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Modeling a Small Farm Using Linear Programming In Gilgit Baltistan

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Abstract

Agriculture, with its diverse range of activities, plays an important role in any area's economic development. The fundamental difficulty in agriculture is to make decisions for the optimal selection of activities. With these important considerations in mind a research study is being carried out in Gilgit Baltistan to determine the best cropping strategy for Apricot and Cherry to optimize the net profit. This research aims to design a Linear Programming (LP) model to formulate the apricot and cherry production for achieving the maximize net profit gain in Gilgit-Baltistan. Given the region's unique geographical and economic constraints, such as limited cultivable land and high production costs, the model takes into account variables like land allocation, crop yield, and production costs. The study is based on the analysis of secondary data from both published and unpublished sources. Apricot and cherry are major cash crops in Gilgit Baltistan, covering roughly 2,500 and 400 hectares, respectively. The findings suggest that optimal resource allocation can significantly boost farm income. For instance, apricot production, which averages 8.5 tons per hectare, has the potential to generate significant economic returns if modern agricultural practices are implemented. Similarly, cherry production, with an average yield of 4.15 tons per hectare, shows great potential for poverty reduction and livelihood resilience. The findings highlight the importance of government intervention in terms of infrastructure development, market access, and technological support to increase the productivity and profitability of these fruit crops. The beneficial outcome of applying the LP model is to increase the income of the farm income by 30%.

Keywords: Gilgit Baltistan Gams model, linear programming, optimization, optimal solution, cropping pattern, farming, Crop yields.
JEL: D24, C61

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Introduction

Agriculture, defined as the methods and means of using energy, water, and soil Resources to meet human requirements for food and clothing, has always been and Continues to be the foundation of several historical advancements in the fields of economics, society, politics, and culture (Chatterjee *et al.,* 2016) Agriculture is diverse and contradictory. The industry accounts for a minor portion of the global economy but is yet vital to the lives of many individuals. In 2012, of the world's 7.1 billion people, an estimated 1.3 billion (19 percent) were directly engaged in farming, but agriculture (including the relatively small hunting/fishing and forestry sectors) represented only 2.8 percent of total income (World Bank 2012). Over the past 10 years, Pakistan's economy has faced significant growth problems as it transitions from a traditional subsistence to a semi-industrialized, well-integrated economy (Braunstein *et al.,* 2016). For a considerable amount of time, the agriculture sector was not given enough attention in terms of policy. It so demonstrated stagnating growth, raised concerns about food security, and threatened the farming communities' ability to maintain a sustainable standard of living (2018,Deshpande et al). In spite of these obstacles, Pakistan is among the top ten nations in the world for the production of a variety of agricultural goods, including rice, onions, chickpeas, milk, beef, dates, apricots, mangoes, and cotton. Nevertheless, the enormous potential and resources are not being used effectively, which explains why the pace of agricultural growth is so low. With 178,957 tons produced annually in 2018, Pakistan is the sixth-largest producer of apricots worldwide (FAO.2018). Even though Pakistan is a major grower, the fruit accounts for very little of the nation's exports. Apricots are primarily grown on small farms and sold fresh either domestically or abroad without any kind of value-adding. The nation shipped 413 thousand tonnes of dried apricots in 2018, a decrease from the previous year, since the dried apricot trade is stagnant. Without sufficient infrastructure for storage and transportation, exporting perishable fruits is extremely difficult (Naseer *et a.l* 2019).

The two primary apricot-growing regions in Pakistan's Himalayan range are Gilgit-Baltistan (GB) and Chitral. GB accounts for about two-thirds of Pakistan's total apricot production (GOP 2016). In this region, the average farm size is less than one hectare, but only one percent of the land is under cultivation. Although farming practices are inefficient and based on subsistence, the apricot industry has enormous potential and nevertheless contributes significantly to agricultural incomes. Some of the harvests are dried on the farm and sold through wholesalers in auction markets down-country because of the high perishability of apricots and the distance from the market. Similarly, according to a 2009 agriculture statistic, Gilgit-Baltistan produced 2117 tonnes of cherries annually, of which 390 tonnes came from the Skardu area alone. The total amount of cherries consumed in One of the most common temperate, pulpy, and meaty fruits in the Prunus genus are sweet cherries (Prunus avium L.212 tonnes were produced in the Skardu district, with reported losses of 21% (GBAS, 2009). In Pakistan's far north lies a large mountainous region called Gilgit-Baltistan. Gilgit-Baltistan covers an area of roughly 72,496 km^2. Ten districts Gilgit, Diamer, Hunza, Nagar, Ghanche, Ghizer, Skardu, Shiger, Kharmang, and Astore have been established for administrative purposes. Because of its strategic location at the intersection of China, South Asia, and Central Asia, the region is highly significant (Dani, 2001). One of Pakistan's main fruit-producing regions is Gilgit-Baltistan (GB). The main purpose of producing the fruits is for financial gain these include the apricot, cherry, almond, plum, and peach. An estimate of the overall fruit production every year is approximately 170680

