



# The Status of National Soil Resource of Bhutan



Asian Soil Partnership Consultation Workshop on Sustainable  
Management & Protection of Soil Resources

13<sup>th</sup> to 15<sup>th</sup> May 2015, Bangkok, Thailand

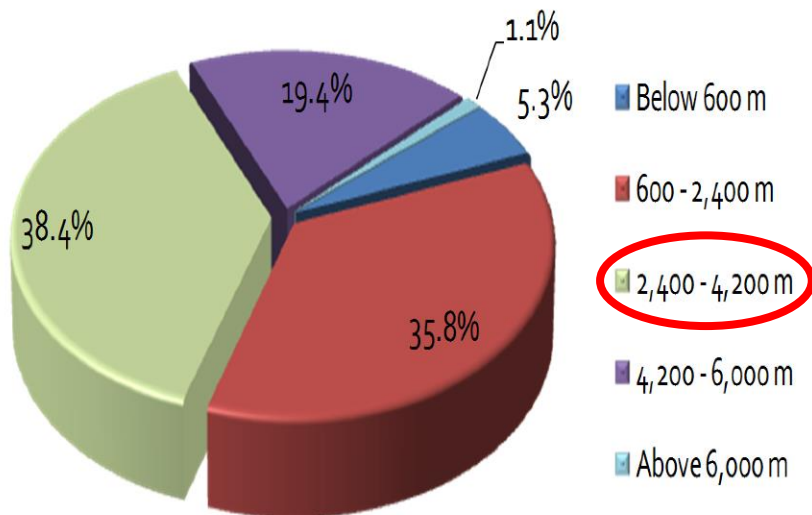
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# Introduction-*The Country* (*contd.*)



