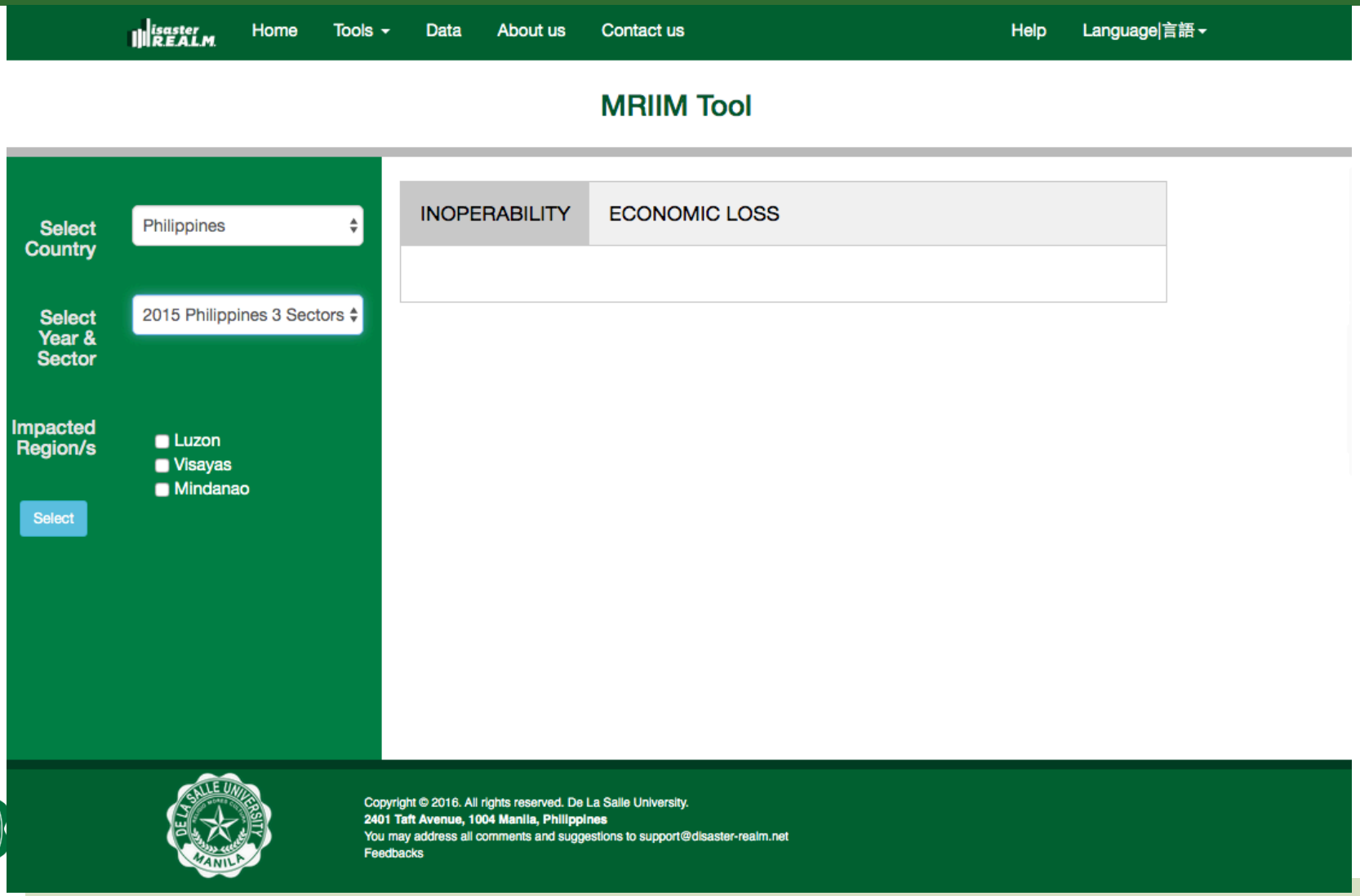
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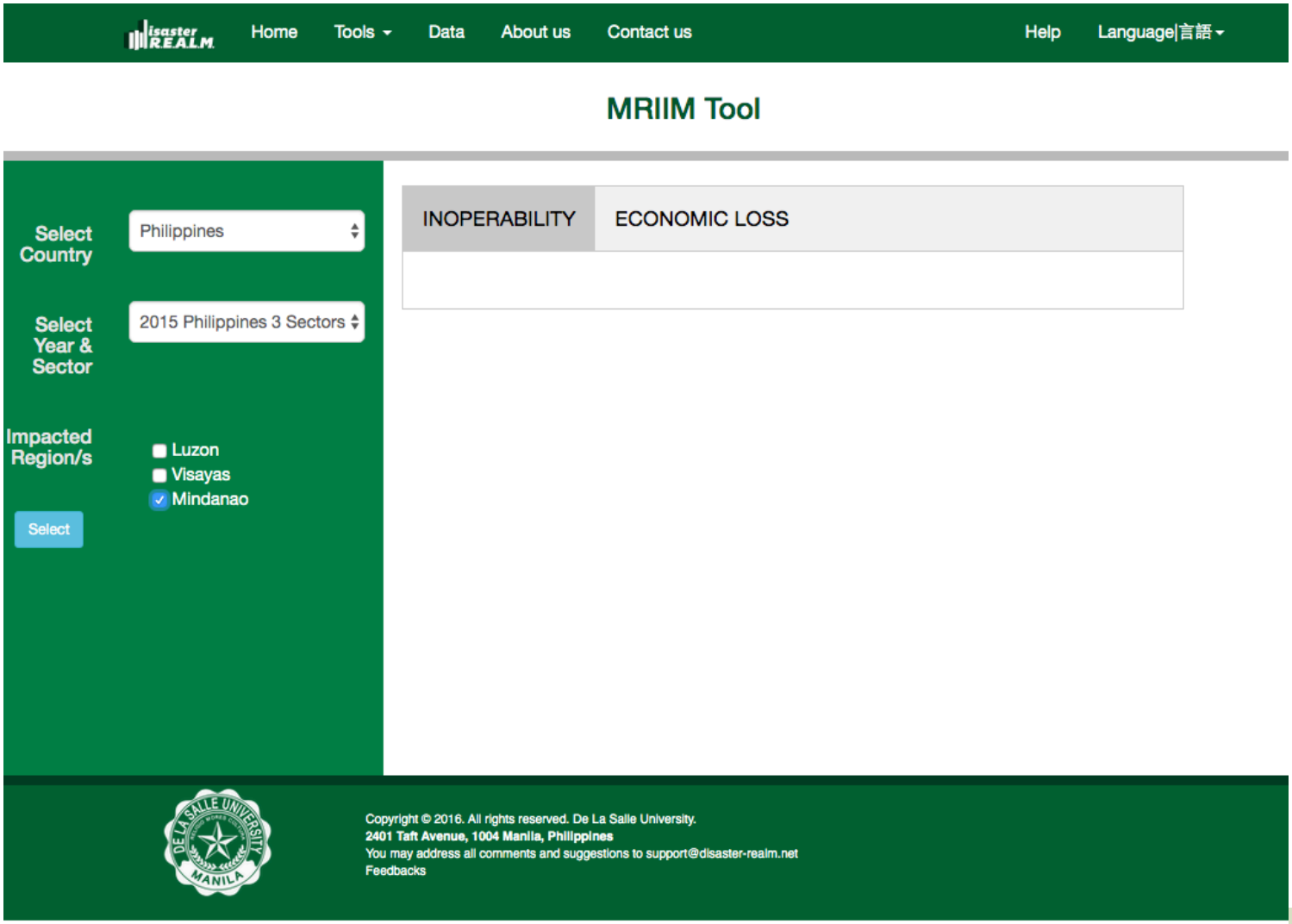
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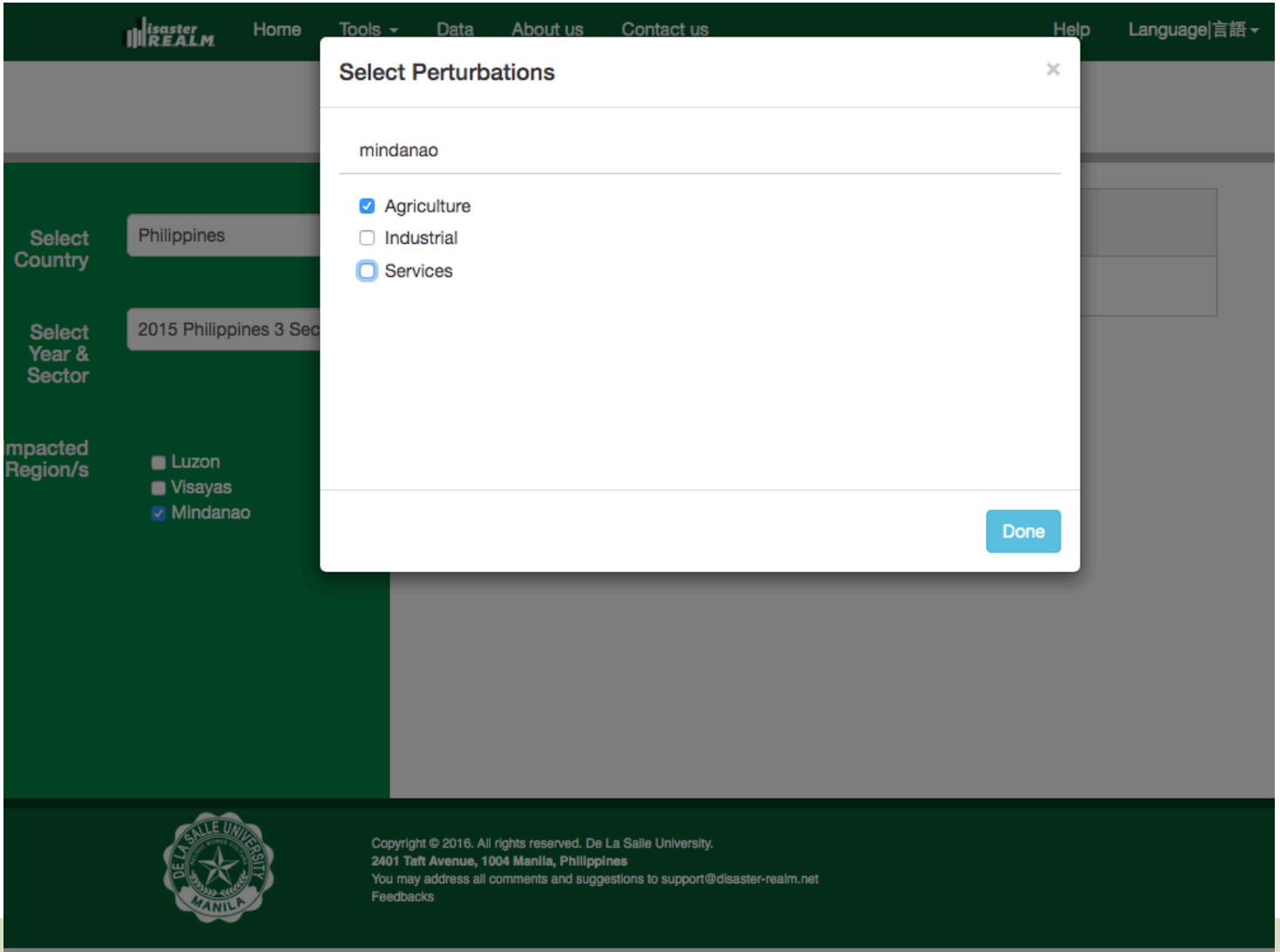
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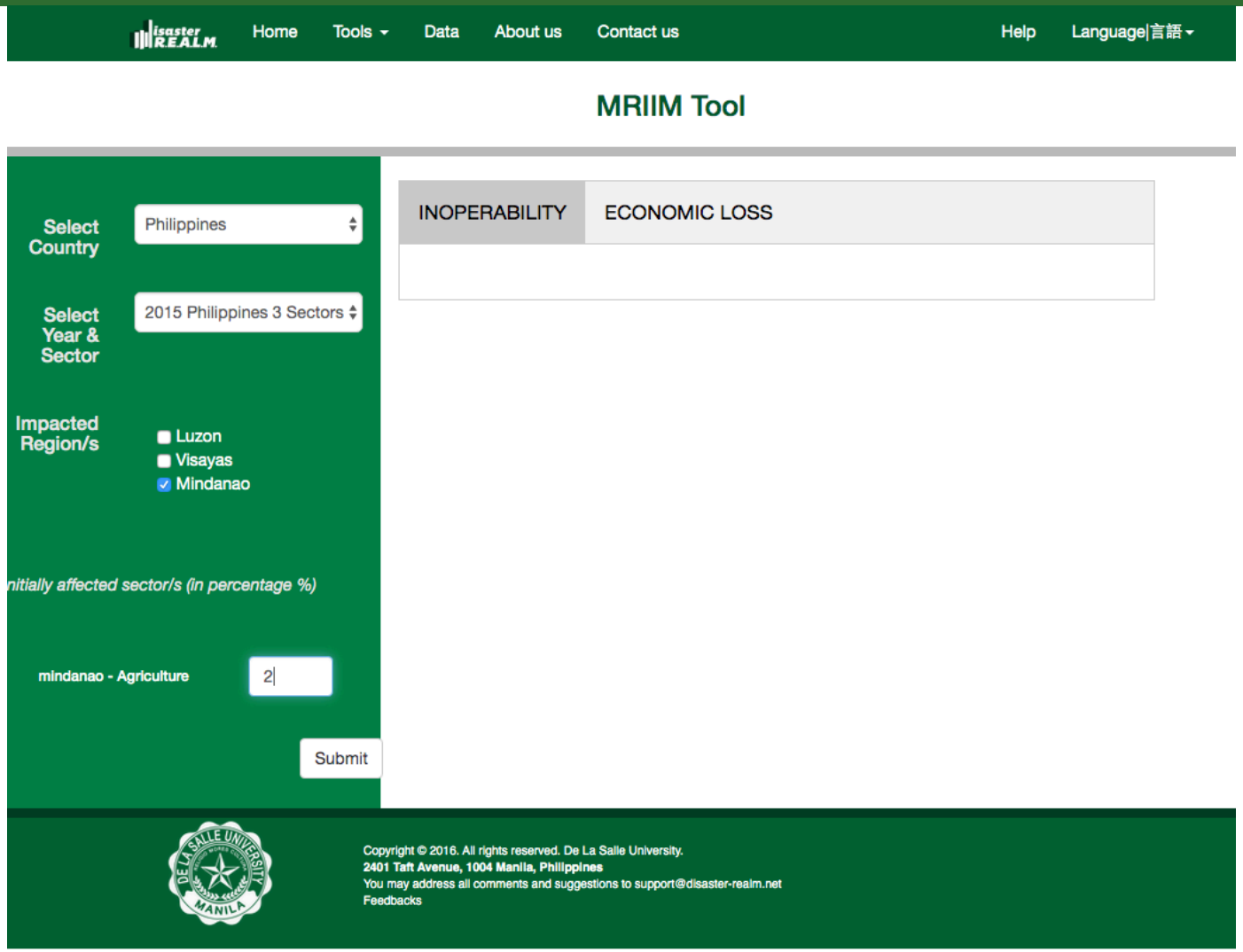
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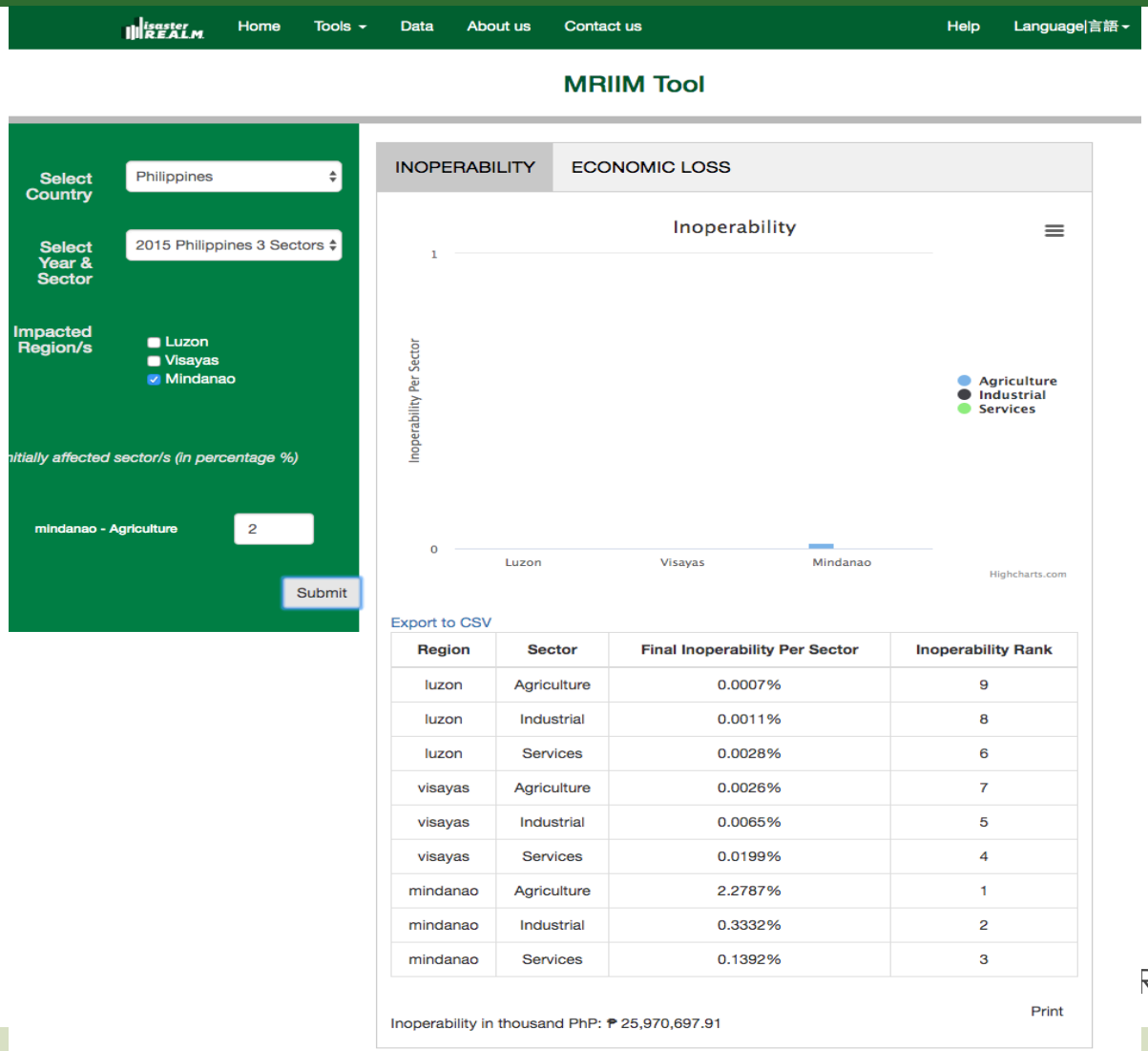

