Community Engagement and Citizen Participation in Flood Risk Reduction

Bringing technology and people together

By:
Dr. Anshu Sharma, Co-founder, SEEDS
Dr. Sumedha Dua, Project Manager, SEEDS

Impacts of Floods

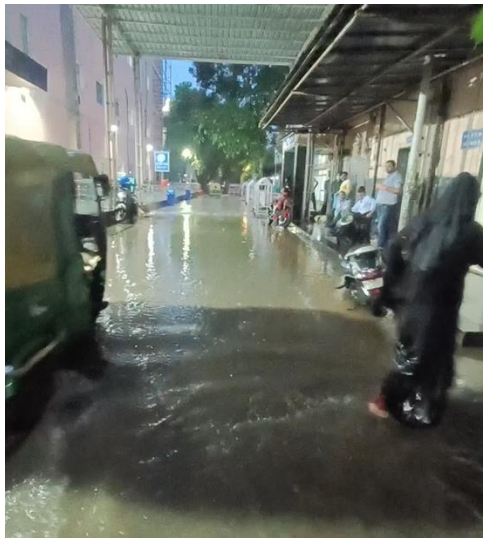
- World Risk Index 2022 – India with second highest disaster risk (WRI 42.31); India is the most populated country – increased damages
- IPCC (2022) – indicates increase in health burdens
- Lack of ability of infrastructure to remain in service after hazard events occur

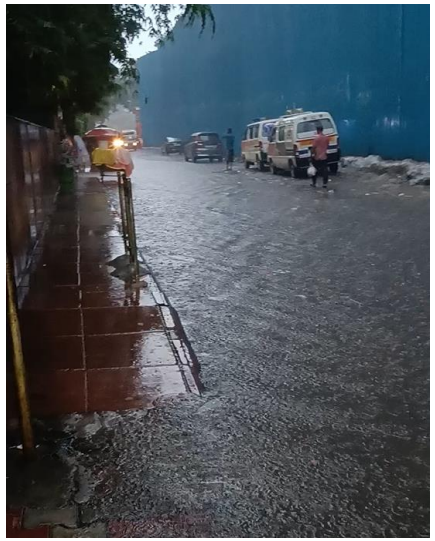
Higher localised flooding, increased travel times → **accessibility of healthcare affected**

Critical infrastructure **losing coping capacity** to surge in demand

Rapid urbanisation, illegal construction, **concretisation near river**

(Source: Dua & Paul (2024))





(Source: Dua & Paul (2024))

Impacts of Floods on Lives and Livelihoods

Loss of lives

17000+ deaths due to floods and heavy rainfall: between 2012 and 2021

(Source: CWC)

Fatalities

2014 J&K floods: 250+
2015 Chennai floods: 500+
2018 Bihar floods: 100+
2019 Kerala floods: 500+

Economic Disruption

Damage to

Houses and Households
Infrastructure, Industries
Agriculture, Livestock

Average annual loss

in India between 1953 to 2019 due to floods: approx. USD 2.2 billion or INR 18000 Cr

(Source: NDMA)

Impacts of Floods on Lives and Livelihoods

Agricultural Losses

Damage to
Crops, Agricultural tools
Soil erosion
Food insecurity

Average annual loss
2017 Assam Floods: INR 2000 Cr
2018 Kerala Floods: INR 3000 Cr
2019 Bihar Floods: INR 1200 Cr

Displacement of Affected Populace

Damage to
Houses and community network
Access to water and sanitation resources
Increased risk of exploitation

Over **1 million people** are displaced annually due to floods.

(Source: MHA)

