Rebuilding coupled with Sustainable Land Use, Food Security, and Agri-business for Community Resiliency in the Gurkha Earthquake Devastated Region in Nepal

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D.D. Poudel, Ph.D.

Professor and Coordinator, Environmental Science Program

Assistant Director, School of Geosciences

University of Louisiana at Lafayette, Louisiana, USA

Most part of this talk was included in my recently given talks in Kathmandu:

April 25, 2016. An International Workshop on the first memorial day of Gorkha Earthquake April 25, 2015, April 24 – 25, 2016, Kathmandu, Nepal, Department of Mines and Geology, GoN.

May 8, 2016. Presentation at the Chamber of Development Committee Chair, Hon. Mr. Rabindra Adhikari, Legislature-Parliament, Singhadurbar, Kathmandu, Nepal.

May 10, 2016. Presentation at the Nepal Reconstruction Authority (NRA) in the presence Mr. Sushil Gyawali, the CEO of NRA, Singhadurbar, Kathmandu, Nepal.

May 11, 2016. Presentation at Nepal Council of World Affairs (NCWA) at NCWA Building, Harihar Bhawan, Lalitpur, Nepal.

Introduction

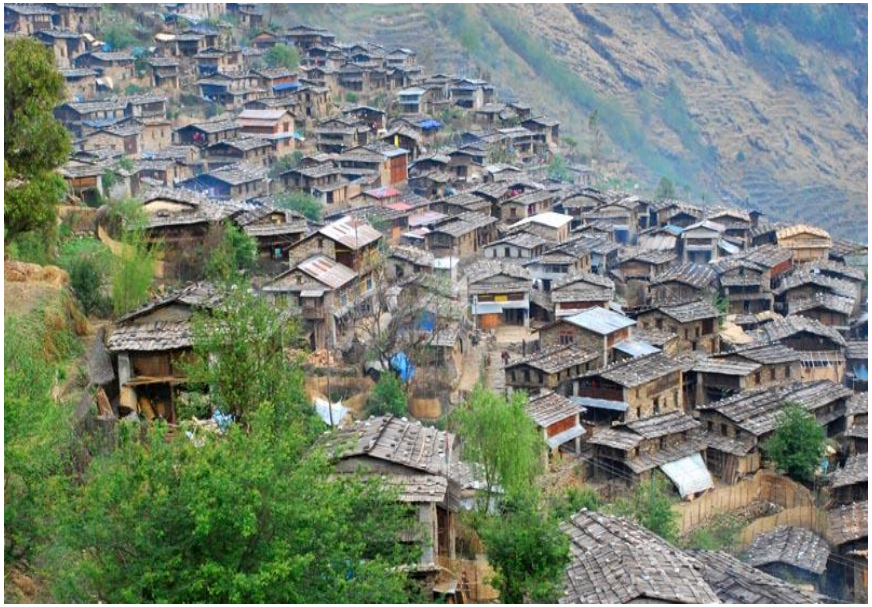
➢ Struck by a devastating 7.8 magnitude earthquake on April 25, 2015 followed by a second 7.3 magnitude earthquake on May 12, 2015 and hundreds of aftershocks.

➢Destroyed thousands of villages, causing almost 9,000 deaths and nearly 25,000 injuries across the 23 districts in the country. Destroyed over 500 temples, many historic palaces and monuments, and damaged roads, bridges, official buildings, and many other infrastructures.

➢Over 8 million people affected.

Kathmandu:
the capital city of Nepal

Rural villages in Nepal



Loss of lives, properties, temples and world heritages


NIC ASIA
ASIA
ASIA
NIC ASIA

Destructions in rural villages

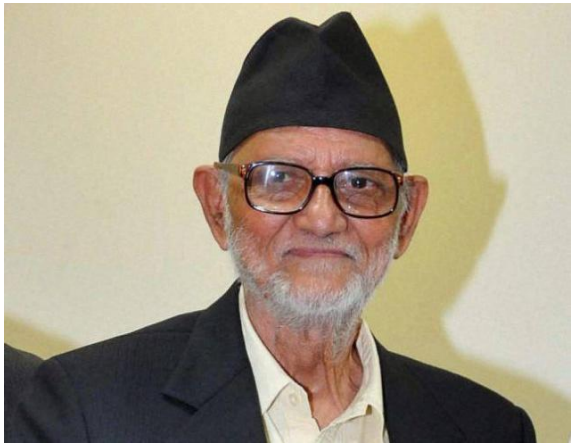
Destructions in rural villages continued

Avalanche, landslides and road cracks

Rescue begins immediately: Nepal Army and Armed Police Force of Nepal

Rescue begins immediately in rural villages: Nepal Army and Armed Police Force of Nepal

Nepal government appeals for international help



Late Mr. Sushil Koirala, then *Prime Minister of Nepal*

Government of India sends rescue team immediately

US rescue team lands in Kathmandu

China, Pakistan & Bhutan

Bangladesh, Israel, Japan, and European team

Many other countries and national and international organizations join the rescue and relief efforts.

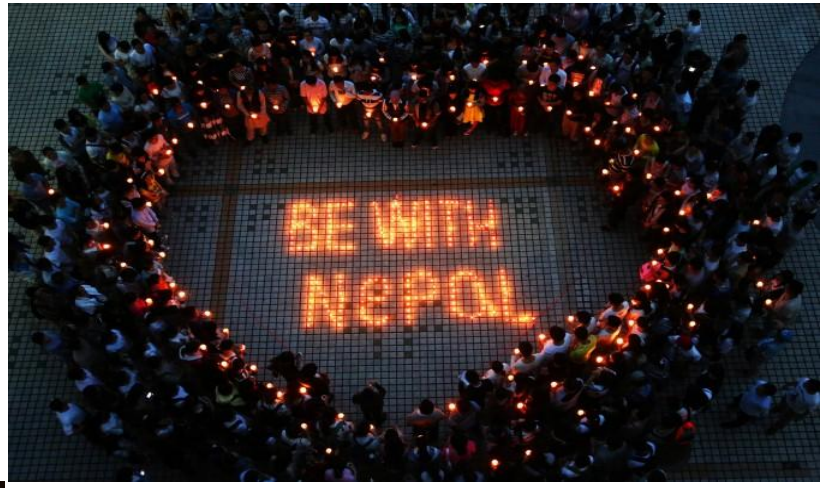
Rescue and relief efforts

Rescue and relief continued

Rescue and relief continued

Food and Water crisis

Prayers come for Nepal from all over the world



Towards a Resilient Nepal

To build a resilient Nepal, we must:

- identify and assess geohazards and develop sustainable land use plan for risk reduction,
- enhance food security, and
- develop Agri-business for rural income and employment opportunities.

