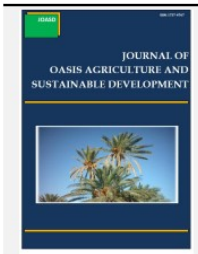

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Oil bearing rose (*Rosa damascena*) Production in Nangarhar Province, Afghanistan: A Sustainable Alternative to Opium poppy Cultivation

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Abstract

Afghanistan, particularly Nangarhar Province, has grappled with the complicate nature of *opium poppy* cultivation, influenced by an intricate combination of historical, socio-economic, and geopolitical factors. *Opium*, serving as the main source of income for many farmers in some provinces of Afghanistan, lies at the core of the country's challenges in state building, governance, security, and development. This study explores a compelling alternative, the cultivation of oil-bearing rose, specifically *Rosa damascena*, as a sustainable and ethical substitute to opium poppy. The analysis of various crop types reveals significant profit variations. In terms of net profits, oil-bearing rose claim the top position, followed by poppy, potatoes, onions, and wheat. When considering the benefit-cost ratio, oil-bearing roses lead at 4.54, followed by onions at 3.34, poppy at 3.13, potatoes at 2.88, and wheat at 2.89. Through a meticulous cost and profitability analysis, this study demonstrates that oil rose cultivation offers not only a financially viable option, but also outperforms *opium poppy* in net profitability. This paper with recommendations collectively pave the way for a transition towards a brighter, more prosperous, and sustainable future for Nangarhar Province, by addressing the multifaceted challenges associated with *opium poppy* farming while fostering an environment of positive change and development.

1. INTRODUCTION

The complex tapestry of Afghanistan's agricultural landscape is a result of the complex interaction among historical, socio-economic, and geopolitical factors (Safi et al., 2024). Within this context, Nangarhar province has emerged as a pivotal focal point of transformation, offering a glimpse of prospective futures in unconventional agriculture and the reshaping of economic and societal paradigms. Afghanistan's history, marked by a sequence of intricate eras, has frequently been overshadowed by the prominence of the poppy crop (Singh and Krishna, 2008). The cultivation of poppy has resulted in a wide range of problems for the nation, encompassing public health issues, security concerns, and economic entanglements (James and Piazza 2012). With its diverse geographical features and historical importance, Nangarhar Province presents an intriguing canvas for reenvisioning the role of agriculture in the region's development. To effectively combat the opium trade over the long term, which currently supplies 80 percent of the world's heroin from Afghanistan, it is necessary to provide the populace with viable alternatives for ensuring their livelihoods (Palmisano, 2007).

In late 2001, when the Taliban regime was overthrown and a new interim government headed by the United States of America and North Atlantic Treaty Organization (NATO) was established. Most of the rehabilitation programs began and progressed quickly. In the series of these developments, more attention was paid to the agricultural sector in Nangarhar, particularly a number of foreign institutions, NGOs and military administrations including Development Alternatives, Inc. (DAI) and the Provincial Reconstruction Team (PRT) played pivotal roles in the province (Gibb, 2015). Furthermore, organizations such as Relief International, MADERA, DACAAR, German Agro Action, the

