Warehouse - Nepal

İdil Yaşar

Azra Çağlasu Gürkan

Büşra Bayrak

Current Situation

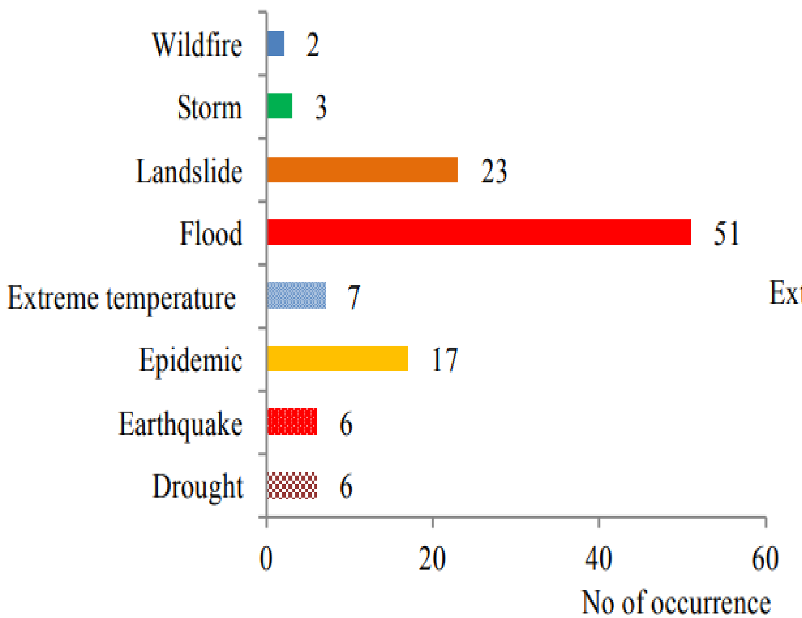


Fig 1: List of disasters with number of occurrence (1900-2014)
Source: Authors made from EM-DAT, 2014