**%of Area by Altitudinal Range**

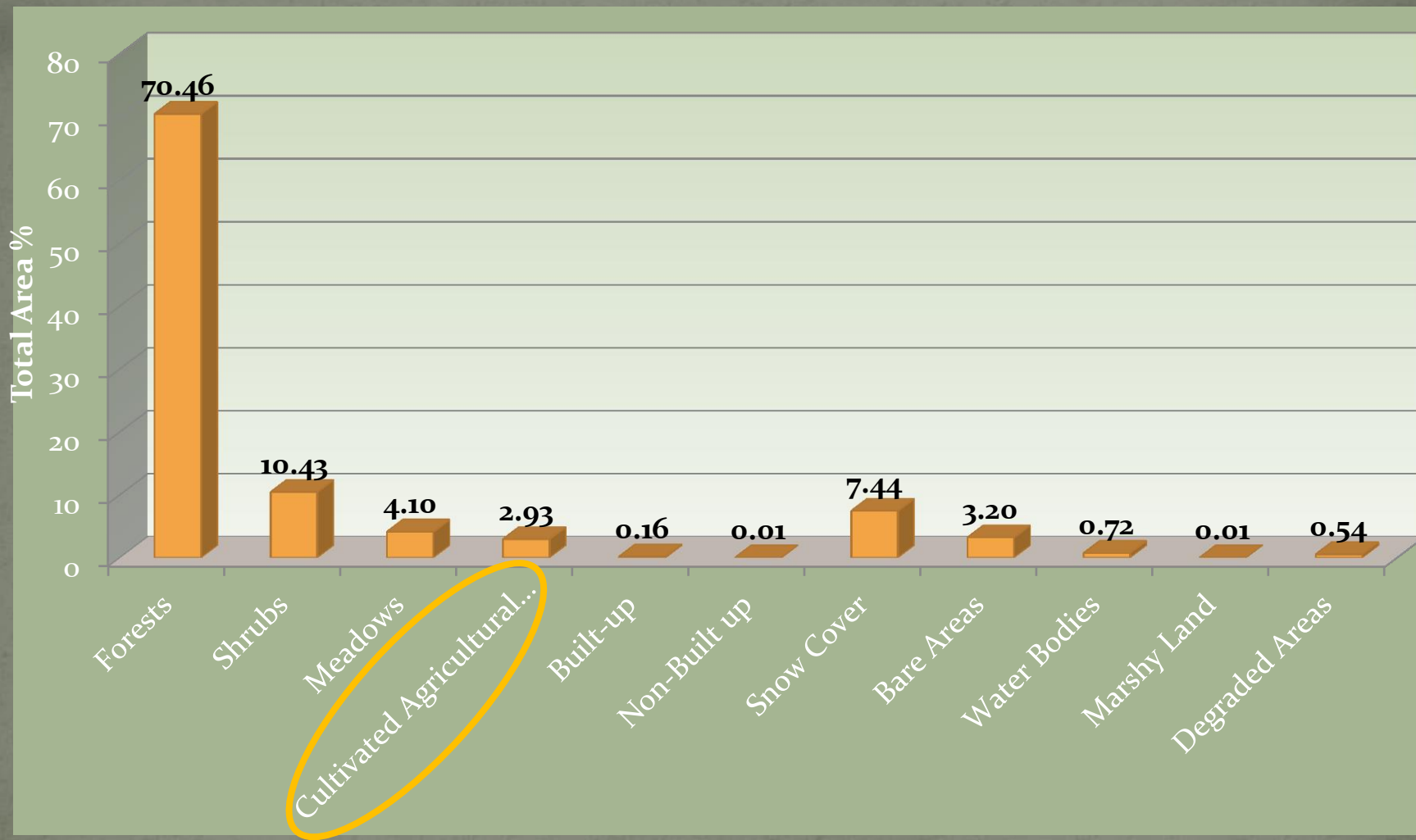


- Total land area → 38,394. km<sup>2</sup>
- Population → 745,153
- Country agrarian ≈ 69% population depend on agriculture
- Farming → largely subsistence based on traditional knowledge with low farm inputs
- Average land holding → < a hectare
- Arable land size → 7.85 % of the total land area
- Agriculture GDP share → 16.2%



