Market proximity is a major incentive for the intensification of farming systems or change of systems to more profitable ones. A common example is the production of perishable products, such as vegetables in urban and periurban areas. Around Kumasi, many rainfed maize-cassava farmers started dry-season vegetable production along streams to generate additional income, while in the city itself, year-round open-space vegetable production is common, especially in bottomlands with water access for irrigation.

**Income of Farming Systems around Kumasi**

These systems are not only output intensive - with for example up to eleven lettuce harvests per year - but also manage to overcome shifting cultivation by farming on the same plot nearly continuously, despite often marginal soil quality. This is only possible through high inputs of manure, water, labour and skills (Drechsel et al. 2002). But what are the benefits of farming with insecure tenure, high risk of pest attacks and much more dependency on in- and output market fluctuations than ever faced in traditional maize and cassava farming in rural Kumasi? The motivation to start urban vegetable farming is for income generation.

The major crops cultivated by urban vegetable farmers are lettuce (9-11 harvests/year), cabbage (2-3 harvests/year), spring onions (8-9 harvests/year), as well as “Ayoyo” (Corchorus sp.), “Alefi” (Amaranth sp.), carrots, radish or cauliflower. Urban vegetable farmers cultivate all of these crops year-round, mostly with manual irrigation, and vary crops according to their own specialisation and market demand.

In periurban Kumasi, farmers still rely on traditional and largely subsistence maize and cassava rainfed farming. Close to streams or where shallow wells can be dug, many farmers start dry-season cultivation of, for example, okra, tomatoes, peppers, or cabbage for the urban market. Besides access to water, dry season vegetable production depends on a good road network.

**Vegetable farming is for income generation**

KUMASI

This study was carried out in urban and periurban areas of Kumasi. The periurban area of Kumasi extends on average 40 km from the city center (Adam 2001). Vegetable farmers in urban Kumasi have informal land arrangements with the authorities or private owners and do not pay rent on the land. The essence is to keep the area clean and to prevent encroachment by squatters. Periurban or rural farmers, on the other hand, hold short-term (e.g., two year) renting or leasing agreements with the chief of their community for the traditional maize-cassava intercropping system.

The major crops cultivated by urban vegetable farmers are lettuce (9-11 harvests/year), cabbage (2-3 harvests/year), spring onions (8-9 harvests/year), as well as “Ayoyo” (Corchorus sp.), “Alefi” (Amaranth sp.), carrots, radish or cauliflower. Urban vegetable farmers cultivate all of these crops year-round, mostly with manual irrigation, and vary crops according to their own specialisation and market demand. In periurban Kumasi, farmers still rely on traditional and largely subsistence maize and cassava rainfed farming. Close to streams or where shallow wells can be dug, many farmers start dry-season cultivation of, for example, okra, tomatoes, peppers, or cabbage for the urban market. Besides access to water, dry season vegetable production depends on a good road network.

**FINANCIAL ANALYSIS**

Surveys carried out by the Kwame Nkrumah University of Science and Technology (KNUST) with International Water Management Institute (IWMI) as well as different British research teams covered in total about 300 farm households. Cost-benefit analysis comparisons were made of farm finances of common rural (A), periurban (B/C) and urban farming (D) systems see table 1 (i.e., traditional maize-cassava farming, additional dry-season vegetable irrigation, and open-space year-round urban vegetable farming, respectively).

Urban and periurban farmers use water from streams and drains and dugout wells and only in selected cases, pipe-borne water. In the urban areas, farmers use watering cans whilst periurban farmers often use either pumping machines or carry water from the stream to their farms. Manual irrigation needs to be carried out with high frequency and makes irriga-

<table>
<thead>
<tr>
<th>Farming system</th>
<th>Typical farm size (ha)</th>
<th>Net revenue (US$)/ha/year</th>
<th>Net revenue (US$)/farm holding/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Rainfed maize or maize/cassava</td>
<td>0.5-0.9</td>
<td>350-550</td>
<td>200-450</td>
</tr>
<tr>
<td>B Dry season vegetable irrigation only (garden eggs, pepper, okra, cabbage)</td>
<td>0.4-0.6</td>
<td>300-350</td>
<td>140-170</td>
</tr>
<tr>
<td>C Dry-season, irrigated vegetables and rainfed maize (or vegetables)</td>
<td>0.7-1.3</td>
<td>500-700</td>
<td>300-500</td>
</tr>
<tr>
<td>D All-year round irrigated vegetable farming (lettuce, cabbage, spring onions)</td>
<td>0.1-0.2</td>
<td>2,000-8,000</td>
<td>400-800</td>
</tr>
</tbody>
</table>
Urban vegetable farmers jump over the poverty line

Urban vegetable farming is mostly done by women, and this is trying to counteract through shifting cultivation (acquiring new land). In irrigated urban vegetable farming, space limitations do not allow for shifting cultivation. Here, output-oriented cash crop production depends on high nutrient inputs to cope with low native soil fertility. On sandy soils, urban farmers enter into a vicious cycle of applying high rates of nutrients (especially N and K) which keep leaching out due to high rates of irrigation. Though, the irrigation water also contains nutrients, and as poultry manure is very cheap, costs, vegetable farming shows its disadvantage: high profits also require more investments and initial capital.

TRADE-OFFS

Urban vegetable farmers in particular obtain relatively high profits on a very small area as compared with the other farming systems. Additional benefits for the society (food supply, employment, trader income, etc.) must however be compared with the negative trade-offs, for example from pesticide use or through soil nutrient mining. Nevertheless, parallel nutrient balance studies by IWMI showed that related costs are low and are more significant in traditional farming (up to 10% of net income) than in intensive vegetable production (up to 1%).

Traditional cropping is based on ash (and soil) nutrient depletion, which the farmer is trying to counteract through shifting cultivation (acquiring new land). In irrigated urban vegetable farming, space limitations do not allow for shifting cultivation. Here, output-oriented cash crop production depends on high nutrient inputs to cope with low native soil fertility. On sandy soils, urban farmers enter into a vicious cycle of applying high rates of nutrients (especially N and K) which keep leaching out due to high rates of irrigation. Though, the irrigation water also contains nutrients, and as poultry manure is very cheap, costs remain low (Drechsel et al. 2002).

REFERENCES