



Walnut Economy Promotion: A Case Study of Kapisa Province, Afghanistan

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ABSTRACT

This paper studies the walnut economy promotion in Kapisa province of Afghanistan for insuring opportunities such as full Employment, Local economic development, reducing immigration, increasing Quality of life, Peace and prosperity and Quality of Education as dependent variables as well as potential opportunity of walnut economy promotion as independent variable. The objectives are to find the socioeconomic impact of walnut gardening on people's life, increase income per capita and analyze the ways of exporting walnut production toward national and international markets. In this study, both qualitative and quantitative methodologies are combined to collect data from fields, local markets, libraries, websites and social media. The problems are different aspects of daily life such as: Unemployment, leaving education and immigration of young generation due to poverty, joining into war groups for salary, etc. At the end some recommendations are proposed as solutions.

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1. Introduction

Horticulture continues to be very important to the development of society and economy. Constraints exist seriously to area expansion and declining other agricultural growth resources. Agriculture is diversifying towards nonfood grains and high value crops such as fruits and vegetables. That is why horticulture comparative advantage is a viable regional solution. (Qadri, 2018)

The benefits of building walnut gardens are so great that can make use of the fruit to its green skin and generate income. The leaves of the walnut tree contain juglone and hydroglugen and the reason for blackening of the hands in contact with fresh skin is this juglone. In traditional medicine, walnut leaves are used as an anthelmintic medicine. Decoction of walnut leaves is effective for reducing blood sugar and blood purification. Walnut leaves are anti-inflammatory and anti-toxic and are also effective for healing herpes. The green skin of the walnut and the naphthalene contained in it has antibacterial properties. The green skin of the walnut is used for various purposes such as insect repellent, in industries for dyeing, pharmaceuticals, making cosmetics and leather, fertilizer, in oil and gas wells to prevent the waste of drilling mud. Because walnut's wood has high resistance to pressure, bending, humidity and stretching, it is widely used in various industries. Turning, inlaying, making sculptures and decorative items, making furniture, wood veneer, etc. are among the benefits of walnut tree wood, which is very versatile and popular. Walnut oil is used in food and pharmaceutical industries and artistic works. (Niaze Giahani, 2022)

Although Afghanistan's topography and climate are ideal for growing high-quality horticulture commodities, the industry has suffered tremendously throughout the past 40 years of strife. Yet, the industry continues to be of utmost significance to the economy as a whole because it employs millions of Afghans, generates income for them, and accounts for half of export earnings. Afghanistan used to be a major exporter of horticultural goods to foreign markets, according to the Food and Agricultural Organization of the United Nations (FAO) because of the variety of climates that allow for a wide range of crops, the long and staged harvest seasons that are advantageous for export, the reasonably rich soils, and the accessibility of groundwater, horticulture has traditionally been a significant asset of the Afghanistan economy.

Afghanistan provided more than 30% of all dried apricots, 18% of raisins, 12% of pistachios, and around 6% of fresh apricots and grapes traded on international markets in the 1970s. Despite a long history of processing horticulture products, there are currently few initiatives. Afghanistan's horticulture industry has suffered due to conflict, and its proportion of the global market for important goods has decreased. Agriculture is significant economically, but small-scale farmers are the majority. Horticulture accounts for one-third of Afghanistan's agricultural output and half of its export revenue. Although Afghanistan's varied climate makes

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it possible to grow a variety of high-quality crops, the country's geography makes it difficult to trade those goods. (Akbari, Beath, Hanbal, Kassim, & Palmade, 2017)

1.1. Research problems

Afghanistan's income per capita which is represented in the National Statistics and Information Authority each year is not enough real. It is represented by calculating the average of the whole country's income considering ease of data collection from big cities with less than partial employment and local areas with extreme poverty, but real situation of the rural people's life can be discovered in this research study based on exact observations in the fields. This study focuses on observing the real facts regarding people's life in Pachaghan valley in Nijrab district of Kapisa province which constitutes about 200+ sub villages (about 50,000 families). This study observes the different aspects of daily life such as: Unemployment, leaving education and immigration of young generation due to poverty, joining into war groups for salary, etc. This study tries to find the ways to use the local horticultural capacities as opportunities to solve the challenges and generalization to whole country.

1.2. Expected outcomes:

Implementation of this research will:

- 1.2.1. Eliminate poverty and hunger by increasing the income per capita of local people.
- 1.2.2. Help the better physical and mental health of local people by increasing income per capita, business and export growth, reforestation and climate promotion and mental relief.
- 1.2.3. Creating jobs for women beside men in the horticulture and livestock farms.
- 1.2.4. Clean water and sanitation due to climate promotion.
- 1.2.5. Affordable and clean energy supply due to reforestation and food production.
- 1.2.6. Wood supply for industry and avoid deforestation.
- 1.2.7. Reduce social inequalities due to economic development, quality education and Intellectual growth.
- 1.2.8. Sustainable economic and social growth of cities and communities due to economic development, quality education and Intellectual growth.
- 1.2.9. Balanced consumption and production.
- 1.2.10. Climate positive change due to reforestation.
- 1.2.11. Promotion of life on land.
- 1.2.12. Insuring peace and stability.