Assessment of vulnerability and risks in communities during floods

Conducting Risk Assessment Using Technology

Understanding the vulnerability of communities

Located on floodplains

Located near river, sea

Proximity to water bodies

Lack of green spaces, deforestation

Waste Disposal Issues

Environmental Degradation

Lack of access to vulnerability information

Cannot decipher warnings

Unable to infer extent of damage

High-density slums

Inadequate infrastructure

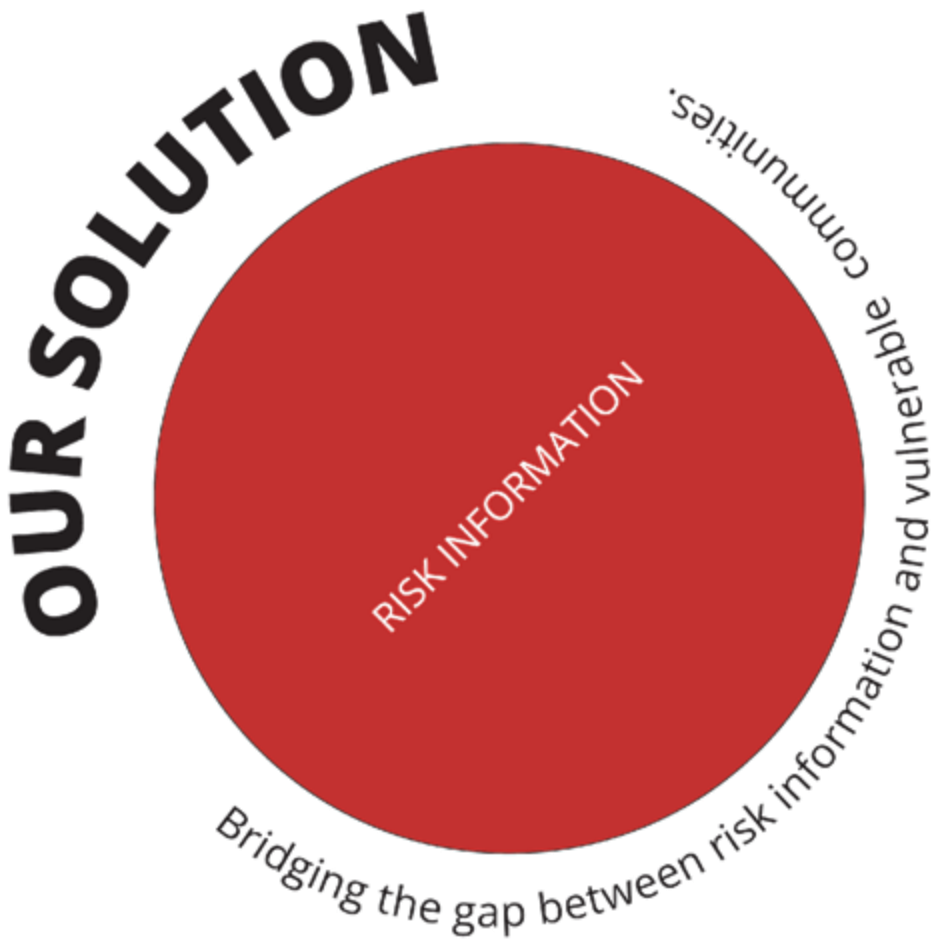
Low-economic zones

Leveraging AI to assess the impact of flooding in communities

Parameters/ Inputs Involved

Building footprints	**Road Networks**	**Slope**
Impervious Surfaces	**Realtime Met Data**	**Vegetation**

Using high-resolution satellite imagery to identify building roof types



Cyclone Fani

Puri, Odisha | April, 2019 | 64 lives lost

The project idea was conceived based on SEEDS's ground observations during response for cyclone Fani.

- Training dataset of over 50,000 houses
- Novel Roof type classification model developed
- Artificial Intelligence expertise of Microsoft's data scientists
- Risk scoring for each building cluster

AI for Resilient Cities Model

Risk score upgradation

1 Framework

Building detection
Roof-type classification
Hyper local risk information
Iteration cycles

2 The model

Risk score
Local risk assessment
City health report

3 Outputs

Geotagged dataset

Dashboard

Risk reports

4 Interventions

City specific advisory
Bootcamps/Workshops
Local innovations
Climate action plans

AI for Resilient Cities Model

1 Framework

Building detection and roof-type classification

AI for Resilient Cities Model

1 Framework

Hyper-local risk information for disaster resilience

01 HAZARD:
Developing a Risk Scoring Matrix
Floods | Cyclones | Heatwaves | Earthquakes

02 EXPOSURE:
Assessing Geographic parameters
Proximity to the river | Porosity of surfaces | built-up density | Vegetation | Slope | Soil type

