

Agricultural Biodiversity Strengthening Livelihoods in Periurban Hyderabad, India

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In periurban Hyderabad, India, leafy vegetables are increasingly grown along the Musi River and sold in urban markets. This agricultural biodiversity can significantly help urban and periurban farmers become more resilient to the impacts of such changes.

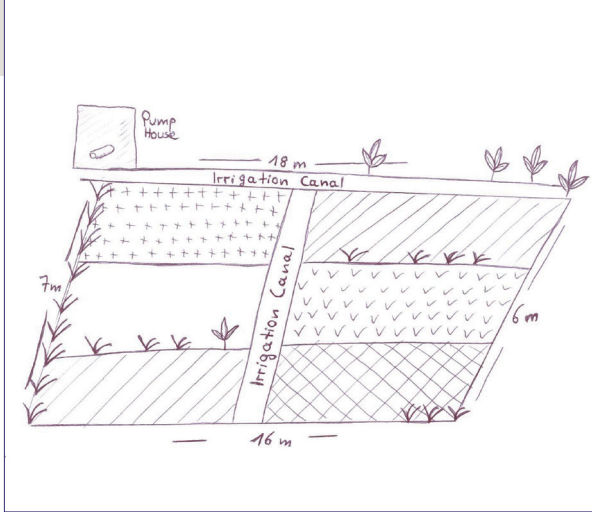
Previous studies showed that periurban agriculture in Hyderabad plays an important role in the livelihoods of a diverse group of people from different castes, religions and social classes (Buechler & Devi, 2002). These livelihood activities are subject to transition and are influenced by the constant growth of the city, with resulting effects like increasing pollution, growth of urban poverty, food insecurity and malnutrition.

Woman harvesting spinach (*Spinacia oleracea*)
Photo: J. Jacobi



During a field study in 2007 (in cooperation with the International Water Management Institute (IWMI) and the University of Freiburg, Germany (IPG/APT)), a rapid appraisal of vegetables cultivated with wastewater irrigation was carried out¹. A large number of vegetable varieties appeared to flourish in the vegetable gardens, unexpectedly also in those where wastewater was used for irrigation. Even though paragrass, a fodder plant, and rice were the dominant crops in the periurban fringes, the vegetable gardens played an important role by supporting the livelihoods of small-scale farmers, many of whom were women (Buechler & Devi, 2002). Spinach (*Spinacia oleracea*) was grown on nearly one third of the area under vegetable cultivation. Other important crops included amaranth (*Amaranthus tricolor*) and roselle (*Hibiscus acetosella var. sabdariffa*). These leafy vegetables - traditionally in high demand - have a short growing season and fetch high market prices due to their usage in traditional dishes. In 2008, the study was extended to compare crop diversity in different irrigation systems and to explore its role in the livelihoods of smallholder farming groups. This phase of the study used the home garden model, which is based on the sustainable livelihoods approach, as theoretical background (Drescher *et al.*, 2006; Drescher 1998). GIS mapping was carried out to capture richness and abundance of varieties and the extent of vegetable cultivation; and semi-structured interviews were conducted with vegetable farmers.

No significant differences were found in the biodiversity indices (Shannon-index or Simpson-index) of gardens that used groundwater compared to those that used wastewater for irrigation. Crop diversity played an important role in both systems in strengthening the resilience of smallholders, allowing them to spread risks such as yield loss or decreasing demand for a certain vegetable. Perennial crops and intercropping were common among farmers who owned the cultivated land and disposed of a well, but more than 70 per cent of the interviewees were in an insecure situation concerning land tenure. Therefore, fast-growing leafy vegetables were cultivated, mostly with wastewater irrigation. These farmers were exposed to pollutants like pesticides and industrial effluents, and fluctuating prices of food, seeds, pesticides and fertiliser. Only one third were native of Hyderabad. The evaluated monthly income from vegetables (in September 2008) per person was INR 1617.20². On average, 4.8 people were farming per acre, so the cultivation was very intensive. Almost half of the participants had secondary sources of income besides vegetable cultivation, for example



Schematic sketch

Photo: J. Jacobi

fodder grass or dairy production. It was thus part of their livelihood strategy to diversify income sources, even though cultivating vegetables was generally regarded as rewarding by the participants.

As the schematic drawing illustrates, the small plots were framed by irrigation canals. Between the plots, mostly cultivated with leafy vegetables, taller plants were grown, either for seeds (e. g. *Amaranthus tricolor*), for tubers and leaves (*Colocasia esculenta*, *Ipomoea batatas*) or perennial plants (*Lagerstroemia parviflora*). 54 varieties of vegetables from 20 families were mapped and identified in the three periurban villages in the research area. Among the vegetables mapped, 18 (including cabbage) were cultivated for the leaves, most of which were usually cooked like spinach.