2. Literature review

Afghanistan was one of the largest exporters of agricultural products in the world in the 1970s. At that time, 10% of the total dry fruits of the world markets were exported by Afghanistan. But from the effect of civil wars in the country; Afghanistan fell behind the world trade caravan. (Aminyar, 2016)

Though little horticultural study has been done in Afghanistan for 5 decades, capacities have declined during the Russian invasion until the end of first period of Taliban regime. The US government supported establishing first organizations for Agricultural research in Afghanistan in 1960s. The US government and the World Bank assisted the extension services that originally established at the turn of the century, development services were advanced largely in the 1970s. Little research on horticulture was conducted in Afghanistan from 1980 to 2001, as the communist administration tried to implement a public farm model which was focused on grain production and large tracts of agricultural land were consumed by conflict. Extension services planned to disseminate developments to the agriculture sector were reduced in both manpower and activity. Afghanistan's universities conducted very little research on agriculture. In 2010 Afghanistan's cultivable Arable land was 12% which estimated at 8 million ha or 12% of the total area. (Henneberry, 2010) According to Ministry of Agriculture and Livestock (MAIL) data, 5,000 ha of medical seeds, 70,000 ha of vegetables, and 120,000 ha of fruit are all grown (Total approximated 265,000 ha). FAOSTAT, the Corporate Statistical Database of the Food and Agriculture Organization, however, estimated that 306,000 ha of horticultural crops were grown in 2012, including 110,000 ha of fresh fruit (including 61,000 ha for grapes), 25,000 ha of nut trees, 98,000 ha of vegetables, 71,000 ha of pulses, and 18,000 ha of herbs and spices. The two sources mentioned above might have calculated some categories incorrectly. For instance, the 2010 Food and Agriculture Organization of the United Nations (FAO) Land Cover Atlas identified 251,000 ha trees and 93,000 ha vineyards totaling above 340,000 ha, estimating the cultivation of horticultural crops between 350,000 and 400,000 ha (nearly 10% of the total under-irrigated area of Afghanistan), from which 40% is fruits, 30% is vegetables, 25% is pulses, and 5% is other crops (herbs and spices). Grapes/raisins, almonds, pomegranates, apples, pistachios, apricots, and others are the principal crops that are farmed and exported. Vegetable crops are grown and consumed in abundance locally. For the production of horticulture crops, irrigation is required due to the climate and soil conditions in Afghanistan. (Akbari, Beath, Hanbal, Kassim, & Palmade, 2017) In order to grow horticulture industry export potential particularly fruits, nuts and vines in next decade, in 2010 the private and public sector investment to the horticulture was suggested, but due to the huge corruption in Ashraf Ghani's government it could not implement.

Dr. David M. Henneberry (2010), in an article titled (50 Things You Need to Know about Agriculture in Afghanistan) lists the important crops, the irrigation dependent agriculture of Afghanistan, high cost irrigation

and mechanized technology requirement for crops production, malnutrition and need to insure food security. This report remarks on the importance of horticulture for not only fruits production, but for livestock and wool industry. According to Henneberry, from 45 to 55% of children less than five years age face malnutrition. He says that about 70% of agriculture work is done by women in Afghanistan, especially the livestock and horticulture.

Sulaiman Akbari, Andrew Beath, Hazem Hanbal, Suhail Kassim and Vincent Palmadein (2017) in a research report titled (Afghanistan Unlocking the Potential of Horticulture) mention the horticulture as a significant pillar in economic, agribusiness and labor, job creator (about 2 million jobs) and growth in Afghanistan. According to this report horticulture system constitutes 34 percent of the country's agricultural gross domestic Product (GDP), 7 percent of national GDP, 1 and 50 percent of Afghanistan's export earnings. By surveying processors and traders the report highlights the constraints toward the growth of horticulture sector such as access to high-value export markets, fragile business environment, insufficient infrastructure, border closings, roadblocks, cross-loading at border crossings, lack of refrigeration along the supply chain, lack of skills, theft of goods and spoilage, lack of quality and phytosanitary certificates, the poor reputation of Afghan products in many export markets and financing. This report underscores that a paradigm shift is needed that start from the market and end toward producers. The report adds three strategic priorities to the National Comprehensive Agriculture Development Program's producer centered list. These priorities are: Trade facilitation, agribusiness hubs, industrial parks and finance. This report has the following specific recommendations:

The country's multipronged strategy toward improving the access of horticultural producers and traders to high-end markets Such as border and customs issues As part of the Afghanistan-Pakistan Transit Trade Agreement (APTTA), air cargo facilities and services and strengthening standards certification and quality assurance.

Government of Afghanistan should start investments toward resolving constraints which producers face such as lack of access to land, utilities, and key services, clear and transparent land and irrigation regulations, the industrial parks with carefully selected locations.

A Public-Private Partnership strategy to facilitate the entry or expansion of top investors along the whole value chain of horticulture. By strengthening the Agricultural Development Fund (ADF), which offers financing options to processors and their suppliers, forming beneficial partnerships between producers, purchasers, and the public sector, and concurrently weighing the benefits of, or alternatives to, an agricultural bank.

Grants to agribusiness enterprises in order to boost productivity, innovation and risk-bearing activities, Patient Capital as a structural Access to Finance (A2F) solution to organize a global competition.

Dr. Cafer Hakan YILMAZ in (2021) in a research titled (Soil Management and Fertilization in Walnut) mentioning the lack of nutrients in the Turkey soil reveals that plant nutrition is important in the production process. He says that the consumers prefer walnut for its fruit quality. The writer recommends the focus on fertilization balance according to soil and leaf samples which it will increase the yield and quality of walnut such as weightiness, dimensions size, yield, shell thickness, internal shrinkage, color, shoot length, lateral branch efficiency, etc. (YILMAZ, 2021)

Dr. Zeynep ERGUN and Dr. Mozhgan ZARIFIKHSOSROSHAHI² in (2021) in a research named (Industrial Use of Walnut) mention the walnut a member of Juglandaceae family of fruits. The genres of juglans having 20 species are significant for economy. In this writing Afghanistan is among top 20 walnut producer countries of the world. This study remarks the rich nutritious facts and multiple use of walnut in the industries such as health, food, energy, etc.