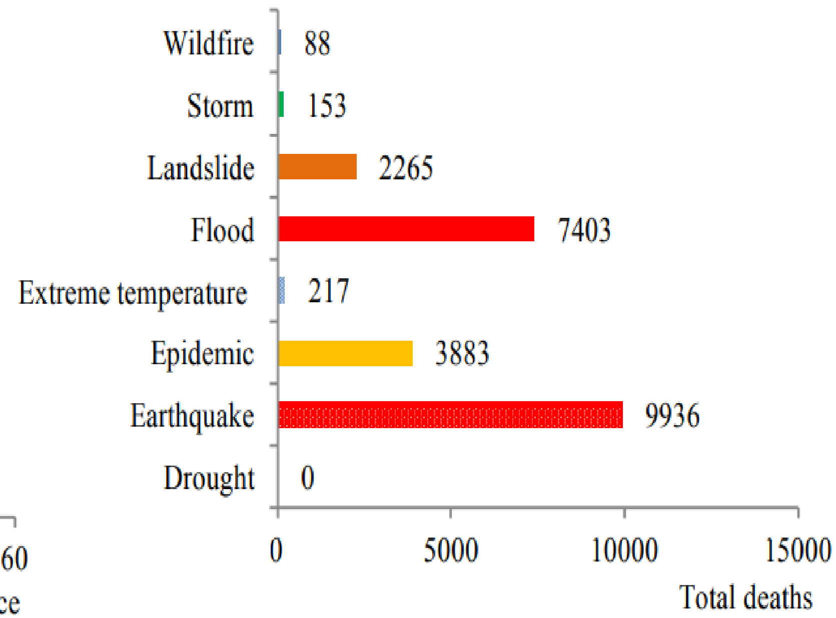
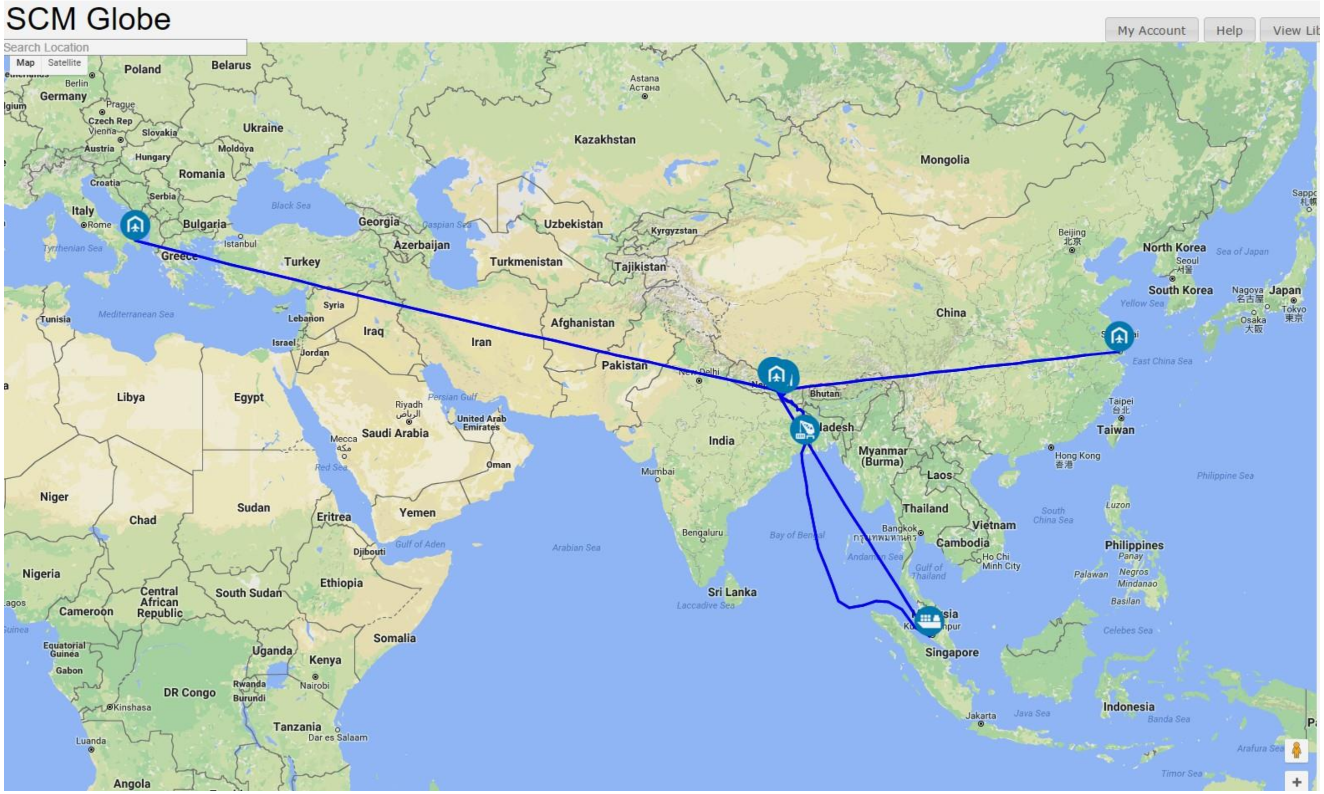


Fig 2: Total deaths claimed by different disasters (1900-2014)
Source: Authors made from EM-DAT, 2014

Current Situation

- **lack of preparedness activities,**
- **difficult and undeveloped physical infrastructure,**
- **low literacy rate,**
- poor public awareness,
- mass poverty,
- unplanned settlement,
- slow decision making process and so on.

Improvement



- 25 April,2015
- 12 May, 2015
- 8000 dead, 18000 affected people, 2.8 million need humenitarian resources
- Malaysia, China, Italy