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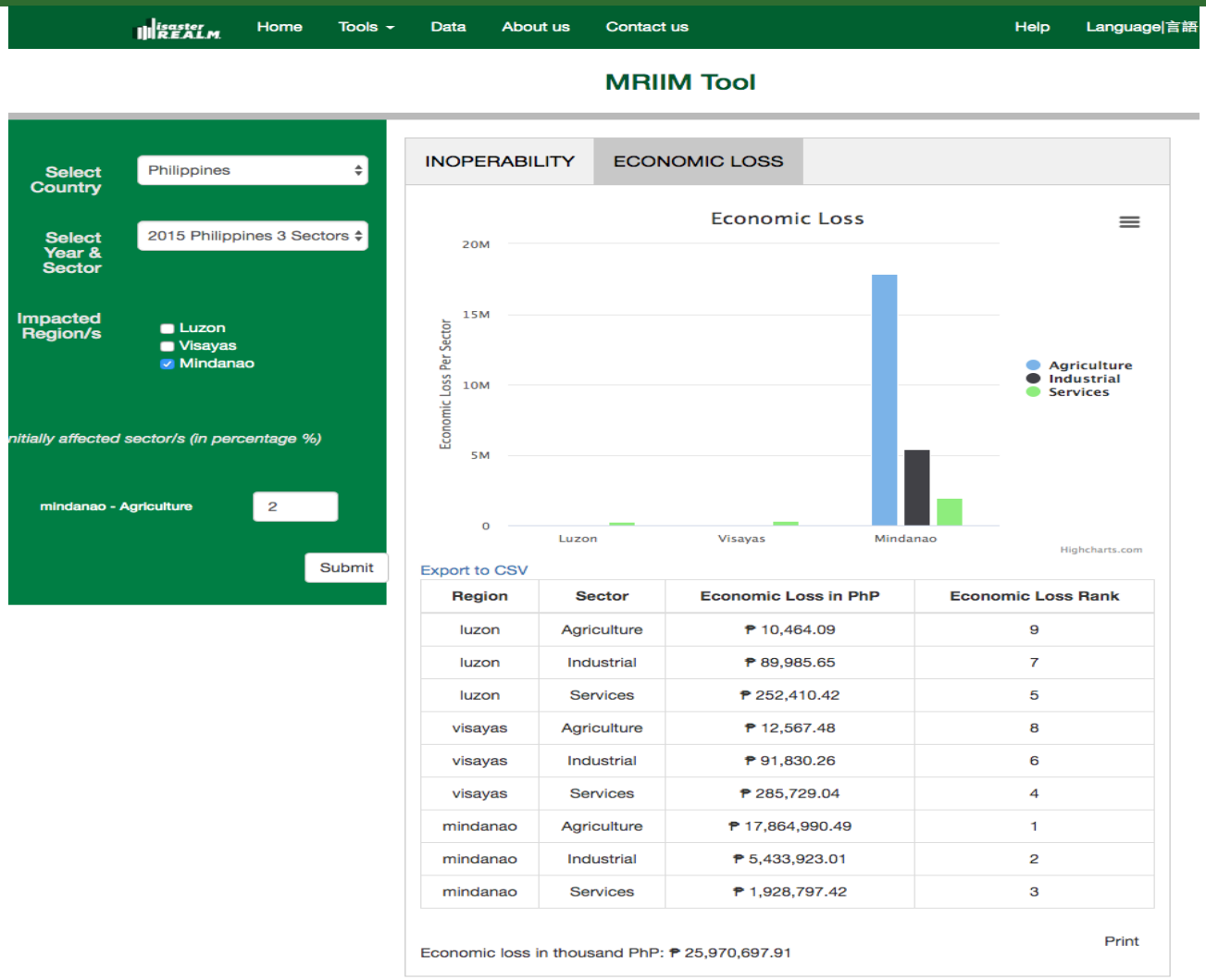
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15M
10M
5M
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Industrial
Services
Highcharts.com
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luzon | Agriculture | ₱ 10,464.09 | 9
