Outline

1. Comprehensive Strategies for Slope Land Management and Rural Development
2. Debris Flow Disaster Management
3. Integrated Watershed Protection for disaster Prevention
4. Integrated Planning and Development for Rural Communities
Council of Agriculture
Soil & Water Conservation Bureau
Organization Chart

Director-General
Deputy Director-General
Chief Secretary

Planning Division - 3 Sections
Watershed Conservation Division - 4 Sections
Rural Reconstruction Division - 4 Sections
Monitoring & Management Division - 4 Sections
Debris Flow Disaster Mitigation Center - New

Secretariat
Personnel Office
Accounting Office
Government Ethics Office

6 Regional Branches - 4 Sections

Taipei
Taichung
Nantou
Hualien
Taitong
Tainan

1st
2nd
3rd
4th
5th
6th
Land Resources Distribution in Chinese Taipei

- **Mountain forest lands**: 46.99% (1,656,520 ha)
- **Plains**: 26.70% (961,933 ha)
- **Hillslopes**: 27.31% (983,653 ha)
- **Slopetalnd**: 73.30% (2,640,173 ha)
Comprehensive Strategies for Slopeland Conservation

Water, Soil, Vegetation, Ecology, Human

Close serves

Expand Social Participation

MIS, GIS, RS, GPS

Slopeland Conservation, Watershed Protection, Slopeland Management, Rural Restoration

Water, Soil, Vegetation, Ecology, Human

貼心服務

優質

效率

團隊

創新

坡地監理

農村再生

治山防災

Slopeland Conservation

High quality

safe

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Slopeland Conservation

High quality

safe
Expand Social Participation

Old

New

Unable Loading

Expand Social Participation
Better Achievement
Recent Debris Flow Disasters

- 2008.9.11  Sinlaku Typhoon
- 2008.7.21  Kalmaegi Typhoon
- 2004.9.10  911 Flood & Haima Typhoon
- 2004.7.25  Aere Typhoon
- 2004.7.02  72 Flood & Mindulle Typhoon
- 2001.9.17  Nari Typhoon
- 2001.7.29  Toraji Typhoon
- 1996.7.30  Herb Typhoon
Effect of 921 Earthquake

Landslides after Mindulle Typhoon in Tachia River Watershed

2004.07.10
Factors Governing Slope Disasters

- Global climate change
- Heavy rainfall with high intensity
- Effect of 921 Chi-Chi Earthquake
- Channels encroachment
- Over-developed hill-slopes
- Landslides and debris flows

Annual Rainfall of Chinese Taipei

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Rainfall (mm)</th>
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<tbody>
<tr>
<td>2005</td>
<td>2,914</td>
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<tr>
<td>2004</td>
<td>2,534</td>
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<tr>
<td>2003</td>
<td>1,840</td>
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<tr>
<td>2002</td>
<td>1,572</td>
</tr>
<tr>
<td>2001</td>
<td>2,332</td>
</tr>
<tr>
<td>2000</td>
<td>2,500</td>
</tr>
</tbody>
</table>

Average 973mm

Distribution of Annual Rainfall
The Island Most Exposed to Multiple Hazards in the World.

2005 世銀災害高風險區評估報告

The Island Most Exposed to Multiple Hazards in the World.

Natural Disaster Hotspots- A Global Risk Analysis

2005年來，全球天然災害死亡超過150萬人

經濟損失平均一年6,599億美元

劇增5倍

天然災害：地震、颱風、洪水、乾旱等四種

三種災害：25% 90% 73%

二種災害：10% 35%

一種災害：5%
Global increasing trend of natural disasters in recent 30 years (1975-2006)

No. of natural disasters


- 1999 Chi-Chi earthquake
- 30 years global increasing trend of natural disasters

No. of natural disasters:
- 100, 200, 300, 400, 500, 600
There are 4 typhoon events averagely within 100 years (1900~1999). The highest is 8 events and only 2 years occurred.

However, there are 7.3 events averagely since 2000~2006. And over 8 events got 3 years.
Risk Management

Risk → Chance

Human Activities

Danger

Disaster

- Change
- Challenge
- Chance

planetvids.com
Hazard Preparedness

Debris Torrents & Landslides

- Potential Debris Flow Torrents: 1,420 Torrents
- Landslide Areas: 43,570 ha
Contingency Response during Disasters

- Rainfall monitoring: Every 10 min.
- Typhoon: Cloud satellite image
- Announce: Debris Flow Warning
- Inform emergency messengers
- Heavy equipments standby at dangerous areas
Alarm of Debris Flow Warning