Swedish Committee, and others actively contributed to the expansion and development of the province's agricultural sector, particularly oil bearing rose cultivation. Nangarhar province had previously been the hotspot of poppy cultivation in Afghanistan. However, this cultivation began to decline in 2005 due to the government's elimination program. Now, olives (*Olea europaea*), citrus (*Citrus spp*), poppy (*Papaver somniferum*), rice (*Oryza sativa*), maize (*Zea mays*), cotton (*Gossypium spp.*), sunflower (*Helianthus annuus*), beans (*Phaseolus spp.*), palm (*Arecaceae*), potato (*Solanum tuberosum*), barley (*Hordeum vulgare*), wheat (*Triticum spp*.), mustard (*Brassica spp.*) and sugarcane (*Saccharum officinarum*), are grown in majority of the lands in Nangarhar province (World Bank, 2014; Gulf Research Meeting, 2021). The peasants are a poor class, due to conventional agriculture and low productivity they are unable to sustain themselves and their families with the income of wheat, corn or related commodities without the cultivation of poppy. Therefore, the government and the organizations working in the agricultural sector looking for an alternative to address such problem (Mansfield, 2020). In October 2004, on the initiative of German Agro Action, a project for oil rose cultivation was therefore launched in which 700 farmers are now growing Damask rose (*Rosa damascena*) on more than 100 hectares of land. With the cultivation of oil bearing rose a long-forgotten Afghan tradition was brought back to life (Sokhibov, 2014). Today, a large volume of rose oil is produced, the majority being sold to WALA, a German cosmetic company that has sponsored the project since it first began. The Afghan government started a substantial and extensive campaign against *opium poppy* cultivation with the slogan "Make perfume, not war" This message resonated well with farmers in Nangarhar, serving as an encouragement for them to immediately switch to growing oil bearing rose rather than opium poppy (Chaon, 2018). However, this project has halt by the end of 2021 due to changes in the government, negligence of the government, withdrawal of foreign assistance institutions from the country, as well as other factors (Chaon, 2018) (Afghanistan—Alternative Development Program/Eastern Region (ADP/E), 2009).

The highest possible level of quality in the global realm of rose oil is achieved through meticulous agricultural practices combined with optimal geographic positioning. Nangarhar province finds itself situated at a latitude of (34.171831) and a longitude of (70.621679), sits at an elevation of (1,814) feet above sea level. It has an arid climate with warm temperatures during the winter. Several districts within Nangarhar including Dar-e-Noor, Nazyan, Achin, Pacheer, Shirzad and Khogyani boast climatic conditions that are favorable for oil bearing rose cultivation. The rose cultivation in Nangarhar is currently in its primary stage, with the cultivation area gradually expanding. This expansion owes its momentum to the encouragement and support provided by the government as well as the burgeoning interest of the local population in rose cultivation.

Rosa damascena, known for its aromatic properties, offers a wide range of culinary uses as a flavor enhancer. Apart from essential oil extraction, its by-products (rose oil, rose concrete, rose water, and rose absolute) offer potential as antioxidants and antibacterial agents within the food industry (Özkan et al., 2004). Middle Eastern and Eastern cuisines incorporate rose water and powdered roses into various dishes, including popular desserts like ice cream, jam, rice pudding, cake, and yogurt. *Rosa damascena* fruits are rich in essential organic and inorganic constituents, including unsaturated and polyunsaturated fatty acids, ascorbic acid, α-tocopherol, β-carotene, and vital minerals (Kazaz et al., 2009). *Rosa damascena* produces four primary products: rose oil, rose concrete, rose water, and rose absolute. The qualities of these products are influenced by factors such as: genetic composition, environmental conditions, agricultural practices, and distillation techniques (Ersan and Başayiğit, 2022).

Central to this transition is the emergence of oil bearing rose cultivation, a natural and fragrant ray of hope among the shadows cast by *opium poppy*. *Rosa damascena*, with its ancient heritage, has woven its fragrance into cultural histories across civilizations (Barnes 2022). This aromatic plant treasure offers a unique opportunity to rewrite the narrative of agriculture in Nangarhar. As oil bearing rose cultivation gains momentum, it offers not only an alternative source of livelihood for farmers, but also carries the promise of revitalizing landscapes, restoring communities, and redefining Afghanistan's position in the international market. This marks the inaugural study delving into the implementation of oil bearing rose as a viable replacement for the growing of poppy in Afghanistan's Nangarhar province. The

knowledge gained from this research stand poised to offer valuable support in developing strategies for bolstering the agricultural sector's growth, with a focus on promoting oil bearing rose cultivation, benefiting not only the government but also non-governmental organizations and policymakers. The primary aims of this article is to assess the factors influencing the profitability and sustainability of growing oil-bearing rose in the eastern zone of Afghanistan as a viable substitute for opium poppy. Concurrently, the use of oil-bearing rose presents cost-effective and advantageous alternative for opium poppy cultivation, leading to comprehensive capacity enhancement. The article seeks to enlighten governmental proponents, policymakers, agricultural stakeholders, and local communities regarding the market demand for rose oil, production costs, advantages, value-added derivatives, cultural practices, and the transition from opium poppy to oil-bearing roses. Additionally, the article strives to facilitate informed decisions based on scientific facts, fostering the advancement of sustainable agricultural practices pertaining to oil-bearing rose. The goals of this initiative to contribute to both social and economic progress, while concurrently diminishing dependence on opium poppy farming and its related illegal activities.

