Conceptualization on Tapping Potentials of NUS to Address ZHC: Linking Production Diversity, Dietary Diversity and Malnutrition

In observance of the International Year of Pulses

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Food and Agriculture Organization of the United Nations (FAO)

3-5 December 2016
1. Global and Regional Challenges: Hunger and Malnutrition

2. Food System Diversity

3. Addressing ZHC: Role of Neglected and Underutilized Species (NUS)
   1. Availability and Use
   2. Categories
   3. Interventions
   4. Potentials
   5. Constraints

4. Towards an Enabling Environment Addressing Common Challenges for NUS

5. Outlook
1. Global and Regional Challenges: Hunger and Malnutrition
Malnutrition

Undernutrition
- Undernourishment (energy deficiency)
- Stunting, wasting, underweight
- Micronutrient deficiencies (e.g. vitamin, mineral)

Overnutrition
- Overweight / Obesity
- Micronutrient excess (e.g. sodium)
Malnutrition accounts for ≈ 30 million deaths per year ≈ 1 death per second (WHO estimate)
Prevalence of Undernourishment in Asia & Pacific

Source: FAO
**Stunting, Wasting and Underweight in Asia & Pacific**

**Stunting**

![Stunting Chart]

- Prevalence of stunting among under 5 children in %
- Oceania, South Asia, East Asia, South East Asia, Sub-regional aggregates
- Blue: Around 2000, Red: Around 2010

**Wasting**

![Wasting Chart]

- Prevalence of wasting among under 5 children in %
- Oceania, South Asia, East Asia, South East Asia, Sub-regional aggregates
- Blue: Around 2000, Red: Around 2010

**Underweight**

![Underweight Chart]

- Prevalence of underweight among under 5 children in %
- Oceania, South Asia, East Asia, South East Asia, Sub-regional aggregates
- Blue: Around 2000, Red: Around 2010
Overweight and Obesity in Asia & Pacific

Source: WHO 2015
Micronutrient Deficiencies in Asia & Pacific

Source: Maplecroft 2012
2. Gaps in the Food System: Limited Diversity
Low Dietary Diversity

Food supply in g per capita per day for a standard person of 70 kg body weight (2,000 kcal)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Cambodia 2011</th>
<th>Lao PDR 2011</th>
<th>Myanmar 2013</th>
<th>Nepal 2013</th>
<th>Recommended daily intake [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>475</td>
<td>489</td>
<td>397</td>
<td>529</td>
<td>300-500</td>
</tr>
<tr>
<td>Roots and tubers</td>
<td>88</td>
<td>122</td>
<td>59</td>
<td>234</td>
<td></td>
</tr>
<tr>
<td>Pulses and legumes</td>
<td>14</td>
<td>8</td>
<td>38</td>
<td>35</td>
<td>50-150</td>
</tr>
<tr>
<td>Animal source foods</td>
<td>146</td>
<td>110</td>
<td>278</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Dairy</td>
<td>7</td>
<td>8</td>
<td>86</td>
<td>143</td>
<td>250-350</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>27</td>
<td>19</td>
<td>59</td>
<td>34</td>
<td>15-30</td>
</tr>
<tr>
<td>Vegetables</td>
<td>106</td>
<td>367</td>
<td>223</td>
<td>313</td>
<td>&gt;400</td>
</tr>
<tr>
<td>Fruits</td>
<td>70</td>
<td>187</td>
<td>108</td>
<td>168</td>
<td></td>
</tr>
</tbody>
</table>

- Overreliance on very few cereals (mainly rice)
- Consumption of vegetables and fruits remains low

Source: FAOSTAT (DGE 2004; FAO 1997; USDA/USDHHS)
For many years, agricultural policies have been in favour of staple and cash crop production.

Intensification of single-crop systems to achieve higher yields of staple crops such as rice, wheat and maize has long been the single focus to reduce hunger without targeting micronutrient deficiencies.

Recent growth of cash crops, such as sugar cane and cassava, has accelerated the low crop diversity in farming systems.

The majority of agricultural households in Asia grow rice.
Feature of Challenge

Disconnection between malnutrition, dietary diversity and production diversity

Holistic and Cost-effective Intervention

Dietary Diversity

Malnutrition

Production Diversity
3. Addressing ZHC: Rediscovery of Role of Neglected and Underutilized Species (NUS)
30,000 edible plant species have been identified globally, of which 7,000 crop species have been used as food.