KHalil İbrahim OĞUZ in (2021) in a research work by the name of (Walnut Juglans regia L. Breeding and Walnut Breeding Criteria) tries to show the history of walnut breeding in the world by country, breeding studies criteria, methods and developments in breeding study, cultivar and rootstock types of breeding and strategies for future breeding. General walnut breeding aims are to breeding new varieties for high yield, disease resistance and pest resistance, biotic and abiotic stresses. Using selection method the first breeding studies in 1948 in France and USA selected high quality genotypes from some walnut homeland countries including Iran, China and Afghanistan and reproducing them in France, USA, China, Iran, Turkey, Spain and Italy and obtained new variations by natural hybridization methods. Phenotyping and new molecular breeding techniques were introduced as a result of the development of breeding techniques later on. Significant improvements in walnut cultivar and rootstock breeding have recently been made thanks to discoveries in genetics and biotechnology. The long-term protection of biodiversity's germplasm will also be ensured by educated biotechnologists, who will be able to identify and engineer desired traits for breeding in an appropriate gene bank. As a result, the use of molecular breeding and biotechnology techniques can be extremely important in countries like the USA, China, France, Iran, and Turkey that conduct walnut breeding studies. Genome-based strategies, genome-wide association analyses, marker-assisted selection, genomic selection, high-throughput genotyping platforms, next-generation sequencing techniques, including genome editing with the CRISPR-Cas9 system, and bioinformatics tools are some of the techniques used in this field.

These methods will enable the production of walnuts as well as the variety and rootstock breeding to yield quick and obvious results. (OĞUZ, 2021)

Dr. Hayat TOPCUin (2021) in a study (Conventional and Molecular Breeding in Walnut) remarks the conventional and molecular approaches of breeding in walnut. The mistakes are made in conventional breeding such as gardening in unfitting climate and sites, plants that are healthy and not true to their name, unfamiliarity of producers with fertilization, wrong pollinator varieties, failure to plan the planting of trees, failure in planting technique, not observing pollinator on flowering characteristics of the main variety. (TOPCU, 2021)

Limitations

- 2.1. Lack of previous academic or industrial research in walnut economy in Afghanistan, despite its significant importance economical capacity.
- 2.2. Lack of appropriate technology to maintain agriculture sector databases.
- 2.3. Loss of all previous data records due to government buildings destruction.
- 2.4. Rejection of some limited quantities of fruits which have been exported to European, the Middle East, or more distant Asian countries because of poor quality, unreliable delivery and delays.

3. Research Gaps

The following Gaps are observed in the walnut economy of Afghanistan:

- 3.1. Despite of vital role, no research has been done on walnut economy of Afghanistan, Neither by industry nor by agriculture academy.

4. Objectives of research

- 4.1. To find the socioeconomic impact of walnut gardening on peoples life in Pachaghan area.
- 4.2. To analyze the extent of increase in the income per capita due to building walnut orchards in Pachaghan area.
- 4.3. To show that the walnut economy promotion in the area can increase the income per capita from \$ 102.275 Deficit to \$ 444.275 Surplus.
- 4.4. To analyze the ways of exporting walnut production toward national and international markets.
- 4.5. To find the solutions for unemployment problems in Pachaghan area.
- 4.6. To Study the opportunities and best use of those opportunities in development of walnut sector economy in Pachaghan area.

5. Methodology

Mixtures of qualitative and quantitative approaches are used to get the best possible result.

5.1. Data collection

The data are collected from some resources such as:

- 5.1.1. Field observation.

Governmental Organizations such as:

- 5.1.2. Ministry of Commerce and Industries.
- 5.1.3. Ministry of agriculture and livestock.
- 5.1.4. Agriculture Directorate of Kapisa Province.
- 5.1.5. National Statistics and Organization Authority.
- 5.1.6. Ministry of Economy.
- 5.1.7. Some online Libraries and data basis.

5.2. Research Questions

- 5.2.1. Why Pachaghan People feel deficit in their income per capita?
- 5.2.2. Why Pachaghan people prefer to immigrate for work purpose?
- 5.2.3. Could walnut economy promotion in Pachaghan increase income per capita, create job and solve unemployment related immigration challenges?
- 5.2.4. How could Pachaghan people contribute from local to international sustainable development goals?

5.3. Variables

5.3.1. Dependent variables:

- 5.3.1.1. Full Employment.
- 5.3.1.2. Local economic development.
- 5.3.1.3. No immigration.
- 5.3.1.4. Quality life.
- 5.3.1.5. Peace and prosperity.
- 5.3.1.6. Quality Education.

5.3.2. Independent variables:

- 5.3.2.1. Walnut economy promotion by academic and industrial researchers.
- 5.3.2.2. Implementation by help of local people which are ready.
- 5.3.2.3. Providing horticulture finance by granter.

6. Discussion

The walnut tree is one of the most valuable and broad-leaved trees that can be found in many parts of the world in the Northern Hemisphere from the centre to the east of Europe and the Caucasus and Afghanistan to the foothills of the Himalayas and China and Japan, as well as its species in North America. In the south, it grows naturally and is planted. The only remaining natural forest of this product in the world is now in Kyrgyzstan and in very good condition. (A complete article about walnut, 2012) The walnut tree is among the trees that grow a lot and its height may reach 10 to 30 meters. A walnut tree can have an economic life of up to 50 years in commercial gardens, but according to the available evidence and documents, the life of a walnut tree can reach more than 1000 years, which can be mentioned as a 1400-year-old walnut tree in the village of Oregon in Chaharmahal and Bakhtiari province of Iran. Due to the increase in the yield of walnut every year and the increase in the price of walnut in the market, the profit from the sale of walnut will also increase every year. (Building a Chandler Walnut Orchard is a sure way to make a profitable investment, 2022) The number of walnut trees per acre depends on the type of walnut tree. Some varieties of walnut seedlings are very tall, and for this reason, it is necessary to plant them with more distances, which is the recommended distance of 10x10. Some other cultivars of walnut seedlings, such as purple Canadian walnut seedlings, purple genotype walnut seedlings, Chandler walnut seedlings and transplanted Fernor, needs less spacing for planting and can be planted with 6x6 or 6x7 spacing. (Investigating the principles of building a walnut garden and its costs, 2022) Deficits in plant nutrients in soils highlight the significance of plant nutrition techniques in the manufacturing process. One of the hard-shelled fruit varieties, walnut, has an interior fruit quality that is significant and a definite consumer preference. A balanced fertiliser is required, per the analysis of soil and leaf samples, to increase the yield and quality of walnuts (fruit internal weight, width, height, yield, shell thickness, internal shrinkage, colour values, shoot length, lateral branch efficiency, etc.). (YILMAZ, 2021) In conclusion, walnuts have a variety of applications in the chemical, pharmaceutical, cosmetic, furniture, paint, and fuel industries in addition to the food industry. (ERGUN & ZARIFIKHSOSROSHAHI, 2021)