Exact Method

75 districts
55 of them vulnerable
20 of them safe

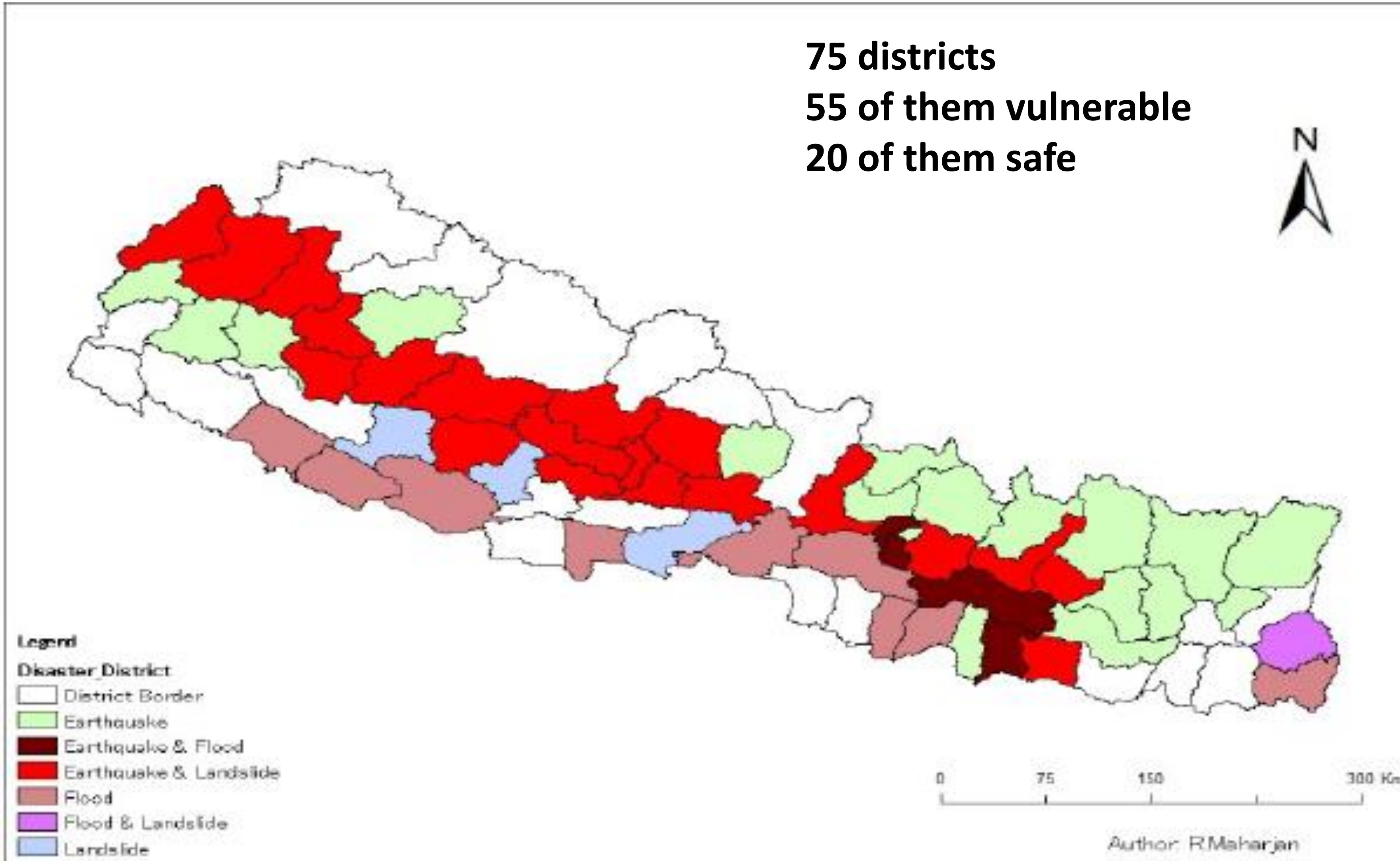


Fig 3: District disaster mapping for Nepal

Exact Method

<u>Assumptions:</u>

- No limited capacity for wh
- Proper road access between wh and deman points
- No existing wh
- No provision of partial coverage

Exact Method

Parameters & Decision Variables:

I= the set of demand nodes (vulnurable to earthquake, landslide and flood)

J=the set of wh locations (all 75 districts)

a_i= demand at node i ϵ I

p= number of wh to locate

$$x_j = \begin{cases} 1 \text{ if a warehouse is located at candidate site } j \in J \\ 0 \text{ otherwise} \end{cases}$$

$$y_i = \begin{cases} 1 \text{ if a demand node } i \in I \text{ is covered} \\ 0 \text{ otherwise} \end{cases}$$

Exact Method

Parameters & Decision Variables:

