

## Review Article

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# Sustainability in horticultural crop production in the cold dry mountain region of Baluchistan, Pakistan: A mini-review

Muhammad Ayub Babar<sup>1\*</sup>, Muhammad Arif<sup>1</sup>, Muhammad Nauman Irshad<sup>2</sup>, Mirwis Kakar<sup>3</sup>, Naqeeb Ullah<sup>4</sup>, Muhammad Arif<sup>5</sup>, Muhammad Ayub<sup>6</sup> and Muhammad Hanif<sup>1</sup>

1. Directorate of Vegetables Seed Production, Agriculture Research Institute, Quetta, Pakistan

2. Department of Agronomy, Balochistan Agriculture College, Quetta, Pakistan

3. Directorate of Agriculture Research, Ziarat, Pakistan

4. Directorate of Post-Harvest and Food Technology. Agriculture Research Institute, Quetta, Pakistan

5. Directorate of Pulses, Agriculture Research Institute, Quetta, Pakistan

6. Directorate of Oil Seed, Agriculture Research Institute, Quetta, Pakistan

\*Corresponding author's email: [genius\\_minds135@yahoo.com](mailto:genius_minds135@yahoo.com)

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### Abstract

This review focuses on the specific activities and challenges faced by farmers in the mountainous region of Baluchistan. Being the largest province of the country there are several problems faced by the farmers who are growing horticultural crops. This review will benefit the researchers and farming community to take important steps to resolve the issue of the horticultural crops sector in the highlands of Balochistan. Boosting the promotion and cultivation and horticultural crops in the region will increase the per capita income of the farming community which will improve their financial condition. To support the growth of horticulture in this dry and chilly region, it is crucial to effectively utilize water and other natural resources. Improving accessibility and means of transportation will also aid in development. Efforts must be made to prevent crop losses due to insects/pests and diseases. Post-harvest losses caused by improper handling, storage, and transportation should be controlled through proper handling, provision of cold storage facilities in the area, and proper transportation to access the market timely. Small growers should have access to credit facilities and necessary inputs such as seeds, fertilizers, insecticides, and pesticides. Through this review, it is suggested that additional studies as well as necessary and useful measures should be taken to promote sustainable horticultural production and practices in Balochistan.

**Keywords:** Horticulture; Irrigation; Pest; Pesticide; Post-harvest; Precipitation

### Introduction

Adopting sustainable horticultural practices is crucial for reducing environmental impact and preserving ecological balance and long-term agricultural yield. It is becoming more

important as global recognition of the need for sustainable horticulture development and environmental stewardship grows [1]. Sustainable development can only be achieved through proper management of soil

resource management [2]. Horticulture drives rural agricultural business development, providing employment and income. Successful horticulture requires management skills crucial for socioeconomic development [3]. Horticultural crop production faces various challenges due to a growing urban population, environmental issues, limited arable land, and the use of potentially harmful chemicals [4]. The topography of the hilly regions has been significantly impacted by extensive deforestation, leading to severe issues such as soil erosion (at a rate of 46.0 t/ha annually), depleted topsoil and micronutrients, dry water bodies, acidic soil, heavy rainfall, and other natural risks such as snow and frost. A balanced strategy is needed for sustainable growth with limited resources like small cultivable areas and large forests [5].

Baluchistan covers a total land area of 34.72 million hectares, accounting for 44% of the country's land mass, with a coastal line that stretches for 770 kilometers [6]. According to the latest Agricultural Statistics, only 7% (2.49 million hectares) of Baluchistan is used for cultivation. The climate in most parts of the province is dry and hyper-arid, with annual rainfall ranging from 50 mm in desert areas to 250-400 mm in other regions. However, the climate is suitable for growing various fruits and vegetables as long as there are irrigation systems in place [7]. The vast expanse of land in Baluchistan is blessed with rich soil, diverse climatic conditions, and abundant water resources [6]. This allows for the cultivation of a variety of tropical, sub-tropical, and temperate fruits and vegetables throughout the province, earning it the title of "fruit basket of Pakistan" [8]. One of the primary sectors driving the economy in Baluchistan is agriculture, which involves about 60-70% of the population either directly or indirectly. Despite its current standing, there is still room for improvement and expansion in this sector, specifically in