Earthquake struck districts

Total area of the 23 districts	3,836,825 ha
Cultivated area	785,581 ha (20.5%)
Non-cultivated area	362,005 ha (9.4%)
Pasture land	315,548 ha (8.2%)
Forest area	1,883,549 ha (49.1%)
Others	490,142 ha (12.8%)
Total population of the 23 districts	8,892,576

Eastern Development Region
Okhaldhunga

Central Development Region
Dolkha
Sindhupalchowk
Rasuwa
Sindhuli
Ramechhap
Kavrepalanchowk
Lalitpur
Bhaktapur
Kathmandu
Nuwakot
Dhading
Makwanpur
Parsa
Chitwan

Western Development Region
Gorkha
Lamjung
Tanahun
Syngja
Kaski
Parbat
Palpa
Nawalparasi

Agricultural Production (Mt) in the 23 districts in 2009

Paddy	1,095,056
Maize	851,254
Millet	152,098
Wheat	307,886
Barley	3,167
Oilseed	34,048
Potato	644,721
Tobacco	118
Sugarcane	370,193
Lentil	17,210
Chick pea	1,192
Pigeon pea	735
Black gram	9,454
Grass pea	668
Jackfruit	5,688

Milk	555,285
Meat	85,202
Mandarine	79,244
Sweet orange	32,848
Lime	6,972
Lemon	5,339
Apple	5,009
Pear	15,691
Walnut	611
Peach	5,616
Plum	4,274
Mango	20,715
Banana	27,205
Guava	14,849
Papaya	8,604

Egg (no.)	355,103
Wool (kg)	141,942
Fish (kg)	41,003
Vegetable (kg)	286,807

Undergraduate students
Mr. Ian Isaacs,
Mr. Grant Kleiner, and
Mr. Bryce Landreneau
working on GIS database and analysis in NASA Regional Application Center at the University of Louisiana at Lafayette, Louisiana, USA.

Mr. Ajay Bhandari, a graduate student in Computer Science at the University of Louisiana at Lafayette, Louisiana, USA, working on NAIS project.

Distribution of relief materials by Asta-Ja RDC, Kathmandu, Nepal

Seed distribution to more than 611 households provided by the Greatergood.org and the hungersite

Distribution of roofing materials to 141 households and a school provided by SNEHA, Hawaii, USA

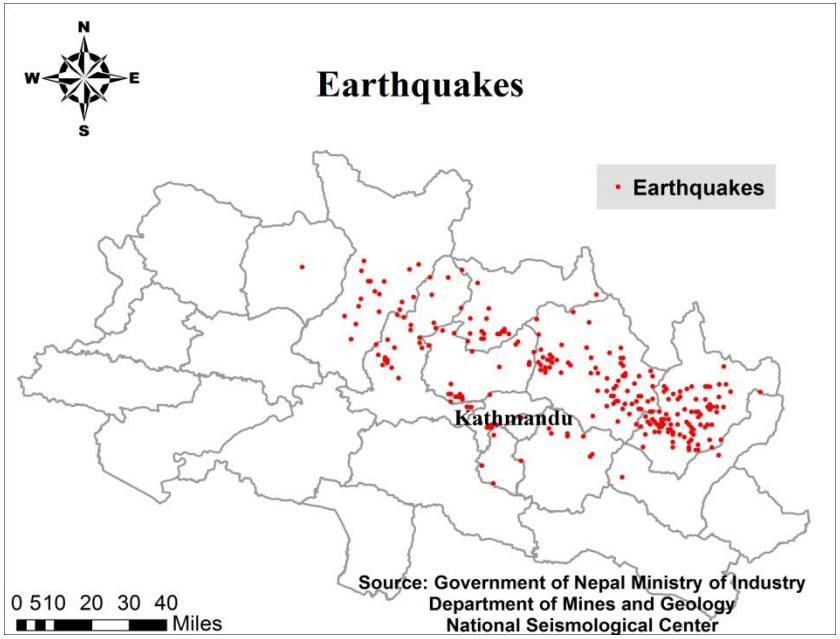
Distribution of 50,000 SuperGrain Bags provided by the Greatergood.org and the hungersite

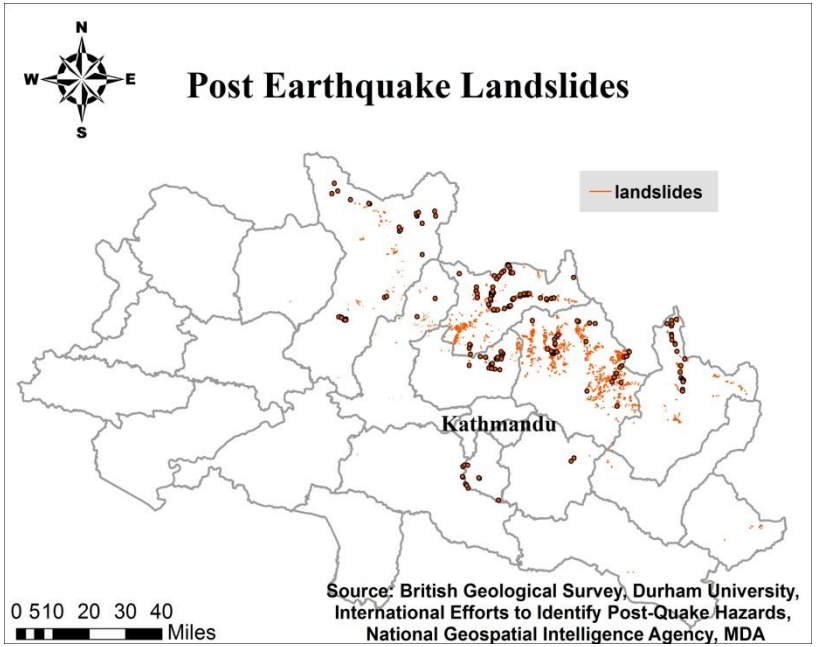
Blanket distribution to 120 families provided by AIA, Lafayette, LA, USA

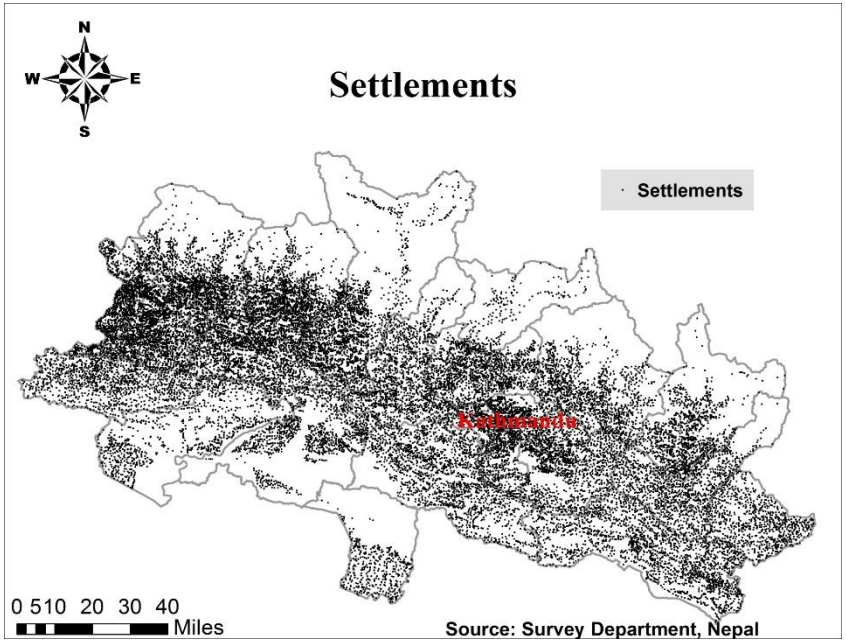
The value of Seeds and Sacks to earthquake victims

