Nutrient management in peri-urban horticulture in Nepal

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**Urban agriculture in developing countries**

“200 million people worldwide are employed in urban farming and related enterprises … providing the food supply of 800 million urban dwellers.” (UNDP, 1996).

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>11%</td>
<td>of the Nepalese HH are depending on UA</td>
<td>(Nigeria → 27%)</td>
</tr>
<tr>
<td>57%</td>
<td>of the Nepalese urban population is engaged in UA</td>
<td>(Ø DC = 37 %)</td>
</tr>
<tr>
<td>80%</td>
<td>of the poorest quantile is relying on UA</td>
<td>(Zezza, 2010)</td>
</tr>
<tr>
<td>54%</td>
<td>of the poorest quantile is uneducated</td>
<td>(Nepal Population Report, 2011)</td>
</tr>
<tr>
<td>60%</td>
<td>of the work in UA is done by women</td>
<td>(Sapkota, 2004)</td>
</tr>
</tbody>
</table>

- Lack of agricultural education
- Use and amounts of agrochemicals based on the advices of fertilizer sellers and the experiences of the farmer
1998: deregulation of the market and introduction of the APP:

- Chemical fertilizers as the "engine of agricultural development"
- Production should increase about 64-75% by the use of chemical fertilizers

1995: 31 kg/ha → 2017: 131 kg/ha

(Shresta, 2010)
Inofficial import between India and Nepal since deregulation
2/3 of the used fertilizers is unofficial (280000 t)
Annual increase of fertilizer of 17% (Urea) and 20% (DAP)
10% annual decrease in official fertilizer sales
Inofficial fertilizers are cheaper, but with unsecure quality (Diwiker, 2008)
I N T R O D U C T I O N

• Regional difference of the fertilizers prices

→ 164 kg/HH (Terrai) // 36 kg/ HH (Hill Region)

• Kathmandu Valley: Cheap prices and good provision of fertilizers

(Diwikar, 2008)
Concept of investigation

Field Work

-> 16 Farms in and around Bhaktapur

Interviews

Soil Sampling

Soil Analyses

Data Analyses

(INVESTIGATION CONCEPT)

Nepal

(Thapa, 2012)
Concept of investigation

- Field Work → 16 Farms in and around Bhaktapur
- Interviews → Farm Structure, Income, Expenditure, Amount of Fertilization, Yields...
- Soil Sampling → Soil description, four mixed soil samples at each farm (0-15cm)
- Soil Analyses → pH levels, C, N, P, K
- Data Analyses → Nutrient Input, Output and Balances; Nutrient Use Efficiencies (NUE); Linkage Soil Nutrient Values and Fertilization Data; Lime demand; Data Validation
Soils

→ 70% of the land in Kathmandu Valley is classified as fertile „khet“ land
→ Inceptisol → Aquept

→ Topsoils: loam, clay or silty clay
→ 8 to 30% clay
→ Subsoils: loamy sand/ coarse sand

→ Oxidation and reduction in the 2. Horizon due to flood irrigation
→ Anthropogenic elements like charcoal, bricks or plastic in the subsoils
Vegetable Yields

Weak correlation between yield and nitrogen fertilization

Many yields above average yields of literature

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Yield (dt/ha/a)</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbage</td>
<td>12 – 2000</td>
<td>400 - 700</td>
</tr>
<tr>
<td></td>
<td>(700)</td>
<td></td>
</tr>
<tr>
<td>Cauliflower</td>
<td>95 – 581</td>
<td>350 - 400</td>
</tr>
<tr>
<td></td>
<td>(535)</td>
<td></td>
</tr>
<tr>
<td>Coriander</td>
<td>11 – 2564</td>
<td>110 - 220</td>
</tr>
<tr>
<td></td>
<td>(437)</td>
<td></td>
</tr>
<tr>
<td>garlic</td>
<td>2 – 1587</td>
<td>60 - 140</td>
</tr>
<tr>
<td></td>
<td>(386)</td>
<td></td>
</tr>
</tbody>
</table>
Fertilizer application

