Journal of Environment Sciences (2024), **Volume X**, 144-153
https://doi.org/10.3126/jes.v10i1.66989

Urban Agriculture in the Kathmandu Valley: Assessing Practices, Impacts, and Challenges for Sustainable Food Production and Well-being

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Abstract

Agriculture, a pillar of human society, is undergoing dramatic changes as a result of global urbanization trends. Urban and peri-urban agriculture emerges as a critical method, providing numerous benefits such as increased food availability, poverty alleviation, and environmental mitigation. The Kathmandu Valley is the center of this study, which investigates the status and impact of urban agriculture on its population. It digs into topics including land availability, agricultural practices, food production, and health consequences. The study surveyed 230 families using a structured questionnaire method, indicating a male predominance (56%) and a diverse ethnic representation. The key findings show that 51% of respondents have access to growing areas, while 76% choose kitchen gardening. The biggest motivations are economic considerations (50%) and personal satisfaction (20%). Participants report cultivating 55% of their diet, which contributes to good health. Despite obstacles such as plant diseases (40%), 95% of respondents are satisfied with urban agriculture. This study sheds light on the potential of urban agriculture in solving Kathmandu's difficulties and offers actionable recommendations for the sustainable implementation of urban agriculture in urban settings.

Keywords: *Challenges, food security, Kathmandu Valley, livelihoods, sustainability*

Introduction

Agriculture has been an important aspect of human society since its inception and continues to play an important role in our lives now. Approximately 80% of the world's population lives in rural areas, where agriculture is the primary source of income (Castañeda et al., 2018). Agriculture employs about 3 billion people globally and involves the cultivation of plants, animals, and fungi to create food, fiber, and energy products. (FAO, 2022). Food and agriculture are key components of the global economy and its driving force, and they are part of a larger social, economic, cultural, and environmental system (Achterbosch et al., 2014; Siemen Van et al., 2018). Population urbanization causes considerable lifestyle changes, altering diets, intensifying land use patterns, and increasing agricultural output. This transformation has transformed agriculture into a worldwide interconnected economy, producing and exporting commodities on a vast scale to feed the world's rising urban and peri-urban populations, which now account for more than half of the total (Tomiyama et al., 2020). Urban areas are locations with high population density and a built environment, whereas peri-urban areas are transitional zones between rural and urban land uses located between the outer and regional centers and the rural environment.

It is estimated that 800 million people worldwide practice urban (and/or peri-urban) agriculture (Monroy et al., 2023). According to an FAO publication produced in collaboration with the NGO Rikolto, "urban and peri-urban agriculture is a critical strategy for building resilience in urban food provision, reducing poverty and increasing employment, improving nutritional outcomes, and mitigating environmental degradation of urban spaces" (Erwin, 2022). According to the publication, urban and peri-urban agriculture provides 26% and 23% of food in Quito (Ecuador) and Arusha (Tanzania, respectively). According to the statistics, urban and peri-urban farmers claim that practicing this sort of agriculture has benefited their income, community, and family harmony.

Growing food in and around urban and peri-urban terrain utilizing commercial, non-commercial, and hybrid technology, is a new strategy in the recent growth of agriculture and food security, and the practice of raising livestock is referred to as urban agriculture (Kafle, et al., 2022). According to the Urban Agriculture Committee of the CFSC (2003), urban agriculture is the growing, processing, and distributing of food and other products through intensive plant cultivation and animal husbandry in and around cities. It offers the opportunity to provide fresh, local food to urban communities contributing to local economic development, poverty alleviation, and social inclusion of the urban poor and women, as well as to the greening of the city and productive reuse of wastes (Orsini et al., 2013).

Urban agriculture includes guerrilla gardening, allotments, balcony, and windowsill vegetable growing, small-intensive urban farms, food production on housing estates, land sharing, rooftops gardens and beehives, school-yards greenhouses, restaurant-supported salad gardens, public space food production (Tornaghi, 2014). Considering the sustained trend of poverty and population concentration in urban areas of developing nations, urban agriculture could potentially serve as a solution to address the challenges associated with urban food security (Zezza & Tasciotti, 2010). Despite increasing recognition of urban agriculture's significance in addressing food security and alleviating poverty among urban populations, it predominantly operates within the informal sector (Rana et al., 2017).

Inadequate resource management in urban areas results in diminished quality of life within cities. Urban agriculture, as a broad strategy, is increasingly being embraced organically in developing countries to combat urban poverty and enhance the overall well-being of urban residents (Orsini et al., 2013).