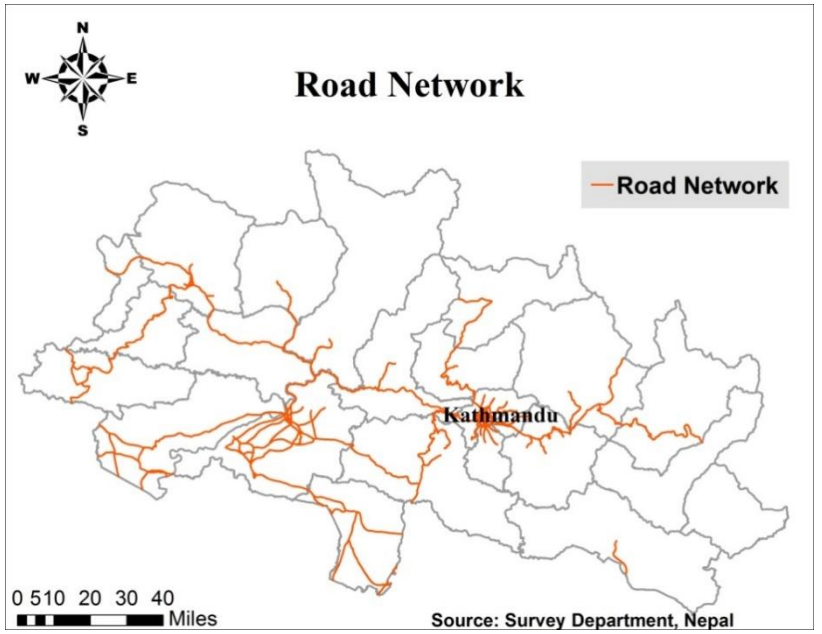
An old woman *– "Vegetable seeds belong to us. We need to feed vegetables to our families; therefore, it is very helpful for us",*
A farmer (male) *– "Seeds are very important for us. Other organizations brought food that feed only us, but you brought seeds which can feed not only us but also other people',* ***Farmers at Chandani, Sindhupalchowk****- "Seeds are very important for us. We will share these seeds with our neighbors", Good appreciation from governmental officials in our seeds distribution, as we were the first organizations distributing rice seeds and vegetable package seeds after the earthquake,* ***A farmer in Mahadevsthan, Kavre*** *–"This relief is different from others. Seeds distribution is associated with survive yourself and let other also survive",* ***Mr. Bishnu Rupakhet, Jibanpur, Dhadhing****- "This relief is much better than other reliefs. These seeds divert us from earthquake sorrows to our soils. They motivate us to plant them and take care of emerging seedlings. Please continue helping us in the future",* ***Farmers in general*** *– "We will feed you with our vegetables from these seeds when you come for the follow-up".*

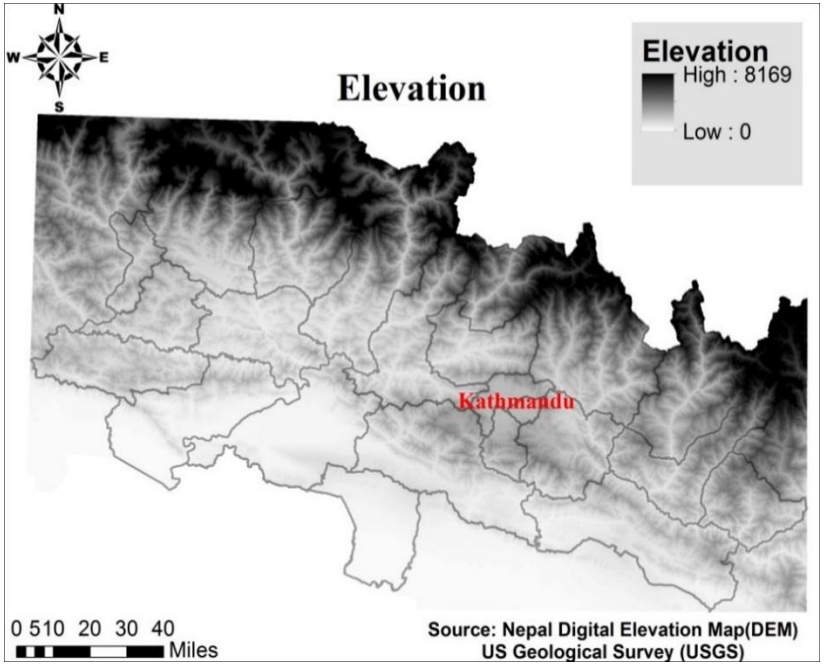
Land use planning for geohazard risk reduction