Since it has been clear how important and valuable walnuts are to human health, there has been a growth in the breeding of high-quality types. Some of the criteria used to demonstrate the dominant breeding factors in walnut breeding include early maturity, white-colored kernels that are simple to remove from the shell, high yield, lateral bearing habit, productivity, dwarfing, late flowering, tolerance to salt and drought, and resistance to diseases and pests like *Agrobacterium*, *Phytophthora*, nematodes, *Aceriaavanensis*, and *Armillaria*. Breeders employ breeding techniques including marker-assisted selection, haploid and polyploid induction, hybridization, genetic engineering, mutation breeding, genome sequencing, bioinformatics, and germplasm assessment. Global climate change has significantly altered walnut breeding and output in recent years. New breeding techniques for walnuts have recently been developed in response to climate change. The breeding strategies and programs that are suggested for use are as follows:

The new walnut breeding strategies should take into account elements such as low chilling requirements, early harvest and late leafing characteristics, maintaining and preserving genetic diversity for breeding new varieties and rootstocks, concurrent use of transcriptomics, metabolomics, and proteomics techniques to understand the characteristics of drought and salinity tolerance in walnuts, genomic selection, high throughput phenotyping, and genome wide association studies in walnuts, as well as genomic selection, high throughput phenotyping, and genome wide association studies in walnuts,... (OĞUZ, 2021)

Due to its high nutritional value, significant economic value, and precious timber, walnuts are one of the hard-shelled fruits that have gained a lot of popularity in recent years. A rise in walnut breeding has been brought on by the major improvement in walnut growth and the promotion of effective and efficient diversity. The main goals of walnut farming have always been high productivity and quality. The primary quality traits addressed in walnut include high yield on lateral branches, extra nut weight, large fruit, the high kernel rate, delayed leafing, early harvest, and light kernel color. Manufacturers have used a variety of techniques to achieve these goals, including marker assisted selection, genetic engineering, variation breeding, genome sequencing, haploid and polyploid causations, proteomics, and metabolomics. The current focus of walnut farming is the integration of conventional breeding techniques with molecular breeding (using knowledge from genomic, transcriptomic, proteomic, and metabolomics studies). Global warming and climate change could have a significant impact on future generations of walnuts. Because of this, walnut growing techniques, especially in the most significant and productive active areas, are working hard to develop walnut varieties quickly and effectively that preserve and continually increase walnut yield and quality. Using transcriptomics, metabolomics, and proteomics for understanding to hard environmental conditions resistance operation in walnut, having generations of different chromosome number plants to increase genome installation feature, combining high-throughput the set of observable characteristics of an individual with GWAS and genomic selection, using CRISPR-Cas9 methods for goal-genome regulation, and ongoing evaluation of genetic variation are just a few examples. (TOPCU, 2021)

6.1. Requirements of Walnut Tree farming

In general, the walnut tree needs between 400 and 1500 hours of cooling depending on the variety, but the cold requirement of most types of walnut is solved between 700 and 1000 hours. If the cooling demand of the walnut tree is not met, it will cause a delay in the formation of buds and reduce the amount of production.

(Walnut tree - a comprehensive guide from planting to harvesting for garden establishment, 2022) The walnut tree likes places with full sun and soils with good drainage. The walnut tree grows well in deep loamy soils with proper drainage and rich in organic matter. The walnut tree tolerates a wide range of soil pH, something between 5 and 9. But the most suitable pH for the better performance of the walnut tree is a neutral environment. (Walnut tree - a comprehensive guide from planting to harvesting for garden establishment, 2022) Walnut trees grow in the latitude of 30-55 degrees north. The best place to build a walnut garden is 800 to 2500 meters above sea level. (Investigating the principles of building a walnut garden and its costs, 2022) Afghanistan lies at an average elevation of 1885 meters above sea level and is located in the geographical orbit of 33 degrees north; most parts of Afghanistan are suitable for building walnut gardens. Afghanistan has a long history of horticulture, and many of its distinctive products, such as dried fruit, are still well-known around the world. Yet, the 40-year-long violence in Afghanistan has severely disrupted horticultural product supply chains and marketplaces, in particular made it difficult for traders and producers to export goods to high-value markets. Notwithstanding its recent dismal performance, Afghanistan's natural resources provide favorable circumstances for horticulture products, and the industry is essential to the country's economy as a whole.

