Research Article

Farmers' Perception and the State of Weeds in Agricultural Fields of Pakistan: A Comprehensive Study of Prevalence and Density

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Abstract | This study was conducted in the region of Ghizer, Gilgit Baltistan, and the Malir region of Karachi in Pakistan. The aim was to determine the prevalence and density of growing unwanted weeds in the seasonal crops of regions. For this purpose, 50 quadrats of 1m by 1m were randomly plotted and analyzed. Polygonaceae, Poaceae, and Chenopodiaceae were the most common families observed. A total of 14 different weed species belonging to 10 distinct families were identified. Goose grass (*Elusine indica*), Lambsquarters (*Chenopodium album*), and Black nightshade (*Solanum nigram*) accounted for 87% of the weeds and had densities of 1.82%, 1.82%, and 1.71%, respectively. Species of Amaranthus viridis were found to be 37% prevalent, with the highest density of 10.40%. and was only determined in the Karachi region while Stinging nettle (Urtica dioica) was found to be less common with a 0.07% density and a 60% prevalence. The highest diversity of weeds was found in the crops of tomato, maize, and alfalfa. Another aim of the study was to have the insights of farmers about the causes and effects of weed growth. The study also revealed the farmers' opinion that climatic conditions had not much impact on the growth of these weeds.

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Introduction

Weed-related losses in Pakistan are estimated at 36 million tons annually, valued at $3 billion (GoP, 2019a). The impact of weed infestation is greater than that of diseases and insect pests (Khan *et al.*, 2023). According to Radicetti (2021), weeds are a persistent problem that contributes to a variety of issues, including a loss in crop quality and quantity. They also make it more likely for diseases and pests to spread and endanger irrigation and to control it, their detailed study is critical.

Unwanted plants known as weeds can be seasonal, biennial, or perennial and thrive in agricultural settings. They are renowned for their strong reproductive rates, absence of natural predators, and capacity to adapt to new environments. In addition, they have allopathic traits and can generate a lot of seeds with staggered dormancy (Haq *et al.*, 2023). When an organism es-

tablishes itself outside of its natural range, rapidly increases its population, and supplants native species, it is referred to as an "invasive species" and the ecosystem it is in is affected. Gause's competitive exclusion principle states that two species cannot survive in the same niche without the more successful competitor excluding the less successful one. Weeds can spread quickly across a large area, competing with agricultural plants and reducing the number of native plant species. Crop yields may be lowered as a result of their competition for resources like nutrients, soil moisture, and sunshine. A major amount of the world's weed flora is made up of families including Asteraceae, Poaceae, Amaranthaceae, and Fabaceae (Sohrabi *et al.*, 2023).

The weed flora is also influenced by the local climate of a region. Commonly found in wheat areas, invasive weed species can lower crop production by 25–30%. Up to 37% more can be produced when weeds are effectively controlled (Loura *et al.*, 2023). The conflict over resources between weeds and the crop, which affects maize growth and yield, is another factor. Due to fierce competition for resources during the first stage of crop growth, Pakistan's cereal-based agricultural pattern has been blamed for the low maize yields. The successful growth of maize depends on effective weed management because it maintains a sufficient supply of essential nutrients and soil moisture. Ineffective weed control can reduce the effectiveness of fertilizer and water use (Amanullah *et al.*, 2021; Ali *et al.*, 2017). The management of crops and their economic worth depend on the identification of these weed species and their patterns of distribution. Numerous researchers have examined how weed communities are distributed across various crops all over the world, including the study of the weed flora of potatoes, which resulted in the identification and classification of 39 plant species into 16 families and 32 genera (Muhammad *et al.*, 2021).

According to a study by Matloob *et al.* (2020), Pakistan has 267 weed species, of which 160 are very destructive in Punjab. This conducted research attempts to collect information from less-researched areas like Sindh and Gilgit and connect it to climate change with the help of farmers' interviews. A thorough understanding of agricultural pests like weeds and their control, cannot be achieved if we do not incorporate climate change effects while collecting information about them (Ramesh *et al.*, 2017).