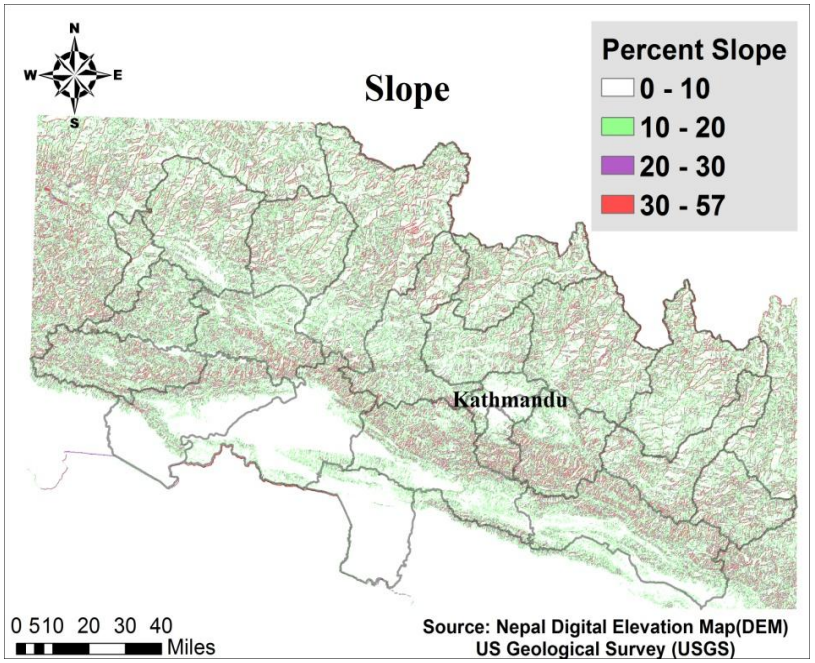


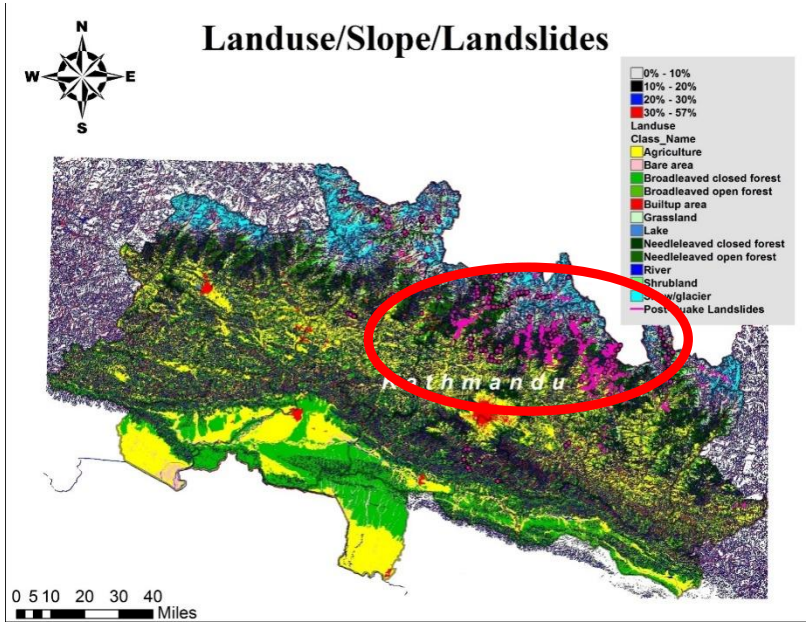


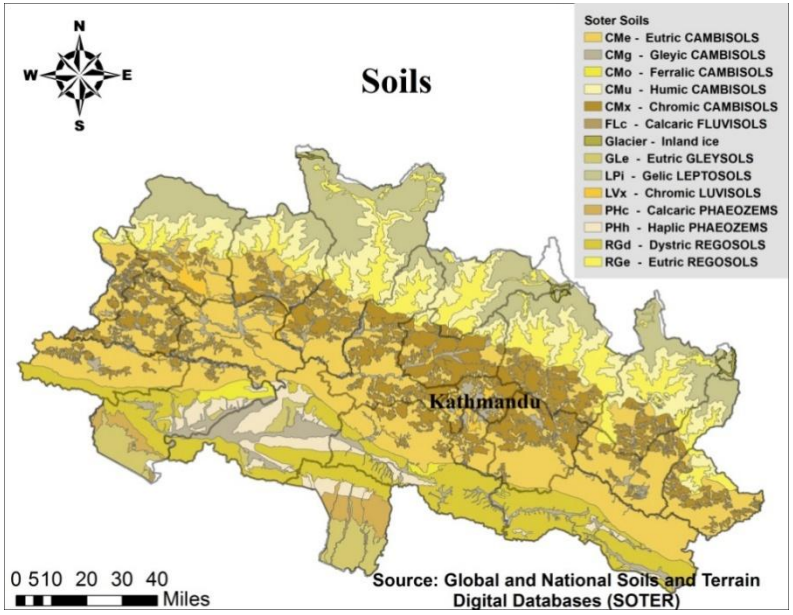





Elevation
Elevation
High : 8169
Low : 0
Kathmandu
0 510 20 30 40
Miles
Source: Nepal Digital Elevation Map(DEM)
US Geological Survey (USGS)


Slope
Percent Slope
0 - 10
10 - 20
20 - 30
30 - 57
Kathmandu
0 510 20 30 40
Miles
Source: Nepal Digital Elevation Map(DEM)
US Geological Survey (USGS)


Landuse/Slope/Landslides
0% - 10%
10% - 20%
20% - 30%
30% - 57%
Landuse
Class_Name
Agriculture
Bare area
Broadleaved closed forest
Broadleaved open forest
Builtup area
Grassland
Lake
Needleleaved closed forest
Needleleaved open forest
River
Shrubland
Kathmandu
0 5 10 20 30 40
Miles


Soils
Soter Soils
CMe - Eutric CAMBISOLS
CMg - Gleyic CAMBISOLS
CMo - Ferralic CAMBISOLS
CMu - Humic CAMBISOLS
CMx - Chromic CAMBISOLS
FLc - Calcaric FLUVISOLS
Glacier - Inland ice
GLe - Eutric GLEYSOLS
LPi - Gelic LEPTOSOLS
LVx - Chromic LUVISOLS
PHc - Calcaric PHAEOZEMS
PHh - Haplic PHAEOZEMS
RGd - Dystric REGOSOLS
RGe - Eutric REGOSOLS
Kathmandu
0 510 20 30 40
Miles
Source: Global and National Soils and Terrain
Digital Databases (SOTER)

- Excessively scattered settlements and most of them are inaccessible by roads.

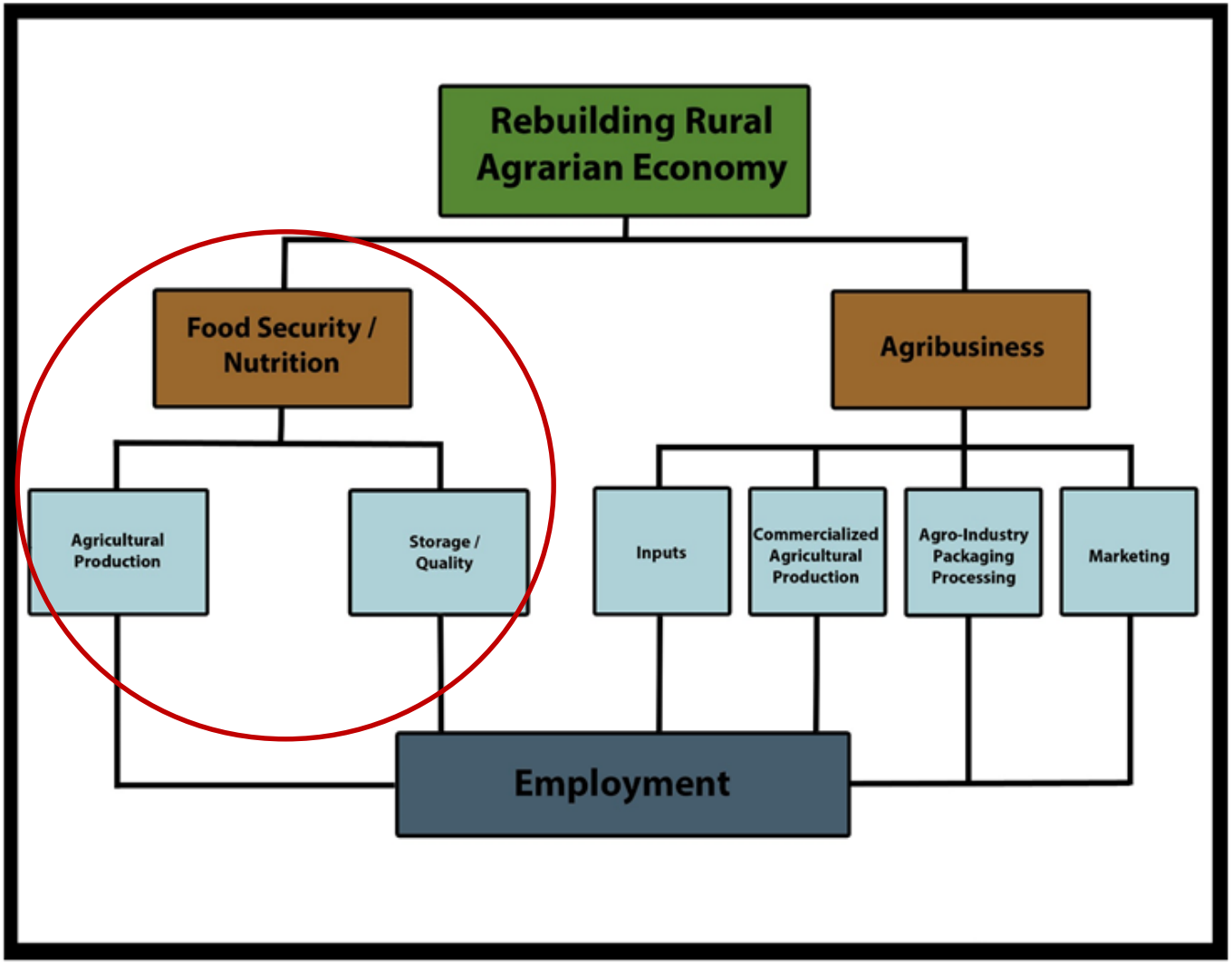
- Post-earthquake landslides closely followed the aftershock areas and concentrated more on high slope forested region.

- Limited land areas with less than 10% slope; most agricultural production occurring in higher slope areas.

- Soils associated with agriculture appear to be Chromic CAMBISOLS and Calcaric FLUVISOLS, while soils associated with post-earthquake landslide areas appear to be Euteric REGOSOLS. REGOSOLS are weakly developed mineral soils in unconsolidated materials.

- With higher resolution, soil maps can serve as a very valuable tool for resettlement planning as well as for sustainable land use development in the earthquake devastated districts.