Walnut is sensitive to spring cold and it is necessary to protect it from sudden spring cold. The suitable temperature for proper production is 18-22 degrees Celsius on average and maximum 35 degrees Celsius. The suitable temperature for pollination is 15-25 degrees Celsius. On the south-facing slopes, flowering occurs faster but increases the risk of spring frost. Planting walnuts in areas with relative humidity above 60-70% should be avoided, and relative humidity should not be less than 25 degrees. (NiazeGiahan, 2022) Temperatures above 42 degrees can lead to the shrinking of the walnut tree fruits and serious damage to the walnut tree. (Walnut tree - a comprehensive guide from planting to harvesting for garden establishment, 2022) Walnut needs a Mediterranean climate in the sense that summers should be mild and winters should be cold. The severe cold of spring season is not suitable for walnut trees at all and burns the walnuts. One of the principles of building a walnut garden is to choose an area that does not experience sudden cold in the spring season. Compared to sandy soil, loamy soil is more productive because it retains the moisture in the soil well. A principle of building a walnut garden is to plant it in a soil that has a salinity of 4 mm/cm and a pH of 5-6 tenths to 5-7 tenths is the most appropriate level for the growth of a walnut tree, because in this situation it absorbs nutrients better. Walnut trees need between 8 and 10,000 cubic meters of water per hectare, depending on the area where walnuts are grown. In the drip irrigation system, 6000 to 8000 cubic meters are enough to irrigate each hectare (2000 cubic meters for an acre). The best time to plant walnut seedlings is from the beginning of February to the end of March. Of course, in cold regions, it is better to postpone the planting of seedlings until the end of the cold period, i.e. early spring. It is necessary to know that planting walnut seedlings in the summer season will cause severe water shortage. After buying a walnut seedling, it is better to plant it before germination. The branching time depends on the type of connection you intend to make. There are different types of grafts, the most famous of which are half-cut, lateral, chisel, tongue and cow. Transplanting should be in winter. (NiazeGiahan, 2022)

A walnut tree occupies a certain space after 15 to 20 years, and because it does not need that space in the early stages of growth, some inexperienced people do not consider it. It is obvious that the amount of the product is directly related to the number of trees. Therefore, especially in the early years the more trees, the more crops. The pruning and removal of excess trees that makes dense planting possible shouldn't be neglected. Trees like Hartley, which grow strongly and their buds are fertile, need a planting distance of 15 to 20 meters, but the planting distance of Chandler is usually 5x7. Rainfall and humidity in late spring and summer increase the prevalence of walnut blight, but varieties whose leaves appear later are usually immune to infection. (A complete article about walnut, 2012)

Due to traditionally low rainfall, 80% of Afghanistan's agriculture depends on some form of irrigation system. The water resource management system needs to be improved in order to insure the sustainability of the agriculture and food security. The most important crops are Wheat, barley, corn, rice and Cotton respectively. Improvement of cereal production is must, especially wheat that requires high cost irrigation and mechanized technology. (Henneberry, 2010)

For most crops, producers buy seeds, which prevent the improvement of the adaptation method. Farmers typically fertilize the soil using diammonium phosphate (DAP), urea, and natural fertilizers to make up for nitrogen and phosphorus deficit. Farmers lack the necessary knowledge for proper fertilization of crops and a large number of inappropriate ones grow in the use cycle. The use of herbicides and pesticides is low, while some chemicals are used. Several horticultural crops need vectors for cross-pollination since they are unable to pollinate themselves. Little tractors are the most common agricultural equipment in Afghanistan. While hand land preparation for horticulture crops predominates, machinery is more frequently used in the district's adjacent centres. Regardless of the requirements of a particular crop, flood irrigation is the most common type of irrigation. Due to poor packing, transportation, and storage options, as well as the danger and unpredictability of both domestic and international shipping, a sizeable amount of the value of horticultural products is lost. Most of the storage warehouses in Afghanistan are of poor quality. In Afghanistan, sorting, grading, packing and handling are basic. Transporting goods to overseas markets profitably is challenging for producers and traders. Although there are well-established marketing channels and sources for market

information, processing of horticulture goods is currently restricted in Afghanistan. A reasonably typical marketing chain for horticultural products includes local intermediates, regional merchants, wholesalers, domestic and international traders, and wholesalers. Although it has been difficult to acquire access to higher value export markets, the performance of Afghanistan's horticulture sector is improving based on key measures including yield and exports. Afghanistan's traders are aware of the necessity to cater to various markets, but a lack of processing reduces the value of the goods. (Akbari, Beath, Hanbal, Kassim, & Palmade, 2017)

6.2. Chandler walnut and its characteristics:

Chandler walnut is suitable for altitudes of 300 to 1200 and performs well at higher altitudes. Afghanistan is at altitude of 1767.84 meters (5800 feet) and has best criteria for walnut gardening. (Afghanistan Geography, 2023) The characteristics of Chandler walnut are: Late flowering (resistant to cold), product uniformity, Short base, high resistance to diseases and pests, early productivity (fruiting from the first year) and Uniformity of the product. Chandler walnut shows a very high resistance to spring cold, the planting distance of this cultivar is 5x7. On average, 15-20 kg of dry walnuts can be harvested for each 5-year-old tree. Non-grafted walnut should not be bought. The non-grafted Chandler variety takes 10 years to bear fruit and causes disappointment to those who have built the Chandler walnut garden. To understand whether the walnut sapling is grafted, only the trunk of the sapling should be examined and the location of the wound should be clearly defined. (Building a Chandler Walnut Orchard is a sure way to make a profitable investment, 2022)