Existing scenario of Kathmandu Valley

The Kathmandu Valley River basin, situated in Central Nepal, encompasses the foothills of the Himalayas and has a rich history of extensive agricultural activity. Roughly 30,000 years in the past, the Kathmandu Basin was submerged underwater (Saijo & Kimura, 2008). With the retreat of the lake, nutrient-rich mudflats surfaced. The topography and fertile soil of the Kathmandu Valley have played a pivotal role in influencing the expansion and progress of the communities within it (Mitchell & Tang, 2017). Farmlands, which were the source of the city's prosperity, are currently being lost to urbanization (Zurick & Rose, 2010). The encroachment of the city on fertile farmland has diminished the capacity of the farming community to adequately feed the current population of the valley (Haack & Rafter, 2006).

Since food is a fundamental requirement for our survival, it is crucial to establish sustainable methods of food production. Urban areas, with their heightened resource needs and environmental impacts, especially food production, present significant challenges. Hence, they warrant significant attention (FAO, 2022).

According to the study by Shakya et al. (2019), urban agriculture has the potential to provide multiple benefits in Kathmandu, including increased food production, income generation, and improved nutrition. The research conducted by Adhikari et al. (2018) found that urban agriculture in Kathmandu has created employment opportunities, especially for women and marginalized communities. A study by Shakya et al. (2017) unveiled that urban agriculture in Kathmandu enhances the accessibility of fresh, nutritious products, ultimately enhancing dietary variety and combating malnutrition. Beyond economic and nutritional advantages, urban farming also fosters sustainable methods and environmental responsibility. Shrestha and Dhungana (2016) conducted a study, which underscored that urban agriculture in Kathmandu alleviates the burden on rural agricultural lands and lessens the adverse effects of food transportation on carbon emissions.

Hence, this study aims to play a key role in bridging the prevailing gaps. The main objective of this study was to overlook the status of urban agriculture and its impact on people in Kathmandu Valley followed by specific objectives such as a) Access to the land for urban agriculture b) Involvement in urban agriculture c) Assessing the type of urban agriculture being practiced and the types of vegetation grown

d) Major reasons for practicing urban agriculture e) Assess the overall health condition of people practicing urban agriculture and f) Study types of fertilizers used, water management, and problems faced.

Materials and Methods

Study Area

The Kathmandu Valley, which includes Kathmandu, Lalitpur, and Bhaktapur and has a total area of 665 km^2 in central Nepal's Bagmati zone, was chosen as a study area. Kathmandu Valley is geographically located at a latitude of 27°42'14" North and a longitude of 85°18'31" East, with an average elevation of roughly 1300 meters above sea level. The valley's three urban hubs are Kathmandu Metropolitan City, Lalitpur Sub-Metropolitan City, and Bhaktapur Municipality, with a combined population of 2,996,341 in 2021 according to the Central Bureau of Statistics (CBS, 2021)

Methods

Pre-Field Visit: As part of the urban agriculture study, a carefully planned tour was conducted in chosen metropolitan areas.

Pre-Data Collection: The research utilized a closed-ended questionnaire survey to collect primary data. The questionnaire was designed based on the research objective. The survey covered Kathmandu (50%), Bhaktapur (32.60%), and Lalitpur (17.39%), with a total of 230 participants involved. Respondents were interviewed face-to-face during data collection. Among them, 115 were actively practicing urban agriculture, while the other 115 had no involvement in this activity. The sample size was determined using a specific formula by Wood et al. (2016).