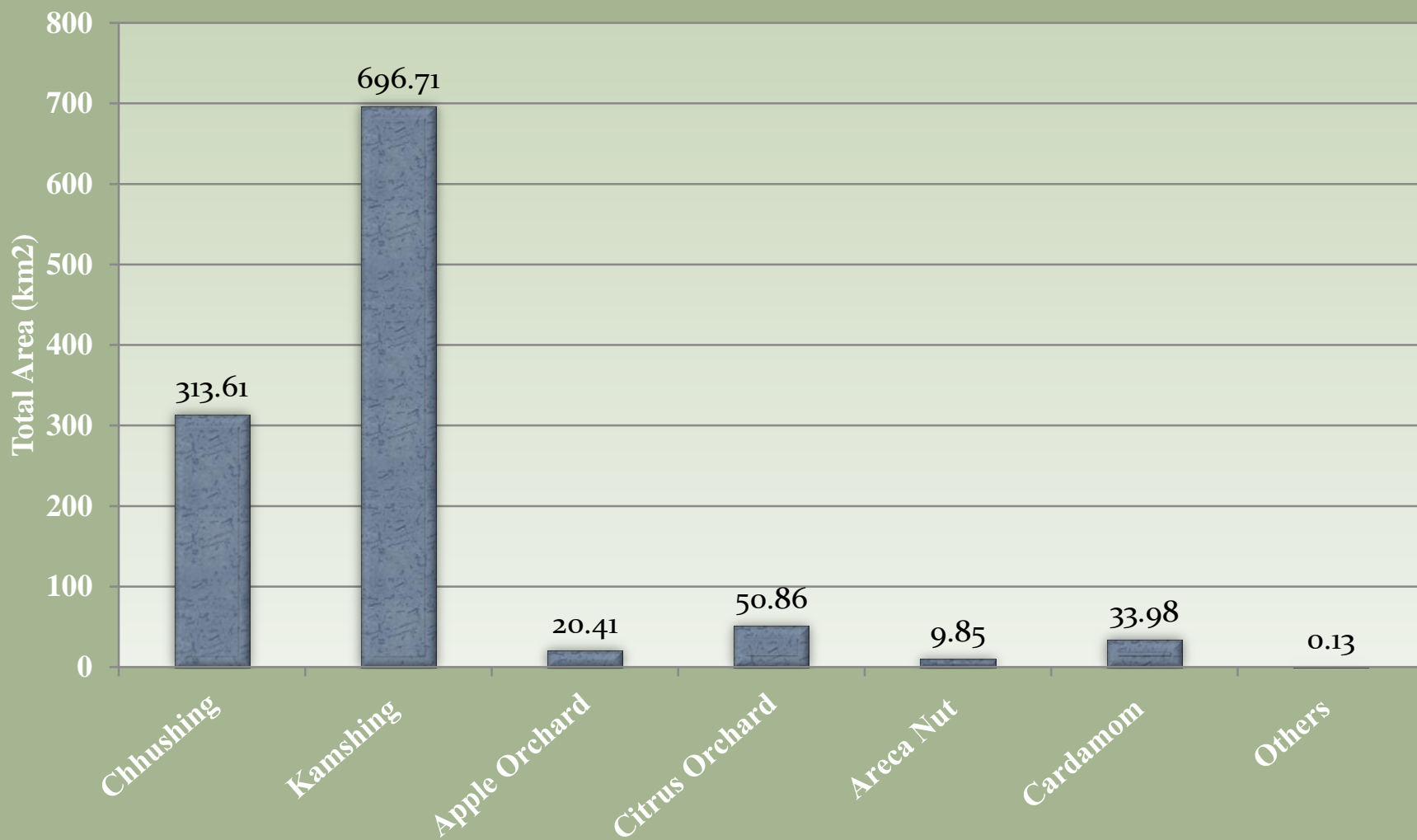


# Land Cover





# Agricultural Land





# Introduction: *Climate, vegetation & soil*



- Within the elevations of 150 to 7550 masl:
  - Climatic zones range from subtropics with high rainfall of about 5,500 mm to alpine with just 400 mm
  - Vegetation vary from sparse high altitude steppe to tropical & subtropical broadleaf forests and river scrub
  - Soils differ from soils formed from Tethyan meta-sediments in the High Himalayas to Quaternary Alluvium in the southern foothills



# Status of soil resource – soil information



- Information on geology and soils important for Bhutan
- Comprehensive information on soils not available
- Geology : 1983, the Geology of Bhutan by Augusto Gansser
- Soils : Karan (1967), Okazaki (1987) & FAO (1983) worked on soil groups for Bhutan using soil chemical and physical properties, precipitation and altitude



# Status of soil resource - soil types



- **FAO/UNESCO (1977) :**
  - $\approx 27\%$  of soils fall under either Cambisols (mid altitude) or Fluvisols (southern belts)
  - $\approx 45\%$  of soils are Acrisols, Ferralsols and Podzols
  - $\approx 21\%$  of soils lithosols on steep slopes
  - Non-volcanic andosols present in few pockets across the country
- Soil types vary along different altitudes and despite steep gradients there are areas of deep and well-developed soils suitable for cultivation
- Farming on steep slopes is limited more by the risks associated with steep slope cultivation such as erosion and climate than by poor soils





# Status of soil resource - soil nutrient status



- The overall soil nutrient status or chemical properties of the soils in Bhutan:
  - Soil pH : within the low to medium range
  - Exchangeable Al saturation % : low to very low indicating no aluminium toxicity
  - Organic Matter content : moderate
  - C:N ratio : between 11 to 14.1 (typical for agricultural soils)
  - P & K contents : low in most soils (However phosphate deficiency is considered more severe as the underlying geology is rich in potassium)
  - BS% : low or very low in most soils
  - CEC : low in most soils



# Status of soil resource-soil *nutrient status*



- Land use and agro-ecological zone are the most important factors determining variation in soil nutrient status in Bhutan.
- Dryland soils mostly have a higher soil nutrient status than wetland soils
- Warm temperate and dry subtropical soils have the most favourable soil nutrient status while humid and wet subtropical soils have low nutrient status
- Different soil fertility management practices followed by farmers on different land use types also contribute to the variation in soil nutrient status.



# Status of soil resource – *current soil mgt. practice*

- Soil managed largely in traditional ways
  - Soil fertility management is mainly through integrated system of using both organic & inorganic sources of plant nutrients
  - In remote parts of the country where access to modern agricultural inputs is limited, farming is very traditional using traditional system of soil fertility management
  - Sustainability of the traditional SFM system is very much dependent on the household labour availability & livestock number
    - Farm labour shortage, decline in livestock size & increasing distance to forests for leaf litters threaten the sustainability of the SFM system