Rebuilding rural agrarian economy while enhancing food security and generating employment and income



Conceptual model for rebuilding Gurkha earthquake devastated rural agrarian economy in Nepal

WFP destroys spoilt rice in Gorkha

Jul 20, 2015-The United Nations World Food Programme (WFP) on Monday destroyed 7.8 metric tons of spoilt rice that were distributed to earthquake survivors in Laprak VDC of Gorkha district. The WFP team burried 120 sacks (7.83 metric ton) of rotten rice that were stored in a WFP warehouse in Deurali VDC, Gorkha.

http://kathmandupost.ekantipur.com/news/2015-07-20/wfp-destroys-spoilt-rice-in-gorkha.html

Rotten or spoiled rice in NFC's rice godown in Birtamod, Nepal

78,291 quintals of rice for earthquake victims at stake.

http://www.ratopati.com/aakhabar/33275/#sthash.gWmZDDsh.dpuf

Rice Postharvest Processes

Corn storage in the mid-hills region of Nepal

Moisture is the enemy of dry products

- Vegetable seeds: 4-8% (no respiration)
- Cereal seeds: 9-12%
- Primary cereals: 12-14%
- Processed cereals: 10-12%

Hermetic packaging maintains desired MC. Hermetic packaging retains low oxygen and carbon-dioxide levels created by the respiration of the commodity inside.

Improving food security

Dry, monitor moisture and pack in hermetic containers

Cocoons

Tunnels

PICS Superbags

Hermetic (airtight) PICS bags made at Chitwon, Nepal (Nafseeds@gmail.com)

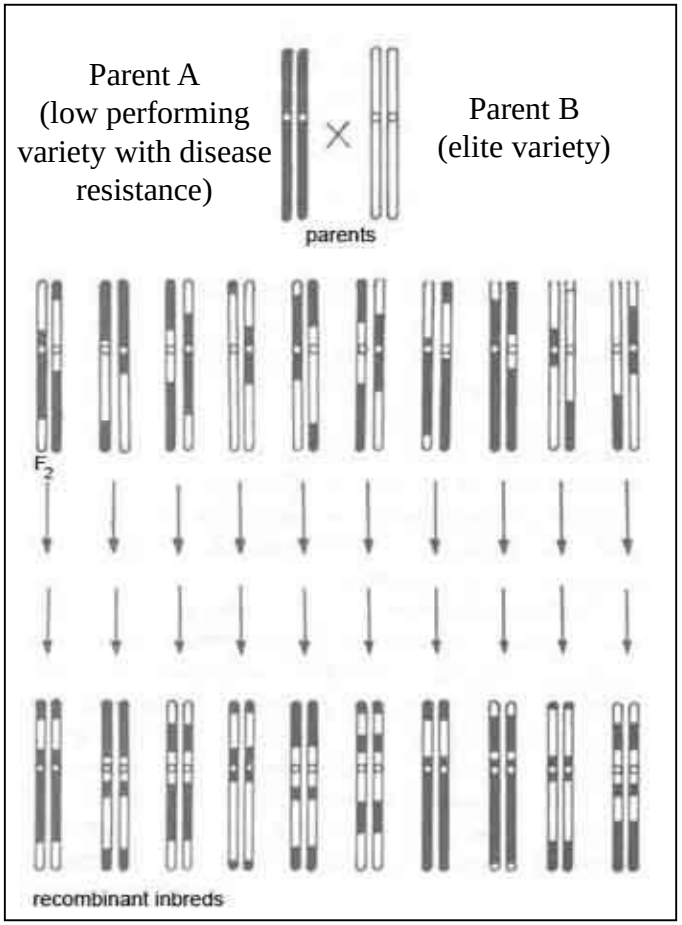
USAID FROM THE AMERICAN PEOPLE HORTICULTURE INNOVATION LAB UCDAVIS UNIVERSITY OF CALIFORNIA

Rebuilding Food Security for Earthquake Victims using Climate Smart Dry Chain Approach

Dr. Peetambar Dahal[1], Prof. Durga D. Poudel[2], Prof. Gokarna GC[3], Uttam Bhattarai[4], Dr. Yubak GC[5], Tulasi Gautam[6] Assoc. Prof. Amir Sapkota[7], Dr. Arjun Karki[8], Sanjita Pradhan[9], Asst. Prof. Dilip Panthee[10], Prof. Ganesh Shivakoti[11], Prof. Kent Bradford[12]

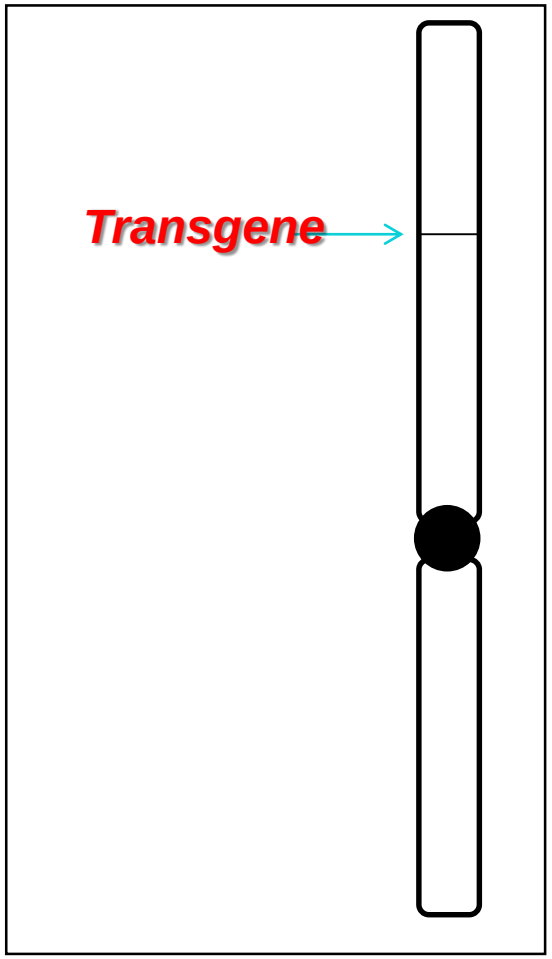
[1]Seed Scientist (Retired) and PhD (1994) from University of California, Davis, USA; Previously at the Dept. of Agriculture, Ministry of Agricultural Development (MOAD), Kathmandu, Nepal. Member, Asta-Ja Research and Development Center (Asta-Ja RDC), Kathmandu, Nepal.
[2]Soil and Environmental Scientist; Affiliated with University of Louisiana at Lafayette, Louisiana, USA; Ph.D. from University of Georgia Athens, Georgia, USA (1998); Previously at Agriculture Input Corporation, Nepal Bank Ltd., Department of Agriculture, MOAD, Nepal; World Vegetable Research and Development Center, Taiwan, and University of California; Davis; Founding President, Asta-Ja RDC, Kathmandu, Nepal.
[3]Molecular Biologist; Affiliated with the Palm Beach State College, Florida, USA; Ph. D. from Vrije Universitet Brussels, Belgium; Previously in Department of Agriculture, Institute of Agriculture and Animal Science, Tribhuvan University, Nepal and Council for Technical and Vocational Education (CTEVT), Nepal; and University of Gothenburg, Sweden; Advisor, Asta-Ja RDC, Kathmandu, Nepal.
[4]Secretary, Ministry of Agricultural Development, Government of Nepal.
[5]Director General, Dept. of Agriculture, MOAD, Nepal.
[6]Joint Secretary, Disaster Relief, Nepal Planning Commission, Nepal.
[7]Affiliated with School of Public Health, University of Maryland, USA.
[8]His Excellency Hon. Nepalese Ambassador to USA.
[9] **Commissioner Member White House Initiative on Asian Americans and Pacific Islanders.**
[10]Tomato Breeder and Geneticist; Affiliated with North Carolina State University, USA; Ph.D. from University of Tennessee, Knoxville, TN, USA. Previously at University of Birmingham and Reading, UK. Member, Asta-Ja RDC, Kathmandu, Nepal.
[11]Economist; Visiting Professor at University of Tokyo; Ph.D from Michigan State University; Previously at Institute of Agriculture and Animal Science, Chitwan, Nepal; Asian Institute of Technology, Bangkok, Thailand.
[12]Affiliated with Department of Plant Sciences, University of California, Davis, USA; Ph.D. (1981) from University of California, Davis.