6.3. What can be cultivated under the walnut tree?

There is a very common belief that says: "Nothing grows under walnut trees", but the reality is far from this belief. Under walnut trees it is possible to have a very lush garden and grow more plants. The chemical compound juglone (hydroxy, naphthoquinone), which is secreted from every part of the tree, is produced by several species of walnuts. Vegetative buds, leaves, stems, barks, and tree roots have the largest concentrations of juglone and hydroxyjuglone, a non-toxic and colourless precursor that sensitive plants oxidise into the toxic form of juglone. Landscape plants that gardeners grow, black walnut (*Juglans nigra*) and white walnut (*Juglans cinerea*) seedlings are the most difficult to grow around. Juglone is also produced by the English or Persian walnut (*Juglans regia*), albeit to a lesser level. Everyone talks about the toxicity of juglone to other plants, but a recent study suggests that juglone may not be such a big problem. It is true that some seedlings are easily affected by juglone, but most mature plants can tolerate it or not at all. These plants are quite tolerant to juglone. Hence, many stories about the growth of walnuts, juglones and other plants are exaggerated, and the poor growth of other plants is mostly due to shady and dry conditions under the tree. These trees absorb a lot of water and make the soil under the tree very dry. This dry soil is the main reason for the problem of gardeners in growing other plants under this tree. The growing conditions under the walnut tree are semi-shaded and dry. As long as you choose plants that like these conditions, you'll have a good chance of growing under a walnut tree. The production of juglone is a protective reaction by the tree to ensure its survival. Many plants (for example; sugar maple, sycamore, black cherry, red oak and American elder) are suitable for growing under a walnut tree. Because these plants produce chemicals for their survival as well as to control toxic substances and compete with other trees near them. The most common symptoms of Juglone sensitivity in sensitive plants are yellowing and wilting of leaves, especially during dry and hot periods during the growing season, which eventually leads to wilting and death of the plant. Zegelon wilt is often confused with water stress wilt. Wilting occurs slowly due to lack of water and can be reversed by watering. Wilting caused by juglone occurs quickly even when there is sufficient moisture in the soil. Wilting caused by Zegelon may be partial or may involve the entire plant. Early wilting symptoms may also be corrected with additional water. The plant does not respond to excess water at the end of the wilting period, the leaves turn brown and the plant dies. Juglone impairs plant respiration, depriving delicate plants of vital energy and cell division, as well as their ability to absorb water and nutrients, according to experimental investigations. Sensitive plants should not be planted beneath the walnut tree. In moist soils with minimal organic matter and microbial activity, they are more exposed to juglone. Zegelon does not move very far in the soil and very little dissolves in water. Juglone's metabolic decomposition can be sped up in soils that have been properly drained and aerated and are home to suitable microbial populations. Very sensitive plants might not be able to tolerate low concentrations where less sensitive plants could since the roots of a removed tree can still release the poisonous compound juglone. Following the removal of a tree, juglone may linger for years. Therefore, neglecting the selection of plants to plant under the walnut tree is not recommended at all. General tips for growing under a walnut tree include the following: Determining the location of gardens away from walnut trees, improving soil drainage with organic additives, preventing the decomposition of leaves, bark and stems in the vicinity of planting areas and Avoid mulch containing walnut shells, wood, bark and leaves. (What should we plant under the walnut tree?, 2020) Lists of juglone tolerant plants for growing under walnut trees are provided in various sources. This list is based on various observations, yet, only a few plants have had their vulnerability to juglone evaluated experimentally. Susceptibility is influenced by a variety of variables, such as contact surface, plant health, soil environment, and overall site characteristics.

6.3.1. Most maple species (*Acer* spp) except silver maple:

1. Eastern red cedar (*Juniperus virginiana*).

2. Birch (*Betulanigra*).
3. Virginia pine (*Pinusvirginiana*).
4. Plantain (*Platanusoccidentalis*).
5. Black cherry (*Prunusserotina*).
6. Callieriana pear (*Pyruscalleryana*).
7. Oak species (*Quercusspp*).
8. Hawthorn species (*Crataegusspp*).
9. Persimmon (*Diosypros virginiana*).
10. American beech (*Fagusgrandifolia*).
11. American elm (*Ulmusamericana*).
12. Bushes tolerant to juglon.
13. Barberry species (*Berberisspp*).
14. American hazel (*Corylusamericana*).
15. Eastern red cedar (*Juniperusspp*).
16. Sumac (*Rhuscopallina*).
17. Smooth sumac (*Rhusglabra*).
18. Black raspberry (*Rubusoccidentalis*).
19. American blackberry (*Sambucus Canadensis*).

6.3.2. Vegetables that tolerate juglone:

Onions, beets, pumpkins and melons, carrots, yolks, beans and corn.

6.3.3. Fruit trees that tolerate juglone:

Cherry, nectarine, plum and peach.

6.3.4. Herbaceous plants that is tolerant to juglone:

1. Yarrow (*Achilleaspp*).
2. Tea grass species (*Hypericum spp*).
3. Anemone species (*Anemone spp*).
4. Iris species (*Iris spp*).
5. European wild ginger (*Asarumeuropaeum*).
6. Begonia (*Mertensiapulmonariodes*).
7. *Calendula officinalis*.
8. Narcissus (*Narcissus pseudonarcissus*).
9. Chrysanthemum (*Chrysanthemum spp*).
10. Primrose (*Oenotheraspp*).
11. Mehr Suleiman (*Polygonatumcommutatum*).
12. Crowned wood fern (*Dryopteriscristata*).
13. Christmas fern (*Polystichumacrostickoides*).
14. Eastern purple flower (*Echinacea purpurea*).
15. Primula (*Primulaspp*).
16. Geranium flower (*Geranium sanguineum*).
17. Sunflower species (*Helianthus spp*).
18. Trillium species (*Trillium spp*).
19. Species of Christmas roses (*Helleborusspp*).
20. Tulip species (*Tulipaspp*).

6.4. A number of important factors in choosing a walnut tree:

1. Leaf and flowering time in walnut tree.
2. The amount and size of the leaves in the walnut tree.
3. Simultaneous opening of male and female flowers in the walnut tree.
4. Walnut harvesting time.
5. Ease of harvesting and processing walnuts.
6. Percentage of pith to walnut bark.
7. Taste, colour and percentage of walnut kernel fat.
8. Performance per unit area.
9. Resistance to deficiency and disease.
10. Resistance to winter cold and dead branches.
11. Overlapping of walnut leaves and fruit.
12. The thickness of the green skin of the walnut fruit.
13. Size and growth rate of walnut tree.