The major objective of this paper is to understand underappreciated weed science components, discuss difficulties of farmers, and close knowledge gaps in weed control in under-study and most climate change-affected areas of Pakistan like Gilgit and Karachi which is crucial for ensuring food security, preserving crop production, and closing yield gaps sustainably in Pakistan (Abbas *et al.*, 2023). This study is the first of its kind to examine and contrast how weeds thrive in the harsh weather of Pakistan's Ghizer (Gilgit) and Malir districts (Karachi). During the study, it was also a goal to provide awareness to farmers about the negative externalities of extensive usage of chemicals.

Materials and Methods

Study area

The study focuses on two unique areas of Pakistan: Ghizer District in Gilgit Baltistan and District Malir in Karachi. These regions are positioned on two opposite sides of the country with entirely different climates and weather conditions (GoP, 2019b). These specific areas were chosen due to their divergent weather conditions, their high susceptibility to climate change, and the relatively limited research conducted on weed studies in these regions.

The region of Gilgit-Baltistan has a colder climate and is prosperous in natural resources. Many farmers use manual tools like spades and bull carts or rent tractors, which can cause delays in farming operations since they lack farm machinery. Further limiting its utilization in the region is the absence of farm equipment repair facilities. Despite these difficulties, the Ghizer district, with its varied geography, culture, and customs, continues to play a significant role in agricultural productivity. The district's area of around 11,565 hectares of total cultivated land is primarily used for growing fruits, vegetables, and grains (GoGB and IFAD, 2021; Ministry of Agriculture, 2020).

On the other hand, the city of Karachi is renowned for its calm environment and nice temperature. The city's natural environment is altering, though, especially in the Malir neighborhood. This region was once well-known for its abundant flora and fertile agriculture, but it is currently seeing a fall in agricultural production. The city is bordered by hills to the west, north, and northeast, while the Malir River, the region's primary supply of water, flows from north to southwest (Fazal and Hotez, 2020). The Malir soil is

among Karachi's most fertile, and it is used to grow a variety of seasonal crops and vegetables, including maize, peas, tomatoes, and onions, but the region is losing its reputation as a fruit and vegetable basket as a result of shady housing developments constructed on farmland and the removal of trash from neighboring communities. Both the local ecosystem and farmers' livelihoods are being harmed by these causes. Ibrahim Hydri, Bin Qasim, Malir, and five Union Councils of Gadap are all located in the Malir Valley (Tribune, 2022; Siddiqui, 2017).

Sampling and data collection

In-person interviews and field surveys were conducted to gather the study's data in November 2022. The District of Ghizer in Gilgit Baltistan and the District of Malir in Karachi were chosen as the two study areas. Personal observations of different weeds were recorded during the sampling process in the form of photographs (SI). The prevalence and density of weeds were determined using the specified formulas after statistical techniques were used to analyze the information from the questionnaires and the author's observations. The results and discussion part includes a table with the data analysis findings and a detailed explanation.

Analysis of data

The data was collected from the questionnaires (SI 2) which were filled by the author upon hearing farmers; responses and the author's observations were analyzed using statistical techniques. The prevalence and density of weeds were calculated using the following formulas:

$$\textit{Prevalence (\%)} = \textit{Number of sites where weed species occur / Total number of sites}$$

$$\textit{The density of weeds (\%)} = \textit{Total number of weed species in an area / Total area}$$

Calculated findings were shown in a table and charts. The study's questionnaire asked questions regarding the property's size, the number of vegetables and other crops cultivated there, cultivation techniques, fertilizer use, weed damage, and loss, as well as current management practices, training, and awareness campaigns. The survey is available in SI. These responses allowed us to evaluate how people view farmers. Microsoft Excel and descriptive statistical analysis were used to analyze the survey data.