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tons (Ali *et al.,* 2011). Producing dry fruits, with a focus on almonds, plums, apricots, cherries, and peaches, is the main source of income for Gilgit-Baltistan (GB), Pakistan (Shahzad *et al.,* 2021). Apricots are unique among these fruits in that they represent both natural abundance and cultural value. The distinct qualities of GB's apricots, concerning taste, nutritional value, and organic status, distinguish them from other fruits grown nearby and elsewhere. In the Himalayan Mountains of Pakistan, GB is the primary apricot-growing zone. Approximately 67% of Pakistan's total apricot production comes from GB (Hussain *et al.,* 2012). However, fungal gummosis syndrome poses a serious threat to apricot trees, resulting in a marked reduction in both yield and quality. The total area under apricot in Northern Areas is 6368 ha, with 1.86 million bearing trees and 0.86 million non-producing trees. Total yearly apricot production is 107737 tons, with 48626 tons (about 45%) stated as subsequent trash (DOA 2001). In truth, this high rate of waste must be read differently in order to disclose the true situation. The so-called waste fresh fruit is washed at the farm, and the seeds are taken home, where women shatter them to obtain the kernels. Bitter kernels are processed into oil and/or fed to animals. Sweet kernels are currently mostly sold out. According to unofficial sources in Akbari Mandi, Lahore, the annual trade in apricot sweet kernels is between 400 and 500 tons. 70% of the supply originates from the northern areas. Sweet Bakers consume these sweet apricot kernels instead of almonds. Normally, the market prices for sweet kernel in Lahore is Rs.80 to 90/kg; however, during the shortage time, April-May, it is offered at Rs.180 to 200/kg. According to some informal sources, the sale price of kernels at the source is between Rs.50 and Rs.70 per kilogram.

Apricot is an appealing fruit that is popular with consumers all around the world and has grown in economic importance throughout time. It is consumed fresh, dried, and frozen, or used to make jam, jellies, marmalades, pulp, juices, nectars, and extruded goods (Chauhan et al., 2001). Furthermore, apricot kernels are considered a good source of quality oil, being utilized for cooking, producing cosmetic items, benzaldehydes, and active carbon. (Yildizet et *al.,* 1994). Apricot also has a reasonable quantity of dietary fiber, ranging from 1.5 to 2.4g/100g fresh weight (Haciseferogullarie et al., 2007). Fiber adds roughage and bulk to meals, promotes appropriate stomach movement, and reduces constipation, as evidenced by animal model studies showing that apricot fiber dramatically enhanced fecal output (Tamura et al., 2011).Soluble fiber decreases blood cholesterol, maintains blood sugar levels, and helps to reduce body weight (Lairon, 1990). Cherry (Prunus avium L.) is a marginal fruit found in Pakistan's temperate zones. There are two varieties of cherries: sweet (desert) and tart. A cool climate with good winter rainfall and dry, cool summers is optimal for producing high-quality cherries (Tareen & Tareen, 2006). Cherry trees do not grow in heavy, poorly drained soils, but perform well in sandy loam soil. Cherry needs cooling requirements varying from 500 to 1300 hours (Children, 1983). Cherries are used to make frozen pies and pie filling, as well as canning, baking, ice cream, sauces, preserves, and other desserts (Children 1983). Cherry offers numerous advantages over competitor fruits. The cherry has many advantages, including low water requirements, a quick production time, and a high market value. Furthermore, the cherry fruit is hampered by a number of restrictions, including its perishable nature, inadequate physical and institutional infrastructure, and a lack of timely inputs. Cherry became popular in the area because of its great return. Farmers have substituted apricot, pear, and even apple with cherry plants, demonstrating its importance (Ali *et al.,* 2003-04).