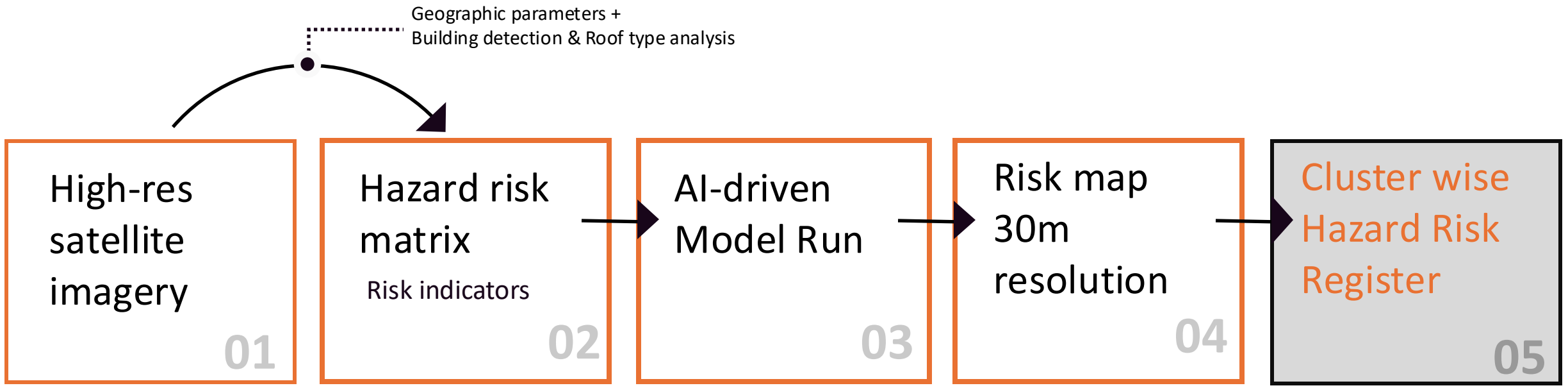
03 VULNERABILITY:
Building detection & Roof Type Classification
RCC | Tarpaulin | Tiles | Thatch | GI sheet