Reasons for cultivating a broad diversity of vegetables

More than 80 per cent of the respondents mentioned economic reasons for a high crop diversity. Statements such as “More varieties mean more customers and therefore more money” indicated a diversified demand. The need to react to variation in prices was also mentioned, and house-to-house sales practised by some respondents required a broad range of products as well. More than half of the participants said that diversity rendered them less vulnerable to pest infections and yield losses. All agreed that a broad diversity was desirable and the three persons with the lowest diversity (six varieties) mentioned their age and lack of external labour as reasons for not cultivating a larger number of different crops. A broad diversity mitigates vulnerability and can therefore be regarded as a strategy to strengthen resilience (Cromwell, 2001).

Farmers' adaptation strategies

Several adaptation strategies of the smallholders interviewed were evaluated during the study and previous research. These strategies helped make them more resilient to economic and ecological stress factors associated with the growing city, limited resources and socioeconomic changes:

- Adaptation to global change in the form of physical water scarcity in South India can be observed by migration to periurban fringes (the majority of the respondents came to Hyderabad in search of work and water), where wastewater is a reliable, uncontested source of irrigation water

that makes it possible to cultivate vegetables throughout the year.

- The study shows an adaptation through high crop diversity to several risk factors such as attacks by pests, yield loss, e. g. through heavy rainfall during the monsoon, and falling market demand and prices.
- Adaptation to the growth of the city can be observed in the selection of crops with a short growing season, which allows migration to other plots when the land is sold for construction, as was observed during the study.
- A short-term cropping system of 2-4 weeks allows farmers to react to market demand and insecure land tenure: most of the farmers reported that they cultivate fast-growing leafy vegetables like amaranth and spinach in order to guarantee a daily income and be able to pay the monthly rent (70 per cent leased the land on a monthly basis with no guarantee of continuation beyond the following month).
- Producing perishable goods like leafy vegetables close to the markets where they can be sold freshly has the advantage of short transportation routes.
- Through cultivation of their own vegetables, producers can reduce their families' food expenditures, which enhances their resilience with respect to the global food crisis.
- The cultivation of leafy vegetables is also in part an adaptation to the use of polluted water. Leafy vegetables can cope with the high nitrogen supply better than fruit-bearing vegetables, and can be harvested earlier than those irrigated with groundwater due to the fertilising effect of polluted water (amaranth: 15-30 days reported in the study, 30-50 in the literature).
- Irrigation regulation helps to alleviate risks from polluted water: several farmers stated that the fields were not irrigated on days when industrial effluents were released. These days were known to the farmers by experience.

The direct advantages of crop diversity for the farmers are enhanced food security through **dietary diversity** (providing

Field preparation in Parvatapuram near Hyderabad

Photo: J. Jacobi





Amaranth (Amaranthus tricolor), red and green variety
Photo: J. Jacobi

minerals, vitamins and proteins) facilitated by self-consumption of the cultivated vegetables (mentioned by all participants), and income generation to improve **financial assets** through the sale and bartering of their produce.

The indirect advantages of crop diversity are **adaptation** to fluctuating input prices and water scarcity (through the use of the reliable wastewater source) and **reduction of risk** through cultivation of plants with different agro-ecological requirements (losses due to the failure of one particular crop can be compensated with the yield of another).

Despite these advantages of cultivating a variety of crops in the urban environment, the producers' livelihoods remain insecure in terms of ecological, social and economic aspects. The use of wastewater, for example, entails health risks, especially the direct risk posed by industrial wastewater polluted with chemicals. An **indirect** economic risk is also posed by soaring fertiliser prices.³

Conclusion

Although there are only a few hundred vegetable growers along the Musi, in a city of seven million, these farmers provide an important diversity of fresh vegetables to the

Diversified vegetable garden near Hyderabad
Photo: J. Jacobi



markets of Hyderabad. The study indicates that this agricultural biodiversity is perceived as an important form of 'natural capital' in the livelihoods of farmers. It is determined mostly by the direct economic benefits to farmers, and in small part also by the type of irrigation used and ecological factors. Crop diversity is thus much more than a short-term adaptation strategy; it is part of the entire livelihood strategy. However, it should be assured that industrial effluents are separated from domestic effluents. This poses fewer risks and is more profitable for urban and periurban farming (Krishnagopal & Simmons, 2007). Cultivating a high diversity of crops in a sustainable way is knowledge intensive. Therefore, these periurban farmers need to be assisted in meaningful ways, such as by setting up farmer field schools and focussing the efforts of agricultural extension services on small-scale farmers.

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Note

- 1) The water from the Musi River, which is polluted by more than 600 million litres of wastewater per day (Krishnagopal & Simmons, 2007) and from the sedimentation basin Nallah Cheruvu (Telugu for black lake) was classified as wastewater. Later, a sewage plant was constructed upstream with a capacity of around 339 million litres per day.
- 2) € 24.70, currency rate March 2009.
- 3) The Guardian, August 12th, 2008: "Soaring fertiliser prices threaten world's poorest farmers". The Hindu 15. 8. 2008: "Millions could starve as fertiliser prices soar"

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