T_J = transportation accesibility index value for site j, j ϵ J

V_J = development index value for site j, j ϵ J

S_J = disaster safety index value for site j, j ϵ J

N_T= the minimum value for transportation accesibility index

N_S = the minimum value for disaster safety index

N_V = the minimum value for development index

Exact Method

$$x_{ij} \leq y_j \quad \forall i, j$$

Maximize	$\sum a_i y_i$	
S.T.	$\sum x_j \geq y_i$	$\forall i \in I \quad j \in N$
	$\sum x_j \leq P$	$j \in J$
	$\sum T_j x_j \geq N_T \sum x_j$	$j \in J$
	$\sum V_j x_j \geq N_V \sum x_j$	$j \in J$
	$\sum S_j x_j \geq N_S \sum x_j$	$j \in J$
	$x_j \in \{0,1\}$	$\forall j \in J$
	$y_i \in \{0,1\}$	$\forall i \in I$

Exact Method

- The cadidate locations are reqired to have

  value of transportation accessibility > 12 (N_T)

  value of development > 0.345 (N_V)

  value of disaster safety > 8 (N_S)

- A total of warehouses need to be located in Nepal to cover all of the 54 demand nodes for

  100 km scenario → 26 warehouses

  200 km scenario → 12 warehouses

  300 km scenario → 7 warehouses

Exact Method

- Redundant coverage will be obtained by further increasing the number of warehouses above 26, 12 and 7 in each of the scenarios.

