


# **RISK FACTORS AND SOCIAL VULNERABILITY**

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Tornado Disaster Risk Reduction for Bangladesh  
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## Goals:

- To understand the risks of severe local storms in Bangladesh.
- To understand the social vulnerability to severe local storms in Bangladesh.
- To suggest policies and actions that can be taken to reduce the vulnerability and reduce injuries, deaths, and impacts.

➤ Severe local storms:

- Most severe in the pre-monsoon season March-May.
- Often move from northwest to southeast - Nor'westers.

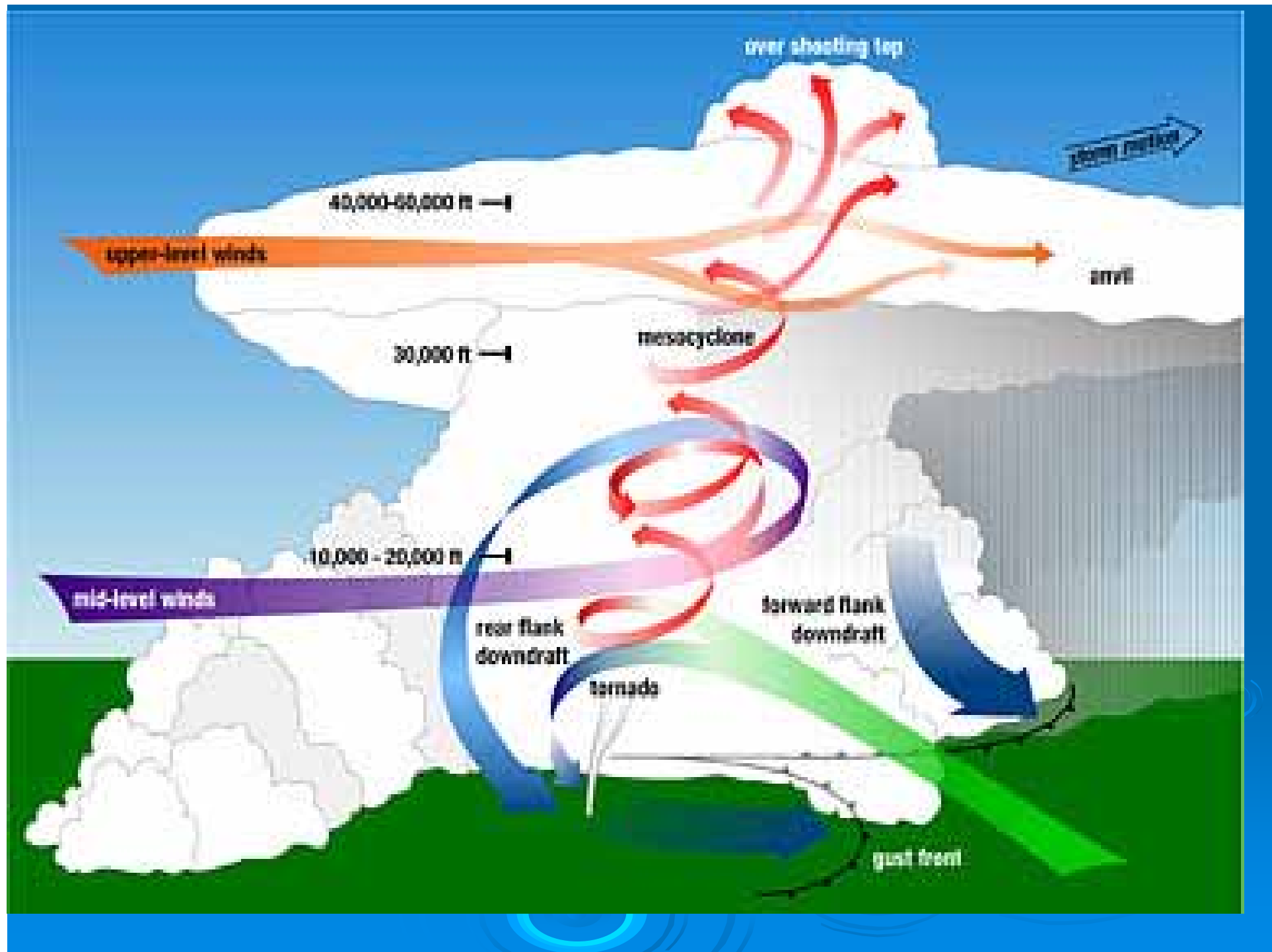
➤ Severe local storms may expose the population to hazards:

