Sustainable Intensification of Agriculture in South Asia

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1. Background
2. Challenges ahead for Conventional high Input Agriculture
3. Sustainable Intensification of Agriculture (SIA)
4. SIA and its importance in South Asia
5. Pathways towards SIA
6. Conclusions
Background

- Rapid Population Growth, Increased Food Demand
- Scarcity of Resources, Environmental Pollution,
- Greater GHG Emissions and Global Warming
- Brundtland Report on Sustainable Development
- UN Earth Summit, other Conventions and Agreements
- Post 2015 Agenda: Sustainable Development Goals (SDGs)
Agriculture and Poverty

- Estimated 702 million people (9.6% of the global population) are living in extreme poverty (less than US$ 1.90 per day).
- South Asia accounts for 37% of world’s poor and nearly half of the malnourished children.
- Nearly 80% of poor live in rural area and earn their living by agriculture and allied activities.
- Agriculture has key role to play in ending poverty and zero hunger (SDG 1 and 2) in South Asia.
The global population is expected to reach 9.7 billion by 2050.

Developing countries need to increase food production by nearly 100%.

To Feed ...  
+2 billion

We Need ...  
+1 billion tonnes of cereal
+200 million tonnes of livestock

By 2050  
every year
What Challenges ahead are in Conventional Agriculture?

Limit to Expansion of Arable Land

- In South Asia, 94% of the potential farm land is already in use.
- By 2030, 98% of all potential agricultural land would come under cultivation.

Source: Land Commodities Research
Soil and Land Degradation

- A total of about 2 billion hectares of land areas are degraded. In South Asia about 25% crop and pasture areas are degraded by water erosion.

- Major drivers are water and wind erosion, livestock grazing, over tillage, desertification etc.

- Soils have been suffered from nutrient loss, soil acidity, compaction, salinity and in some cases toxic materials accumulation.
The per capita availability of water has been rapidly decreasing worldwide.

- SA has only about 4.5% of world’s renewable water.
- Water productivity is one of the lowest.
- Average irrigation efficiency is below 40%.
- Water demand: Agriculture (70%), Industry (22%), Human Consumption (8%).
Pesticides Use Impacts

- Pesticides and Environmental Implications
  - Pesticides Use is Rising
  - Human Health Hazards
  - Pest Resistance to Pesticides
  - Pesticides Treadmill
  - Disruption in Pest-Predator Relation
  - Environmental Pollution
# Fertilizer Consumption Intensity, Kg/ha
![World Bank](https://www.worldbank.org/indicator/ag.con.fert.xls)

<table>
<thead>
<tr>
<th>Country</th>
<th>2002</th>
<th>2013</th>
<th>2014*</th>
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</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>3.4</td>
<td>5.0</td>
<td>12.3</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>188.6</td>
<td>208.7</td>
<td>279</td>
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<tr>
<td>Bhutan</td>
<td>9.8</td>
<td>15.2</td>
<td>15</td>
</tr>
<tr>
<td>India</td>
<td>100.3</td>
<td>157.5</td>
<td>165</td>
</tr>
<tr>
<td>Maldives</td>
<td>6</td>
<td>201.5</td>
<td>207.4</td>
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<tr>
<td>Nepal</td>
<td>16.7</td>
<td>57.7</td>
<td>67.4</td>
</tr>
<tr>
<td>Pakistan</td>
<td>97.5</td>
<td>135.3</td>
<td>134.4</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>304.6</td>
<td>160</td>
<td>245</td>
</tr>
<tr>
<td>South Asia</td>
<td>99.8</td>
<td>149.3</td>
<td>158.5</td>
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<tr>
<td>Average</td>
<td>98.7</td>
<td>120</td>
<td>138</td>
</tr>
</tbody>
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**Growing Use of Chemical Fertilizers**

- Global fertilizer nutrient consumption is expected to reach 192 million MT in 2017.
- South Asia is the second largest fertilizers consuming region in the world.
- Fertilizers are responsible for 14% agricultural GHG emissions, soils and water pollutions.
Nitrogen use efficiency in cereal production decreased from 80 to about 20 percent between 1960 and 2000 globally.