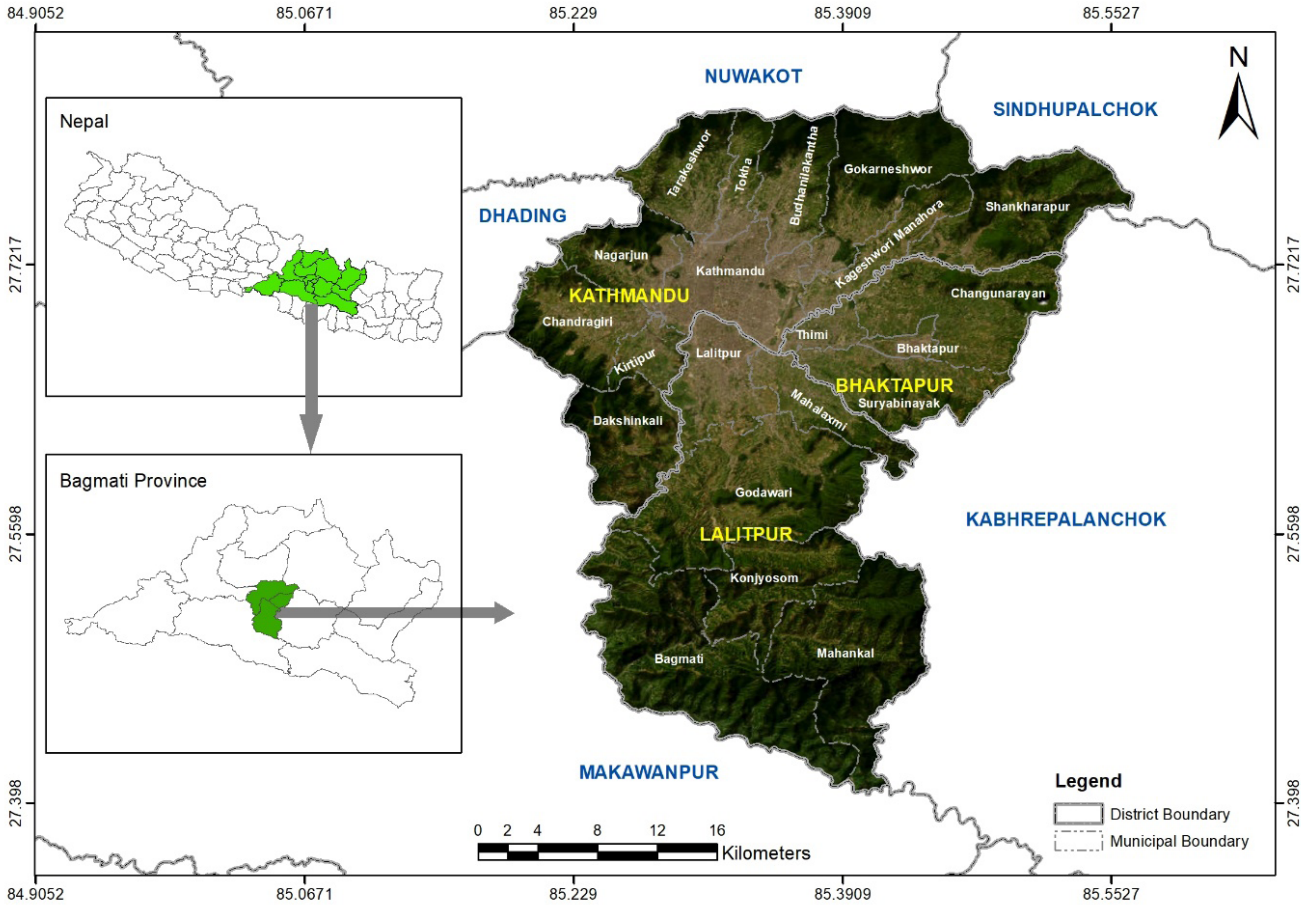

Figure 1: Map of the study area

$$Sample\ size = \frac{r+1}{r.SD2}(ZB + Z\alpha/2)2\frac{1}{d2}$$

r = ratio of control to cases, 1 for an equal number of cases, and control

SD = standard deviation from the previous study

d = expected mean difference between case and control, taken from the previous study

Z_B = 1.28

$Z_{\alpha/2}$ = 1.96

Key Informant Interview (KII): To gather comprehensive insights, the study employed Key Informant Interviews (KIIs) with legislators, accomplished farmers, and school instructors totaling 15 individuals.

Secondary Data Collection: Secondary data was obtained from a range of relevant literature sources including published/unpublished articles, abstracts, periodicals, free data sites, and various other online resources.

Data Analysis: The collected data was subsequently collected and analyzed using Kobo toolbox and MS Excel.

Results and Discussion

The study surveyed a total of 230 households and filled up a structured questionnaire form, resulting in 56% being male and 44% female participants. The study revealed a predominance of male participation in urban agriculture, possibly influenced by the higher number of male respondents in the survey. In terms of ethnicity, Janajati individuals accounted for 33% of participants, followed by Brahmins at 31%, and Chettri at 21%. Other ethnicities like Newar, Madeshi, and various others were also represented.

The collected data illustrated that the majority of respondents, i.e. 60%, lived in their own houses, while the remaining 40% were renters. This suggests that a significant number of respondents who were actively involved in urban agriculture owned their residences, providing them with a convenient setup for engaging in this practice.

Access to growing space/kitchen garden at home

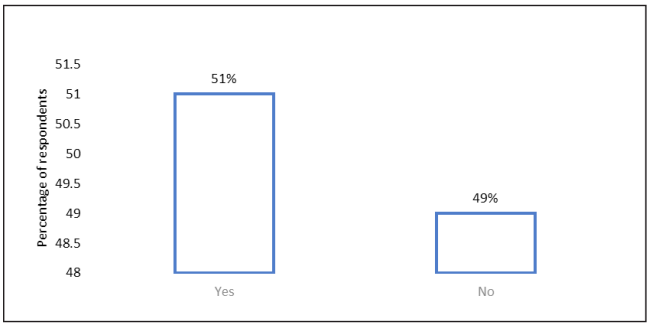

Figure 2: Access to growing space at home

According to the study, a majority of respondents had access to growing space or kitchen gardens at home. Specifically, 51% of respondents had land available for urban agriculture, whereas 49% did not. Some individuals without access to growing space still express interest in urban agriculture. They engaged in practices like rooftop farming using flower pots, grow bags, and various other equipment.