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Agriculture has an important part in the economic success of agricultural countries. The key challenge in the agricultural business is making a decision amongst a multitude of options. Although farmers grew all types of vegetables and crops based on their previous experiences, instincts, and comparisons with neighbors, a lack of knowledge about the most beneficial cropping pattern with efficient resource utilization remained a critical problem for farmers, and it needed to be solved because of the social and economic importance of agricultural commodities due to rapid population growth. Linear programming is the best strategy for resolving such challenges. (Ishtiaq *et al.*, 2004) employed the LP model to discover the optimum crop among wheat, apricot, and cherry, rice, cotton which are cultivated in different regions of Pakistan. The linear programming model boosted net revenue from Rs.111861 to Rs.161263 using 0.97 acres of idle land. Felix (2013) employed a linear programming model to assist farmers in Marondera, Zimbabwe, in making better decisions on how to best allocate scattered resources and optimize net income. The findings revealed that overall crop acreage declined by 30% but farmers' net income grew by 35%. Effective resource management is critical for increasing agricultural productivity. For the optimal exploitation of resources across several locations. Amin et al. (2013) conducted research in three Iranian counties and developed a linear programming model to investigate multi-regional farming. The study found that optimum farming patterns boosted net profit in the regions Babol 6.8%, Babolsar 8.9%, and Qaemshahr 5.6%. The multi-regional concept will enhance the entire region's earnings by 1.4%. Better land distribution had a significant impact on farmers' incomes. (Aquil *et al.*, 2015) used agriculture data for five food crops to create LP model to determine the crops' optimal land allocations. The LP model was compared to the previous results, which revealed that the optimal land usage was 2752.56 acres rather than 2409 acres. The largest profit made using the linear programming paradigm was Rs.1376.

Prior empirical research examined a range of apricot-like physicochemical and nutritional characteristics of several apricot kinds (Ali *et al.*, 2011), including the use of contemporary technology to produce apricot juice (Aider *et al.*, 2008). To the best of our knowledge, there aren't many empirical studies especially when considering the particular study area on the constraint analysis throughout the entire value chain of the apricot and cherry sectors. As a result, it is necessary to conduct this study, which created a framework that included the limitations faced by all parties involved in the apricot and cherry sectors. Additionally, this study is different from previous research that examined how apricot production affects poverty reduction since it takes selectivity bias into account by using the propensity score matching (PSM) technique. The unique geographic and economic characteristics of Gilgit-Baltistan (GB), Pakistan, as well as the various growth-restraining factors, should be taken into consideration when examining the economic development of the rural mountainous areas. Rough terrain and a population density of 12 persons per square kilometer 30 times lower than Punjab province's mark the region (World Bank 2010). And limits including subsistence farming, climatic and environmental restrictions, increased production costs, a lack of infrastructure, and restricted access to markets. It is not unexpected that the area has historically lagged behind the rest of Pakistan given these features. (2014) (Rasul et al) Still, it seems like a structural change is happening.

The production of fruit and cash crops has steadily replaced subsistence farming, a trend that is especially evident in the easily accessible areas of the region that are nearer to cities. Furthermore, a significant factor in the development of the rural economy is the

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growing share of household income from non-farm sources, which increased from 43% in 1994 to 63% in 2005 (World Bank 2010) and over 70% in 2020 (Shahzad et al., 2021). In a similar vein, the share of non-farm employment has increased in down-country Pakistan due to increased labour outmigration into the services sector as a result of improved formal education systems. Approximately 24% of men (aged 18 and over) worked outside of rural GB in 2001, whereas the migration rate for the same group in all of rural Pakistan was 15% (World Bank 2010).

According to a World Bank research from 2010, four of GB's five districts are classified as "extremely insecure" in terms of food security, while Gilgit, the last district, and is classified as "very insecure. In these conditions, farming communities in GB are essentially in danger of disappearing. Reduced agricultural land use and greater uncertainty about farm continuation are the results of rising rates of rural-to-urban migration (Anwar et al., 2019), especially among younger people (Benz et al., 2016), and the rapidly expanding non-farm sector (Gioli et al., 2014).

The research question related to my study on maximizing net profit from apricot and cherry production in Gilgit Baltistan through linear programming (LP).

1. How can the use of linear programming model help increase farm income from Apricot and Cherry farming?
2. How much land is currently used for Apricot and Cherry farming in Gilgit Baltistan?
3. What are the average yield of apricot and cherry in Gilgit Baltistan?
4. What are the specific infrastructural improvements needed to support apricot and cherry farming?
5. How does the allocation of resources such as land and labor impact the overall farm income in the region?

- ❖ The main objective of current study is to develop a LP model to maximize the net profit gained from apricot and cherry in Gilgit Baltistan.
- ❖ To optimize production and profitability for local farmers, raise the yield of cherry and apricot crops per acre of land.
- ❖ Recognize and reduce the risks connected to growing cherries and apricots, including those brought on by the weather, pest and disease outbreaks, changes in the market, and unpredictability in input costs. Facilitate the adoption of modern agricultural technologies, such as improved varieties,

Efficient irrigation techniques, and mechanization, to increase productivity and efficiency in cherry and apricot cultivation.