Results and Discussion

The sites in the Malir District (Memon Goth, Haji Shidi Goth, Bin Qasim Town, and Kari Kor Malik Bangla) and the five sites in the Ghizer District (Phander Bala, Gupis, Yasin (Sandhi), Hatoon, and Ishkoman) yielded a total of 14 species of weeds from 10 families. 12 of the 14 weeds that were recognized as being present in both climatic conditions were discovered. Goose grass (*Elusine indica*), lambsquarters (*Chenopodium album*), and blacknight shade (*Solanum nigram*) were the three weeds with the highest prevalence rates (Table 1). These weeds are common in Pakistan and may flourish in any challenging environment and soil type (Shrestha *et al*., 2021). *Cuscuta campestris, Reynoutria multiflora, Ambrosia artemisiifolia, Chenopodium murale, Rumex dentatus, Convolvulus arvensis, Digitaria sanguinalis*, and *Urtica dioica* are additional weeds discovered in both locations. Only the Malir district was used to identify Amaranthus viridis and Taraxacum officinale (Figure 1). *Elusine indica, Chenopodium album,* and *Solanum nigram* are 87% more common. All of the study sites and the crops chosen for the investigation—maize, tomato, and alfalfa—showed the presence of the species. The density of weed species ranges from 0.07% to 10.4%, with *Amaranthus viridis* (Chulat) having the highest density because it thrives in Karachi's sandy soil (Figure 1) without needing to sprout from seeds. *Taraxacum officinale* (Kakronda), which grows primarily in loamy soil type after it absorbs excess water, exhibits the same characteristics. Three different crop kinds were investigated, with maize plants showing the highest occurrence (44%) followed by lucerne crops (31%), and tomato crops 25% (Figure 2). Pictures are available in SI.

Farmers' opinion of climate change's influence on weed growth and control measures

According to farmers' opinion, the study discovered that the climate has a substantial impact on agriculture in the Malir and Ghizer districts. Due to the extreme temperatures in the area, Ghizer's agricultural activities are restricted to March through September and crops of maize, wheat, and pearl millet are dominant at this time of the year. (Khan *et al*., 2013). While in Karachi, certain seasonal crops are grown all year. But the cropland is compromising day by day with the increase of different developmental and urbanization activities.

Table 1: *Prevalence, Density, botanical, family, common and local names of weed species in Karachi and Gilgit region.*

S. no.	Botanical name	Family name	Common name	Local names	Location		Prevalence	Density
					Gilgit (sites)	Karachi (sites)		
1	*Elusine indica*	*Poaceae*	Goosegrass	Sehni ghass	3	5	87%	1.82%
2	*Chenopodium album*	*Chenopodiaceae*	Lambsquarters	Kharfiya	3	5	87%	1.82%
3	*Solanum nigram*	*Solanaceae*	Blacknight shade	Badnajaniyan	3	5	87%	1.71%
4	*Cuscuta campestris*	*Cuscutaceae*	Golden dodder	Akash bail	3	4	75%	0.89%
5	*Rumex dentatus*	*Polygonaceae*	Bitter dock	Jangli palak	3	4	75%	0.75%
6	*Ambrosia artemisiifolia*	*Asteraceae*	Rag weed	--	3	4	75%	1.02%
7	*Digitaria sanguinalis*	*Poaceae*	Crabgrass	Jangli ghass	3	3	60%	0.10%
8	*Rumex crispus*	*Polygonaceae*	Curly dock	Khatti buti	3	3	60%	0.20%
9	*Urtica dioica*	*Urticaceae*	Stinging nettle	Bicho Phal	3	3	60%	0.07%
10	*Chenopodium murale*	*Chenopodiaceaae*	Goosefoot	Kharfa	2	3	50%	0.10%
11	*Reynoutria multiflora*	*Polygonaceae*	Tube fleece flower	Thunb	3	2	50%	0.08%
12	*Convolvulus arvensis*	*Convolvulaceae*	Field bindweed	Naro/Lehli	3	2	50%	0.30%
13	*Taraxacum officinale*	*Asteraceae*	Dandelion green	Kakronda	1	0	37%	8.67%
14	*Amaranthus viridis*	*Amaranthaceae*	Green amaranth	Chulat	1	0	37%	10.40%