Involvement in urban agriculture

According to the collected data, the primary obstacle preventing participants from engaging in urban agriculture was their residency in rented homes, which resulted in a lack of access to suitable growing space despite their interest. Conversely, homeowners, while having both the space and interest to participate in urban agriculture, often faced a constraint in the form of limited free time for engagement.

Types of urban agriculture

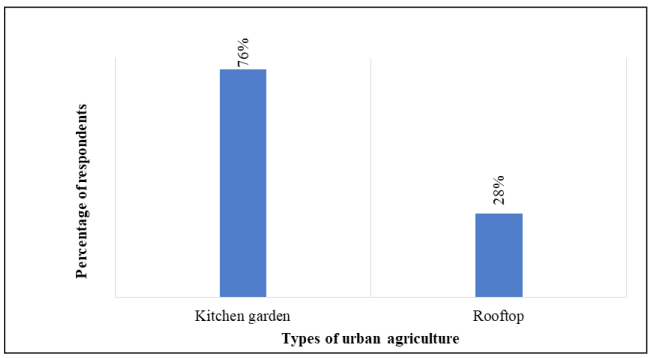

Figure 3: Types of urban agriculture being practiced

According to the collected data, it was evident that approximately 76% of the overall respondents engaged in urban agriculture preferred kitchen

gardening, while the remaining 24% opted for rooftop gardening. Respondents with ample space typically opted for kitchen gardening in their urban agricultural pursuits, whereas those with limited space gravitated towards rooftop gardening. The result is supported by the study conducted by Bhattarai and Adhikari (2023) which stated that in dense urban centers, such as the cities like Kathmandu Valley and Pokhara, thousands of residents have resorted to urban agriculture on rooftops, on balconies, and in backyards.

Reason for Practicing Urban Agriculture

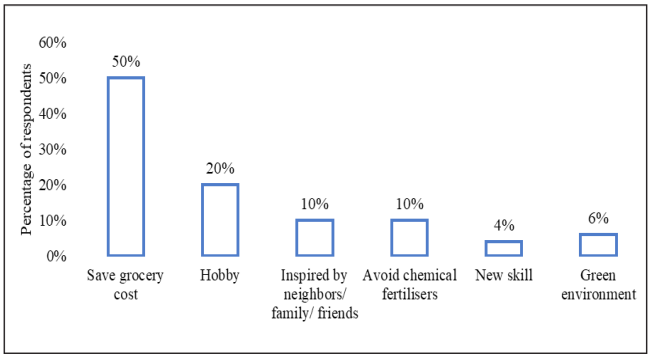

Figure 4: Graphical representation of reasons for practicing urban agriculture

Approximately 50% of participants began urban agriculture to reduce their grocery expenses. Another significant factor was the satisfaction derived from urban farming, with 20% stating it as their primary reason. Additionally, 10% were influenced by family, friends, or neighbors, appreciating the chemical-free nature of the practice. This meant they could consume products without added chemicals or preservatives, promoting safer and healthier eating habits. Furthermore, 6% undertook urban agriculture to contribute to a greener environment and cleaner air. Lastly, 4% embraced urban agriculture as an opportunity to acquire new skills and gain valuable techniques and knowledge in the process. Similar findings were noted by Ngahdiman (2017), who showed that beneficial perceptions, confidence in engaging in urban agriculture, the influence of the social environment, and the influence of role models greatly direct how urban people perceive these practices. Furthermore, a study by Shamsudin (2014) demonstrated that urban residents' attitudes about urban agriculture can be influenced by financial advantages.

Percentage of vegetables/fruits covered by agricultural production to the meal

Most participants engaged in urban agriculture reported that approximately 55% of their diet consisted of vegetables and fruits grown in their kitchen gardens and rooftops. They were successful in cultivating half of the needed vegetables at home, while the other half i.e., 45% had to be purchased from markets, indicating a shortfall in self-produced products. This shortfall was attributed to challenges such as limited space, subpar soil quality, a shortage of fertilizer, and a lack of expertise in vegetable cultivation. Research shows that gardeners incre