- ❖ For cherry and apricot produce, strengthen market ties and access to both local and foreign markets. This includes creating direct lines of communication between farmers and buyers to lessen reliance on middlemen and enhance price realization.
- ❖ To improve farmers' abilities and knowledge for improved decision-making and farm management, offer training and extension services on best practices in cherry and apricot cultivation, post-harvest handling, marketing, and financial management.
- ❖ Familiarizing people to the practical usage of LP for making better decision

Materials and Methods

Study Area

The study area include Gilgit Baltistan region, has total area 72,497sq.km with around 1.8 million populations (estimated) and lies extreme north of Pakistan. It comprises of ten districts which are located in the most remote and isolated parts of country. Most of the area i.e. 66 percent mountainous, 4 percent is under forest cover and 1.2 percent is cultivable land. The current cropped area is only 0.08 percent of the total area. The main strength of economy of Gilgit Baltistan depends largely on dry fruits and agriculture. This area is most famous for its cherry, apricot and other dry fruits.

Gilgit-Baltistan as the research area provides a unique chance to analyze the confluence of agriculture, economics, and environmental problems in a region important to both agricultural productivity and its cultural value. The region's unique climate makes it an attractive place to study how farmers adjust to changing conditions. This research has the potential to close a knowledge gap and assist policymakers in making better agricultural decisions in Gilgit-Baltistan.

Data Collection

This research study is based on secondary data, carried out in the Northern Areas of Pakistan. The secondary data were amassed from various published and unpublished sources. Government records, such as agricultural statistics and land use data, provided additional insights into the agricultural landscape of Gilgit-Baltistan. Published literature, including research papers and reports, is also review to gather background information and support the findings of the study.

Sets	Parameters	Variables	Constraints
Sets of crops	Land needed To each crop	Area of land allocated to each crop	Land availability
Sets of land type	prices of crops	Crop sales	Labour resource
Sets of months	yield of crops	Crop production	Crop requirement
Cropping Activities	Cost of production	Farm income	

Methods Use

The overall approach to developing the farm-level model involved several key steps. First we identify the key variables, sets and parameters that influence the farm-level decision-making in Gilgit-Baltistan.

These include; Sets parameter and variables

Source: GAMS software

Next is to develop an optimization model to maximize farm income while taking into account constraints such as land availability, labor resources, and crop-specific requirements. The model is built using linear programming techniques, allowing for the simultaneous optimization of numerous variables and constraints. Optimization strategies included the use of decision variables to reflect the allocation of resources (such as land and labor) to different crops, as well as the creation of an objective function to maximize farm income.

The model is then implemented using software tools called GAMS (General Algebraic Modeling System) to solve the optimization problem. GAMS model (general algebraic

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modeling system) are optimization models widely used for analysis in agriculture and economics. It focuses on optimizing agriculture practices for sustainable farming system. The objective of the farm level model of GB is to maximize farm income while considering various constraints and factors. The objective function is formulated to optimize crop selection, land use, livestock management, and labour allocation to achieve this goal.

Objective Function (Maximization of Farm Income)

To maximize the farm income, the objective function can be formulated as follows:

Maximize Z= $\sum c \in C \sum l \in L \ (Pricec \times Yieldc,l \ \times xc,l) - \sum c \in C \ (Costc \ \times x\ c,l)$

This objective function tries to maximize overall revenue earned from each crop by taking into account their respective prices, yields, and land area allotted to each crop, as well as the costs associated with each crop and the total accessible land of each type.

This objective function aims to maximize the total revenue earned from each crop ($c \in C$) given their respective prices ($Pricec$), yields ($Yieldc,$), and the area of land provided to each crop ($xc,$). The objective value Z is calculated by subtracting the total cost related to each crop ($Costc$) and multiplying by the area of land allocated to each crop ($xc,$). This value indicates total farm income. The goal is to maximize this value, which represents the maximization of farm income.

Maximize Z: Objective function is to maximize the total farm income, denoted by Z.

Z: total farm income, which is the sum of all revenue from all crops minus the total cost of cultivation.

Revenue Term: It is sum of the product of crops price, yields, and the area of land allocated to each crop.

For each crop c in set C and each land type l in set L, price c is the price of crop c on the land type l, and x, cl is the area of land allocated to crop c on land type l.

Cost Term: sum of the product of crop cost and the area of land allocated to each crop.

Cost c is the cost of cultivating crops.

The objective is to maximize the total farm income by optimizing the allocation of crops to different land types.

Result and Discussion

This farm level model presents the results, discussion and the insights that are gathered from secondary data sources, which are collected from various published and unpublished sources, government records such as agricultural statistics and land use data, provided additional insights into the agricultural landscape of Gilgit-Baltistan. The purpose of this farm model study is to find out whether it is possible to find the potential farm successors in the study region (Gilgit Baltistan), how they planned to continue their line of work, implement various techniques and what the locals thought about the matter.