6.5. Comparison between Traditional and modern methods of Walnut cultivation and its production

6.5.1. Traditional method

The older the tree, the higher the yield and load. The peak yield of a walnut tree is the fifth and sixth decades of the tree's life. The walnut tree yields between 7 and 10 kg in the first year from 15 to 25 years old. The yield of a walnut tree in the 20s is between 15 and 25 kg. The yield of the walnut tree from the 30s to the

60s is between 20 and 45 kg. An adult walnut tree that is 60 to 80 years old has 13 to 55 kg of fruit. A walnut tree that is 80 to 100 years old weighs between 13 and 32 kg. If we have a good and fertile land, the harvest of the walnut tree starts at the age of 10.(Niaze Giahn, 2022)

6.5.2. Modern method

If we use grafted walnut seedlings in the construction of a walnut garden, the harvest will start from the fifth year, and every year the life of the tree increases, the amount of product will increase. The best seedlings for cold areas are the modified species of walnut tree. The suitable seedlings for cold areas are Chandler and Fernor walnut seedlings, which are late flowering, but have good fruit and are safe from the danger of spring cold.(Niaze Giahn, 2022)

6.6. Cost-benefit calculation of current wheat and corn economy

Table.1 Traditional wheat and corn annual yield

No	Traditional wheat and corn annual yield	Unit	Number	Unit Price in \$	Total price in \$
1	Wheat (Suck=49 Kg)	Sack	12	22	264
2	Wheat straw (Back=49 Kg)	Back	15	6	90
3	Green straw (plants)	Back	10	3	30
4	Corn (Suck=49 Kg)	Sack	6	14	84
5	Corn straw (Back=49 Kg)	Back	4	11	44
6	Corn boll for firewood (Back=49 Kg)	Back	2	5	10
7	Corn boll for human and animal	Sack	2	2	4
8	Keeping a milk cow and a calve	Pair	1	550	550
9	Keeping sheep	head	1	160	160
10	Dung (Back=49 Kg)	Back	30	2	60
11	Sheep dung (Back=49 Kg)	Back	5	1	5
Total annual yield in \$					1301

Source: Writer

Table 1. Traditional wheat and corn annual cost

No	Traditional wheat and corn annual cost	Unit	Number	Unit Price in \$	Total price in \$
1	Wheat seed	Kg	50	25	1250
2	White fertilizer for wheat	Kg	49	1	49
3	White fertilizer carriage wage	Kg	49	0.05	2.45
4	Black fertilizer for wheat	Kg	49	2	98
5	Black fertilizer carriage wage	Kg	49	0.05	2.45
6	Dung (Back=49 Kg)	Back	50	2	60
7	Dung carrier wage (Back=49 Kg)	Back	50	0.5	25
8	Irrigation	Times	5	3	15
9	Wheat Planting	Acre	1	25	25
10	Wheat Harvesting	Acre	1	20	20
11	Carrying to threshing place	Back	25	1	25
12	Thresher wage (Sack=49 Kg)	Sack	12	1	12
13	Straw carrier wage (Back=49 Kg)	Back	4	4	16
14	Black fertilizer for corn	Kg	20	2	40
15	Black fertilizer carrier wage	Kg	20	0.05	1
16	White fertilizer for corn	Kg	35	1	35
17	White fertilizer carrier wage	Kg	35	0.05	1.75
18	Irrigation	Times	4	3	12
19	Corn seed	Kg	30	0.5	15
20	Corn Planting	Acre	1	25	25
21	Corn Wheat Harvesting	Acre	1	20	20
22	Carrying to threshing place (Back=49 Kg)	Back	25	1	25
23	Thresher wage (Back=49 Kg)	Sack	12	1	12
24	Corn straw carrier wage (Back=49 Kg)	Back	4	4	16
25	Thresher wage (Sack=49 Kg)	Sack	12	1	12
26	Straw carrier wage (Back=49 Kg)	Back	4	4	16
27	Corn purifier wage	Person	10	4	40
28	Purified corn carrier wage	Person	4	4	16
29	Corn straw carrier wage	person	4	4	16
30	Corn boll carrier wage	person	3	4	12
Total annual cost					1914.65

Source: Writer

From the wheat and corn two tables we conclude:

Total annual yield: **\$1301.**

Total annual cost: \$1914.65

Annual Balance: \$613.65 deficit.

Annual income per capita: \$ 102.275 deficit

6.7. Cost-benefit calculation of modern Chandler walnut economy

Table 2. Chandler Walnut annual yield

No	Chandler Walnut annual yield (1 USD=90 Afghanis).	Yield unit	No of trees	Each tree yield	Total trees yield	Unit Price (\$)	Total price (\$)
1	Walnut farm (an acre)	Kg	60	50	3000	0.4	1200
2	Walnut wood	Kg	60	14	840	1	840
3	Walnut dry leaf (Back=49 Kg)	Back	60	0.5	30	0.5	15
4	Green straw (Back=49 Kg)	Back	60	0.5	30	10	300
5	Keeping a milk cow				1	450	450
6	Keeping a calf				1	100	100
7	Keeping a sheep				1	160	160
8	Dung from (1 cow & 1 calf) (Back=49 Kg)	Back			30	0.4	12
9	Dung from (1 sheep) (Back=49 Kg)	Back			5	0.5	2.5
Total annual yield							3079.5

Source: Writer

Table 3. Chandler walnut annual cost

No	Chandler walnut annual cost (1 USD=90 Afghanis).	Unit	Number	Unit Price in \$	Total price in \$
1	Black fertilizer for walnut trees	Kg	75	2	150
2	Black fertilizer carriage wage	Kg	75	0.05	3.75
3	Dung (Back=49 Kg)	Back	60	2	120
4	Dung carrier wage (Back=49 Kg)	Back	60	0.5	30
5	Irrigation	Times	5	3	15
6	Walnut Harvesting and collecting	person	12	4	48
7	Carrying to inventory place	Person	12	4	48
Total annual cost					414.75

Source: Writer

From the chandler walnut two tables we conclude:

Total annual yield: \$3079.5

Total annual cost: \$414.75

Annual Balance: \$2664.75 surplus

Annual income per capita: \$444.125

Comparing the traditional wheat and corn with chandler walnut we conclude:

Table 4. Comparison between traditional wheat and corn economy & Chandler walnut economy

Traditional wheat and corn annual pure return (1 USD=90 Afghanis).	Modern chandler walnut annual pure return
\$613.65 deficit.	\$2664.75 surplus
Annual income per capita: \$ 102.275 deficit	Annual income per capita: \$444.125 Surplus
Difference in income per capita: Approximately 6 times.	
Result: Walnut economy can increase the income per capita from \$ 102.275 deficit to \$444.125 surplus.	