2. NAVIGATING POPPY CULTIVATION IN AFGHANISTAN

2.1 Historical roots

The tradition of cultivating poppy in Afghanistan has long historical roots dating back to ancient times. Afghanistan's geographical location, favorable climate, and conventional agricultural skills have positioned it as one of the world's primary producers of poppy. The significant expansion of poppy cultivation in Afghanistan began in the late 19th century, fueled by four decades of instability and violence both within the nation and in neighboring regions. Before 1970, opium poppy cultivation in Afghanistan was mostly confined, catering primarily to local needs (Asad & Harris, 2019). However, pivotal changes happened in 1979, coinciding with the Soviet Union's invasion of Afghanistan, the rise of a dictatorial regime in Iran, the expansion of the opium processing industry in Pakistan (which was also engaged in poppy cultivation), and increased poppy cultivation in far-off regions like Turkey. These interrelated factors created fertile ground for the spread of poppy cultivation in Afghanistan (Byrd, 2009).

Opium poppy cultivation played a crucial role in supporting the Mujahideen resistance against the Soviet Union's invading forces. During this period, intriguing parallels emerged, including political parties in Pakistan supporting the Afghan Mujahideen, Iran's abrupt elimination of poppy cultivation, shifts in the opium sector, the banning of poppy cultivation in Turkey, and Pakistan's gradual abandonment from direct

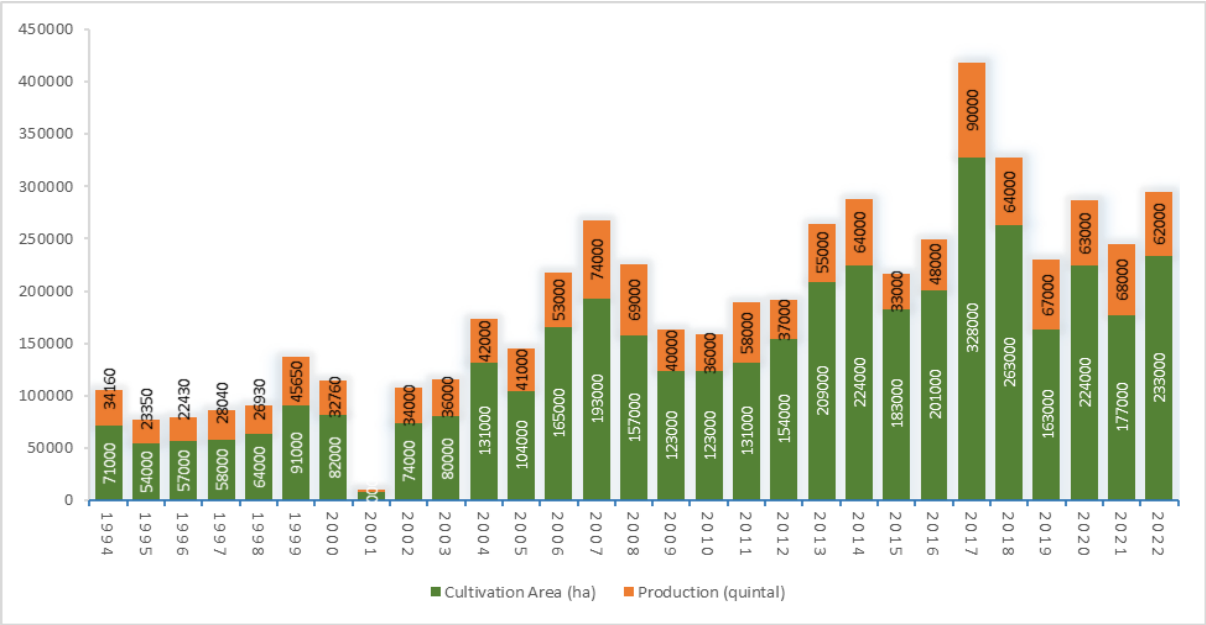

Fig. 1. Opium poppy cultivation ((Hectares) and production (Quintal) in Afghanistan, 1994-2022