Overall, health condition

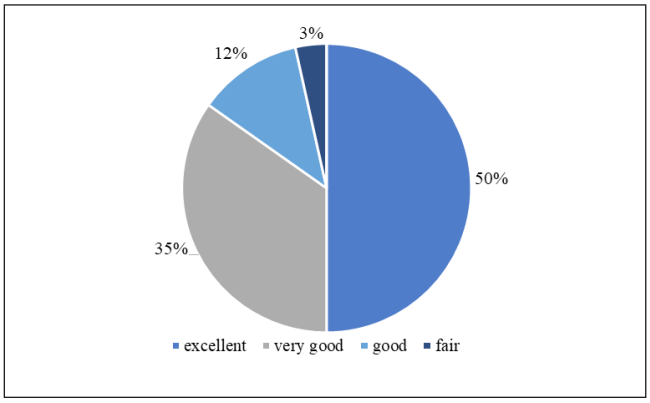

Figure 5: Overall health condition of respondents

Participants engaging in urban agriculture were asked about their health over the past four weeks. According to the study, none of the respondents indicated poor health, with 50% reporting excellent health condition, 35% feeling very good, 12% having good health and the remaining 3% reporting fair health. This positive health trend is likely a result of the prevailing healthier lifestyle in urban areas. A study by Hawkins et al. (2011) conducted previously, reported positive impacts of urban agriculture on physical health in general and improved muscle mass by Park et al. (2016). Other studies reported outcomes that were related to the health of people with mental disabilities (Dewi, et al., 2017) or mental health (Soga, et al., 2017). Park et al. (2016) found that urban agricultural activities improved the psychological health of women by demonstrating that women participants of urban agriculture exhibit lower depression scores compared to non-participants.

Impact on physical activity

The study highlighted that most participants in urban agriculture faced few physical limitations, allowing them to consistently perform at their best. Only 9% of respondents encountered hindrances due to their physical health, while an impressive 91% operated at peak levels. Those actively engaged in urban agriculture experienced minimal constraints due to their physical well-being, indicating that they tend to have superior work capabilities compared to non-participants. Their involvement in urban agriculture translates to the potential for larger and more significant accomplishments, as they maintain healthy diets and engage in regular physical activities. The correlation between regular exercise and involvement in urban agriculture may explain these positive outcomes.

In regards to this, gardening and food production is a beneficial exercise. The term "exercise" refers to a variety of tasks that require both fine and gross motor skills, such as moving compost piles or cutting flowers (Brown & Jameton, 2000). According to gardeners, "activity" in the garden boosts efficacy, pride, confidence, and self-esteem (Hanna & Oh 2000; Waliczek et al., 1996).

Use of fertilizer

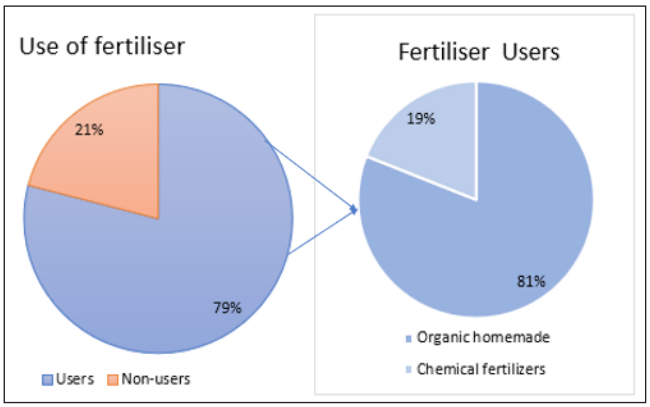

Figure 6: Graphical representation of the use of fertilizers

According to Fig. 6, 79% of urban agriculture participants use fertilizers. Among fertilizer users, 81% prefer organic homemade options like OWDC (Original Waste Decomposer), vermicomposting, leaf mold, composting, and animal waste to nurture their crops. The remaining 19% opt for chemical fertilizers such as urea, diammonium phosphate (DAP), and single super phosphate (SSP). Interestingly, 21% of respondents don't use any type of fertilizer; instead, they create compost manure at home through various methods to enhance crop yield. For pest control, they first use a homemade soapy water solution. If this proves ineffective, they resort to store-bought chemicals. This careful approach aims to ensure that the produced goods are as free from harmful chemicals as possible. A study by Wielemaker et al. (2019) also presented the types of fertilizer inputs used, showcasing a mix of on-site and off-site sources. Out of 25 urban farms, around 80% of the farms utilized compost, 60% used manure from their animals, all farms incorporated external inputs despite none of the farmers preferring synthetic fertilizers but rather preferred certified organic fertilizers derived from plant and animal residues and sourced as locally as possible.

Water used for urban agriculture

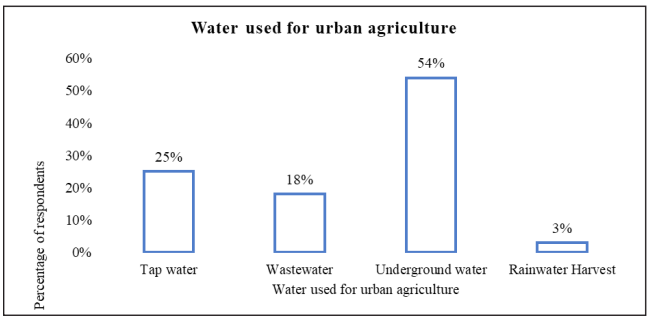

Figure 7: Water used for urban agriculture

More than half of the respondents (54%) primarily depend on underground water sources like wells and borewells for their irrigation needs. Tap water is the second most common source, utilized by 25% of participants, followed by wastewater at 18%, and collected rainwater at 3%. Regarding irrigation methods, a substantial majority (97%) employ manual techniques such as buckets, hoses, and watering cans, while only 3% opt for piped water supply.

