Does Wastewater Irrigation Lead to Reduced Crop Diversity?

Two Studies from South Asia

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Introduction: Assumed negative impacts

Faced with a lack of irrigation water, farmers in waterscarce regions have begun to make use of the ever increasing volumes of untreated wastewater created in many cities of low income countries [1]. This practice is perceived as highly dangerous by many planners, decision makers and scientists [2]. Beside concerns about negative impacts of wastewater irrigation on health, soils and groundwater, possible adverse implications for agricultural sustainability have been discussed. Based on theoretical considerations, several researchers have stated that wastewater irrigation lead to a reduction in crop diversity [3]. This would be a negative impact as crop diversity plays an important role for small scale farmers' resilience and livelihoods [4]. To test this hypothesis of declining crop diversity under wastewater irrigation, two studies were carried out in South Asia, one near Faisalabad, Pakistan and one near Hyderabad, India (Fig. 1).

Case study 1: Faisalabad, Pakistan

With three million inhabitants, Faisalabad is the third biggest city of Pakistan. At the western fringe of the city, most farmers in the village Chakera use untreated wastewater to irrigate their fields (Fig. 3) while the farmers in neighbouring Kehala use groundwater and canal water.

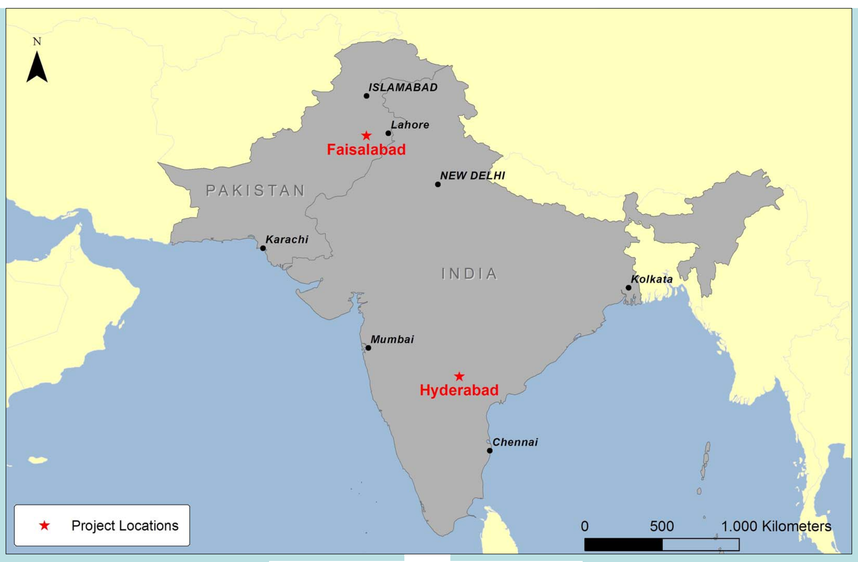

Fig. 1: Locations of the two study sites.

Case study 2: Hyderabad, India

Hyderabad has seven million inhabitants and is the fifth biggest city in India. Much of the city‘s wastewater is disposed of into the Musi River. Many periurban farmers downstream of the city u-se polluted river water to irrigate their vegetable gardens (Fig. 5).

Methods: Tax records

Detailed records of a local tax authority (*Khasra* records) were used to compare the crop species richness (CSR) [5] of the two research villages. The data were processed and analysed using an SQL database, a Geographical Information System (GIS) and MS Excel.

Methods: Crop mapping

The crop diversity of wastewater- and groundwater irrigated vegetable gardens was compared. Data were gathered through field mapping and farmer interviews and processed in a GIS. Subsequently, the Simpson‘s Index of Diversity and the Shannon-Index [6] for both wastewater- and groundwater irrigated vegetable gardens were calculated.

Result: Higher diversity with wastewater

When wastewater irrigation started in Chakera in the 1960s, the average CSR per 100 hectares (3.7) was 27.5% higher than the one of non-wastewater irrigated Kehala (2.9). With increasing wastewater irrigation in Chakera in the following decades, the CSR per 100 hectares increased to 4.1 while the CSR of Kehala dropped to 2.2 in the same period, a difference of 86.4% (Fig. 2). On average, 18.8 different crops per year were cultivated in Chakera and 17.2 in Kehala since 2000.

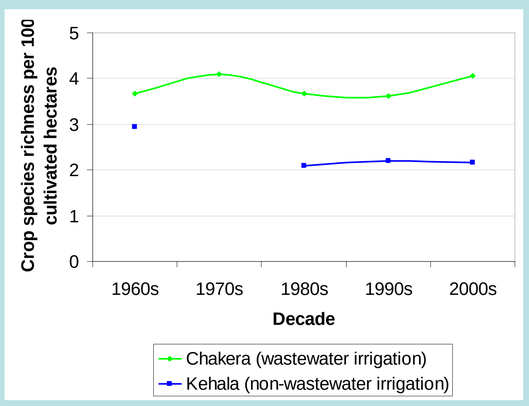

Fig. 2: Development of the Crop Species Richness in the two Pakistani research villages.

Fig. 3: Untreated wastewater used for agricultural irrigation near Faisalabad. Picture: M. Gayer.

Result: No reduced diversity

Neither with regard to the Shannon Index nor with regard to the Simpson Index was there any significant difference between the crop diversity of vegetable gardens irrigated with wastewater and vegetable gardens irrigated with groundwater. However, there was a significant difference in species composition: mostly leafy vegetables like Malabar spinach (*Rumex vesicarius*, Fig. 5) were cultivated with wastewater and fruit-bearing vegetables (such as tomatoes) with groundwater.

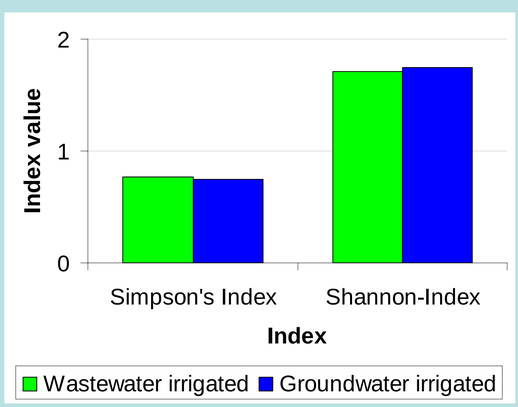

Fig. 4: Two indices used to compare crop diversity under wastewater and groundwater irrigation.

Fig. 5: Vegetables cultivated with polluted water diverted from the Musi River. Picture: J. Jacobi.

Conclusion: No negative impact of wastewater irrigation on crop diversity

The empirical data from the two studies presented here show that wastewater irrigation has not had the expected negative impact on crop diversity in the research areas. The findings add further weight to the growing conviction among many researchers that wastewater irrigation, if properly managed, can play a beneficial role in limiting the pressure on scarce fresh water resources and contribute to food security.

Literature

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