the horticulture sector [6]. The province's God-given ecological zones make it particularly ideal for agricultural production. From cereals to tropical fruits, herbs to drupes, and deserticolous to coastal crops – every type of agriculture thrives in Baluchistan. However, farming communities in the province face many challenges when it comes to various agronomic practices, especially concerning vegetable crops and irrigation water scarcity. As a result, vegetable growers struggle to achieve high yields while also facing high production costs [7]. Some of the commonly grown vegetables in the province include potatoes, tomatoes, onions, cauliflower, okra, brinjal, peas, chilies, lettuce, carrots, turnips, and radish. Farmers have learned to adapt to the diverse climate conditions in different producing areas and are now able to grow most vegetable crops year-round [6-8]. The highlands areas of Kalat, Mastung, Quetta, Pishin, Gulistan, Killa Saifullah, and Loralai are ideal for growing deciduous fruits and temperate vegetables. This region experiences cool summer temperatures that rarely exceed 36 degrees Celsius, with heavy frost and snow during winter. It is the main producer of apples, grapes, and stone fruits in Baluchistan. At higher altitudes (around 6000 ft), in Ziarat, Kaway, Zandera, and Kalam, the summer temperatures remain below 34 degrees Celsius and these areas receive heavy snow and frost in winter. These regions are perfect for cultivating apples, cherries, pears with soft flesh, and plums that ripen outside of the usual season. The chilling requirements of these fruits are met in Baluchistan due to its dry and cold weather, resulting in excellent quality produce. With the availability of electricity, more tube wells are being dug up which increases the area suitable for growing a variety of fruits and vegetables [6, 7].

Mr. Ahmed Saeed discussed the issue of the horticulture sector in dry cold mountain

regions of Pakistan and he mentioned in his proceedings (Regional Workshop on Sustainable Agriculture in Dry and Cold Mountain Areas, Islamabad, Pakistan), that the climatic conditions of these areas are most suitable for growing of fruits and vegetables. These areas have a high potential for raising stone fruits, pome, and different kinds of vegetables. With little effort and improvement in transportation, storage, proper training, provision of quality seeds and storage facilities, we can achieve higher production and intensive promotion of horticultural crops. The pre and post-harvesting losses due to insect pest attacks, unavailability of proper storage facility, packing, and poor handling must be controlled [6].

The purpose of this review is to examine the sustainability of horticulture crop production in cold and dry mountainous regions in Baluchistan to find out the reasons behind the low production, post-harvest, and irrigation losses to suggest possible solutions and actions to overcome the situation.

### **Horticultural crop production in the region**

Apples, grapes, almonds, apricots, peaches, plums, and pomegranates are the main crops produced in the uplands of Baluchistan. Two divisions - Quetta and Zhob - contribute significantly to fruit, vegetable, and nut production. The Hana and Urak regions are known for their apple orchards. As the soil quality is poor in these areas, farmers often have to bring in truckloads of fertile topsoil to improve it before planting apple trees or other horticultural crops [6]. This additional effort adds to the initial cost of setting up an orchard. The stretch of road from Quetta to Hana and Urak is lined with apple and apricot trees, making the drive through this area a memorable experience. Ziarat Valley is famous for its diverse range of fruits and nuts, but the cherry is the most important crop in this region. The black and red cherries grown

here are of superior quality [6, 9]. Over the years, there has been a significant improvement in horticultural production in Baluchistan, both in terms of quantity and quality. This can be attributed to the utilization of subsoil water resources. The introduction of improved varieties of deciduous fruits and their adaptation to local climatic, soil, and biotic conditions, as well as the development of advanced production techniques and effective technology transfer, have all contributed to the growth of horticultural production in the province [7, 9]. However, for sustainable growth in this sector, certain issues need to be addressed and constraints need to be removed. Water resource conservation both surface and underground is crucial for long-term horticultural development in Baluchistan as water is the main limiting factor. Irrigation of horticultural crops is done through tube wells, open surface wells, streams, or ancient "Karezes" - tunnels dug from valley sides to bring water to lower-lying cultivated areas in valleys. Unfortunately, not many Karezes are still functional due to declining groundwater levels caused by excessive use of wells and pumps. With very little aquifer recharge occurring, it is crucial to balance the extraction of subsoil water and ensure its efficient use. Similarly, controlling surface water flow is essential for storing water for irrigation purposes and preventing soil erosion caused by water [6].