Biotechnological Advancement



Conventional Plant Breeding

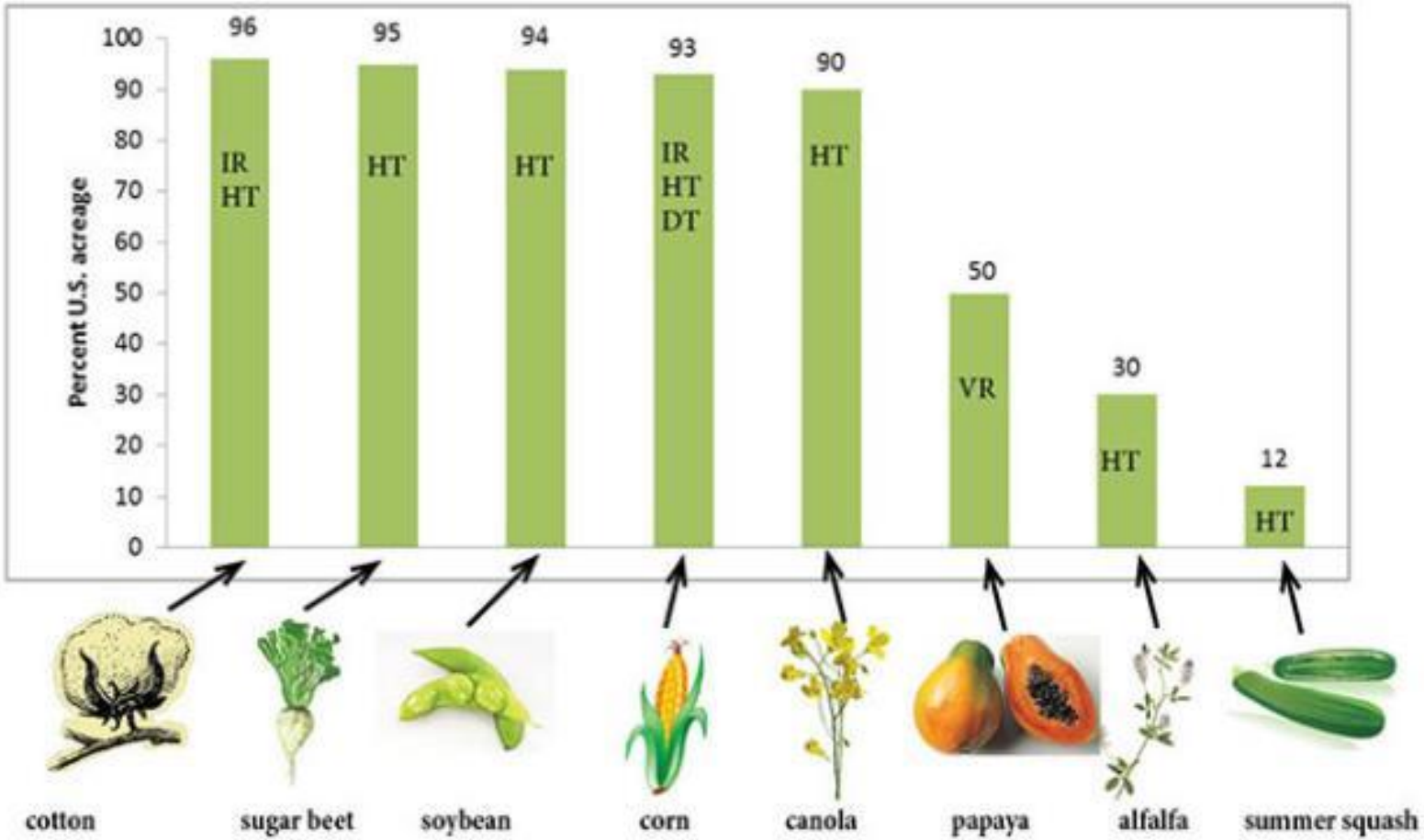
VS



Genetic Engineering

Courtesy: Dr. Dilip Panthee

GE Crops that have been commercialized in US



Courtesy: Dr. Dilip Panthee

What is a GMO? GE Crop Traits

- **Herbicide tolerance - crop can withstand herbicide applications**
- **Insect tolerance - plant produces toxin to kill pest**
- **Improved nutrition – plant produces a substance of nutritive value or is changed to not produce an antinutrient**
- **Disease resistant – crop is resistant to certain disease**
- **Stress Tolerance – crop is tolerant of stress, low nutrient levels or excess nutrients**
- **Increased Storage – crop can be stored longer to avoid spoilage losses**
- **Medicinal uses – crops that produce medicines or vaccines**
- **Industrial uses – crops to make more efficient industries**
- **Toxin removal - removal or silencing of genes responsible for toxins in plants**
- **Improved Metabolism – change in metabolism to improve efficiency**

Courtesy: Dr. Dilip Panthee

Who benefits most from crop biotech (GMO)?

Table 2 Average impact on yield, by technology, for developed and developing countries

Technology	Difference in yield (%)	Number of results	Minimum (%)	Maximum (%)	Standard error of the mean (%)
Developed countries	6	59	–12	26	1.0
Herbicide-tolerant cotton	0	6	–12	17	3.8
Herbicide-tolerant soybean	7	14	0	20	1.7
Herbicide-tolerant and insect-resistant cotton	3	2	–3	9	5.8
Insect-resistant corn	4	13	–3	13	1.6
Insect-resistant cotton	7	24	–8	26	1.9
Developing countries	29	107	–25	150	2.9
Herbicide-tolerant corn	85	1			
Herbicide-tolerant soybean	21	3	0	35	11
Insect-resistant corn	16	12	0	38	4
Insect-resistant corn (white)	22	9	0	62	6.9
Insect-resistant cotton	30	82	–25	150	3.5

Yield difference for adopters was calculated as (GM yield – conventional yield)/conventional yield, averaging yields across surveys, geographies, years and methodologies. The difference in the number of results reported in **Tables 1** and **2** is due to two results reported as 'positive' with no numerical value. A two-tailed *t*-test shows a significant difference between the average yields of developed and developing countries ($t = 7.48$, df = 134, $P < 0.0005$).