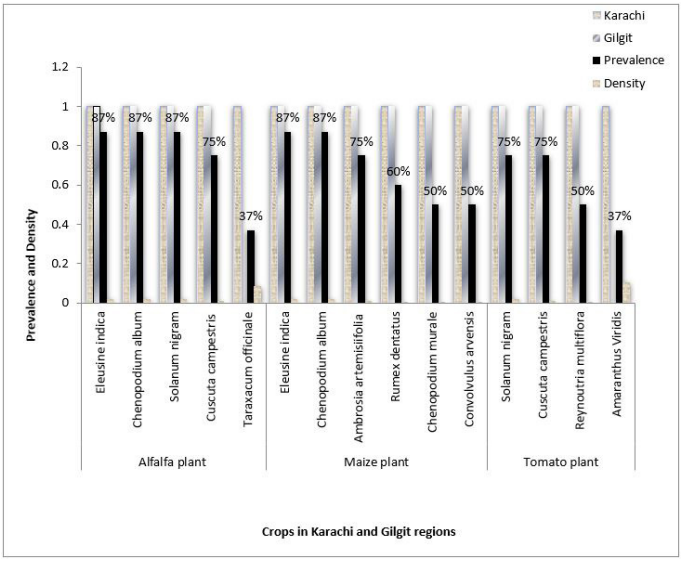

Figure 1: *Prevalence and density of each weed in 3 different crops of Karachi and Gilgit.*

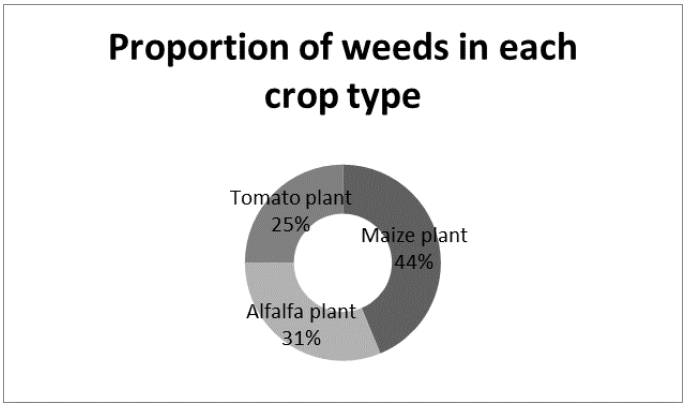

Figure 2: *Proportion of found weeds in different crop types.*

Local farmers claim that the weather, soil, water, and temperature in both districts have little bearing on the growth of weeds (invasive plants). They claimed that the growth of weeds is not directly influenced by the climate. Water, however, significantly affects weed growth. Weed growth is influenced to a high or low extent by soil type and temperature differences. The loamy sandy soil in the Malir district is well-drained and ideal for producing a wide range of plants. Because of this, farmers in the Malir district regard the soil there as fertile and advantageous, making it ideal for the year-round cultivation of a variety of seasonal crops. The Ghizer district's soil type is silty-clay loam, which has silty ground particles with properties that lie halfway between those of sand and clay. Silty soils are abundant and sufficiently nutrient-rich. Most plants will develop if the drainage system is channeled adequately for silt. Farmers noted and acknowledged that weed development in both districts is mostly influenced by soil fertility.

In the fields of maize, tomatoes, and lucerne plants in both regions, the growth rate of weed species was nearly the same. To maintain crop productivity, these undesired species were eliminated twice a month. Farmers in both locations employed manual labor and archaic methods. The weeds were taken out with the use of khurpi and karkani tools.

Due to their lack of training and knowledge in this area, farmers did not apply or identify the use of

any chemical sprays, such as herbicides, pesticides, or weedicides. The majority of the farmers in both districts are day laborers who are merely instructed by local managers to work on fields for inadequate wages. They are ignorant of many aspects of weed management. 90% of households in the Ghizer district are engaged in subsistence farming. However, the agricultural output of the area cannot satisfy the local food needs. A data collection survey on the agricultural sector in Sindh Province in the country in 2022 indicated that 41% of women are heavily active in agriculture as a result of the high percentage of male emigration (Ministry of Agriculture, 2022). The Malir district, in comparison, employs 70% of men in the planting, weeding, irrigation, and harvesting of crops, while the number of female employees has been constrained by socioeconomic factors, urbanization, and the loss of agricultural land.

Involving as many farmers as possible was the goal of this project. However, because of some vague concerns, the majority of them showed hesitation and reluctance. Although these are simply speculation, these worries may be due to real threats like possible taxes or government restrictions. Even so, we were able to speak with two leading farmers from Karachi and five from Gilgit, and their combined perspectives serve as a good representation of the farming community.

The weed species in the Ghizer region of Gilgit Baltistan and the Malir district of Karachi are similar. Farmers observed that water amount, climatic change, and seasons have no noticeable effect on weed development, therefore it is discovered that weed growth is based on soil texture. However, it should be mentioned that this study only considered data from two districts, and more investigation is required to identify the different weed species present in Pakistan's agricultural regions.