### **Profile of the cold dry mountainous region of Baluchistan**

Baluchistan covers a total geographical area of 34.719 million hectares. Its upper highlands reach heights of up to 3,657 meters and cover the central and eastern portions of the province. The land is mostly rugged mountains with scattered fertile valleys. Some major cities in this region include Quetta, Pishin, Ziarat, Loralai, and Zhob [6]. These areas are characterized by arid and cold mountain climates with altitudes ranging

from 1500 to 3657 meters above sea level. The valleys in this zone provide suitable conditions for growing fruits and vegetables through careful management of water resources on the steep slopes of the surrounding arid mountains [6, 7]. In these remote areas where agriculture thrives despite harsh environmental conditions. Fruit and vegetable crops flourish in wide open valleys surrounded by plateaus and foothills. The slopes of steep and barren mountains provide a stark backdrop for these small but resilient oases amidst an otherwise sparsely vegetated landscape [7].

#### **Precipitation**

The amount of precipitation in this region is relatively low, averaging between 50 to 400 mm [6]. This makes irrigation essential for the successful cultivation of fruits and vegetables. During the winter season, snow and rain are crucial elements that contribute to nearly 90% of the total annual precipitation. The monthly evapotranspiration rate is particularly high, emphasizing the need for proper water management techniques. Every drop of water is precious in this arid environment, and careful attention must be paid to ensure its efficient use for agricultural purposes [6, 7].

#### **Soils**

The soils in this particular zone exhibited a wide range of physical properties, varying in texture, fertility level, and depth. On the slopes, the soil was shallow and calcareous, with minimal amounts of organic matter. In contrast, the soils found in the valleys were deep and comprised of sandy loam or loamy clays. Despite their depth, they contained low levels of organic matter and had a high concentration of calcium carbonate, resulting in a pH above 7.5, indicating a slightly alkaline environment. Overall, these soils held an intricate balance of minerals and compounds, each contributing to the unique characteristics of this environment [6, 7].

#### **Irrigation system**

Water is a crucial factor in growing and producing horticultural products. In this region, irrigation for fruits and vegetables is mainly done through open surface wells, streams, "Karezes," and tube wells powered by electricity. With the help of tube wells, vast areas have been transformed into cultivated land for fruits and vegetables [6, 7, 10].

#### **Sustainable horticultural practices (Possible Solutions and Actions)**

##### **Water conservation**

As the need for water conservation intensifies, implementing water-saving practices is crucial. Drip irrigation is a highly effective technique for reducing water usage in horticulture. By directly supplying water to the plant's roots, it minimizes evaporation and runoff, resulting in up to 50% less water consumption while maintaining optimal plant hydration. This method also helps prevent weed growth and fungal infections caused by excessive moisture on leaves. Precision irrigation takes water conservation to the next level by using advanced technology to deliver precise amounts of water tailored to each plant's specific needs. By utilizing weather data, soil moisture sensors, and computerized controls, this approach maximizes efficiency and minimizes waste by only providing water when and where it is needed [1]. On the other hand, it is necessary to cement water channels to prevent leakage and wastage. This will require the construction of new check dams as well as repair and maintenance of old ones to regulate the flow of water. In addition, repairs and maintenance of "Karazes" (underground water channels) must be prioritized to ensure a reliable supply of water. These innovative solutions can help alleviate water scarcity in the region and promote sustainable resource management [1, 6, 10].

### **Sustainability in yield and quality**

Despite being a region known for its horticultural crops, the quality and yields of these plants have yet to reach their full potential. This can be attributed to several key factors that hinder their growth and production [1, 6, 10, 11].

#### **Use of new advanced varieties**

Although newer and more promising varieties have been successfully introduced, there are still some growers who cling to the old and familiar cultivars. These trusted but low-yielding varieties produce subpar-quality produce, yet some farmers continue to hold onto them out of tradition or habit. It is necessary to emphasize the use of new and advanced varieties to increase per-hectare production [1, 6].

#### **Inadequate use of nutrients**

Maintaining soil health is crucial for sustainable horticulture methods, as it supports ongoing production, promotes plant growth, and aids in ecosystem functioning. The natural quality of the soil in this region is poor and contains minimal amounts of organic material. Similarly to other areas in the country, the crops lack proper fertilization, leading to decreased yields and subpar quality. By using well-balanced fertilizers that contain all necessary macro and micronutrients, it is possible to improve both economic returns and overall crop health [1, 6, 10].

