Integrating Pulses into rice-based systems in Asia: Experience from ICARDA

FAO Regional Initiative on Zero Hunger Challenge

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Bangkok, 30 March 2017
Importance of Pulses
Human, animal and soil health improvement

Common Pulses
- Chickpea
- Lentil
- Field pea
- Faba bean
- Grass pea
- Pigeon pea
- Cowpea
- Mungbean
- Urdbean
- Rice bean
- Common bean
- Horse gram

Improved nutrition
Animal feed
Improved livelihood
Sustain natural resources
ICARDA is Mandated for Research on Four Food Legume crops

Lentil, Faba bean, Grass pea and Kabuli Chickpea
Agriculture in Asia......

- Predominantly cereal dominated
  - Rice in eastern & southern India, Bangladesh, Bhutan, Nepal, east Asia
- To ensure food and nutritional security
- Cereal crops receive Government support
- However, in the recent past diversification of cereal-based production system received attention
Foods from Pulses
Pulses residues and rice straw is a nutritious and palatable combination.
Water Efficiency and Nitrogen fixation

Water efficiency

Water efficiency in food production (measured in galleons per ton)

- Pulses: 2,500 galleons
- Eggs: 3,200 galleons
- Chicken: 4,500 galleons
- Pork: 5,900 galleons
- Beef: 20,700 galleons

- Daal (1kg): 1250 liters
- Chicken (1kg): 4325 liters
- Mutton (1kg): 5520 liters
- Beef (1kg): 13000 liters

Soil Health

- 70-210 kg/ha N Fixed
- 40-70 kg/ha N benefit
- Phosphorus availability
- Negative carbon food print
Rice-Pulse offers nutritional balance

Rice Pulse are integral part of Asian diets

• Pulses are three times richer in protein as compared to rice
• Pulses have complementary Amino acid profile with cereals

<table>
<thead>
<tr>
<th>Amino acid</th>
<th>Animal</th>
<th>Cereals</th>
<th>Pulses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoleucine</td>
<td>46.7</td>
<td>39.8</td>
<td>45.3</td>
</tr>
<tr>
<td>Leucine</td>
<td>79.6</td>
<td>86.3</td>
<td>78.9</td>
</tr>
<tr>
<td><strong>Lysine</strong></td>
<td>84.3</td>
<td>30.5</td>
<td>67.1</td>
</tr>
<tr>
<td>Methionine &amp; Cystine</td>
<td>37.7</td>
<td>41.1</td>
<td>25.3</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>11.4 (mg/100 g of protein)</td>
<td>12.1</td>
<td>12.3</td>
</tr>
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</table>

Crop                  | Protein (%)          |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Chickpea</td>
<td>21.5 (18.0 – 30.6)</td>
</tr>
<tr>
<td>Pigeonpea</td>
<td>21.0 (18.8 – 28.5)</td>
</tr>
<tr>
<td>Urdbean</td>
<td>22.0 (21.2 – 31.3)</td>
</tr>
<tr>
<td>Mungbean</td>
<td>23.0 (20.8 – 31.8)</td>
</tr>
<tr>
<td>Lentil</td>
<td>25.0 (20.4 – 30.5)</td>
</tr>
<tr>
<td>Rice</td>
<td>7.0</td>
</tr>
<tr>
<td>Wheat</td>
<td>11.0</td>
</tr>
</tbody>
</table>

• Micro-nutrient rich grains (Fe, Zn, Se, folate)
• Prebiotic carbohydrates make pulses a great functional food
Undernourished people in Asia remains a concern

Many Asian countries including India is among the countries with 20-34% populations undernourished and categorized as ‘Alarming’ in the GHI.
Pulses with high Fe and Zn supports to combat micronutrient deficiency

High Fe Lentil grown in rice-based systems
Diversification and Intensification Leads to...