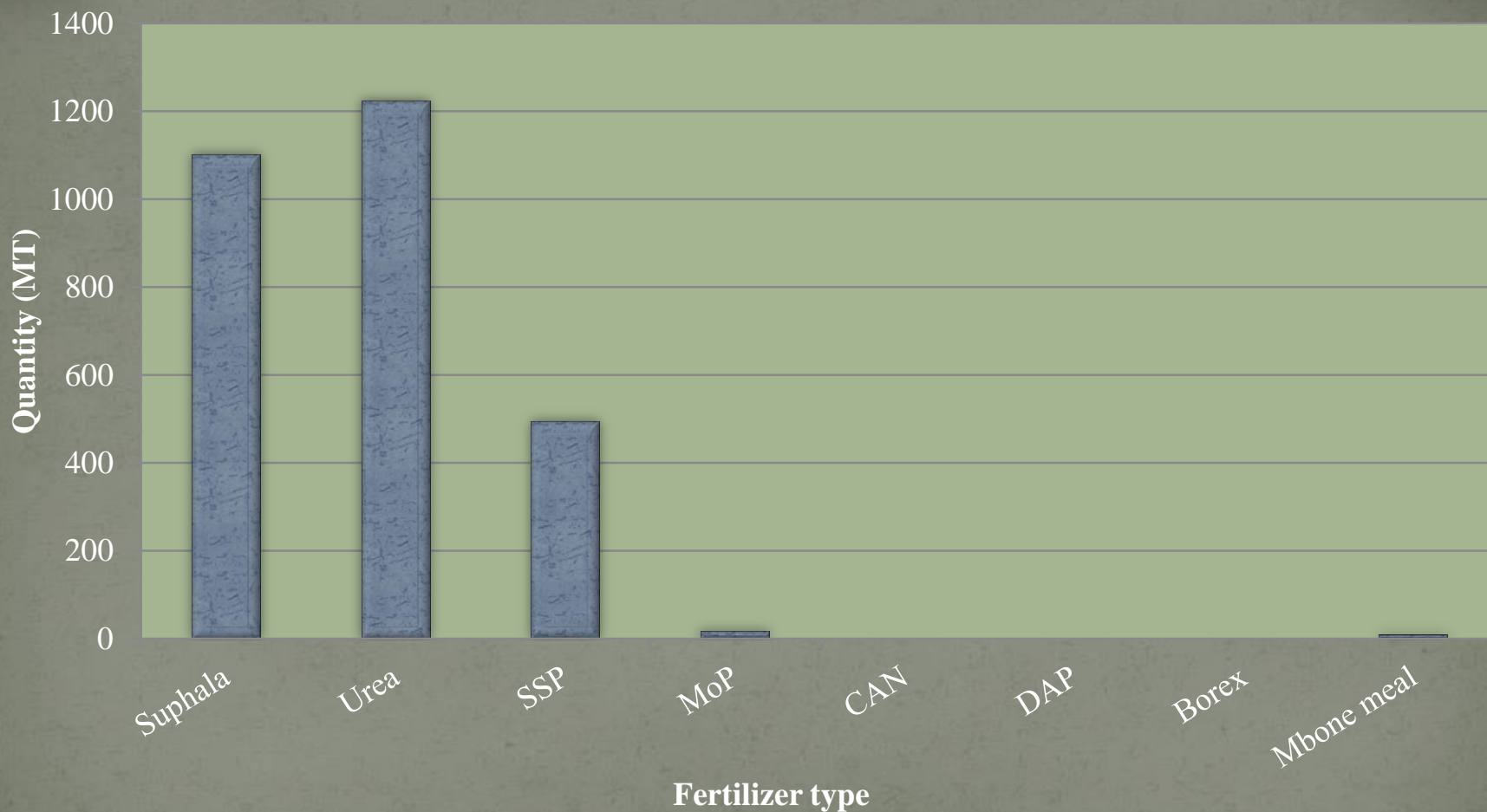
# Status of soil resource – *current soil mgt. practice.....contd.*



- Current SFM practice involves using inorganic fertilizers along with organic sources of plant nutrients due to:
  - increased awareness among farmers of the benefit of using inorganic fertilizers;
  - increased and improved access to inorganic fertilizers;
  - farmer's enhanced purchasing power;
  - Inorganic fertilizers are used mainly in cash crops e.g. potatoes & apples



# Status of soil resource – *current soil mgt. practice.....contd.*



Types of inorganic fertilizers and quantities distributed between July 2013 and June 2014.



# Status of soil resource – *current soil mgt. practice.....contd.*



- A steady increase in the amount of inorganic fertilizers imported and distributed : from about 250 MT in 1960 to 2998 MT in 2006
- Import and distribution between July 2013 and June 2014 : about 2848 MT.
- The long term goal of the country is to produce its food crops organically or at least provide options to the farmers between organic and conventional ways of growing food crops.
- As Bhutan ventures into achieving this objective, the use of inorganic fertilizers & plant protection chemicals will decline or keep their use as low as possible



# Status of soil resource – *current soil mgt. practice.....contd.*



- Current use of inorganic fertilizer is very low as compared to many countries in the region
- Top soil erosion resulting in declining soil productivity is a huge problem affecting crop growth and yield especially in dryland on steep mountain slopes.
- To prevent soil erosion and other forms of land degradation, farming on steep slopes are characterized by series of terraces, contour bunds, hedgerows and other methods of sustainable land management.