luzon | Industrial | ₱ 89,985.65 | 7
luzon | Services | ₱ 252,410.42 | 5
visayas | Agriculture | ₱ 12,567.48 | 8
visayas | Industrial | ₱ 91,830.26 | 6
visayas | Services | ₱ 285,729.04 | 4
mindanao | Agriculture | ₱ 17,864,990.49 | 1
mindanao | Industrial | ₱ 5,433,923.01 | 2
mindanao | Services | ₱ 1,928,797.42 | 3
Print
Economic loss in thousand PhP: ₱ 25,970,697.91

Conclusion and Future Recommendations

- This study has developed 3 tools available through a web-based freeware founded on sound economic models
  - IIM Tool for static analysis
  - DIIM Tool for dynamic analysis
  - MRIIM Tool for multiregional analysis
- This platform uses technology to give information to policy makers backed with science-based estimates.
- This study is able to show that while national level input-output analysis can provide good estimates, it is better to have regional level tables in order to see the interactions between sectors within regions and across regions.
- The Taal Volcano Eruption's economic impact is not limited to its nearby regions, but extends to the rest of the country.
- There is a need to develop MRIIM models with higher resolution in order to derive more region-specific results.

Acknowledgements

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  - National Academy of Science and Technology
  - The OML Center

Thank you for your attention.

Questions?

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For more information on IIM in the Philippines

www.disaster-realm.net