- Food diversification, thus ensuring balanced nutrition
- More diet options to consumers
- Additional income to farmers
- System sustainability
- Availability of animal feed
- Scope for value addition
Challenges to Pulse Production under rice-based systems

• Mostly grown under rainfed marginal conditions: considered as secondary crops
• Instability in yield: prone to a range of biotic and abiotic stresses
• Changing climate: emerging new stresses
• Low yield potential: limited use of desirable gene (s)
• Use of less inputs by farmers
• Paucity of appropriate policy support
• Limited access to quality seed of improved varieties
• Low investment in pulses R & D
Visuals from South Asia Traveling workshop on Food Legumes in Bangladesh (February, 2015)
In India:

- **Rice**
  - Jul-Oct
- **Lentil**
  - Nov-Feb
- **Sesame/Mung bean**
  - Mar-May
- **Fallow after rice**
  - Nov-June
New pattern: Aman rice - Pulses - Boro rice

Aman rice

Pea, Grasspea, Super-early lentil

Boro rice
Opportunities for Enhancing Pulses Production

- Closing the yield gaps: crop management
- New genetic gains
- Horizontal expansion
- Intensification
- Reduced post-harvest losses
- Value addition

Yield potential for rainfed agriculture in Drylands

<table>
<thead>
<tr>
<th>Varieties (3)</th>
<th>ICM (4)</th>
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</thead>
<tbody>
<tr>
<td>Farmers' Yield</td>
<td>Improved Yield</td>
</tr>
<tr>
<td>910</td>
<td>1108</td>
</tr>
<tr>
<td>1066</td>
<td>1568</td>
</tr>
</tbody>
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65-75% Yield Potential
Exploitable Yield Gap

ICARDA
Science for Better Livelihoods in Dry Areas
## Early lentils to fit in rice-rice systems

<table>
<thead>
<tr>
<th>Traits</th>
<th>Timely Sown</th>
<th></th>
<th>Late sown</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Parent ILWL-118</td>
<td>Selection IPLWS-118</td>
<td>Parent ILWL-118</td>
<td>Selection IPLWS-118</td>
</tr>
<tr>
<td>Days to flower initiation</td>
<td>98</td>
<td>30</td>
<td>No</td>
<td>46</td>
</tr>
<tr>
<td>Days to pod initiation</td>
<td>105</td>
<td>37</td>
<td>Flowering</td>
<td>52</td>
</tr>
<tr>
<td>Days to maturity</td>
<td>182</td>
<td>62</td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Pods/plant (no.)</td>
<td>60-90</td>
<td>10-12</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

- **Marker ALD-22**
  - IPLWS118 (Extra early) 1 2 3 4 5 6
  - ILWL118 Parent

- **Marker ALD-21**
  - IPLWS118 (Extra early) 1 2 3 4 5 6
  - ILWL118 Parent

- **Induced variation**
- **Natural variation**
Introduction of lentil first time in rice-fallows

Farmers grew Moitree Lentil variety. Yield ranged from 455-1120 kg/ha. Av. 756 kg/ha produced worth USD 622/ha
Employment to landless farmers, pulses in diet
Spineless Cactus: Valuable Fodder
Unused-rocky and weedy habitat are planted with Cactus
Cactus growth in Farmers’ Fields in India
Primarily used as fodder and fruit
Registered commercial cultivars (50; 2007 Mexico)
Nopalitos production & uses

Different presentations and trade marks of tender processed cladodes

Different presentations and trade marks of tender cladodes processed in vinegar (pickles)
Value added products from Cactus

Cactus pear juice

- Protect against premature aging
- Reduce inflammation
- Promote optimal cellular health
- Detoxify the body

Sonoran Bloom - The Power of Nopal Cactus

COSMETICS

SEED OIL

Carbox seed oil 100% organic from morocco

FUNCTIONAL FOODS

Cactus pear juice

- Protect against premature aging
- Reduce inflammation
- Promote optimal cellular health
- Detoxify the body
Thank you
Five prioritized NUS crops

**Bangladesh:** Foxtail millet, Taro (Pani Kachu), Cowpea, Snake Guard, Coriander

**Cambodia:** Sesame, Wild yam, local nut, bitter guard, Amla fruit

**Vietnam:** Finger millet, buckwheat, Elephant yam, Lima bean, Amaranth

**Myanmar:** Local aromatic rice, Elephant Yam, Sesame, Cowpea, Lablab bean

**Bhutan:** Bitter buckwheat, barley, Kidney bean, Finger millet, Urd bean

**Nepal:** Buckwheat, Red Amaranth, Deltoid Yam, Fababean, Drumstick,

**West Bengal (India):** Carrot, Lentil, Cowpea, Amaranths, drumstick

**Lao PDR:** Sorghum, Rice bean, Purple yam, Red bean