# Status of soil resource – current soil mgt. practice.....contd.







# Main Issue : *land use in general*



- Four factors have greatly influenced evolution of land use in Bhutan:
  - The biophysical setting, population dynamics, the history of land allotment and access to public land, and the level of economic development of the farming community.
  - Inefficient land utilization and low production per area, environmental degradation, difficulties associated with intensification of agriculture and the diversification of rural labour into non-agricultural activities influence the development of agriculture in the country.
  - The naturally limited land resource for agriculture due to difficult topography, land fragmentation and lack of land use policy are other important issues.



# Main Issues & Soil Threats

- Eastern Himalayas : among the most complicated landscapes in the world - soil information gathering is a challenging task
- Difficult terrain & topography & limited resources including technical and financial resources are the main constraints in generating good soil information
- Lack of good comprehensive soil information is a huge drawback
- No national soil maps, which are crucial for informed planning and decision making purposes



# Main Issues & Soil Threats

## ..contd



- The predominantly steep slopes put the limited productive land resources at risk from various forms of degradation.
- Direct factors : overgrazing, forest fires, excessive forest use, unsustainable agricultural, poor irrigation system management, infrastructure development, unsustainable mining, industrial activities, urbanization, and solid waste
- Indirect factors are population growth and structure, poverty, climate change and policy and institutional issues



# Main Issues & Soil Threats ...contd.



- Labour force availability
- The Poverty-SLM linkage
- Remoteness / input supply costs
- The considerable “gestation time” for long-term SLM interventions
- Cumbersome approaches: resource-intensive nature of SLM approaches
- Sectoral approach to combating land or soil degradation : green sector versus brown sectors



# Main Issues & Soil Threats

## ...contd.



- With increasing population, the already limited arable land is dwindling both in size and productivity.
- On rugged and steep slopes cultivation in most cases is practiced without proper soil and water management measures.
- Improper management of irrigated paddy lands on steep slopes, shortening of fallow period of *tseri* (slash and burn), burning crop residues, and lack of cover crop establishment when necessary have caused land degradation in numerous places.
- Intensification of agricultural production as farmers' move from traditional subsistence farming to market – based farming and with the introduction of high yielding improved crop varieties, use of inorganic fertilizers has added to the problem.