- Tornadoes
- Strong winds
- Lightning
- Hail
- Floods



- **Tornado** – a small violently rotating column of air extending from a thunderstorm.
- Path width: 100-1000 m, average 150 m.
- Path length: 1-100 km, average 15 km.
- Wind speeds: 120-300 km/hr.
- Forward speed: 20-60 km/hr.
- Duration: 10 minutes to one hour.





NSSL Photo



➤ Bangladesh has one of the highest frequencies of tornadoes in the world, similar to central United States.

➤ Deadly

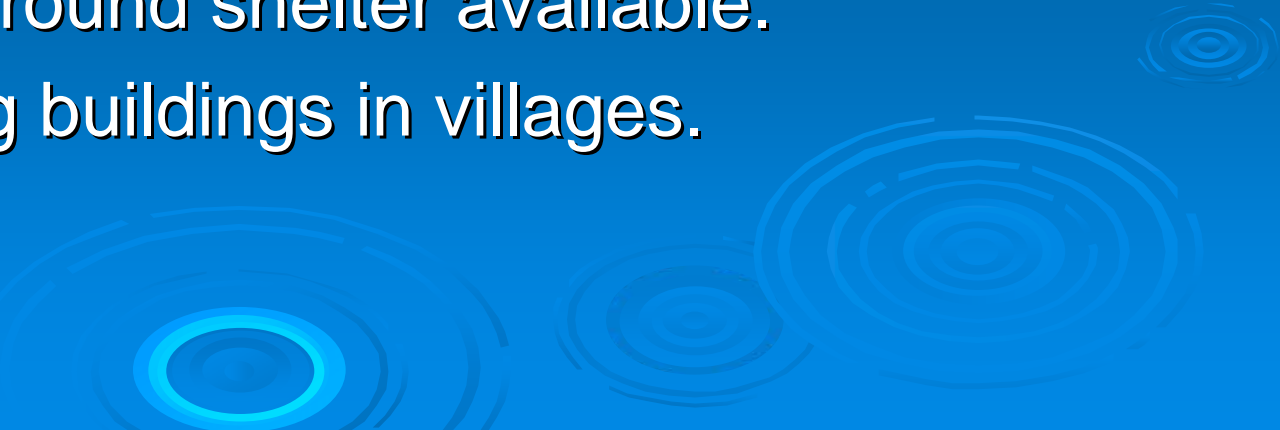
- 1,300 dead on 26 April 1989
- 700+ dead on 13 May 1996
- 76 dead on 14 April 2004

## ➤ **Vulnerabilities to tornadoes**

### ➤ **No warning**

- Doppler radar can give advance warning of tornado formation.
- Warning must be communicated to people.
- People must react to the warning.

### ➤ **Weak shelters**

- Homes provide little protection from wind.
  - No underground shelter available.
  - Few strong buildings in villages.
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NWS photo by Mike Branick