### Globally Identified Edible Plant Species
- 7,000 species used as food

### Crop Species Used in Human Diets
- **Used as food**: 150 crop species
- **Commercial cultivation**: 103 crop species
- **90% of energy in human diets**: 62 crop species

- rice, wheat, maize, potato
Cultivated Underutilized Species in Asia-Pacific Region

- Fruits: 34%
- Vegetables: 27%
- Miscellaneous: 19%
- Roots & Tubers: 7%
- Nuts: 4%
- Pseudocereals & Millets: 4%
- Industrial Crops: 3%
- Pulses: 2%

Source: Bioversity International (2014)
A Holistic and Cost-effective Intervention

- Dietary Diversity
  - High nutrient content, essential source of micronutrients and protein
  - Income generation
  - High commercial value
  - Adapted to marginal conditions
  - Crop Diversity in Asia

- Holistic and Cost-effective Intervention

- Malnutrition
- Production Diversity

- High nutrient content, essential source of micronutrients and protein
### Potential of NUS

Values for 100 g dry product

<table>
<thead>
<tr>
<th></th>
<th>Energy (Kcal)</th>
<th>Protein (g)</th>
<th>Dietary Fibre (g)</th>
<th>Iron (mg)</th>
<th>Folate (DFE mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickpeas</td>
<td>355</td>
<td>21.2</td>
<td>5.4</td>
<td>5.4</td>
<td>557</td>
</tr>
<tr>
<td>Rice</td>
<td>365</td>
<td>7.1</td>
<td>1.3</td>
<td>1.2</td>
<td>8</td>
</tr>
<tr>
<td>White, polished, raw</td>
<td>x 3</td>
<td>x 4</td>
<td>x 4</td>
<td>x 70</td>
<td></td>
</tr>
<tr>
<td>Mung beans</td>
<td>347</td>
<td>23.9</td>
<td>1.15</td>
<td>6.74</td>
<td>625</td>
</tr>
<tr>
<td>Rice</td>
<td>365</td>
<td>7.1</td>
<td>1.3</td>
<td>1.2</td>
<td>8</td>
</tr>
<tr>
<td>White, polished, raw</td>
<td>x 3</td>
<td>x 1</td>
<td>x 4</td>
<td>x 78</td>
<td></td>
</tr>
<tr>
<td>Lupin beans</td>
<td>371</td>
<td>36.7</td>
<td>9.74</td>
<td>4.36</td>
<td>355</td>
</tr>
<tr>
<td>Rice</td>
<td>365</td>
<td>7.1</td>
<td>1.3</td>
<td>1.2</td>
<td>8</td>
</tr>
<tr>
<td>White, polished, raw</td>
<td>x 5</td>
<td>x 8</td>
<td>x 4</td>
<td>x 44</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>0 days</th>
<th>60 days</th>
<th>% improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>11.1</td>
<td>11.8</td>
<td>6.3</td>
</tr>
<tr>
<td>Serum Fe (µg/dL)</td>
<td>51.5</td>
<td>89.8</td>
<td>74.4</td>
</tr>
<tr>
<td>Total Fe binding capacity (µg/dL)</td>
<td>405.3</td>
<td>377.6</td>
<td>-6.8</td>
</tr>
<tr>
<td>Trans ferritin saturation (%)</td>
<td>12.8</td>
<td>24.3</td>
<td>89.8</td>
</tr>
<tr>
<td>Serum ferritin (ng/mL)</td>
<td>29.5</td>
<td>41.2</td>
<td>39.7</td>
</tr>
</tbody>
</table>

After 60 days, n=33

### WHO's hemoglobin thresholds used to define anemia

(1 g/dL = 0.6206 mmol/L)

<table>
<thead>
<tr>
<th>Age or gender group</th>
<th>Hb threshold (g/dl)</th>
<th>Hb threshold (mmol/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (0.5 - 5 years)</td>
<td>11.0</td>
<td>6.8</td>
</tr>
<tr>
<td>Children (5 - 12 years)</td>
<td>11.5</td>
<td>7.1</td>
</tr>
</tbody>
</table>
Rediscovering the Potential of NUS