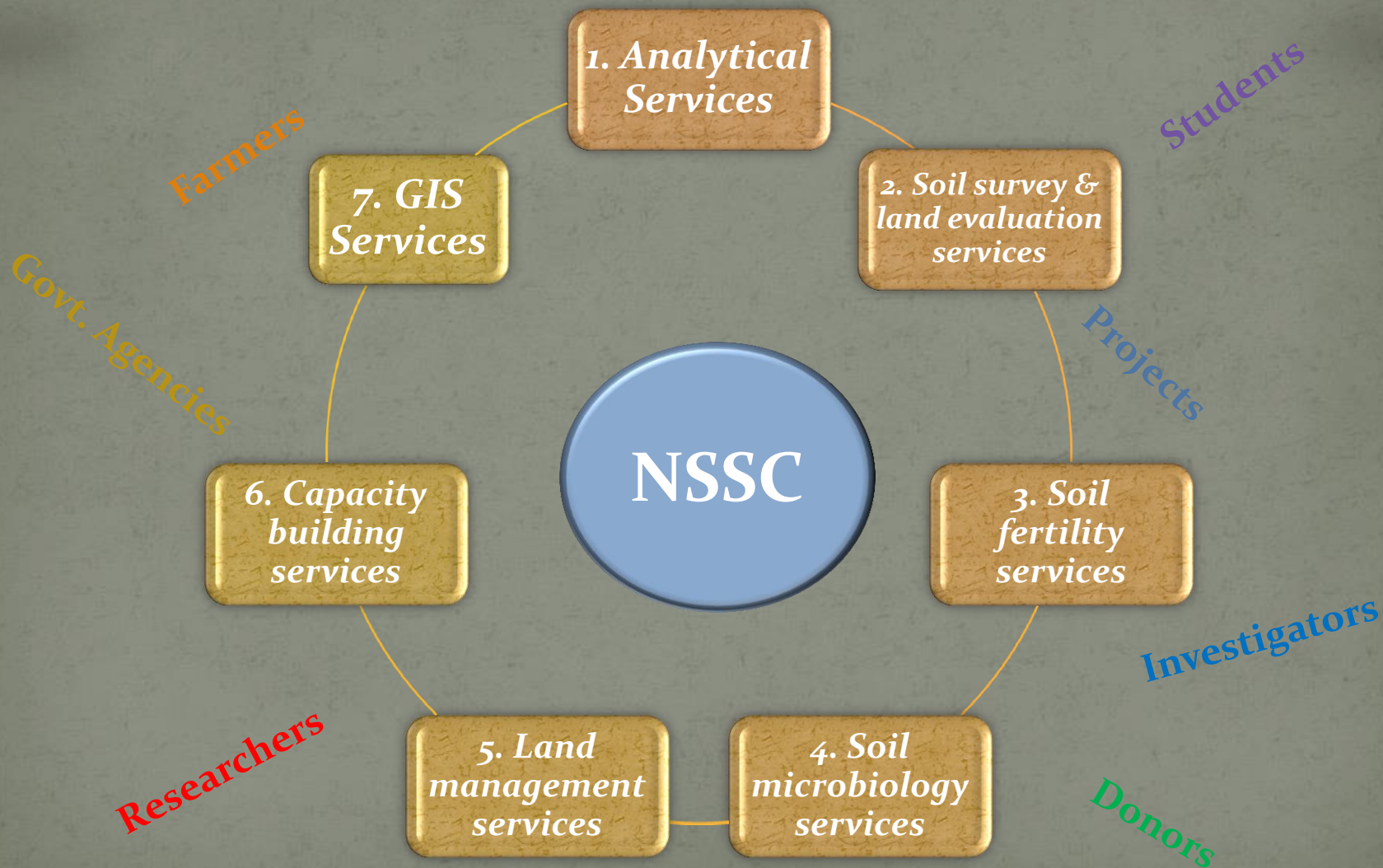
# Main Issues & Soil Threats ...contd.



- Imbalanced use of inorganic fertilizers and nutrient mining are the main contributing factor under intensive cultivation. Nutrient mining is also a serious problem in areas with subsistence farming and poor soil fertility management.
- In the absence of proper land suitability and capability classification systems, land is not being used optimally and sustainably.
- Soil/land degradation : threat to the livelihoods of subsistence farmers, country's objective to achieve food self sufficiency and security and hydropower generation, the country's growing revenue source.



# Ongoing activities: *National Soil Services Centre*





# Ongoing activities : *includes the following...*



- Soil erosion rates for Bhutan being established with long term erosion plots in several locations across the country
- Soil surveys being conducted for digital soil mapping
- A systematic soil database *viz.* Bhutan Soil Database (BHUSOD) is being established and built upon
- Long term study on the soils of major crops conducted to study changes in soil fertility status over time under farmer soil fertility management practices





# Ongoing activities : *includes the following...*



- Forest soils analyzed for carbon stock as the part of the country's forest inventory exercise
- Land swapping and resettlement programs implemented to protect marginal soil/land from degradation
- The National Action Program to combat land degradation being implemented
- UNCCD's Land Degradation Neutrality (LDN) Project is being implemented as one of the fourteen pilot countries



# Ongoing activities : *includes the following...*



- Sustainable soil/land management technologies and approaches being implemented with funding support from GEF/SGP
- Land Degradation mapping of lower Ammo Chhu basin with financial support from South Asian Association of Regional Cooperation (SAARC).
- On farm & on station soil fertility trials conducted to establish crop nutrient requirements and soil nutrient budget



## Ongoing activities : *includes the following...*



- Ways and means to supply bio-fertilizers and bio-pesticides to replace inorganic fertilizers and plant protection chemicals are being explored
- Promotion of payment for environmental services
- Research on using soils as proxies of environmental fluctuation in the south eastern slopes of the Bhutan Himalaya



# National priorities of sustainable soil management ..include



- Mainstreaming sustainable soil & land management into government policies & plans
- Finalizing land policy
- Granting land to landless
- Implementing National Action Program
- Promotion of organic agriculture though out the country



# National priorities of sustainable soil management ..include



- Producing soil maps
- Building capacities of the regional research and development centres to enable them to handle soil and land related issues more efficiently & effectively
- Building good soil database
- Promoting and implementing SLM technologies and approaches across the country



*Thank you & Ka-drin-chey!*