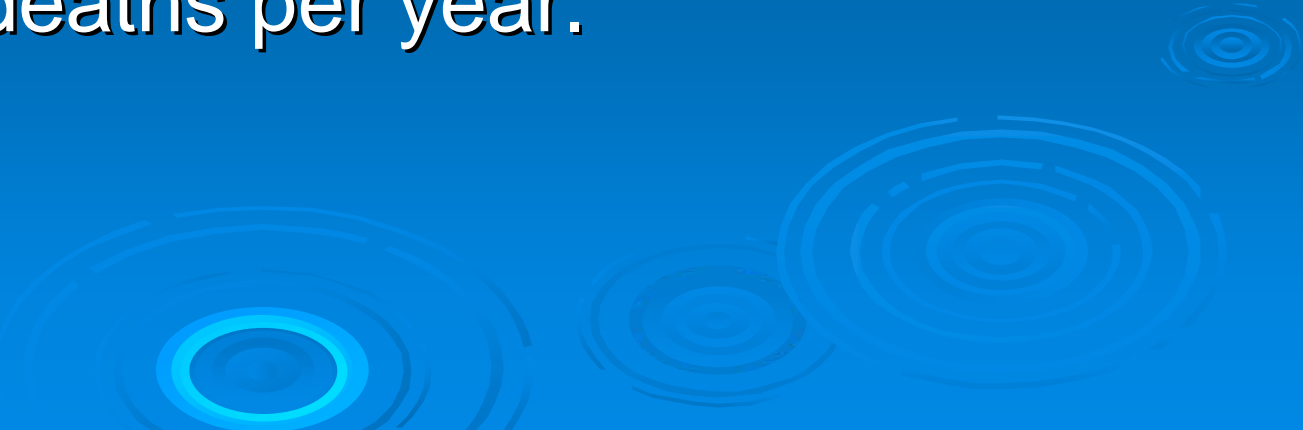


## ➤ **Strong winds**

- Severe thunderstorms may have strong 'straight-line' winds.
- Wind speeds over 100 km/hr.
- Affect wide area over a long distance.
- More common than tornadoes.
- Annual death toll may be greater than for tornadoes.




## ➤ **Lightning**

- Occurs with all thunderstorms.
  - Causes injury and death to people outdoors.
  - Starts fire, disrupts communications.
  - 40 strikes/km<sup>2</sup> in central Bangladesh during the pre-monsoon season.
  - 500-1000 deaths per year.
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## ➤ Hail

- Common in severe storms in Bangladesh.
- Bangladesh has the world's highest death and injury toll from hail.


## ➤ Floods

- Intense rainfall in severe local storms.
  - 5-10 cm rain in one hour.
  - Damages property, crops, causes deaths.
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Social vulnerability is a function of:

- Risk of the event occurrence – HIGH!
- Mitigation and preparation
  - Knowledge of risks
  - Warnings and communication of warnings
  - Shelter availability and use
- Social factors
  - Housing strength
  - Education
  - Gender
  - Income
  - Beliefs and customs
  - Resilience

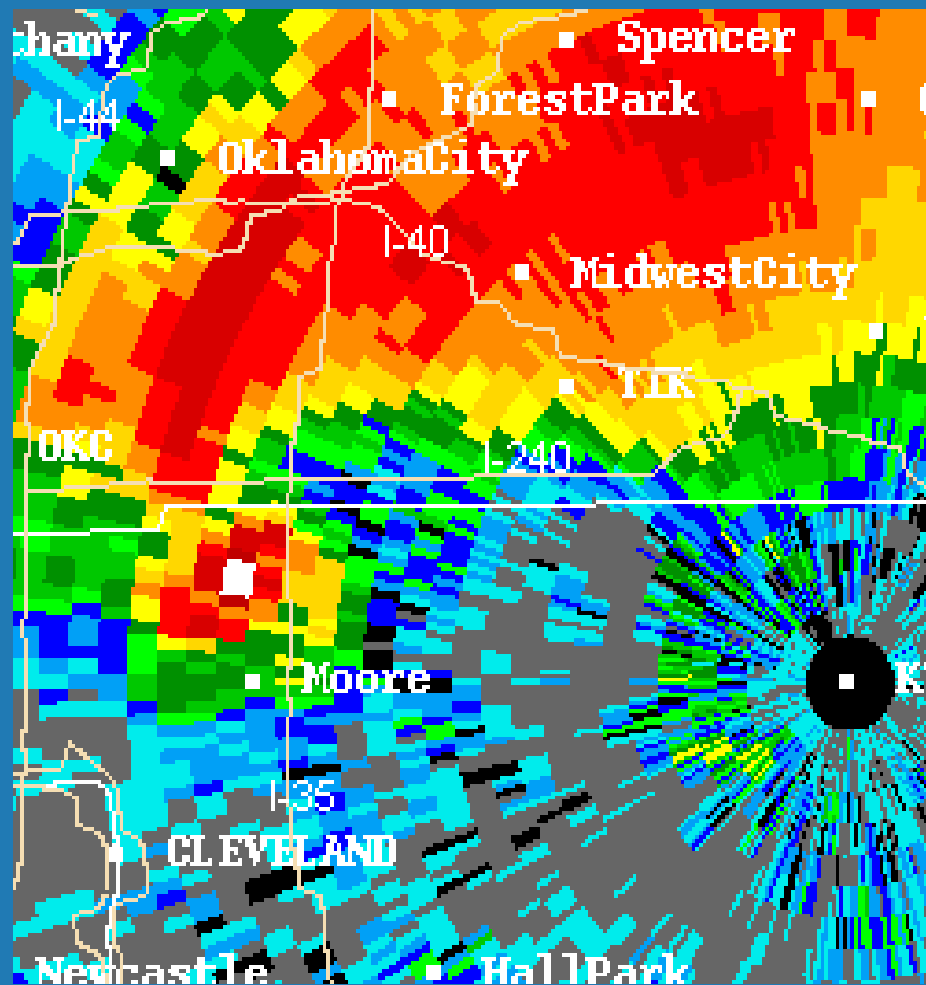
# Policies and actions to reduce vulnerability