Sources: UNODC and UNODC/MCN opium surveys 1994-2022 [*UNODC, 2002; UNODC, 2015; UNODC Research Brief, 2022*].

poppy cultivation while maintaining its position as a center for poppy processing and narcotics production. These events collectively raised Afghanistan to a significant position as a leading global opiate producer and exporter by the mid-1980s. By 1989, as Soviet forces withdrew from Afghanistan and Dr. Najibullah's government was overthrown in 1992, international aid to the Afghan Mujahideen decreased, making opium the primary funding source (Steinberg, 1995; Bolka, 2005). The rise of the Taliban in 1994, originating in Kandahar and eventually capturing Kabul in 1996, further entrenched the opium trade as they imposed a mandatory contribution system on farmers (Goodhand, 2005). During this period, opium cultivation extended across roughly 90.000 hectares of land, with Afghanistan producing an astounding 80 percent of the world's opium (Byrd, 2009).

In the last year of the Taliban government, a comprehensive ban on poppy cultivation was implemented nationwide. However, in regions beyond Taliban control, such as Badakhshan, opium production increased by 160 percent, along with the establishment of opium processing facilities. Following the Taliban's ousting in late 2001 and the entry of American and NATO forces, a period of interim administration led to a comeback in poppy cultivation as farmers turned to it due to economic incentives (Wegerich & Morgan, 2009). By the year 2005, despite the ban of poppy cultivation in several provinces backed by foreign aid and government endorsement, viable alternatives were not adequately provided. This situation resulted in economic hardships for farmers and local communities. In response to the economic difficulties and the reappearance of the Taliban, poppy cultivation continued. In the initial year of the Taliban's return in 2021, poppy cultivation saw a notable increase. However, by 2022, a renewed ban was enforced across most, if not all, of Afghanistan, without the introduction of viable alternatives. This complex history underscores the formidable challenges and complexities associated with addressing opium poppy cultivation in Afghanistan.

2.2. Socioeconomic impact

The cultivation of opium poppy in Afghanistan has significant socioeconomic consequences. While it serves as a crucial income source for farmers in economically deprived regions, it simultaneously fuels drug addiction and health crises among the population, posing a serious threat to public well-being. Moreover, it fosters criminal networks and insurgent factions through illegal trade, promoting instability and hindering progress (Kienberger *et al*., 2017; Pain, 2023).The growth of opium poppy has altered land usage patterns, with farmers in many areas prioritizing poppy cultivation over legitimate agricultural activities as a means of addressing their economic challenges (UNODC, 2019). However, this pattern repeated cultivation of opium poppy leads to land degradation and jeopardizes the long-term sustainability of agriculture in Afghanistan. Despite these negative consequences draw backs, the income generated from opium poppy cultivation exerts a complex influence on Afghanistan's economy, serving as a vital income source for numerous families and communities. At the same time, it stands as a stimulus for criminal activities and corruption. The opium poppy economy emerges as a major and difficult challenge faced by Afghanistan. It not only links into economic stagnation and poverty but also intersects with the processes of state formation, governance, security, anti-corruption efforts, and counter-insurgency measures. An integrative approach that strategically addresses all these interconnected issues is essential for Afghanistan to pave the way for sustainable development amid these intricate and formidable obstacles (Lone and Cachia, 2021).