Source: Writer

7. Results and Conclusion

This study looks at various areas of daily life, including unemployment, young people leaving school and immigrating because of poverty, people joining armed groups for financial gain, etc. This study looks for potential to solve problems and apply solutions to the entire nation by using local horticultural resources. Horticulture remains crucial to the growth of society and the economy. Limitations exist seriously to area expansion and reducing other agricultural growth resources. Increasingly, non-food grains and high-value crops like fruits and vegetables are being grown. The comparative advantage of horticulture is a workable local option. Horticulture has historically been an important potential asset of Afghanistan's economy due to the

variety of temperatures that allow for a wide range of crops, the long and staged harvest seasons that are favorable for export, the reasonably rich soils, and the accessibility of groundwater. The advantages of creating walnut gardens are so significant that one may use the fruit, wood, oil, even the green skin to make money. The sector is of utmost importance to the economy as a whole because it employs millions of people and contributes to half of export revenues. The National Statistics and Information Authority's annual representation of Afghanistan's per-capita income is not accurate enough. Implementation of this research project can bring full employment, local economic growth, no immigration, Quality life, wealth and harmony and quality education. Afghanistan provides the ideal conditions for walnut planting because of its elevation of 1767.84 meters (5800 feet) above the sea level. Chandler walnut is distinguished by its late flowering (cold-resistant), uniform product, short base, strong resistance to diseases and pests, early productivity (fruiting from the first year), and uniform product features. The planting area of Chandler walnut is 5x7. Chandler walnut exhibits a very strong tolerance to spring cold. Under the walnut trees it is possible to cultivate advantageous and money making vegetables and fruits such as Onions, beets, pumpkins, melons, carrots, yolks, beans, maize, Cherry, nectarine, plum and peach. The yield and burden increase as the tree ages. The harvest will begin after the fourth year if we utilize grafted walnut seedlings to build a walnut garden, and as the tree's lifespan increases so will the amount of product. The modified species of walnut trees make the best seedlings for cold climates. Chandler and Fernor walnut saplings, which have good fruit but late flowering and are protected from the risk of spring frost, are suitable for cold climates. Today the people in pachaghan cultivate wheat and corn which yield \$613.65 deficit (Annual income per capita: \$ 102.275 deficit), that is why they immigrate for work to Iran and other countries, but by walnut economy promotion we can help the people to yield \$ 2664.75 surplus (Annual income per capita: \$ 444.125).

8. Recommendations

8.1. Illegal loggings for local fuel demands have greatly depleted Afghanistan forests. Currently, less than 2% of its land is covered by forests, even though based on conservation considerations and environmental factors, should account at least 5%. Implementing walnut gardening can solve the fuel demand of local people and contribute to reforestation.

8.2. Promote walnut economy to increase the income per capita of Pachaghan people from current \$ 102.275 Deficit to \$ 444.125+ Surplus in future.

8.3. Promote Walnut economy to create full employment and solve unemployment related immigration challenges of Pachaghan people.

References

1. A complete article about walnut. (2012, March 14). Retrieved from Faculty Research and entertainment: <http://tahghigh-pgu.blogfa.com/post/299>
2. What should we plant under the walnut tree? (2020). Retrieved February 23, 2023, from DRNAHAL: <https://drnahal.ir>
3. Building a Chandler Walnut Orchard is a sure way to make a profitable investment. (2022, September 7). Retrieved from <https://ana.press/>: <https://ana.press/>
4. Investigating the principles of building a walnut garden and its costs. (2022, February 26). Retrieved from Arghavan Nahal.
5. Walnut tree - a comprehensive guide from planting to harvesting for garden establishment. (2022, February 12). Retrieved from Kabiri Farm: <https://kabirifarm.com/walnut-tree-best-guidline-for-farming/>
6. Afghansitan Geography. (2023). Retrieved from Country Reports: <https://www.countryreports.org/country/Afghanistan/geography.htm>
7. Akbari, S., Beath, A., Hanbal, H., Kassim, S., & Palmade, V. (2017). *Afghanistan Unlocking the Potential of Horticulture*. World Bank.
8. Aminyar, Z. (2016, November 26). *Advantages and disadvantages of going to the World Trade Organization*. Retrieved from Afghan Paper: <http://afghanpaper.com/nbody.php?id=124737>
9. ERGUN, Z., & ZARIFIKHSOSROSHAHI, M. (2021, December). *Industrial Use of Walnut*. Walnut. Ankara, Turkey: iksad publishing house.
10. Henneberry, D. (2010). *50 Things You Need to Know About Agriculture in Afghanistan*. Oklahoma: Oklahoma State University.
11. Niaze Giahani. (2022, May 22). *Building a walnut orchard is a long-term investment with excellent returns*. Retrieved from Plants need : <https://plantsneed.com/walnut-garden/>
12. OĞUZ, H. (2021, December). *Walnut (Juglans regia L.) Breeding and Walnut Breeding Criteria*. Walnut. Ankara, Turkey: Iksad Publishing House.
13. Qadri, B. (2018). *The manifold importance of the walnut sector to the economy*. ResearchGate, 1.
14. TOPCU, H. (2021, December). *Conventional and Molecular Breeding in Walnut*. Walnut. Ankara, Turkey: Iksad Publishing House.
15. YILMAZ, C. (2021, December). *Soil Management and Fertilization in Walnut*. Walnut. Ankara, Turkey: iksad publishing house.