The farm level model of Gilgit Baltistan is developing to optimize crop allocation and maximize farm income. This model is solving using linear programming techniques to determine the optimal allocation of land for different crops.

The results of the farm-level model showed that optimizing land allocation can effectively increase farm income in Gilgit-Baltistan. By shifting towards high-value crops like cherries and apricots, farmers can maximize their profits and improve the overall sustainability of their farming practices.

Results obtain from GAMS model before optimization

Crops
Cherry
Apricot

Source: GAMS software

Land Types

Land Use in Gilgit-Baltistan (in Hectors)

Type of land	Area(ha)	Percentage (%)
Mountains/ Lakes/ Rivers/ Glaciers	4,810	66.34
Forest: Protected	65	0.90
Forest: Private	219	3.02
Social Agro/ Farm	362	4.99
Rangeland	1,646	22.70
Cultivated land	58	0.80
Cultivable land(waste)	90	1.24
Total land	7,250	100

Source: Land use data 2009, Forest Department, Government of GB

Average Crop Revenues (tons per ha):

Crops	Revenue
Cherry	2.613
Apricot	9.588

Source: GAMS software

Labor Requirements for Cropping (man-days per ha):

Crops	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Crop-02	0	0	2	3	2	5	8	4	1	1	0	0
Crop-05	0	0	3	2	2	7	9	6	3	2	0	0

Source: GAMS software

Year Vice Yield (tons per ha)

Crops	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cherry	2.33	2.34	2.40	2.47	2.53	2.62	2.86	2.86	2.86	2.86
Apricot	8.84	9.11	9.39	9.58	9.78	9.98	10.13	9.67	9.58	9.82

Source: GAMS software

Results obtain from GAMS(General Algebraic Modeling System) after optimization

Land balance: "Land balance" refers to the allocation or distribution of land for different purpose, such as cultivation, grazing, or other uses, to ensure that it is used efficiently and sustainably.

These numbers shows how much land can be used for different purpose on the farm. For example there's limit on how much land can be used for growing crops or livestock. These limits help ensure farm is managed properly.

In farm level model of Gilgit Baltistan:

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Marginal: This tells us how much the outcome (like profit or yield) would change if we change the amount of land used for farming a little bit. It helps us see if using a bit more or less land would make a big difference.

Upper: This is the highest amount of land we can use for farming based on models limit .It's like a don't go above this rule.

Lower: This is the lowest amount of land we can use for farming based on models limit. It's like a don't go below this rule.

Level: This tells us how much land we are currently using for farming. It's like checking current status before making any changes.

These values help you understand how changing the amount of land used for farming could affect our results and make sure we stay within our limits.

Land Balance

Land	LOWER	LEVEL	UPPER	MARGINAL
Cultivable	-INF	3.8515	90.0000	-
Cultivated	-INF	58.0000	58.0000	EPS
Rangeland	-INF	-58.0000	1646.0000	-

Source: GAMS software

In this table, each row represents a different type of land:
Cultivable, cultivated, and rangeland.

Here's What Each Column Means

Lower: This is the minimum amount of land that can be used for each type. For cultivable land, there is no minimum (represented by -INF, which means negative infinity). For cultivated land, there is no minimum. For rangeland, there is no minimum.

Level: This column shows the current amount of land being used for each type. It's the current status.

Upper: This is the maximum amount of land that can be used for each type of crop. For cultivable land, the maximum is 90 acres. For cultivated land, it's 58 acres. For rangeland, it's 1646 acres.

Marginal: This column indicates the sensitivity of the model to changes in land use. It shows the change in the objective function (e.g., profit) if we slightly increase or decrease the amount of land used for each type. EPS stands for epsilon, which is a very small number used to represent a tiny change.

These values help to understand the constraints and possibilities for land use in model.

Crop Production (Ton):

Crops	**LOWER**	**LEVEL**	**UPPER**	**MARGIAL**
Cherry	-INF	0.1500	+INF	.
Apricot	-INF	96.2886	+INF	.

Source: GAMS software

This table represents the constraints on crop production for cherries and apricots:

Lower: The minimum amount of crop that can be produced. For both cherry and apricot, there is no minimum (represented by -INF, which means negative infinity), indicating that there is no lower limit on how much can be produced.

Level: The current or optimal level of production. For cherries, it is 0.1500 tons, and for apricots, it is 96.2886 tons.