http://www.nature.com/nbt/journal/v28/n4/pdf/nbt0410-319.pdf

Courtesy: Dr. Dilip Panthee

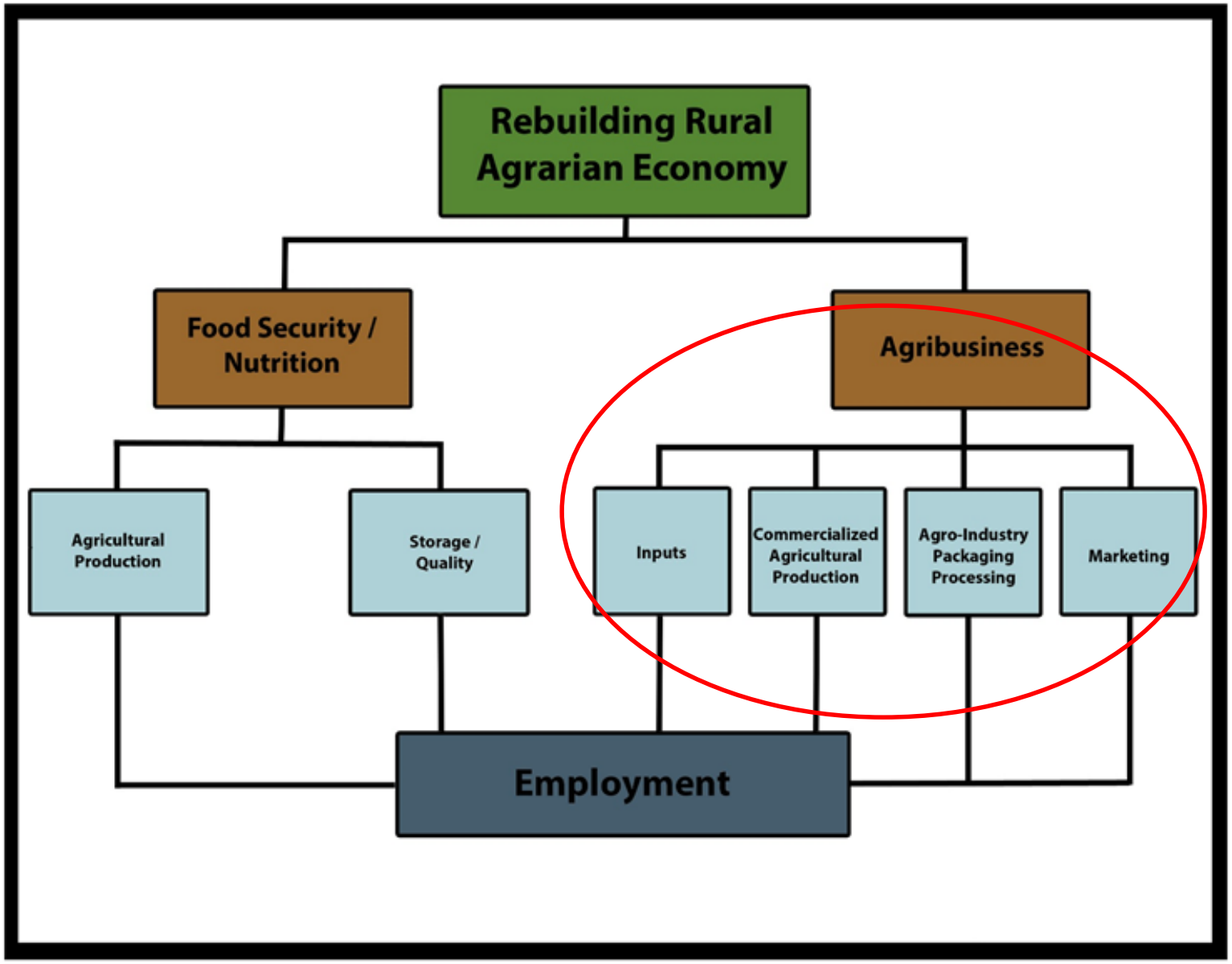
Are non-GMO foods necessarily more healthy?

European Commission - A decade of EU-funded GMO research

The main conclusion to be drawn from the efforts of more than 130 research projects, covering a period of more than 25 years of research, and involving more than 500 independent research groups, is that biotechnology, and in particular GMOs, are not per se more risky than e.g. conventional plant breeding technologies.

https://ec.europa.eu/research/biosociety/pdf/a_decade_of_eu-funded_gmo_research.pdf

Courtesy: Dr. Dilip Panthee


Rebuilding Rural Agrarian Economy
Food Security / Nutrition
Agribusiness
Agricultural Production
Storage / Quality
Inputs
Commercialized Agricultural Production
Agro-Industry Packaging Processing
Marketing
Employment

Number of Registered Agriculture and Wildlife small and cottage industries (as of 2009) in earthquake devastated districts of Nepal (MPRC, 2010).

District	No. of Agriculture and Wildlife industries	District	No. of Agriculture and Wildlife industries
Okhaldhunga	41	Makwanpur	47
Dolakha	17	Parsa	7
Sindhupalchowk	66	Chitwan	299
Rasuwa	25	Gorkha	36
Sindhuli	37	Lamjung	44
Ramechhap	43	Tanahu	89
Kavrepalanchowk	243	Syangja	3
Lalitpur	47	Kaski	93
Bhaktapur	84	Parbat	34
Kathmandu	297	Palpa	6
Nuwakot	101	Nawalparasi	80
Dhading	100		
Total	1101		738

Small and cottage industries

Cheese production

Mushroom production

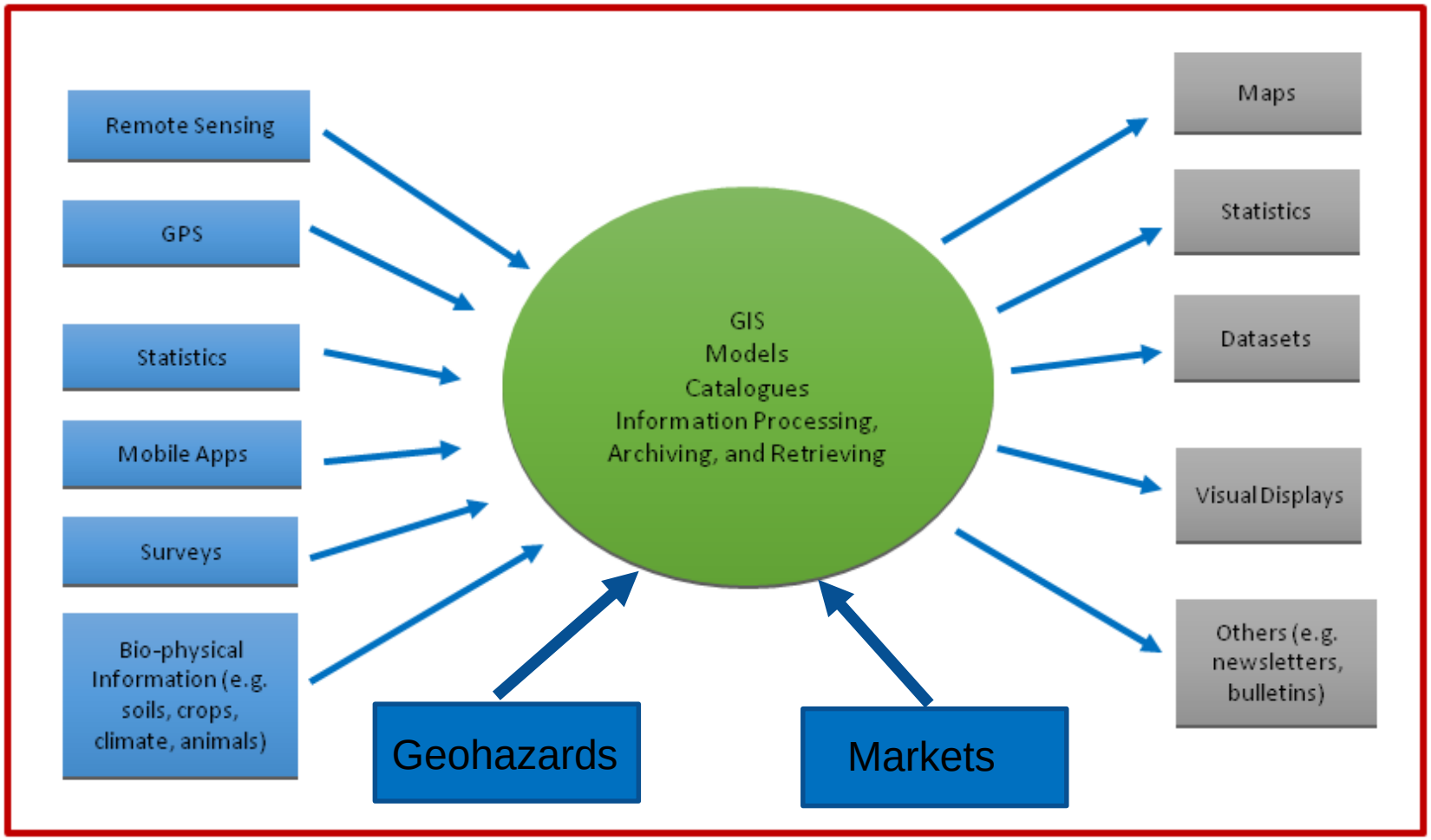
Wooden handicraft

Oil extraction

Carpet production

Pashmina production

Nepal Agri-business Information System (NAIS)