**Nutrition**
- Reduce the risk of over-reliance on a few major staple crops
- Improve micronutrient content in global diets

**Socio-economic**
- Tap commercial potential and income/empowerment opportunities for marginal groups

**Production**
- Millets
  - Tap suitability for climate-adaption and mitigation

**Ecology**
- Tropical fruits
  - Tap commercial potential and income/empowerment opportunities for marginal groups

**Pulses**
- Tap suitability for climate-adaption and mitigation
## Constraints that NUS Face

### Enabling Environment: Two Dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Constraints</th>
<th>Implications</th>
</tr>
</thead>
</table>
| Technical | Low investments by farmers, researchers and policy makers | • Limited industrial development  
• Lack of effective research |
|          | Farmers lack knowledge | • Unsophisticated production methods  
• Insufficient postharvest techniques |
|          | Focus on increased production and self-sufficiency in cereals | Secondary crop status/no share in agricultural policies |
| Policy   | Lack of policy and market support | • Lack of incentives  
• Lack of price support  
• Inadequate (knowledge of) marketing channels  
• Little guaranteed consumption |
Underutilization of NUS and Constraints

NUS
nutritional, production, environmental and socio-economic benefits

High potential
in addressing zero hunger and malnutrition

insufficiently identified

Underutilized
low production, productivity and consumption

insufficiently tapped

How?
4. Towards an Enabling Environment
Addressing Common Challenges for NUS
Neglected and Underutilized Crop Species are hidden treasures.

**Policy**
Create sound enabling policies and provide for coherence in national food and agriculture policies

**Agro-Technical**
Develop capacity, provide infrastructure and promote research for improved nutrition

**Socio-economic**
Raise awareness and increase incentives for availability, access and consumption of diverse, nutritious and safe food

**Institutional**
Foster multi-sectoral and multi-stakeholder food system approach along the value chain
Enabling Environment: Value Chain Approach

Better governance

Multi-sectoral and Multi-stakeholder

Assets and Inputs → Production → Postharvest → Trade and Marketing → Consumption

Farmers and Farm Enterprises
Processors
Traders
Consumers

Farmer Organizations
Transporters
Wholesalers

Warehouses
Retailers
Enabling Environment: Policy Analysis

- **Assets and Inputs**
  - Seeds
  - Nutrients
  - Irrigation
  - Fertilizer
  - Greenhouses

- **Production**
  - Agricultural intensification
  - Crop and farm diversification
  - Labour/Machinery

- **Postharvest**
  - Storage
  - Waste management
  - Transport
  - Processing

- **Trade and Marketing**
  - Market linkages
  - Price control
  - Commodity groups
  - Knowledge centres
  - Food labelling

- **Consumption**
  - Nutrition education
  - Awareness campaigns
  - Cooking demonstrations
  - Consumption surveys

Incentives for NUS?

- Seed law
- Land Tenure Rights
- Postharvest Strategy
- Price Policy
- School Feeding/Meal

- Distribution Act
- Strategic Grain Reserves
- Warehouse Receipts Act
## Enabling Environment: Policy Analysis

<table>
<thead>
<tr>
<th>Assets and Inputs</th>
<th>Production</th>
<th>Postharvest</th>
<th>Trade and Marketing</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Budget Allocation</strong></td>
<td><strong>Example</strong></td>
<td><strong>Staple</strong></td>
<td><strong>NUS</strong></td>
<td></td>
</tr>
<tr>
<td>• Seed Law</td>
<td>Japan: irrigation projects delegated to village associations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Distribution Act</td>
<td>USA: Reclamation Act (1902)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Irrigation</td>
<td>Japan: Land Mortgage Bank (1897), Farmland Law (1952)</td>
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<tr>
<td></td>
<td>USA: Farm Credit Act (1933)</td>
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<td></td>
<td>India: All-India Agricultural Research Service (1973)</td>
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</tbody>
</table>
5. Outlook
Outlook

• NUS Mapping via geoinformatics application
• Policy, regulatory and institutional analysis on NUS
• Technical analysis on NUS
• Value chain analysis on prioritized NUS
• Scale up in the region
• Enabling policies for integrating NUS into agro-food value chains for better nutrition
Thank you!