1. Early Storm Detection and Warning
  2. Education and Preparedness
  3. Shelter from the Wind
  4. Empower Women
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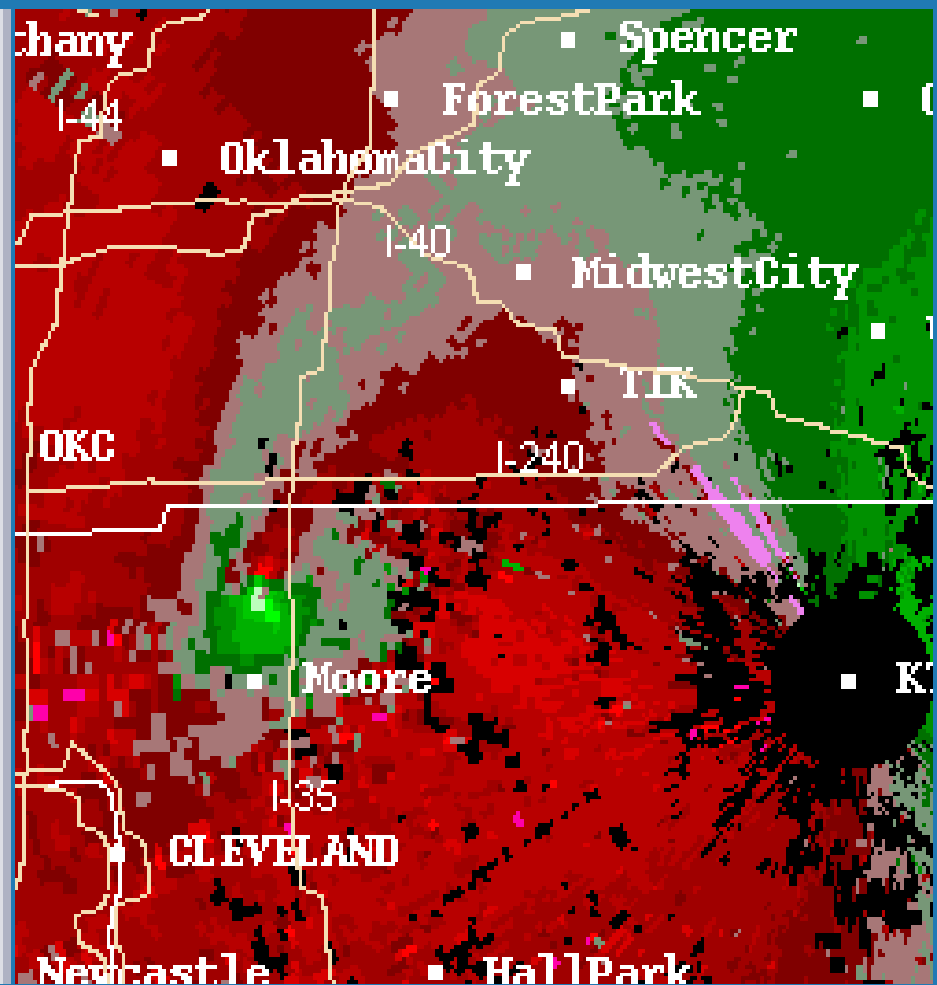
# 1. Early Storm Detection and Warning

- Install Doppler radar.
  - Detect severe weather, BMD issues warnings.
- Communicate the warnings to the population.
  - BMD tells radio, television, and local authorities.
  - Local authorities warn door-to-door or with speakers.
  - Mobile telephones may deliver warnings.
  - Need redundancy in warnings, several sources.