#### **Integrated pest management (IPM)**

IPM is a crucial horticultural method that combines multiple techniques to efficiently control pests while minimizing the use of harmful pesticides. Biological, cultural, physical, and chemical methods are used to maintain pest levels and promote ecological balance [1, 6, 10].

#### **Plant protection measures**

Fruits and vegetables are susceptible to numerous diseases and insect pests, but unfortunately, the measures taken to protect these plants are inconsistent and insufficient,

resulting in significant decreases in both crop yields and produce quality [1, 6, 10].

#### **Biodiversity enhancement**

Incorporating biodiversity into horticultural practices is essential for promoting sustainable methods. By enhancing biodiversity, ecological resilience will strengthen, ecosystem services will improve, and the overall health and productivity of horticultural systems can be boosted. One of the main ways to enhance biodiversity in horticulture is by diversifying the types of plants grown. By planting a variety of crops, flowers, and native plants, farmers can create habitats and food sources for a wide range of creatures such as pollinators, beneficial insects, birds, and other wildlife. The presence of diverse plant species also creates a more stable and resilient environment, reducing the risk of pest outbreaks and promoting natural pest control [1, 6, 10, 11].

#### **High input cost**

Implementing sustainable horticulture practices often comes with its own challenges, particularly in terms of financial considerations. The costs involved in transitioning to sustainable practices, such as obtaining, and adopting new technology, and making infrastructural improvements, can create financial strain for farmers. These challenges are compounded by limited access to financial resources, credit options, and government incentives. The cost of fertilizers, fungicides, and pesticides has drastically increased, making them unaffordable for small-scale farmers. The government should find solutions to ensure that these necessary inputs are available at reasonable prices for fruit and vegetable growers, to maintain sustainable horticultural production [1, 2, 6, 7, 10].

#### **Post-harvest losses**

Fruits and vegetables have a limited shelf life, post-harvest losses can reach up to 30-35%, depending on the type of produce. To prevent these losses, it is important to handle

them with care, use suitable packaging, store them correctly, and improve transportation methods [1, 6, 10].

#### **Market demand and access**

The implementation of sustainable horticulture practices may not be a priority for farmers due to limited demand in the market and difficulty accessing sustainable markets. Without recognition and reward from the market for their efforts, farmers may be reluctant to adopt sustainable methods. To promote the adoption of these practices, it is important to establish and strengthen connections with the market, as well as offer incentives for participating in sustainable practices [1, 2, 5, 10].

#### **Transportation and direct access to the Market**

The efficient and timely transportation of produce from production areas to consumer centers is crucial for the success of the horticultural industry. However, this process is hindered by inadequate means of communication and transport. As a result, middlemen are taking advantage and profiting at the expense of both the consumer and producer. To overcome this issue, fruit growers must organize into cooperatives. This will not only improve the management of resources and inputs but also ensure fair and sustainable income from horticultural commodities for all involved parties [1, 2, 6, 10].

#### **Establishment of processing units/ industry**

Processing, once seen as a safety measure for fruit and vegetable production, has now evolved into a thriving industry of its own. Currently, there are no processing facilities in the areas where these fruits and vegetables are grown. The government should provide incentives to encourage the establishment of new processing units in these areas for the mutual benefit of both growers and processors [6, 10].

#### **Conclusion**

It is concluded from this review that, to support the growth of horticulture in this dry and chilly region, it is crucial to effectively utilize water and other natural resources. Farmers should adopt advanced agricultural practices to overcome the issues of low productivity. Efforts must be made to prevent crop losses due to pests and diseases, and post-harvest losses caused by improper handling, storage, and transport. Small growers should have access to credit facilities and necessary inputs such as certified seeds, fertilizers, insecticides and pesticides. It would also be beneficial to organize growers into cooperatives for efficient services and marketing of their produce. Improving accessibility and means of transportation will also aid in development.

#### **Authors' contributions**

Conceived and designed the experiment: MA Babar & M Arif, Performed the experiment: MN Irshad & M Kakar, Analyzed the data: Naqeebullah & M Arif, Contributed reagents/materials/analysis tools: M Ayub & M Hanif, Wrote the paper: MA Babar & M Arif.

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