In South Asia, nutrient ratio was 6.5:2.4:1.1, ideal ratio is considered to be 4:2:1 for NPK use efficiency.

Adopt Integrated Soil Nutrient Management System
Since the introduction of HYVs of crops in 1930s, 75% of crops diversity was lost.

Rice, Wheat and Maize are providing 60% diet worldwide today.

In 1960s there were 30,000 wild rice varieties, now less than 50 are expected to survive.
Agriculture and Climate Change

- 1/3rd GHG from Agriculture Sector
- Major sources are Livestock, Manure, Fertilizer, Paddy Field and land conversion and biomass burning
- Food grain import will rise nearly 3 times by 2050 in developing countries
Yield Growth Slowdown

- Global cereal production increased by an average of 3.6% between 1960 & 1970 but only by 0.6% between 1990 & 2000.

- Diminishing returns to modern HYVs, deteriorating quality of water and soils and toxin build up and climate change impacts.
Nearly one third or 1.3 billion metric tons of global food per year is either lost or wasted or thrown away.

About 40% food losses occur in both developing and developed nations.

Which regions waste the most food?
Per capita food losses and waste, kg/year

Source: The Food and Agriculture Organization of the United Nations (FAO)
## Low Investment on Agricultural R&D

<table>
<thead>
<tr>
<th>Country</th>
<th>Spending as % of AGDP</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1996</td>
</tr>
<tr>
<td>Bangladesh</td>
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<tr>
<td>Nepal</td>
<td>0.25</td>
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<tr>
<td>India</td>
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<tr>
<td>Pakistan</td>
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<tr>
<td>Sri Lanka</td>
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<tr>
<td>Japan</td>
<td>4.03</td>
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<tr>
<td>Australia</td>
<td>4.06</td>
</tr>
<tr>
<td>S Korea</td>
<td>1.66</td>
</tr>
</tbody>
</table>

Source: Flaherty et al, 2013
Sustainable Intensification of Agriculture
Sustainable Intensification Of Agriculture

- Intensification here means increasing the efficiency of inputs use.
- More crops per kg of nutrient, per drop of water, per unit of energy.
- More production, yield or income per unit of land, input or energy with minimum impacts on environment.
Why Sustainable Intensification?

- To address the need for increasing agricultural production, and improving the efficiency and resilience of the food system.
- To address scarcity of resources such as water and other natural capitals and cope with climate change impacts and mitigation procedures.
SDG 1: **No Poverty** — End Poverty in all its form everywhere

SDG 2: **Zero Hunger** - End Hunger, Achieve Food Security and Improve Nutrition and Promote Sustainable Agriculture

SDG 6: **Clean Water and Sanitation** — Ensure Availability and Sustainable Management of Water and Sanitation

SDG 7: **Affordable and Clean Energy** - Energy Access to Affordable, Reliable, Sustainable Management and Clear Energy for All

SDG 12: **Responsible Consumption and Production** — Ensure Sustainable Consumption and Production Patterns

SDG 13: **Climate Action** - Take Urgent Action to Combat Climate Change and Its Impacts

SDG 14: **Life Below Water** - Conserve and Sustainably Use of the Oceans, Seas and Marine Resources for Sustainable Development

SDG 15: **Life on Land** - Protect, Restore and Promote Sustainable use of Terrestrial Ecosystems, Sustainably Manage Forests, Combat Desertification and Halt and Reverse Land Degradation and Halt Biodiversity Loss
Agriculture is the mainstay of South Asian countries.

The average annual growth of cereal production was 2.49 percent for the last 50 years.

Food Security is becoming major priority in the region.

Agriculture is dominated by smallholders. The major farming system is rain fed.

Cropping systems are cereal dominated and productivities of major crops are at or below world average.
Major Challenges as identified by 5th SAARC Technical Committee on ARD

- Low and unstable growth rate in agriculture
- Non-shifting of labor force from agriculture to non-agriculture.
- Widespread poverty, hunger and under nutrition
- Growing natural resource degradation affecting sustainability of agriculture
- Vulnerability of the region to natural disasters due to climate change
- High energy price and high inputs and costs of production
- Growing vulnerability to agricultural pests and diseases creating biosafety and biosecurity threats
Major Opportunities as of the 5th SAARC TC-ARD

- A large yield gap, input use, and better use of modern technologies.