Rainfall forecast

Predict Rainfall > Warning

Real Rainfall > Warning

Sea typhoon alarm

Sea & land typhoon alarm

Yellow alarm

Red alarm

Rainfall of Debris Flow Warning: 250~550mm

Advise Evacuation

Enforce Evacuation
Debris Flow Disaster Standard

- Confirming the level of disaster preparedness in every village
- Strengthening the weakest item in disaster preparedness
- Planning short, medium and long term disaster preparedness for village

Scores for environment of villages in disaster package

- High Index for disaster preparedness
- Mid Index for disaster preparedness
- Low Index for disaster preparedness

Scores for villages in disaster preparedness
Serious Debris Flow Disaster Scene Investigation

- Scene Investigation SOP and related form and report template, making the disaster process complete

Disaster Occurred

Fastest Report

Faster Report

Real Record
- Collect disaster area meteorological and hydrological data
- Discuss the cause of disaster

Instant News
- In disaster scene, carefully record
- Show the real condition by photos

Complete Report
- Collect the disaster info
- Analyze the cause of disaster and suggestion
Set up Debris Flow Disaster Emergency SOP

Disaster Warning & Info

Prevent secondary disaster & recovering/reconstruct

Precaution Evacuate Drill

Disasters info collection

Education for Hazard Preparedness
颱風豪雨發布後，於土石流危險區先進駐重機械待命。

台南縣南化羌礦坑緊急搶通
嘉義縣中埔鄉東興村緊急搶修通

Heavy Equipments Standby at Potential Hazardous Spots

重機械待命
進駐
搶通

Heavy Equipments spot
Debris Flow Monitoring Stations

Field Monitoring

Data Transmission

Information Display

Debris Flow Disaster Response Center

Monitoring Vehicle

Real Time Image
Kalmaegi Typhoon
Debris flow warning and evacuation example

Potential debris flow torrent

13 houses destroyed by debris flow, but no one got hurt

台27線 2008.7.21 16:30 Aerial Photo

July 18, 2008

高雄縣六龜鄉中興村
土石流災害

卡玫基颱風
高雄縣六龜鄉中興村
土石流災害

13戶民宅受損
人員已事前疏散
無傷亡
Promote the Disaster Prevention on Local Communities

**Pre-Disaster**
- Reinforce the system of disaster prevention
- Enhance the ability of emergency response
- Discover source of disaster

**Disaster**
- Rescue cooperation
- Emergency response
- Decrease the loss of disaster

**Post-Disaster**
- Rehabilitation and reconstruction

Sustainable communities
Disaster management
Coexist with nature

Promote the Disaster Prevention on Local Communities

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Sustainable communities
Disaster management
Coexist with nature
**Risk Mapping**

Warning Simulation of Debris Flow Disaster Condition

Downstream river left bank residents are at higher risk.

Disaster intensity criteria:

- High: $h_{max} > 22.5 \text{ mm}$
- Medium: $11.0 \text{ mm} < h_{max} < 22.5 \text{ mm}$
- Low: $h_{max} < 11.0 \text{ mm}$

GIS mapping of debris flow impact area risk diagram.
Evacuation Routes and Drills for Debris Flow Disaster Mitigation

- 416 Evacuation routes planned
- 410 debris flow evacuation drills held

<table>
<thead>
<tr>
<th>Year</th>
<th>Evacuation Routes</th>
<th>Debris Flow Drills</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>81</td>
<td></td>
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<td>2004</td>
<td>67</td>
<td></td>
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<tr>
<td>2005</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>69</td>
<td></td>
</tr>
</tbody>
</table>
Rainfall Cones DIY

- Distribute 21,000 DIY rain gauges to people.

DIY rain gauges

72水災遭土石流淹沒
但人員平安撤離

義工親送雨量筒
2004.5.24
Community Development vs Community Precaution

- Local independence
  - Community Development

- The concept of Precaution
  - Community entering
    - Community Development

Community Development

Safe Community

Preparedness Community

Emergency rescue

Via community’s participation, movement, thinking to build up a better environment.

Combine safe with disaster precaution.

Aim to large-scale disaster, ex: earthquake, fire accident to become autonomy community precaution.

The emergency work when disaster occurred.

Via community’s participation, movement, thinking to build up a better environment.

Combine safe with disaster precaution.

Aim to large-scale disaster, ex: earthquake, fire accident to become autonomy community precaution.