The School of Geosciences at the University of Louisiana at Lafayette, Louisiana, USA is collaborating with the Asta-Ja Research and Development Center (Asta-Ja RDC), Kathmandu, Nepal for the development of Nepal Agri-business Information System (NAIS).

- Cottage industries such as organic coffee, cheese, leather products, handcrafts, garments, carpets, bamboo works, pickles, honey, woolen products, spices, and dairy products were commonly found in the earthquake devastated areas.

- The earthquake has not only devastated these industries through loss of lives, destruction of buildings and the damages of equipment, it has also hampered the industries by damaging roads and disrupting communication and marketing activities.

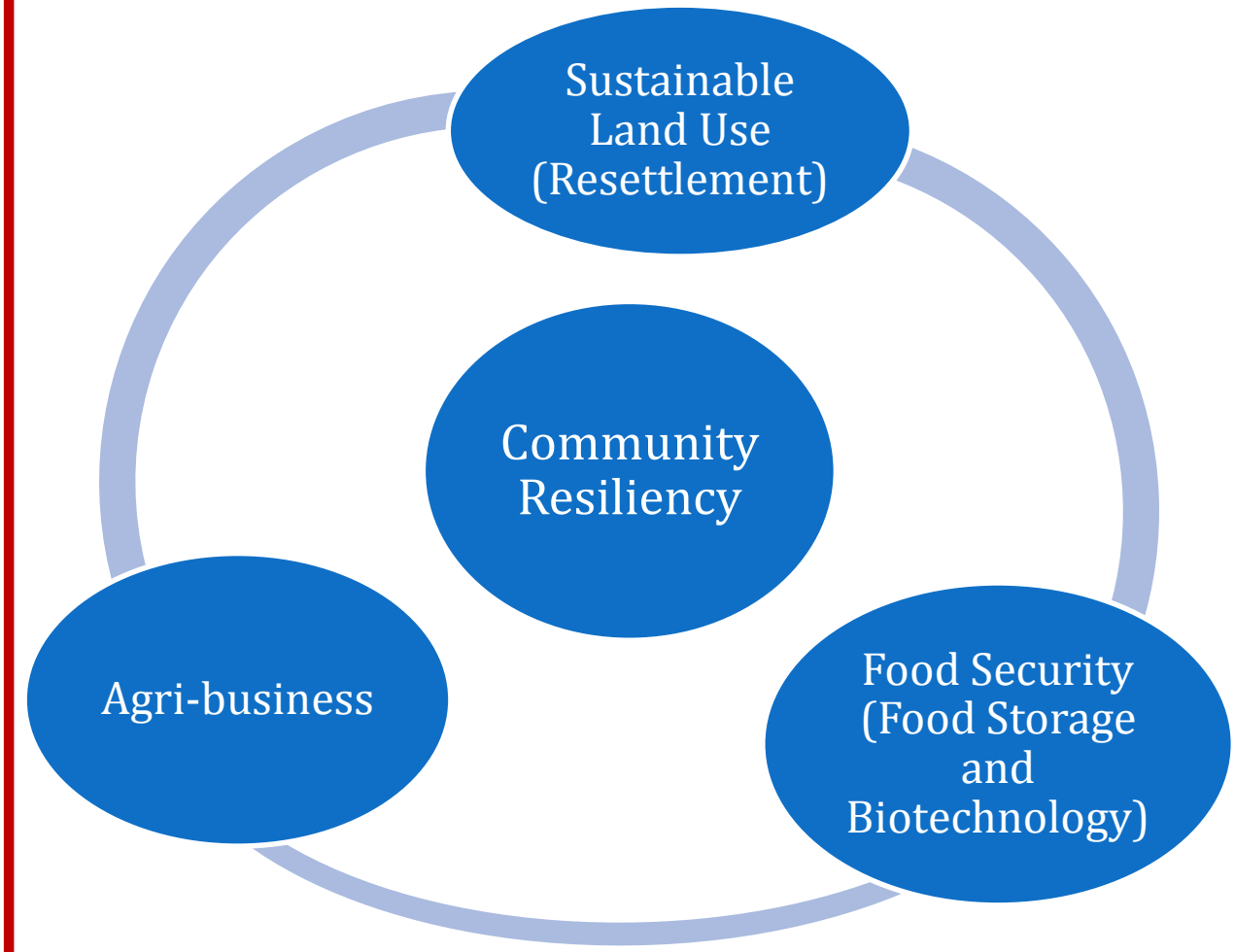
- The earthquake devastated communities are not able to take care of these industries due to their financial losses, lack of manpower, disrupted inputs and raw materials supplies, and other technical difficulties.

- Rejuvenation and the development of agri-business in the region will provide jobs and income in rural communities, creating opportunities to both rebuild from within and raise the standard of living.

- Local communities will benefit from increased income and employment, enhancing rural development, accelerating earthquake recovery, and raising the standard of living.

Asta-Ja RDC decides Land Use Planning, Food Security and Agri-business as its major R&D agenda for Community Resiliency

ASTA - JA for PROSPERITY



Three Cornerstones of the Community Resiliency

Conclusions

- The widespread devastation has also created a once-in-a-millennia opportunity for resettlement planning, sustainable land use development, food security enhancement, and agri-businesses promotion in Nepal.

- Soil information and maps will be very helpful in resettlement planning and the development of sustainable land use types in the region.

- Development of a GIS-based Nepal Agri-business Information System (NAIS), which will promote/facilitate agri-businesses, is necessary for rebuilding rural agrarian economy in the earthquake devastated region.

- It is important that rebuilding efforts must be coordinated with resettlement planning, research and development, land use planning, food security and agri-business for nation's fast-paced socio-economic development, and geohazard risk reduction.

- Sustainable land use planning, food security, and agri-businesses are the three cornerstones for community resiliency and a resilient Nepal.

Acknowledgements

Thanks to GreaterGood.Org and the hunger site for funding SuperGrain Bags and seeds relief for earthquake victims. Thanks to SNEHA and AIA for providing funding support for roofing materials and blankets. Also, thanks to Ministry of Agriculture, GoN, Asta-Ja RDC, Asta-Ja Abhiyan Nepal, DADOs, and Asta-Ja volunteers for supporting the relief work. Special thanks to students Mr. Ian Isaacs, Mr. Grant Kleiner, Mr. Bryce Landreneau, and Mr. Ajay Bhandari at UL Lafayette for their work on data processing and database development. I acknowledge all those who took pictures that I have presented here which were posted online or were shared with me. Special thanks to Dr. Peetambar Dahal, retired seed scientist from UC Davis, USA, for his help on Climate Smart Dry Chain Approach.

Thank you for your attention!