Reflectivity



Storm-relative Velocity

WSR-88D Imagery of Moore, Oklahoma Tornadic Supercell ( 3 May 1999 )

824  
WFUS53 KDDC 060137  
TORDDC  
KSC097-060200-  
/O.NEW.KDDC.TO.W.0051.070506T0137Z-070506T0200Z/

BULLETIN - EAS ACTIVATION REQUESTED  
TORNADO WARNING  
NATIONAL WEATHER SERVICE DODGE CITY KS  
837 PM CDT SAT MAY 5 2007

THE NATIONAL WEATHER SERVICE IN DODGE CITY HAS ISSUED A

\* TORNADO WARNING FOR...  
NORTHERN KIOWA COUNTY IN SOUTH CENTRAL KANSAS.

\* UNTIL 900 PM CDT

\* AT 833 PM CDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED AND  
A STORM CHASER REPORTED A TORNADO 1 MILES WEST OF GREENSBURG...MOVING  
NORTH AT 25 MPH.

\* LOCATIONS IMPACTED INCLUDE...  
GREENSBURG...  
HAVILAND...  
RURAL RESIDENCES OF NORTHERN KIOWA COUNTY.

THIS INCLUDES HIGHWAY 54 BETWEEN MILE MARKERS 101 AND 124.

WHEN A TORNADO WARNING IS ISSUED BASED ON DOPPLER RADAR...IT MEANS  
THAT STRONG ROTATION HAS BEEN DETECTED IN THE STORM. A TORNADO MAY  
ALREADY BE ON THE GROUND...OR IS EXPECTED TO DEVELOP SHORTLY. IF YOU  
ARE IN THE PATH OF THIS DANGEROUS STORM...MOVE INDOORS AND TO THE  
LOWEST LEVEL OF THE BUILDING. STAY AWAY FROM WINDOWS. IF DRIVING...DO  
NOT SEEK SHELTER UNDER A HIGHWAY OVERPASS.

A TORNADO WATCH REMAINS IN EFFECT UNTIL 1000 PM CDT SATURDAY EVENING  
FOR WEST CENTRAL KANSAS. A TORNADO WATCH ALSO REMAINS IN EFFECT UNTIL  
1000 PM CDT SATURDAY EVENING FOR SOUTHWESTERN KANSAS.

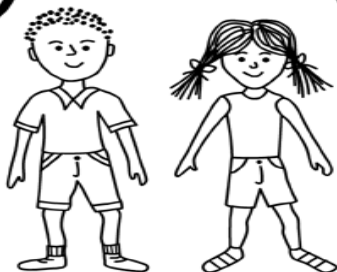
LAT...LON 3755 9947 3749 9901 3769 9902 3772 9932

## 2. Education and Preparedness

- There is limited access to electronic media and this restricts delivery of warnings.
- Illiteracy restricts text-based warnings and use of educational materials.
- Develop severe storm education material with text and visual images.
- Emphasize education about storms and storm safety in schools.
- Use folk songs, dramas, billboards, posters.
- As technology diffuses, adapt new methods.



## Billy and Maria Learn About



**KY3** **TORNADO SAFETY TIPS**  
S T O R M T E A M

- GO TO A BASEMENT OR THE LOWEST FLOOR POSSIBLE
- EVACUATE MOBILE HOMES... FIND SUBSTANTIAL SHELTER
- MOVE TO AN INTERIOR ROOM AWAY FROM WINDOWS & DOORS
- COVER HEAD AND NECK WITH BLANKETS OR PILLOWS