The emergency work when disaster occurred.
Overview of Shang-An village, Shui-Li Township

- 三部坑集水區面積 368.6公頃
- 集水區面積
- 三部坑
- 368.6公頃
- 台21線
- 陳有蘭溪
- 上安村計14鄰
- 494戶
- 1560人
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- 494戶
- 1560人
HISTORY

- **Jul. 31, 1996 – Typhoon Herb**
  賀伯颱風造成省道21線受土石流埋沒。

- **Sep. 21, 1999 – Chi-Chi Earthquake**
  九二一大地震造成民房全倒15棟，半倒23棟。

- **Jul. 30, 2001 – Typhoon Torji**
  桃芝颱風三部坑爆發土石流，造成死亡9人，失蹤5人，民宅沖毀26戶，埋沒29戶，農田流失80公頃等災情。

Typhoon Torji hit Shang-An Village
Before and after debris flow
in Shan-An, Shui-Li, Nantou County

Discharge of debris flow can be approached
\[ \geq 10 \text{ times of clear water} \]
Advance omnibearing planning of watershed control

- Forest Management
- Hazard villages
- Debirs flow
- Safe villages
- Disaster mitigation measures
- Social concern
- Ecology improvement
- Debirs flow
- Integration
- Advance omnibearing planning of watershed control

- Disaster prevention
- Rural development
- Slopelands conservation
- Environmental greening and beautification
- New community environmental improvement
- Debirs flow real-time
整治率接近60%，可视为最理想或适宜的整治率目标值。

截至96年，台湾集水区整治率约为37.7%。
Comparison Between Landslide and Preparedness in Japan

<table>
<thead>
<tr>
<th>Year</th>
<th>Landslide</th>
<th>Preparedness</th>
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<tbody>
<tr>
<td>1982</td>
<td>7,300</td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>9,800</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>13,300</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>17,200</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>20,500</td>
<td></td>
</tr>
</tbody>
</table>

整備率 25%

113,557 處數
Watershed Conservation & Management Project in Shihmen Reservoir

Because the typhoon rainfalls resulted in more feculent water in reservoir.
Integrated Reservoir Watershed Conservation Project in Su-Le

Debris flow disaster 2005.2.26 15:01  After Restoration 2006.6.09 storm
Su-Le Real-Time Monitoring Pictures
Landslide Vegetation Recovery in Sa-Luen-Zi
Debris Flow situation in Hwa-Shan Area

- Chi-chi Earthquake in 1999 – upper stream severely collapsed.
- Torrential Rain in 2000 – large number of sandstone moved down and overflowed the check dam.
- Typhoon Nari and thunder shower in 2001, debris from Da-Chien Mountain flowed down and damaged villages and three bridges.

Debris Flow overwhelmed houses on Sep. 16, 2001
Debris Flow changed roadways on Sep. 16, 2001
Integration of Debris Flow Disaster Mitigation and Rural Development

in Hua-shan, Ku-keng, Yunlin

Community Empowerment

After Typhoon Nari, 2001

Villagers participation

Emerging Business & Ecology

Debris flow monitoring

After Treatment
### SWOT Analysis of Post-Disaster Community Recovery

#### Strengths & Weakness (優勢、劣勢) (內部)
- Natural environment
- Property features
- Local culture
- Human resources
- Tourism & Recreation
- Traffic
- Public facilities
- Land utilization
- Natural disaster

#### Opportunities & Threats (機會、威脅) (外部)
- Major transportation
- Construction
- Agriculture land release
- Development policy
- 2-day weekend
- WTO
- Economic recession

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921地震、豪雨、土石流，雲林縣以古坑鄉受災最嚴重，而華山地區亦受到嚴重的損害，住宅倒塌、公共活動場所毀損

社區事務由社區重新以積極的態度打造屬於新的文化地景，將家鄉改頭換面迎接新生命的開始

- Community serves as a standard.
- Safety orientation
- Drive community disaster prevention
- Transform to rural development
抽藤坑溪緩衝綠帶
Improvement of Engineering Environment

Simulation of Buffer Zone
After 10 years
Outdoor Classrooms for Soil & Water Conservation

Integrating communities with outdoor soil & water conservation classrooms

22 locations
535,990 visitors/yr

Soil & Water Conservation Bureau
Rural Development with Various Scales

**National-wide**

Prospective of sustainable development

**County / District**

Balanced development

**Community**

Rural restoration
Integration of community construction and ecological engineering

- Combine human, landscape, and industries.
- Obtain materials from local resources.
- Start from local industries and tourism.
- Utilize natural ecology and meet community’s requirements.
Future Prospects

- Plan Hua-Shan a new life circle as four main areas and ten sub-areas where possess different
- Integrate the business operation of Hua-Shan community and debris flow outdoor classrooms to bring a renovation concept to the public.
營造富麗新農村

Promote Rural Restoration Communities

Promote 4000 Communities for Rural Restoration
Future Perspective for Slopeland Conservation & Rural Development

— T.H.I.N.K —

- Technology: Research, development and practice.
- Human management: Improve people’s knowledge of precaution against disaster.
- Investigation: Investigate the potential locations to cope with disasters.
- Notice: Accurately control possible occurring time and give a declaration.
- Knowledge: Information and database as well as expert decision-making system.
Thank You for Attention

Soil and Water Conservation Bureau
Always Working with You