3. Oil bearing rose- the identified alternative cash crop in Afghanistan

Opium poppy cultivation and trade constitute a morally reprehensible and pose significant global dangerous. Various organizations and institutions, including the United Nations Office on Drugs and Crime (UNODC), have looked for alternative approaches to combat and prevent opium cultivation. One such approach, highlighted by Cohen (2009), targets *opium poppy* growers and smugglers directly through a bottom-up approach. This involves providing financial assistance, wheat, and other viable substitutes to discourage opium poppy cultivation. However, this article introduces a distinctive alternative to opium: an opiate substitution program centered on the cultivation of oil-bearing rose. This alternative is particularly relevant in challenging economic and ecological contexts, offering a more sustainable and less harmful alternative to the opium trade. Opium poppy and oil bearing rose are both cultivated by a range of individuals, from small landowners to larger enterprises,

facilitating a meaningful comparison. Opium poppy cultivation often occurs in remote areas away from roads to avoid detection, while rose are grown in various locations, both nearby and more distant. Interestingly the altitude conductive to opium and rose cultivation aligns, with both thriving at elevations between 700 and 900 meters above sea level. Notably, higher-altitude rose cultivation areas experience reduced evaporation rates, positively influencing rose oil production and quality. In terms of growth cycles, opium typically matures for production in four to six months, while rose require a longer period of three to four years following planting before they can be harvested for their oil.

The cultivation of oil bearing rose represents much more than a physical alternative to poppies; it embodies a pathway towards comprehensive cultural, social, political, and economic transformation within the region. Transitioning from poppy to rose holds the potential to counteract the long term detrimental effects associated with opium production (Evered, 2011). Given specific conditions and reasons, it is imperative for Afghanistan's government to actively endorse and promote oil bearing rose cultivation as a viable alternative. This transition offers multifaceted benefits, addressing immediate challenges like security concerns and barriers to economic development, mitigating environmental degradation, breaking the cycle of poverty, and fostering cultural advancement among minority groups. Therefore, it is prudent for the government to provide farmers with financial assistance and necessary agricultural resources to facilitate the shift towards oil bearing rose cultivation. Simultaneously, implementing strict bans on opium poppy cultivation, production, transportation, and trade is essential to take a robust stance against this menace. By embracing oil bearing rose cultivation as an alternative, Afghanistan's government can effectively address pressing challenges while promoting holistic development, socio-cultural progress, and economic resilience within the nation. This transition holds the promise of positive, long - lasting change for Afghanistan and its people.

4. OIL BEARING ROSE CULTIVATION HISTORY AND POTENTIAL IN AFGHANISTAN

The ancient roots of oil bearing rose cultivation in Afghanistan are deeply intertwined with the country's rich history, weaving intricate narratives of the nation's rich cultures, artistic tradition, and a profound appreciation for beauty and fragrance. Similar to regions across the globe, the rose holds a special place as a symbol of love within Afghanistan. In the tapestry of Afghan literature, poets employ the rose as a poignant metaphor, reflecting the exquisite beauty of their beloved subjects. In the realm of daily life, rose are tenderly offered to cherished individuals, serving as eloquent expressions of love, respect, and humility. These blooms embellish wedding settings, adorning the vehicles that carry brides and grooms as they embark on new chapters of their lives. Rose have become an integral part of weddings, festivals, and religious ceremonies, symbolizing concepts of beauty, love, and purity in Afghan culture (Gotev, 2018). Beyond their role in ornamenting homes and workplaces, rose hold a deeper significance. They transform into gestures of admiration towards political figures and acts of reverence at sacred shrines, transcending their role as mere ornamental flowers. They embody the depth of afghan culture, where beauty and sentiment converge, reflecting the country's complex and vibrant heritage.

The art of cultivating rose in Afghanistan represent a harmonious blends of tradition, economic potential, and agricultural expertise. The country's strategic geographical location and diverse climate create an ideal environment for nurturing the Damask rose (*Rosa damascena*), celebrated for its aromatic excellence and the extraction of rose oil. Afghanistan's unique topography, ranging from towering mountains to fertile plains, provides the perfect backdrop for rose cultivation. The continental climate, marked by distinct seasons including harsh winters and warm summers, enhances the quality of oil bearing rose cultivation, releasing a symphony of fragrances. The availability of vast cultivable land further contributes to the success of oil bearing rose farming. Regions known for their favorable climates and fertile soils, such as Nangarhar, Kabul, and Parwan, play a significant role in oil bearing rose cultivation.