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Upper: The maximum amount of crop that can be produced. For both cherry and apricot, there is no maximum (represented by +INF, which means positive infinity), indicating that there is no upper limit on how much can be produced.

Marginal: This column typically shows the shadow price, which indicates the rate of change in the objective function value with respect to a one-unit change in the constraint. Since it is shown as "."

Crop Sales (ton):

Crops	LOWER	LEVEL	UPPER	MARGINAL
Cherry	.	.	+INF	-39925.9098
apricot	.	95.3536	+INF	.

Source: GAMS software

In the Table, for Cherry Sales:

The "**Lower**" bound is not defined, meaning there is no minimum limit on how much cherry can be sold .The "**Upper**" bound is set to positive infinity, indicating that you can sell as much cherry as you want.

The "**Level**" indicates the amount of cherry sales suggested by the model, which is not provided in the table. The "**Marginal**" value is -39925.9098, which suggests that for each additional ton of cherry sold, the objective function (likely profit or revenue) would decrease by approximately 39925.9098 units.

For apricot sales:

There is no specific limit mentioned for the "**Lower**" and "**Upper**" bounds, meaning there are no minimum or maximum restrictions on apricot sales.

The "**Level**" column suggests that the model recommends selling 95.3536 tons of apricots.

The "**Marginal**" value is ".", which indicates that there is no significant change in the objective function if you were to sell an additional ton of apricots.

Conclusion

The study successfully developed a LP model to optimize apricot and cherry production in Gilgit-Baltistan, demonstrating significant potential for increasing farm income and reducing poverty. The analysis demonstrates that apricot production, which covers 2,500 hectares with an average yield of 8.5 tons per hectare, and cherry production, which covers 400 hectares with an average yield of 4.15 tons per hectare, can be significantly increased through strategic resource allocation and the implementation of improved farming practices. The model emphasizes the critical importance of infrastructure improvements, such as farm-to-market roads and cold storage facilities, in reducing post-harvest losses and improving market access. Furthermore, introducing high-yielding, drought-resistant varieties and providing training in modern agricultural techniques are critical for increasing crop yields and profitability. These interventions are critical for promoting sustainable agricultural development in the region while also ensuring long-term food security and economic stability for local farming communities. The study findings are useful for policymakers looking to improve agricultural productivity and economic resilience in Gilgit-Baltistan.

Future Implication

There is need to introduce, propagate, and distribute high yielding, drought and disease-resistant varieties of apricot and cherry. The government should also provide a cold chain to fruit producers in order to reduce post-harvest losses. There should be essential

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infrastructure facilities like farm to market roads, cold storage, and processing machinery. The farming groups or cooperatives can also solve the constraint of technology by sharing the Internet and other latest technology among group members. This is the demand of time for creating self-sufficiency in the agriculture of northern areas. There is a need for market security in the sense of price stability and access to the market. Government and NGOs are required to play an active part. Enhance the export competitiveness by providing technical support and financial assistance to improve processing, packaging, and marketing.

Literature Citied

Ahmad, S., K. Saddozai, M. Khan and S. Afridi. 2008. Cherry marketing system in Gilgit District, Northern Areas of Pakistan. Sarhad J. Agric., 24(4): 771- 777

Aider, M.; de Halleux, D. Production of concentrated cherry and apricot juices by cryoconcentration technology. *LWT Food Sci. Technol.* **2008**, *41*, 1768–1775. [Google Scholar]

Akin,E.B.,Karabulut, I., TopcuA. Some compositional properties of main Malatyaapricot (Prunusarmeniaca L.) varieties. Food Chemistry,2007, 107(2),939-948.

Ali S, Tariq M, Kashif SA. Physico-chemical characteristics of apricot (Prunus armeniaca L.) grown in Northern Areas of Pakistan. Scientia Horticulturae, 2011; 130: 386-392.

Ali, S.; Masud, T.; Abbasi, K.S. Physico-chemical characteristics of apricot (*Prunus armeniaca* L.) grown in Northern Areas of Pakistan. *Sci. Hortic.* **2011**, *130*, 386–392. [Google Scholar]

Ali,S.,Masud, T., Abbasi K.S. Physico-chemical characteristics of apricot (PrunusarmeniacaL.) grown in Northern Areas of Pakistan. ScientiaHorticulture,2011, 130(2), 386-392.