RESULTS INTERVIEWS
Fertilization Input Ratio

Nitrogen

- Urea N/ year
- DAP N/ year
- PM N/ year
- Compost N/ year
- Potash N/ year

Phosphorous

- DAP N/ year
- PM N/ year
- Compost N/ year
- Potash N/ year

→ High ratio of chemical fertilizers

**N**: 41% - 100% (73%)

**P**: 0% - 99% (76%)
**Nutrient Balances**

<table>
<thead>
<tr>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input: 190 – 1208 (522)</td>
<td>0 – 1767 (338)</td>
<td>0 – 208 (65)</td>
<td>N: 361 – 1640</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P: 197 – 260</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>K: 325 – 900</td>
</tr>
<tr>
<td>Output: 50 – 257 (137)</td>
<td>7 – 49 (23)</td>
<td>41 – 366 (147)</td>
<td>N: 276 – 644</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P: 37 – 65</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>K: 305 – 597</td>
</tr>
<tr>
<td>Balance: 58 – 951 (385)</td>
<td>-8 – +1727 (295)</td>
<td>-328 – -6 (-85)</td>
<td>N: 85 – 882</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P: 109 – 196</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>K: 20 – 306</td>
</tr>
<tr>
<td>NUE: 10 – 80 (30)</td>
<td>0 – 53 (15)</td>
<td>0 – 1992 (356)</td>
<td>N: 35 – 170</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P: 7 – 82</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>K: 216 – 708</td>
</tr>
</tbody>
</table>

(Khai, 2007 in Vietnam)
(Safi, 2011 in Afghanistan)
# Soil Analyses

## VDLUFA Category C

<table>
<thead>
<tr>
<th>P (g/kg)</th>
<th>0.11 – 0.79</th>
<th>0.1 – 0.2</th>
</tr>
</thead>
</table>

**Nutrition Category P**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>11</td>
</tr>
</tbody>
</table>

- The soils are oversupplied by Phosphorous

## K (g/kg)

<table>
<thead>
<tr>
<th>0.04 – 0.38</th>
<th>0.08 – 0.17</th>
</tr>
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<tbody>
<tr>
<td>0.13</td>
<td></td>
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**Nutrition Category K**

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<tbody>
<tr>
<td>3</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
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</table>

- 9/16 soils have a Potassium deficit
Soil acidification

- Input of H+ due to chemical fertilizers
- Release of Protons due to nitrification (≈ 2 H+/NH₄⁺) and volitalization

(Urea 36 H+/kg; DAP 72H+/kg)

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<thead>
<tr>
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</thead>
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<tr>
<td>pH (CaCl₂)</td>
<td>3,9 – 6,2 (5,0)</td>
</tr>
<tr>
<td>H+ Input via Fertilizer</td>
<td>3,8 – 43,2 (17,55)</td>
</tr>
<tr>
<td>Loss of CaO</td>
<td>104 - 1191 (484)</td>
</tr>
<tr>
<td>Lime Demand (pH 7)</td>
<td>2150 – 14333 (5325)</td>
</tr>
</tbody>
</table>

- 1,4 – 11,5 (kmol ha⁻¹ year⁻¹) in Thailand (Fujii, 2009)
- 20 – 33 (kmol ha⁻¹ year⁻¹) in China (Guo, 2010)
- pH decrease 1980 - 2000 of 0,3
- doublication of Protons in the soil!!!

H+ Input due to chemical fertilizers
- Release of Protons due to nitrification (~2 H+/NH₄⁺) and volitalization (Urea 36 H+/kg; DAP 72H+/kg)
The Yields are not increased by the Nitrogen application and can be limited by the Potassium deficit.

The Nitrogen surplusses can get leached out and affect the environment.

A higher ratio of organic Fertilizers might decrease the N-surplusses and increase the K input.

**Further on:**

- Farmers complained about the decreasing soil fertility over the last years.
- Most of the grown vegetables require a neutral soil reaction for best yields.
- There could be an increasing risk of plant deseases (e.g. Clubroot).

**Essentially:**

- An independent agricultural guidance for the farmers is needed urgently.
References

- Zezza, A. & Tasciotti, L. Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries; Food Policy, 2010, 35, 265 - 273
References


- Sapkota, K., 2004: Gender Perspectives on Periurban Agriculture in Nepal; Tribhuvan University, Kathmandu, Nepal

- Diwakar, J. et. al.: STUDY ON MAJOR PESTICIDES AND FERTILIZERS USED IN NEPAL; *Scientific World*, 2008, 6, 76-80

- Thapa, R. B., Murayama, Y., 2012: Scenario based urban growth allocation in Kathmandu Valley, Nepal; Landscape and Urban Planning; Volume 105, Issues 1–2, Pages 140–148
Thank you for your attention!
Increase of the leaf – flower ratio by the excess supply of nitrogen at the beginning of cultivation?