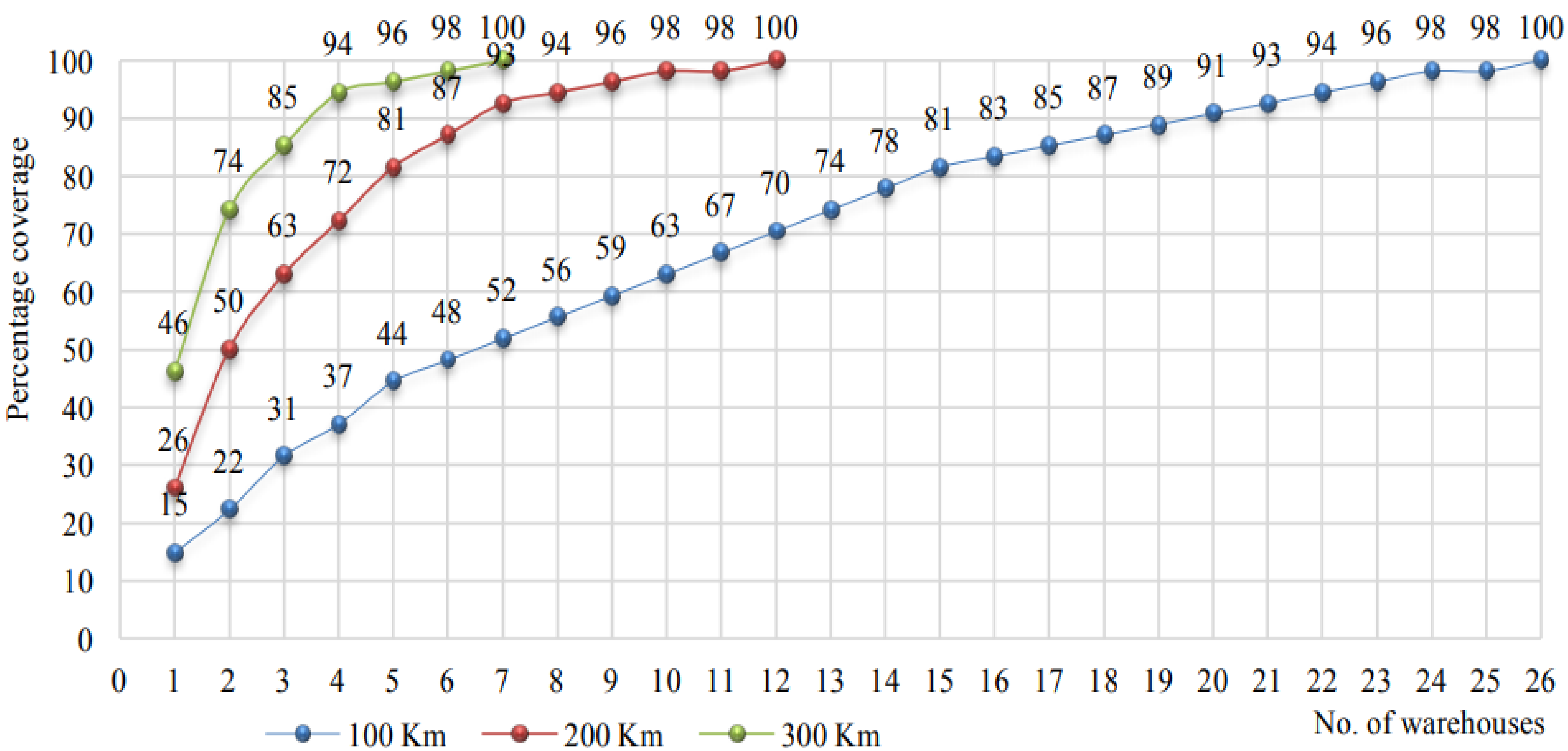
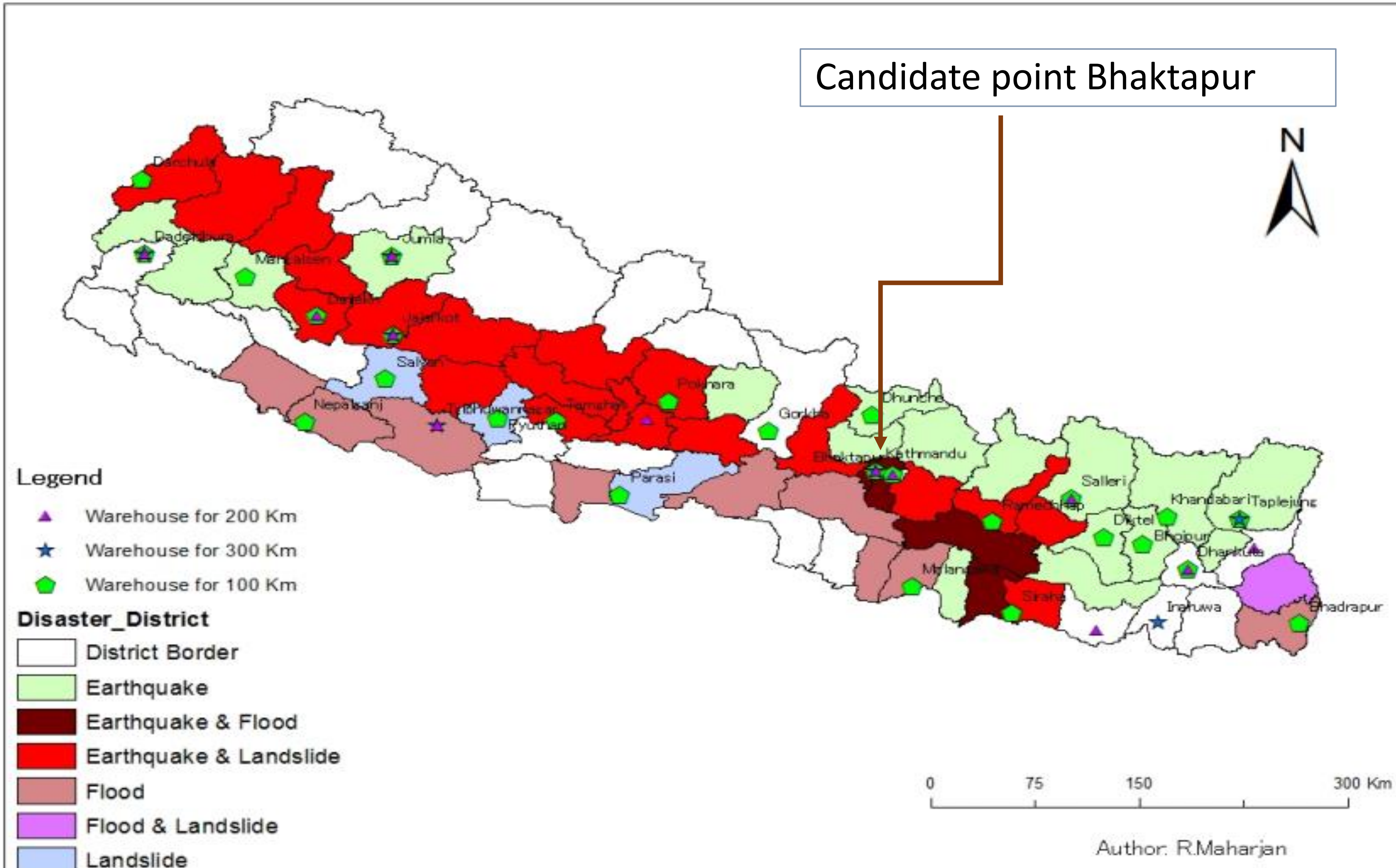