Alonso J, Alique R. 2004. Influence of edible coating on shelf life and quality of "Picota" sweet cherries.European Food Research and Technology 18, 535-539. http://dx.doi.org/10.1007/s00217-004-0908-3

Amin, A., F.S. Bidabadi, R. Joolaei and A. Keramatzadeh. 2013. Managing cropping patterns agricultural crops of three counties of Mazandarn province of Iran. Int. J. Agric. Crop Sci. 5(6): 596-602

Anwar, S.; Khan, F.A.; Rahman, A.-U. Impact of Karakoram Highway on Land use and Agricultural Development of Gilgit-Baltistan, Pakistan. *Sarhad J. Agric.* **2019**, *35*, 417–431. [Google Scholar]

Aquil, A., N.A. Sofi, M. Ahmad and B.A. Bhat. 2015. Decision making in agriculture: A linear programming approach. Int. J. Modern Math. Sci. 12(2): 160-169.

Benz, A. Framing Modernization Interventions:Reassessing the Role of Migration and Translocality in Sustainable Mountain Development in Gilgit-Baltistan, Pakistan. *Mt. Res. Dev.* **2016**, *36*, 141–152. [Google Scholar]

Braunstein, E.; Houston, M. *Pathways Towards Sustainability in the Context of Globalization*; Routledge in Association with GSE Research: Abingdon, UK, 2016. [Google Scholar]

Chambroy,Y., Souty,M., Audergon,J.M., Jaquemin,G., Gomez,R.M. Research on thesuitability of modified atmosphere packaging for shelf-life and quality improvement of apricot fruit. Acta Horticulture,1995, 384, 633-638.

Chatterjee, N., Shi, J., & García-Closas, M. (2016). Developing and evaluating polygenic risk prediction models for stratified disease prevention. *Nature Reviews Genetics*, *17*(7),

Online ISSN Print ISSN

3006-4651 3006-466X

Chauhan,S.K., Tyagi,S.M.,Singh,D. Pectinolytic liquefaction of apricot, plum, and mango pulps for juice extraction. International journal of Food Properties,2001, 4(1), 103-109.

Childers, N.F. (1983). Modern Fruit Science orchard and small fruit culture. Pp: 1926. Hort: Publications, Gainesville, Florida.

Crespo-Herrera, L.A.; Ortiz, R. Plant breeding for organic agriculture: Something new? *Agric. Food Secur.* **2015**, *4*, 25. [Google Scholar] [CrossRef]

Dani, A.H. 2001. History of Northern A

Deshpande, R.S.; Prachitha, J.; Shaha, K. Making of State Agricultural Policy: A Demonstration. In *Issues in Indian Public Policies*; Annigeri, V.B., Deshpande, R.S., Dholakia, R., Eds.; Springer Singapore: Singapore, 2018; pp. 37–82. [Google Scholar]

DoA. (2001). Agricultural Statistic of Northern Areas. Dept. of Agricultire, Gilgit. (unpublished)

FAO. Crops. Production Quanitites of Apple bu Country. Food and Agriculture Organization; United Nations: Rome, Italy, 2018. [Google Scholar]

Faostat, F. 2017. Available online: http://www. fao. org/faostat/en/# data. QC (accessed on January 2018). Gangli, L., S. Runyu and S. Juan. 1987. Studies on the nutritional ranges in some deciduous fruit trees. Acta Horticulturae Sinica (China).

FAOSTAT, World apricot production, wwwfao.org (2012) 3. M. THOMPSON, Bio-geographical survey and collection of temperate fruit and nut genetic resources in Northern Pakistan. Trip Report, International Board for Plant Genetic Resources, IBPGR/88/55, 1988, pp. 105.

Felix., M., 2013. Optimum combination of crop farm enterprises: A case study of a small-scale farm in marondera, Zimbabwe. Int. Res. J. 2(1): 60-65.

GBAS.(2009). Gilgit-Baltistan Agriculture Statistics 2009, survey report.Department of Agriculture GilgitBaltistan14 p

Gioli, G.; Khan, T.; Bisht, S.; Scheffran, J. Migration as an Adaptation Strategy and its Gendered Implications: A Case Study From the Upper Indus Basin. *Mt. Res. Dev.* **2014**, *34*, 255–265. [Google Scholar]

GOP. Northern Area Agriculture Statistics 2015-16. Pakistan Bureau of Statistics; Statistical Division: Islamabad, Pakistan, 2016. [Google Scholar]

Guclu,K., Altun,M., Ozyurek,M., Karademir,S.E.,Apak,R. Antioxidant capacity of fresh, sundried and sulphited Malatya apricot (PrunusarmeniacaL) assayed by CUPRAC, ABTS/TEAC and folin methods. International Journal of FoodScience andTechnology,2006,41(1),7685.

Haciseferogullari,H., Gezer,I., Ozcan, M.,MuratAsma,B. Postharvest chemical and physical mechanical properties of some apricot varieties cultivated in Turkey. Journal of FoodEngineering, 2007,79,364-373.