04 RISK:
Hyper-local Risk Scoring
Risk Scoring from 1 to 5 at building cluster level
30m Risk tiles

AI for Resilient Cities Model

1 Framework

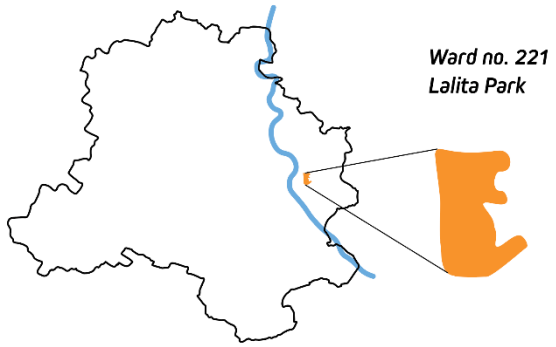
Runs on an iterative process



AI for Resilient Cities Model

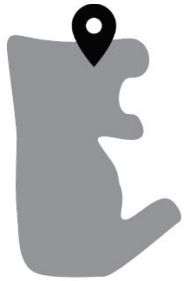
2 The Model

Developing risk scoring matrix and hyper local assessment

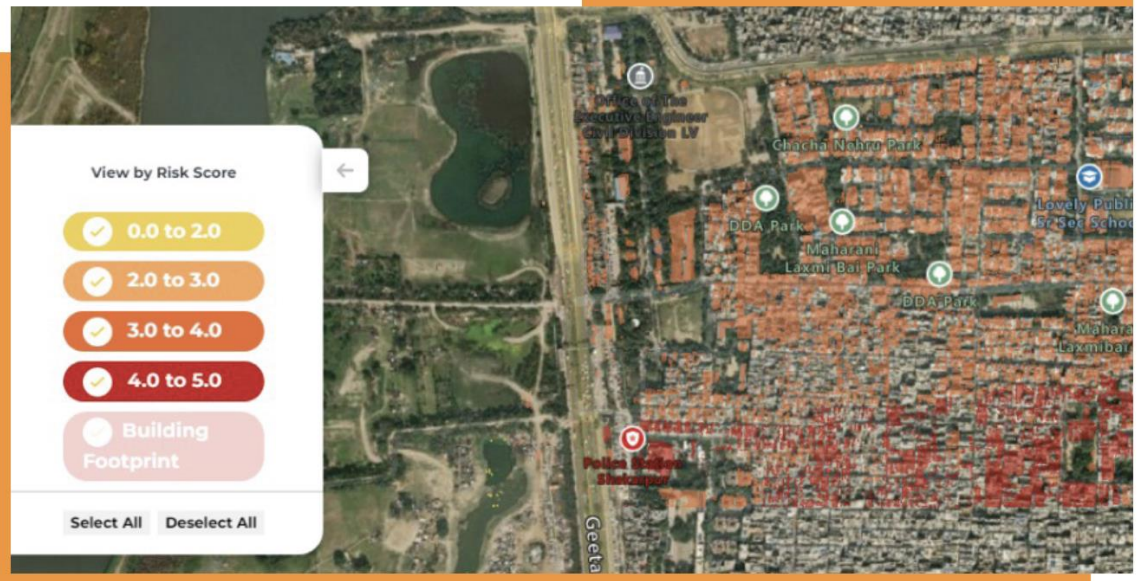


Ward level risk score:

3.5



Total count of buildings	4,994
Risk score	**Building count**
0.0 to 2.0	11
2.0 to 3.0	52
3.0 to 4.0	3,689
4.0 to 5.0	1,242



Extreme heat in the capital

Between March and May this year, Delhi experienced

5 heatwaves

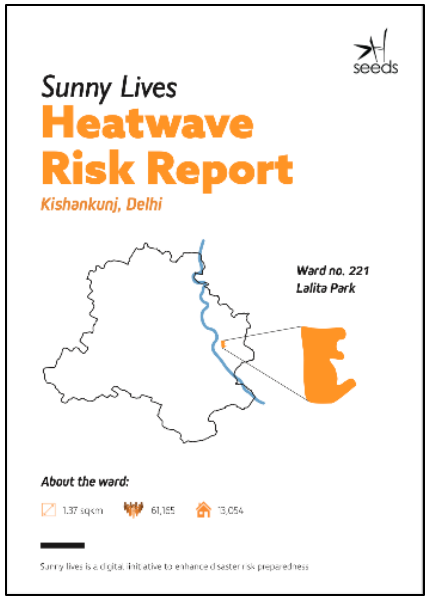
five heat waves with record-breaking temperatures reaching up to

49.2°C

, leading to devastating socioeconomic and public health impacts

AI for Resilient Cities Model

3 Outputs for a city



Risk Reports

Analysis for hazard(s) for the cities at ward and building cluster level.

- **Hazard risk analytics showing high risk spots in cities**
- Risk information from open-source datasets

Dashboards

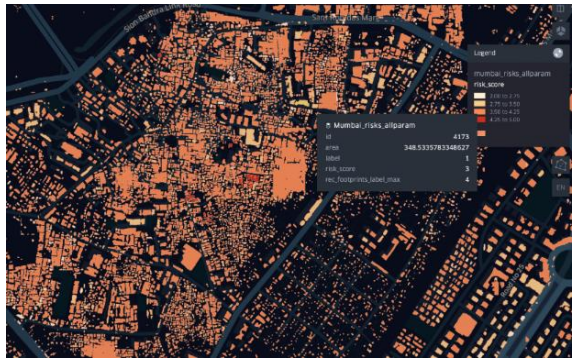
Developing hazard risk dashboards for city/state authorities.

- Providing actionable insights for authorities.
- Risk information as a plug in to existing portals.

Geo tagged Hazard risk data

Subscription for **Geospatial data** of all buildings (wards or pincode) categorized by roof type

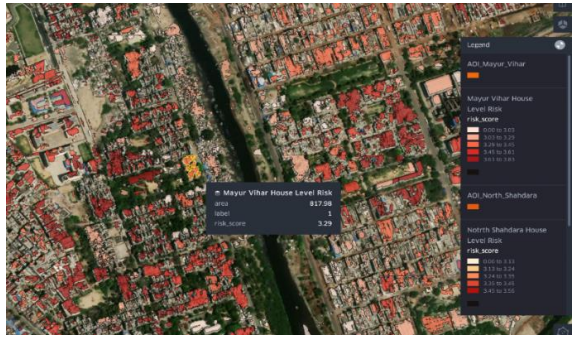
Multi-hazard model scalable across geographies



Flooding

The model was tested for cyclone induced and monsoon flooding in

- Mumbai, Maharashtra
- Puri, Odisha
- Porbandar, Gujarat
- Gaya, Bihar
- Nellore, Andhra Pradesh



Heatwaves

The model was piloted in cities falling under Core Heatwave Zones (CHZs) in

- East Delhi
- Nagpur, Maharashtra

Earthquakes

The earthquake model was run for:

- Gangtok, Sikkim
- Dehradun, Uttarkhand

Precision in Risk Assessment unmatched by traditional methods.