Fig 5: Coverage rates for 100 Km, 200 Km and 300 Km scenarios

Exact Method



Exact Method

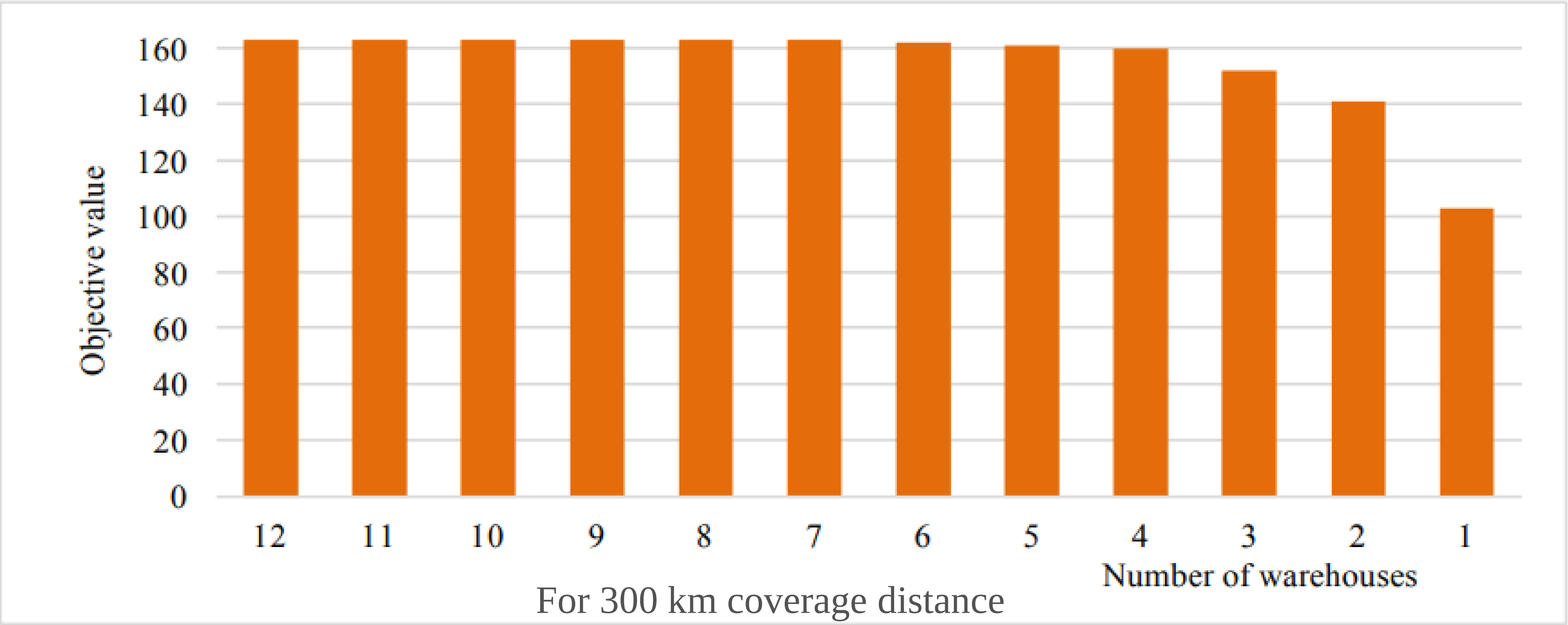
- The model is modified in order to incorporate the population of each demand nodes. With priority values assigned to each demand nodes, the impact of population size on overall coverage and location selection is observed.