In terms of water availability, 73% of respondents have not faced a shortage of water for their urban agriculture activities, 15% encounter occasional shortages, and 12% face regular scarcity. Interestingly, 78% of participants use wastewater for watering purposes at a level of 25% or less, while

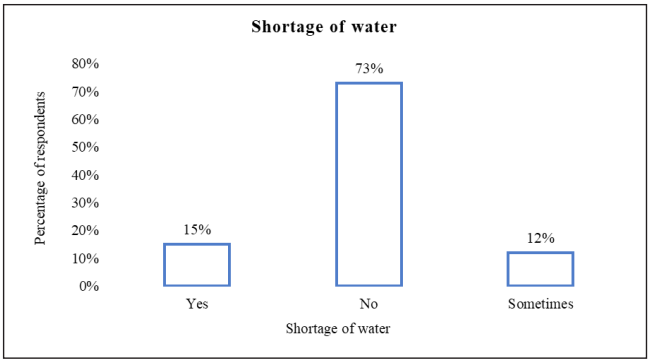

Figure 8: Graphical representation of shortage of water

12% rely on it for 75-100% of their irrigation needs. This suggests a need for more effective utilization of wastewater resources in urban agriculture.

Land area covered by the kitchen garden and rooftop farming

According to the study, most urban agriculture activities occur on plots of land under 100 sq. ft. (9.29 sq. meters). The next most common land size, at 19%, ranges from 500-1000 sq. ft. (46.45-92.90 sq. meter), while only 7% work on areas between 200-500 sq. ft. (18.58-46.45 sq. meter) Growers make creative use of space, employing techniques like utilizing old items and employing growing bags to fit urban agriculture into smaller areas of their homes. According to a survey conducted by Dhital et al. (2016), urban agriculture occupies between 0 and 300 m2 of land in municipalities like Dhulikhel and Pokhara. To cultivate the plants of their choice, practitioners employed a variety of containers, including paint buckets, tin bins, fish boxes, cement bags, rooftops, side walls, and pieces of land surrounding the house.

Participants in urban agriculture, whether they have limited or ample space, tend to focus on a small portion of their available area. Despite other professional commitments, they allocate time during the day or evening for urban agriculture. This practice not only granted them access to organic products but also led to savings on grocery costs. Many individuals preferred to engage in urban agriculture within compact spaces due to easier management and cost-effectiveness.

Types of Vegetation Grown

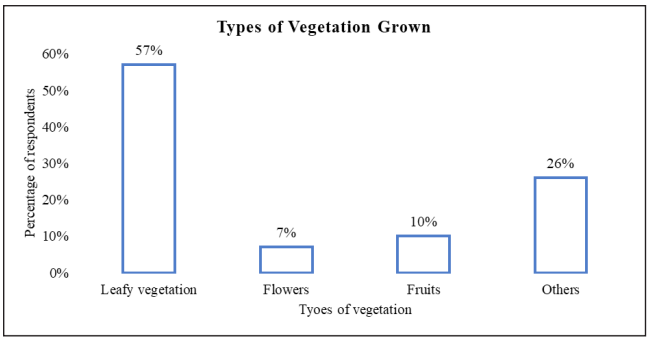

Figure 9: Types of vegetation grown in urban agriculture

Leafy vegetables were the most prevalent, accounting for 57% of all respondents. The second most commonly grown category, at 26%, consisted of various crops like grains, corn, and wheat. Fruits were grown by 10% of participants, while 7% focused on cultivating decorative flowers. The majority of products included staples like mustard greens, onions, garlic, and spinach, chosen for their high consumption rates. Some participants with ample land space also engaged in the cultivation of crops like wheat and barley. Additionally, several respondents planted a diverse array of plants and flowers to enhance the aesthetic appeal of their homes and surroundings.

A study conducted by Dhital et al. (2016) in Dhulikhel and Pokhara also represented that urban agriculture practitioners preferred growing vegetables such as cauliflower, beans, leafy vegetables, radish, cucurbits, onion/garlic, cabbage, and others.

Problems Faced During Urban Agriculture

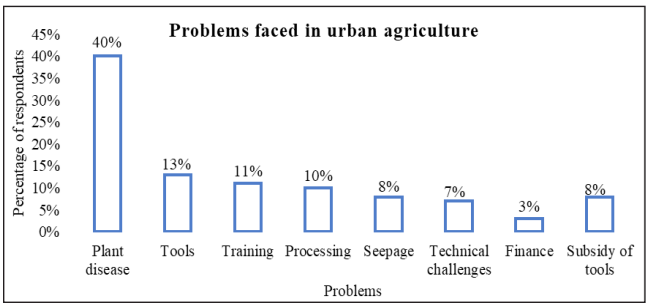

Figure 10: Problems faced in urban agriculture

According to Figure 10, the most common challenge faced by respondents, accounting for 40%, was related to plant diseases. The second-highest issue,

at 13%, pertained to problems with tools. Training-related difficulties were experienced by 11% of respondents, while process-related issues affected 10%. Additionally, 8% encountered problems with seepage and tool subsidies each, 7% faced technical challenges, and the remaining 3% dealt with financing problems.