Conclusions and recommendations

This study aimed to examine the prevalence and diversity of weeds in agricultural lands of Maize, tomato, and alfalfa crops in the most climate change harshly affected regions i.e. Ghizer district of Gilgit Baltistan and Malir district of Karachi, and to assess farmers' understanding of term and concept of "climate change and its impacts on crops and weeds growth". Three different crop kinds were investigated, the highest weed occurrence found in maize plants i.e. 44% followed by Alfalfa crops (31%), and tomato crops 25%. The highest diversity of weeds was found in the crops of tomato, maize, and alfalfa.There were a total of 14 weed species from 10 distinct families identified, with Amaranthus viridis having the greatest density in Karachi i.e. 10.40% while Stinging nettle (Urtica dioica) was found to be less common with a 0.07% density and a 60% prevalence. 12 of the 14 weeds that were recognized as being present in both climatic conditions were discovered. 87% of the weeds found were Goose grass (*Elusine indica*), Lambsquarters (*Chenopodium album*), and Black nightshade (*Solanum nigram*) and had densities of 1.82%, 1.82%, and 1.71%, respectively.

The survey also discovered that farmers believed climate had a minimal bearing on weed development and that maize crops had the most species, followed by lucerne and tomato crops. The information was gathered using field surveys, and in-person interviews, then statistical methods were used to analyze it. The analysis's findings are tabulated and thoroughly described, offering useful suggestions for further study and enhancing local weed management procedures.

A more localized strategy is essential to improving weed management procedures in Pakistan. It is advised to carry out province-specific weed investigations across the various regions of the nation. This would give a thorough grasp of the variety of weed species that are there as well as how they act in various climatic and soil conditions. Working closely with local farmers can provide important insights into age-old weed control techniques that have proven successful over time in various locations. There is a need to create and promote flexible and resilient weed management solutions given the unpredictable environment in Pakistan. This entails not only choosing the best strategies but also coordinating their use and timing with shifting weather patterns.

Similarly, having well-trained farmers is essential for successful weed control in agriculture. Workshops and campaigns can raise awareness of the negative effects of weeds and their efficient control. Farmers are essential to the food industry, but they sometimes earn insufficient earnings. Better pay packages and personal protection gear should be offered to improve their quality of life.

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Novelty Statement

This paper addresses the abundance of weeds in two extremely opposite and under-study territories and the climate of Pakistan along with its farmers' statements. So far there is no published study of weed density found on Karachi's agriculture farms and Gilgit's agriculture lands.

Supplementary Material

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.sja/2024/40.3.841.847

Conflict of interest
The authors have declared no conflict of interest.

References

Abbas, A., M. Mubeen, W. Younus, Q. Shakeel, Y. Iftikhar, S. Bashir, M.A. Zeshan and A. Hussain. 2023. Plant diseases and pests, growing threats to food security of Gilgit-Baltistan, Pakistan. Sarhad J. Agric., 39(2): 510-520. https://doi.org/10.17582/journal.sja/2023/39.2.510.520

Ali, H.H., Peerzada, A.M., Hanif, Z., Hashim, S. and Chauhan, B.S., 2017. Weed management using crop competition in Pakistan: A review. Crop Prot., 95:22-30. https://doi.org/10.1016/j.cropro.2016.07.009

Amanullah, S., Sohail, M. and Sheikh, I.A. 2021. Maize (*Zea mays* L.) competition with weeds and its effects on water and fertilizer use efficiency. J. Plant Sci., 15: 23-29.

Data collection survey on agricultural sector in sindh province in the Islamic Republic of Pakistan. 2022. Ministry of Agriculture, Government of Pakistan. Available at: https://agriculture.gov.pk/datacollection/sindh

Fazal, O. and Hotez, P.J. 2020. NTDs in the age of urbanization, climate change, and conflict: Karachi, Pakistan as a case study. PLoS Neglected Trop. Dis., 14(11): e0008791. https://doi.org/10.1371/journal.pntd.0008791

GoGB and IFAD 2021. Assessment of water management practices and irrigation systems in Ghizer district of Gilgit Baltistan. Retrieved from https://www.ifad.org/documents/water-management-ghizer-district.