Maximize $$z = \sum p_i a_i y_i$$

Where,

p_i = priority value for each demand node based on population density

Exact Method



Objective value : the sum product of demand nodes and their associated priority values.

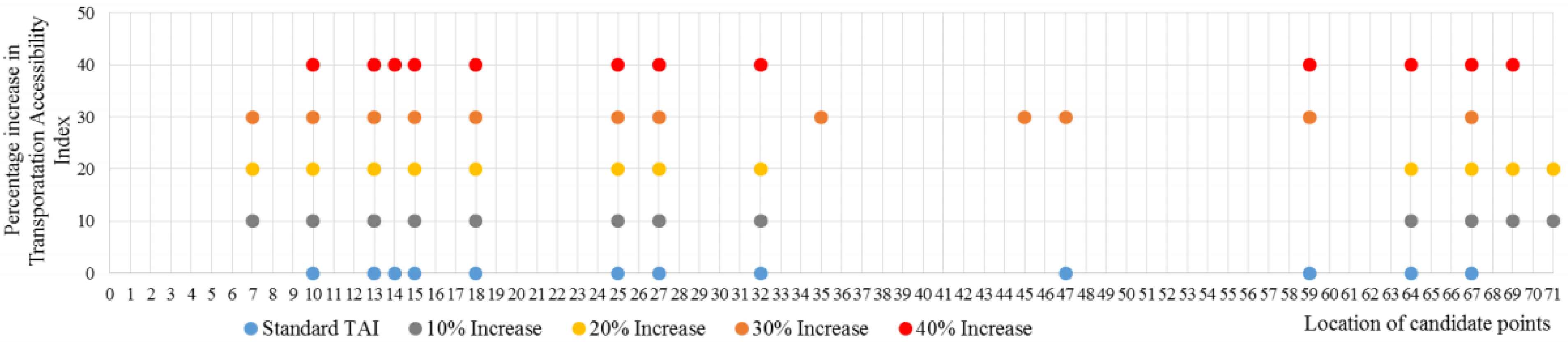
Exact Method

Sensitivity Analysis

To see

- the impact of changing the value of transportation accessiblity constraint (N_T) on location selection.