- Better management, use and conservation of natural resources, biodiversity and ecosystem services to protect the environment and enhance agricultural systems.

- There is a huge potential for HRD and their capacity building in agriculture.

- Bridging rural infrastructural gap.
The region is home to the largest number of people who are hungry and live below the poverty line.

There is a need to double the food production by 2050 without further harming the environment and natural resources.

South Asia has agro-ecological disadvantages compared to temperate regions of the world. Crop yields nearly 50% lower than temperate regions.

South Asia is projected to be worst affected by climate change.
A Conceptual Framework of Sustainable Intensification of Agriculture

**Key Agroecological Pathways**
- Water Use Efficiency
- Conserving Biodiversity
- Improved Genetic Resources
- Farming System Approach and Multiple Cropping
- Integrated Soil Nutrient Management
- Integrated Pest Management
- GHG Mitigation & Adaptation

**Socio-Economic Pathways**
- Access to Market/Trade
- Reducing Food Wastage
- Reducing Meat & Dairy Consumption
- Reducing Human & Livestock Population
- Better Input Supplies
- Small scale Mechanization and Reduced Outmigration
- Off-farm Employment
- Government Policies Supporting SAI
- Better Research, Extension & Learning
- Farm Credit & Financing

**Sustainable Intensification Outcomes & Outputs**
- More Production
- Less Resource Use
- Less Environmental Impacts
- Climate Resilience
- Increased Food & Nutrition Security
- Better Livelihoods
- More Incomes
Pathways Towards Sustainable Intensification of Agriculture
Farming System Approach rather than Monoculture to achieve input efficiency, increased productivity, ecosystem services and biodiversity conservation.
Improving Soil Fertility through Integrated Soil Nutrient Management

- Improve fertilizer use efficiency
- Assessing the nutrient balance in the agro ecosystems
- Judicious and efficient use of chemical fertilizers, organic manure and bio-fertilizers in an integrated way.
Integrated Pest Management (IPM)

- It is an ecosystem-based strategy that seeks to control pests through a combination of techniques (given below):
  - Crop Diversity,
  - Biological Control,
  - Developing Pest Resistant Crops,
  - Chemical control,
  - Cultural or Mechanical control,
  - Use of biopesticides
Pathways...

- **Conserving Agro Biodiversity**
  - *In situ* and *ex situ* conservation
  - Payments for agro biodiversity conservation services
  - Policy to promote, regulate and mix of the spread of HYV, Hybrid and local varieties of crops.
Reducing fossil-fuel consumption,

- Enhancing soil carbon sequestration,

- Shifting in land use from annual crops to long rooted perennial crops,

- Conservation tillage, improving fertilizer use efficiency,

- Livestock feed and digestibility improvement and effective manure management
Livestock population has increased from 3.5 billion to 4.3 billion (1980-2010)

Chicken population 22 billion, three times the human population on earth!

The livestock sector is the world’s largest user of agricultural land.

In India, 42 animals grazing per ha, threshold is 5 animals

Global meat production quadrupled from 78 to 319 million MT (1963-2015).

Switch to poultry and smaller ruminants.
Pathways...

- Strengthen Agriculture Extension Services (focusing effective service delivery)
- Greater Access to Input Supply. Make Easy Access to Production Credits
- Access to Market and Transport Services
CONCLUSIONS

- Conventional high input agriculture is unsustainable. Needs to shift to sustainable intensification of agriculture.
- Adopt ISNM, IPM and water use efficiency technologies in agriculture.
- Create rural employment opportunities and address agricultural feminization, rural energy and climate adaptation issues.
- South Asia needs to invest more on agriculture, research and extension.
Conclusions...

- SIA encourages self-reliance rather than national food self-sufficiency goal (at any costs).

- The UN Sustainable Development Goals (SDGs) must become the policy guidelines in agricultural and rural development.

- Policy reforms to support SIA, need pro-poor and inclusive policies to eradicate poverty, hunger and enhancing agricultural sustainability in the region.
Thank You for your Attention!