Early Warning & Preparedness for proactive measures

Customized Solutions tailored to locational characterization

Scalability and Integration seamless incorporation into existing systems and workflows

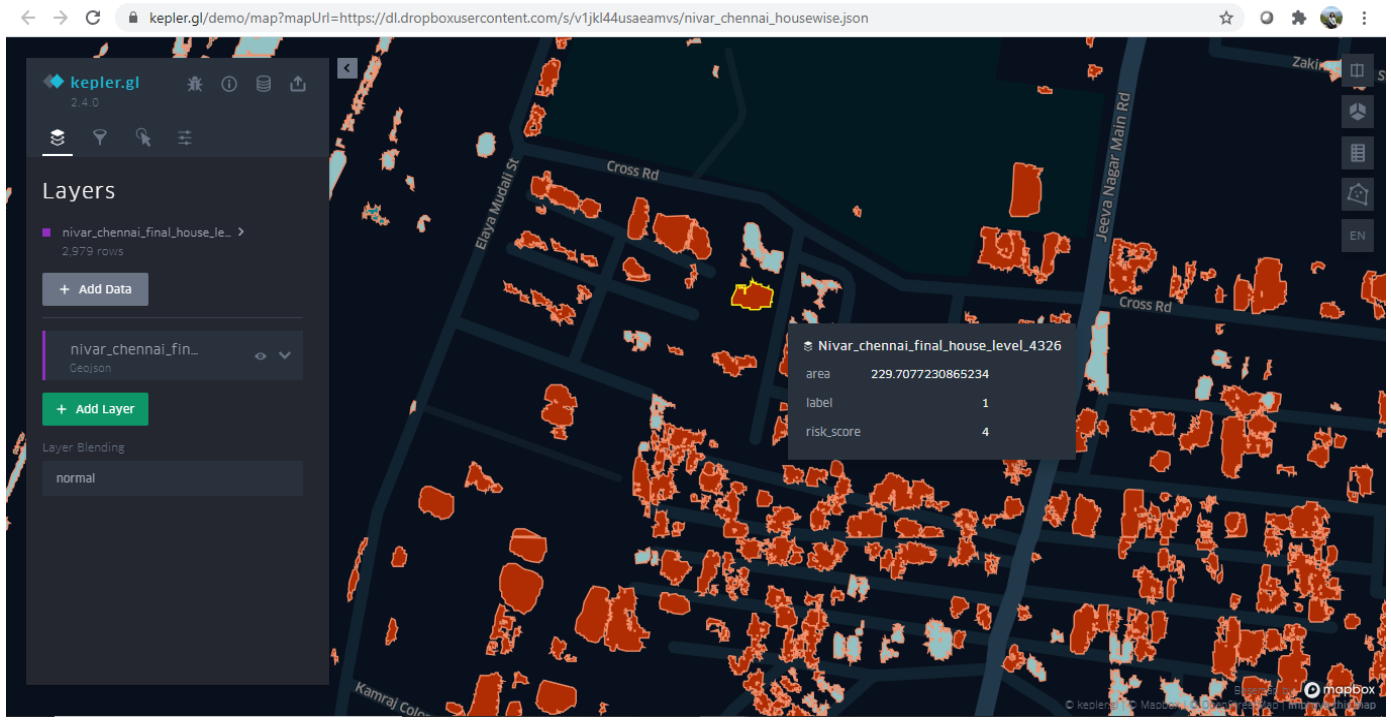
Community Engagement accommodating needs of individual users & organizations

Competitive Advantage through incorporation of hyper-local high resolution risk assessment

Deploying the Model in Cyclone Prone Areas

Assessing vulnerabilities due to coastal floods

Assessment of Vulnerabilities during Cyclone **Nivar (2020)**



Model Run in Chennai

- November 2020
- **Very severe cyclonic storm**
- Affected States:
  - Tamil Nadu
  - Andhra Pradesh
  - Puducherry