$$\sum T_j x_j \geq N_T \sum x_j \qquad j \in J$$



For 200 km coverage distance

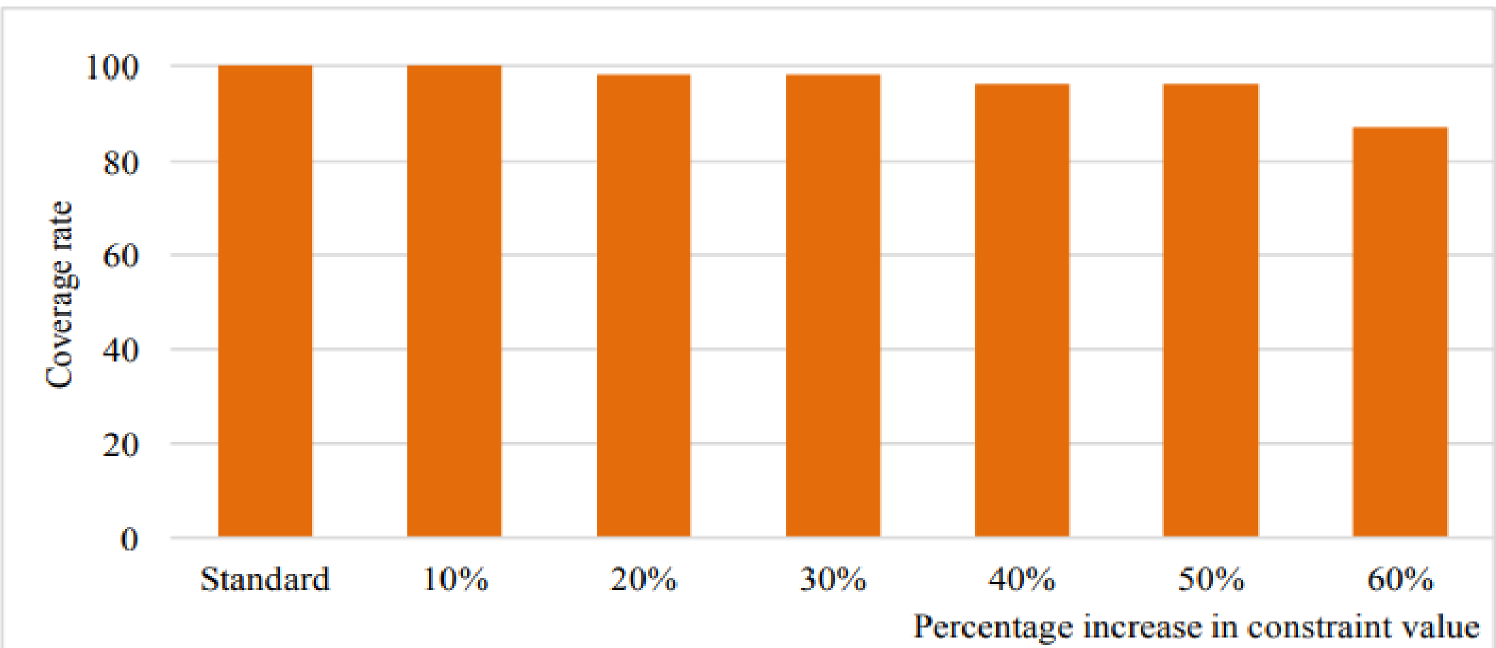
Exact Method

To see

- the impact of changing transportation accessibility (N_T) and development index (N_V) on coverage for 300 km.

$$\sum T_j x_j \geq N_T \sum x_j \qquad j \in J$$

$$\sum V_j x_j \geq N_V \sum x_j \qquad j \in J$$



Exact Method

Results

- The study determines the optimal number and location of warehouses utilizing the MCLP as an integer task.
  - ➢The optimal number of warehouses
  - ➢The higher the desired service level
  - ➢Decrease in response time
  - ➢The number of warehouses and the geographical constraints
- This model can also determine the location for search and rescue centers.
  - ➢For military, public facilities like fire station location and health center location etc.

Additional Example

- Location Determination of Logistics Warehouse facility using Fuzzy Multi Criteria Decision Making (FMCDM) Approach in Western Sea Sector of Indonesia
  - Choose warehouse locations to support the element of warships in maritime security operations in Indonesia by MCDM
  - The criteria of location of warehouse

    security

    transportation access

    facility of warehouse support.

Alternative Actions

QUESTIONING	CORRECTNESS
Transportation accesibility based on km. What about geographic diffrences?	Instead of distance, consider time.
Capacity of warehouses?	$\sum_i ai * zij \leq xj * capj \quad \forall j \in J$ where zij= $\begin{cases} 1 \; if \; demad \; node \; i \; is \; served \; by \; wh \; j \\ 0 \; otherwise \end{cases}$ capj=capacity of each wh
It is assumed that all demand points have proper road access but only 43% of the population has access.	$\sum_j bij * xj \geq yi \quad \forall i \in I$ where bij= $\begin{cases} 1 \; if \; there \; is \; a \; road \; btw \; i \; to \; j \\ 0 \; otherwise \end{cases}$

Comparison in Turkey

- Opening new Search and Rescue (SAR) stations for Turkish Air Force

(Location Search and Rescue Stations In The Aegean And Western Mediterranean Regions Of Turkey by M. Melih BAŞDEMİR)

$$\sum L_j \bullet x_j \geq N_L \bullet \Sigma x_j \qquad j \in J \qquad (4)$$

$$\sum G_j \bullet x_j \geq N_G \bullet \Sigma x_j \qquad j \in J \qquad (5)$$

$$\sum W_j \bullet x_j \geq N_W \bullet \Sigma x_j \qquad j \in J \qquad (6)$$

N_L = the minimum value that has to be met by limiting constraint (4), to set the standard for logistics.

N_G = the minimum value that has to be met by limiting constraint (5), to set the standard for geography.

N_W = the minimum value that has to be met by limiting constraint (6), to set the standard for weather.

L_j = the individual logistics value that SAR site j takes.

G_j = the individual geography value that SAR site j takes.

W_j = the individual weather value that SAR site j takes.

References

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