### 3. Shelter from the Wind

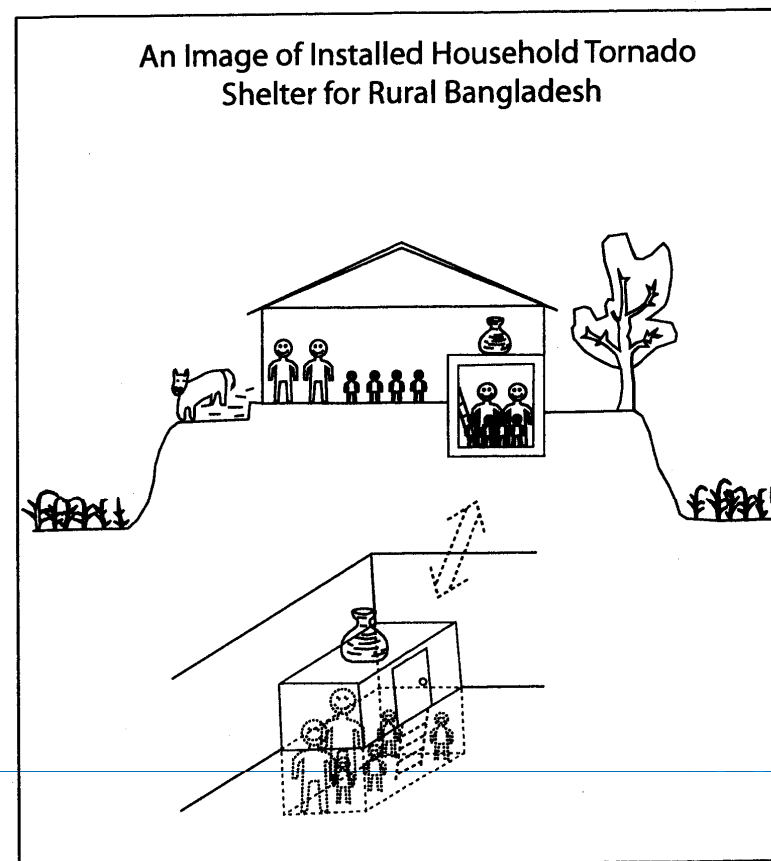
- Shelter in a sturdy building reduces injury and death.
- Rural homes do not resist the wind.
- Build community shelters (Kishor Mehta).
- Need an inexpensive in-home shelter.
- Ono developed and tested the acceptance of an in-home storm shelter for Bangladesh.
- BOSS (Bangladesh Ono Storm Shelter).
- Choose a village struck by a storm, fund and assist construction of BOSS shelters, monitor acceptance and use of shelters.

# Shelters for American homes, US\$3,000-5,000



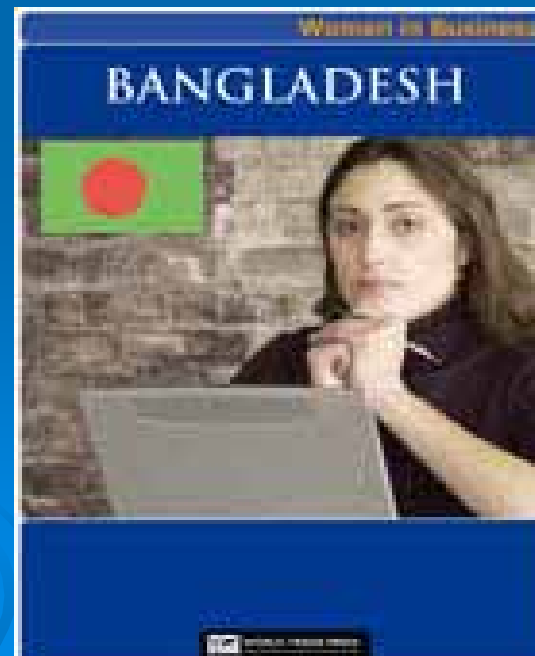
## ➤ BOSS tornado shelter (Ono, 2001)

- In floor of home on elevated earth.
- 2-4 m long, 1.2 m wide, 2 m tall.
- Made from concrete or clay, bamboo, brick.
- Used for storage when not occupied.
- Cost \$200.



## 4. Empower Women

- Women are more vulnerable to natural hazards than men – income, health, nutrition, children - gendered inequality.
- Ensure that women are represented in the education, preparedness, and decision-making to reduce vulnerability and improve recovery.



## Summary

- High frequency of severe local storms, no warnings, poor communication, weak housing, and no shelters.
  - High social vulnerability in Bangladesh!
  - Expansion of Doppler radar, issuance of warnings, and communication can save lives.
  - Inexpensive and simple actions can also save lives – education, preparedness, shelters, women.
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