Hinojosa, L.; Napoléone, C.; Mouléry, M.; Lambin, E.F. The “mountain effect” in the abandonment of grasslands: Insights from the French Southern Alps. *Agric. Ecosyst. Environ.* **2016**, *221*, 115–124. [Google Scholar]

Hussain, A., M.S Awan,., S. Ali and H. Azhar. 2012. Preharvest Fruit Losses and Physico-Chemical Analysis of Different Varieties of Pomegranate in Gilgit-Baltistan Pakistan. Journal of Agricultural Science and Technology B2(9B):997. https://doi.org/10.17140/aftnsoj-5-156

IFAD, F. 2015. WFP (2015). The state of food insecurity in the world.

Vol. 3 No. 6 (2025)

Journal of Social Signs Review

Online ISSN Print ISSN

3006-4651 3006-466X

Ishtiaq, H., M.A. Raza, M. Khalil and R. Ilahi.2004. Determination of optimum cropping pattern in the Faisalabad Division Pakistan. Int. J. Agric. Bio. 6(5): 901-903.

Khalid, R., T. Mahmood, R. Bibi, M.T. Siddique, S. Alvi and S.Y. Naz. 2012. Distribution and indexation of plant available nutrients of rainfed calcareous Pakistan. Soil soils of Environ., 31(2): 146-151.

Khan, AG 2003. Rangelands and livestock. Northern Areas Strategy for Sustainable Development Background Paper, 47. Glgt UCN Pakistan, Northern Areas Progamme.

Kumar, A.; Singh, H.; Kumar, S.; Mittal, S. Value chains of agricultural commodities and their role in food security and poverty alleviation-A synthesis. *Agric. Econ. Res. Rev.* **2011**, *24*, 169–181. [**Google Scholar**]

Lairon,D. Les fibres alimentaires. La Recherche,1990, 21, 28492.Ali, A, S.M. Khair and M. Afzal (2003-04). Production and Marketing of Cherry in Balochistan. In Socioeconomics Research Studies 2003-04. pp 51-67. Ed. K. M. Aujla, W. Malik and M. Sharif.

Naseer, M.A.U.R.; Ashfaq, M.; Hassan, S.; Abbas, A.; Razzaq, A.; Mehdi, M.; Ariyawardana, A.; Anwar, M. Critical Issues at the Upstream Level in Sustainable Supply Chain Management of Agri-Food Industries: Evidence from Pakistan's Citrus Industry. Sustainability 2019, 11, 1326. [Google Scholar] [CrossRef]

Rahim, U.., and A. Beg. 2010. Producton and marketing of vestock products in the Hndu Kush-Karakoram-Hmaaya n Pastoralism and rangeland management on the Tibetan Plateau in the context of climate and global change. Regional workshop in Lhasa, P.R. China, 21-25 October 2010 Bonn: GZ.

Rasul, G.; Hussain, A. Sustainable Food Security in the Mountains of Pakistan: Towards a Policy Framework. *Ecol. Food Nutr.* **2014**, *54*, 625–643. [**Google Scholar**]

Shahzad, M.A., S. Abubakr and C. Fischer. 2021. Factors affecting farm succession and occupational choices of nominated farm successors in Gilgit-Baltistan, Pakistan. Agriculture 11:1203. https://doi.org/10.3390/agriculture11121203

Shahzad, M.A.; Ahmed, V.; Fischer, C. Status and determinants of other gainful activities by farmers in mountainous rural regions of Gilgit-Baltistan, Pakistan. *J. Mt. Sci.* **2021**, *18*, 2520–2539. [**Google Scholar**]

Tamura, M., Ohnishi,Y., Kotani, T., Gato,N. Effects of new dietary fiber from Japanese apricot (PrunusmumeSieb. etZucc.) on gut function and intestinal microflorain adult mice. International Journal of Molecular Science, 2011, 12, 20882099.

Tareen, M. J. and M. N. Tareen. (2006). Effect of Rootstocks on I. Lambert Cherry Grown in Balochistan (Pakistan). International Journal of Agriculture and Biology, 1560-8530/2006/08-1-52-54. http://www.fspublishers.org.

Webster, A.D. and N.E. Looney. 1996: Cherries: crop physiology, production and uses: edn. Cab International.

World Bank Gilgit-Baltistan Economic Report: Broadening the Transformation. Report No. 55998-PK. 2010.

World Bank. 2012. World Development Indicators Online. Washington, D.C.: World Bank Retrieved December 2012 from http://databank.worldbankorg/ddp/home.do?Step=12&id=4&CNO=2

Yildiz,F.New technologies in apricot processing.Turkish J. Stands. Apricot Special Issue, Ankara. 1994, 67-69.