Participants reported various problems and diseases affecting their plants, posing challenges for effective resolution. Among these, foreign invaders like insects and pests were a significant issue for those engaged in urban agriculture. To address this, participants typically used a combination of organic and store-bought pesticides to manage damage and improve their production outcomes.

Satisfaction from urban agriculture

According to the study, an overwhelming 95% of participants expressed satisfaction with the results and benefits they derived from their urban agricultural activities. The remaining 5% reported dissatisfaction and were less content with their urban agriculture efforts. This contentment is attributed to the consumption of organic, healthy products and the fresh air generated by the plants, contributing to overall well-being and satisfaction. The obtained result resembled that of a study by Park et al. (2016) which also showed that 95.8% of the interviewed elderly participants expressed their satisfaction with gardening intervention.

Conclusion

Finally, this study focuses attention on the critical role of urban agriculture in solving food security, poverty reduction, and general well-being concerns, particularly in the context of the Kathmandu Valley. With a sizable amount of the world's population living in cities and peri-urban areas, urban agriculture emerges as a strategic and linked strategy for enhancing urban food security.

The study emphasizes the various aspects of urban agriculture, such as kitchen gardens, rooftop farming, guerrilla gardening, and more. Urban agriculture not only helps with local economic development and poverty alleviation, but it also promotes social inclusion, especially among marginalized communities and women. According to the findings, urban agriculture in the Kathmandu Valley has the potential to improve food production, revenue generation, and nutritional outcomes.

The difficulties that urban agriculture practitioners encounter, such as restricted space, plant diseases, and tool-related issues, emphasize the importance of supportive policies and actions. Furthermore, the study underlines the favorable relationship between participation in urban agriculture and improved health outcomes, as evidenced by participants' overall health and physical activity levels.

The study reveals significant variables affecting urban agricultural adoption, such as a willingness to save money on groceries, satisfaction from the activity, and the development of a greener environment. Importantly, urban agriculture provides an alternative and sustainable way to food production by addressing the encroachment of urbanization on fertile farmland in the Kathmandu Valley.

Finally, the findings highlight the importance of urban agriculture as a comprehensive strategy that can change urban landscapes into more sustainable, resilient, and healthy ecosystems. As urbanization shapes the future of human habitation, integrating and encouraging urban agriculture can play an important role in guaranteeing food security, improving livelihoods, and supporting environmental sustainability in urban areas.

References

Achterbosch, T. J., Berkum, S. V., Meijerink, G. W., & Asbreuk, H. (2014). Cash crops and food security: Contributions to income, livelihood risk and agricultural innovation.

Adhikari, D., et al. (2018). Urban agriculture as a strategy for poverty alleviation and social inclusion: Evidence from Nepal. Environment, Development and Sustainability, 20(6), 2495-2515.

Audate, P. P., Cloutier, G., & Lebel, A. (2019). Scoping review of the impacts of urban agriculture on the determinants of health. BMC Public Health 19, 672.

Bhattarai, K., & Adhikari, A. (2023). Promoting Urban Farming for Creating Sustainable Cities in Nepal. Urban Sci. 7(2).

Brown, K. H., & Jameton, A. L. (2000). Public Health Implications of Urban Agriculture. Journal of Public Health Policy, 21(1), 20-39.

Castaneda, A., Doan, D., Newhouse, D., & Nguyen, M. C. (2018). A New Profile of the Global Poor. World Development, 250-267.

Dewi, N. S., Komatsuzaki, M., Yamakawa, Y., Takahashi, H., Shibanuma, S., Yasue, T., . . . Sasaki, S. (2017). Community Gardens as Health Promoters: Effects on Mental and Physical Stress Levels in Adults with and without Mental Disabilities. Sustainability 9(1), 63.

Dhital, B., Sharma, A., & Adhikari, S. (2016). Urban Agriculture, Waste Management and Food. International Journal of Environment, Agriculture and Biotechnology (IJEAB) 1(4).

Erwin, D. (2022). Urban and periurban agriculture case studies-Overview, conclusions and recommendations. An annex to Urban and peri-urban agriculture – From production to food systems. Rome, Italy: FAO.

FAO. (2022). WORLD FOOD AND AGRICULTURE STATISTICAL YEAR BOOK 2022. FAO.

Haack, B. N., & Rafter, A. (2006). Urban growth analysis and modeling in the Kathmandu Valley, Nepal. Habitat International 30(4), 1056-1065.