Actions Taken

30+ Areas of Impact identified using model

Advisory Dissemination to vulnerable households

Volunteer reach out with community groups

Assessment of Vulnerabilities during Cyclone **Yaas (2021)**

- May 2021
- **Very severe cyclonic storm, 150 kmph**
- Affected States: Odisha, West Bengal

Materials for house construction
• Asbestos sheets • Tarpaulin • Thatch, Bamboo

Actions taken by dwellers
• Evacuation to shelter • tightened house structure • safe-guarded essential documents

Actions Taken

- Outreach to Self-Help Groups (mostly women-led)
- Door-to-door volunteers disseminating advisories
- Reached out to 1030 families in Penthakata (Puri)
- Rebuilding houses with help of community

Assessment during Cyclone **Nisarga (2020)** and **Tauktae (2021)**

- May 2020 and May 2021
- **Extremely severe cyclonic storm, 160-170 kmph**
- Affected Areas: Bhavnagar, Porbandar, Mahuva, Amreli

Model Run in Porbandar (Rasulnagar, and Mahuva)

Risk score legend

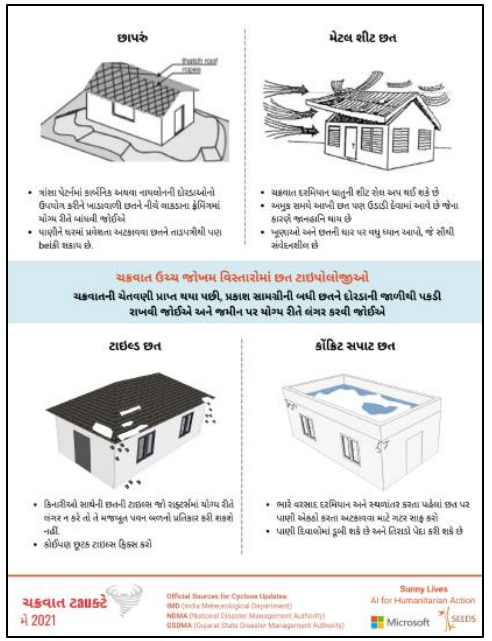
1 2 3 4

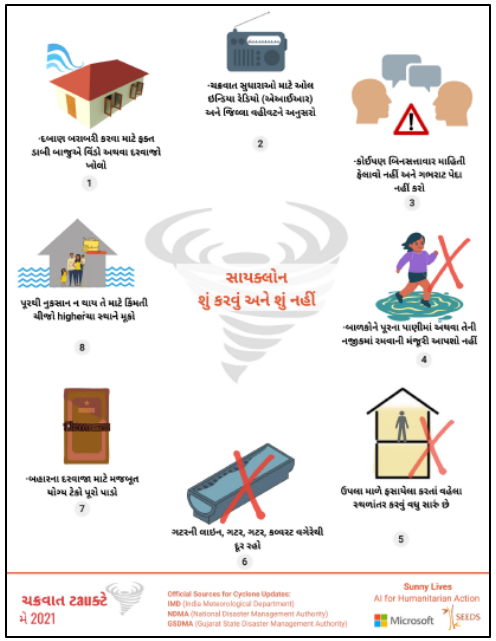
Actions Taken

Outreach of warnings through local organisations working with communities

Dissemination of cluster-specific advisories

Survey conducted **with support from GIDM** to assess damages and losses





Impact of Recovery, DRR, and Tech-led Resilience

AI-led hyper-local risk assessment enables

- Timely evacuation
- Actionable advisories
- Autonomy and accountability of communities

Improved Economic Conditions

- Reduced loss of household assets, livelihoods
- Safe official documents, fewer new debts

Partnering with Govt agencies

- To reduce vulnerabilities
- Conduct surveys, campaigns, workshops, dissemination

Improved Health Conditions

- Better sanitation and hygiene
- Secure drinking water
- Reduced risk of water-borne diseases

Improved Social Conditions

- Reduced loss of life & injury
- Reduced anxiety and trauma

Thank You

To conduct a similar AI-based hyperlocal risk assessment in your area, you can write to us at:
sumedha@seedsindia.org