Government of Pakistan. 2019a. Economic survey of Pakistan 2018-19. Government of Pakistan, Finance Division. p. 17–41.

Government of Pakistan. 2019b. Climate of Pakistan. Pakistan Meteorological Department. Retrieved from https://www.pakmet.com.pk/climate-of-pakistan.html

Haq, S.M., Lone, F.A., Kumar, M., Calixto, E.S., Waheed, M., Casini, R., and Elansary, H. O. 2023. Phenology and diversity of weeds in the agriculture and horticulture cropping systems of Indian Western Himalayas: Understanding implications for agro-ecosystems. Plants, 12(6): 1222. https://doi.org/10.3390/plants12061222

Khan, M.A., Ahmad, S., and Raza, A. 2019. Integrated weed management for agronomic crops. *Agronomic Crops: Volume 2: Management Practices*, 257-281. https://doi.org/10.1007/978-981-32-9783-8_14

Khan, M.Z., Khan, B., Awan, S., Khan, G. and Ali, R., 2013. High-altitude rangelands and their interfaces in Gilgit-Baltistan, Pakistan: current status and management strategies. *High-altitude rangelands and their interfaces in the Hindu Kush Himalayas*, *66*.

Khan, B.A., M.A. Nadeem, H. Nawaz, M.M. Amin, G.H. Abbasi, M. Nadeem, M. Ali, M. Ameen, M.M. Javaid, R. Maqbool and M. Ikram. 2023. Pesticides: impacts on agriculture productivity, environment, and management strategies. In Emerging contaminants and plants: Interactions, adaptations and remediation technologies. Cham: Springer International Publishing, pp. 109-134. https://doi.org/10.1007/978-3-031-22269-6_5

Loura, D., Dhankar, A. and Kumar, S. 2023. Weed management practices in wheat (Triticum aestivum L.): A review. Agric. Rev., 44(1): 1-11.

Matloob, A., Safdar, M.E., Abbas, T., Aslam, F., Khaliq, A., Tanveer, A., and Chadhar, A. R. 2020. Challenges and prospects for weed management in Pakistan: A review. Crop

Prot., 134: 104724. https://doi.org/10.1016/j.cropro.2019.01.030

Ministry of Agriculture. 2020. Agricultural Production in Gilgit-Baltistan. Government of Pakistan. Retrieved from https://www.agriculture.gov.pk/index.php/component/content/article/42-general/1558-agricultural-production-in-gilgit-baltistan

Ministry of Agriculture. 2022. Data collection survey on agricultural sector in Sindh province in the Islamic Republic of Pakistan. Government of Pakistan. Available at: https://agriculture.gov.pk/datacollection/sindh

Muhammad, N., Sohail, M., and Sheikh, I.A. 2021. Diversity of weed flora in potato fields of Pakistan. J. Plant Sci., 15(2): 105-110.

Radicetti, E. and Mancinelli, R. 2021. Sustainable weed control in the agro-ecosystems. Sustainability, 13(15): 8639. https://doi.org/10.3390/su13158639

Ramesh, K., A. Matloob, F. Aslam, S.K. Florentine and B.S. Chauhan, 2017. Weeds in a changing climate: vulnerabilities, consequences and implications for future weed management. Front. Plant Sci., 8: 95.

Shrestha, A., Anwar, M.P., Islam, A.M., Gurung, T., Dhakal, S., Tanveer, A. and Ikram, N. A. 2021. Weed science as a new discipline and its status in some South Asian universities and colleges: Examples from Bangladesh, Bhutan, Nepal and Pakistan. CABI Reviews. https://doi.org/10.1079/PAVSNNR202116017

Siddiqui, R. 2017. Environmental degradation and its impact on agriculture in Malir district of Karachi. J. Agric. Biol., 17(1): 51-58.

Sohrabi, S., Naqinezhad, A., Kortz, A., Hejda, M., Gherekhloo, J., Zand, E. and Pyšek, P. 2023. Alien flora of Iran: species status, introduction dynamics, habitats and pathways. Biol. Invasions, 25(5): 1359-1371. https://doi.org/10.1007/s10530-023-03001-x

Tribune. 2022. Illegal housing developments damaging Malir's agriculture. The Express Tribune, 1 July. Available at: https://tribune.com.pk/story/2388184/illegal-housing-developments-damaging-malirs-agriculture