Hanna, A. K., & Oh, P. (2000). Rethinking Urban Poverty: A Look at Community Gardens. Bulletin of Science, Technology and Society. 20(3), 207-216.

Hawkins, J. L., Thirlaway, K., Backs, K., & Clayton, D. A. (2011). Allotment Gardening and Other Leisure Activities for Stress Reduction and Healthy Aging. HortTechnology hortte, 21(5), 577-585.

Kafle, A., Myers, B., Adhikari, R., Adhikari, S., Sanjel, P. K., & Padhyoti, Y. (2022). Urban Agriculture as a Wellbeing Approach and Policy Agenda for Nepal. . Agriculture, Natural Resources and Food Security, 221-238.

Mitchell, M., & Tang, B. (2017). Loose Fit City: The Contribution of Bottom-Up Architecture to Urban Design and Planning. Routledge.

Monroy, P., Arends, R. M., & Lopez, P. D. (2023, 05 30). Retrieved from Ciudades Sostenibles: https://blogs.iadb.org/ciudades-sostenibles/en/world-hunger-day-how-and-why-should-we-integrate-urban-agriculture-into-city-planning/

Ngahdiman, N. I., Terano, R., Mohamed, Z., & Sharifuddin, J. (2017). Factors affecting urban dwellers to practice urban agriculture. Interntioal Journal of Advanced Research (IJAR), 1580-1587.

Orsini, F., Kahane, R., Nono-Womdim, R., & Gianquinto, G. (2013). Urban agriculture in the developing world: a review. Agronomy for Sustainable Development, 695-720.

Park, S., Lee, A., Son, K., Lee, W., & Kim, D. (2016). Gardening intervention for physical and psychological health benefits in elderly women at community centers. HorTechnology 26(4), 474-483.

Park, S., Lee, A., Son, K., Lee, W., & Kim, D. (2016). Gardening intervention for physical and psychological health benefits in elderly women at community centers. HortTechnology 26(4), 474-83.

Rana, S., Bapak, R., & Rachmawati, R. (2017). Exploring Peri Urban Agriculture and Existing Farmers in the Kathmandu Valley. Romanina Review of Regional Studies.

Saijo, K., & Kimura, K. (2008). Expansion of an ancient lake in the Kathmandu basin of Nepal during the Late Pleistocene evidenced by lacustrine sediment underlying piedmont slope. Himalayan Journal of Sciences 4(6).

Shakya, B., et al. (2019). Urban agriculture as a sustainable food system for food security and nutritional health of urban poor: A case study from Kathmandu, Nepal. Journal of Agriculture and Environment, 17, 127-143.

Shakya, M., & Shrestha, P. (2017). Contribution of urban agriculture to household food security in Kathmandu, Nepal. Journal of Agriculture and Environment, 18, 79-96.

Shamsudin, M., Rezai, G., & Teng, P. (2014). Public Attitude Toward Urban Agriculture in Malaysia: Study on Values and Knowledge in Klang Valley. Journal of Food Products Marketing, 20:sup1, 35-48.

Shrestha, P., & Dhungana, R. (2016). Urban agriculture for poverty alleviation, food security, and environmental sustainability in Kathmandu Valley, Nepal. Resources, 5(4), 43.

Siemen Van, B., Just, D., & Ruerd, R. (2018). The food systems approach: sustainable solutions for a sufficient supply of healthy food. Wageningen Economic Research memorandum : 2018-064.

Soga, M., Cox, D. T., Yamaura, Y., Gaston, K. J., Kurisu, K., & Hanaki, K. (2017). Health Benefits of Urban Allotment Gardening: Improved Physical and Psychological Well-Being and Social Integration. Public Health 14(1), 71.

Tomiyama, M. J., Takagi, D., & Kantar, M. B. (2020). The effect of acute and chronic food shortage on human population equilibrium in a subsistence setting. Agric & Food Security, 9(6).

Tornaghi, C. (2014). Critical geography of urban agriculture. Progress in Human Geography, 551-567.

Van Berkum, S. D. (2018). The food systems approach: sustainable solutions for a sufficient supply of healthy food. Wageningen Economic Research.

Waliczek, T. M., Mattson, R. H., & Zajicek, J. M. (1996). Benefits of community gardening on quality-of-life issues. Journal of Environmental Horticulture. 14(4), 204-209.

Wielemaker, R., Oenema, O., Zeeman, G., Weijma , & J. (2019). Fertile cities: Nutrient management practices in urban agriculture. Science of, 1277-1288.

Wood, C. J., Pretty, J., & Griffin, M. (2016). A case–control study of the health and well-being benefits of allotment gardening. Journal of Public Health, e336-e344.

Zezza, A., & Tasciotti, L. (2010). Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries. Food Policy.

Zurick, D., & Rose, A. (2010). Landscape Change in Kathmandu Valley, Nepal. *Focus on Geography 51(4)*, 7-16.