Oil bearing rose cultivation plays a pivotal role in Afghanistan's economy, offering significant economic opportunities. The production of rose oil sustains the livelihoods of numerous cultivators and laborers involved in the intricate process of harvesting and extraction. Afghanistan's rose oil, prized for its exceptional quality and unique fragrance, serves as a

valuable export commodity, contributing to the nation's revenue. The global cosmetics industry, in particular, seeks the captivating aroma of Afghan rose, creating opportunities for this fragrant treasure to reach international market. While the history of oil bearing rose cultivation in Afghanistan dates back to the 1960s, the industry has faced challenges that have interrupted its growth. Ongoing issues range from limited access to modern agricultural practices to the need for improved post-harvest infrastructure and the expansion of market channels. Additionally, security concerns in some regions cast a shadow over the entire production and trade of these aromatic products (UNDP, 2004).

A numerous international development agencies and organizations take on the responsibility of maintaining Afghanistan's economic stability while grappling with the challenges posed by poppy cultivation. These entities diligently seek out alternatives and opportunities to tackle the issue at its source. Prevailing sentiment advocates against the indiscriminate distribution of cash aid or food to farmers as a means to discourage poppy cultivation. Instead, the consensus leans towards promoting agricultural alternatives that can replace poppy cultivation. This twofold approach aims to preserve the farmers' livelihoods and reduce the prevalence of criminality and corruption associated with poppy farming. By offering viable alternatives, these organizations strive to address the root causes of poppy cultivation while promoting the economic well-being of Afghan communities. It reflects a comprehensive strategy to create lasting change and sustainable development in the region.

In the search for alternatives to poppy cultivation, a diverse array of institutions and organizations have introduced a range of plants to various regions as substitutes for poppies. Prominent among these is saffron, a high-value crop that also offers employment opportunities for women in agriculture Additional alternatives such as mint, various leguminous plants, nuts, and fruits have been proposed as viable replacements for poppies, with certain options, like saffron in Herat, have yielded positive results. Presenting an unexplored alternative is oil bearing rose, a non-consumable plant with the potential to address the challenges associated with poppy cultivation (Holm, 2005). This idea arises from the growing demand for cosmetics and perfumes both domestically and internationally. The cosmetics market's value reached a staggering $12.2 billion in 2022, projected to further swell to $24.3 billion by 2030, demonstrating a Compound Annual Growth Rate (CAGR) of 11.1% from 2023 to 2030 (Global cosmetic product market) (zion, 2023).

Positioning oil bearing rose cultivation as a constructive replacement for the poppy has the potential to bring substantial economic benefits for Afghan farmers. . Currently rose oil valued at approximately $15.000 per kilogram, rose oil bears a luxurious price tag. On average, it requires the extraction of 3.500 kilograms of rose blossoms to produce a single kilogram of this precious oil. The global cosmetics and perfume sector's annual demand for rose oil reaches 3 tons, necessitating around 12.000 tons of rose blossoms. As an illustration, in Afghanistan's eastern zone, a single hectare of rose can produce approximately 3.500 kilograms of flowers, valued at $3.000 (UNDP, 2004).With careful cultivation practices and training, this yield holds the promise of even greater returns. By tapping into the untapped potential of oil bearing rose cultivation, Afghanistan has the opportunity not only to address the challenge posed by poppy cultivation but also to revitalize its agricultural and economic landscape. This transition may lead to increased income and improved livelihoods for Afghan farmers while contributing to the country's overall economic development.

5. EXPLORING OIL BEARING ROSE CULTIVATION: FROM LINEAGE TO HARVEST

The species (*Rosa damascena*), known as the foremost and familiar species of rose, is characterized by thorns and a remarkable resilience against winter's cold temperature. Its lineage is believed to have stemmed from the crossing of (*Rosa moschata*) and (*Rosa gallica*), or in some sources, the crossover of (*Rosa gallica*) and (*Rosa phoenic boiss*) (Iwata et al., 2000)(Widrlechner, 1981). The exact point of origin and specific region remain unknown. Within this category of roses, many rose in this category inherently possess the ability to yield precious oil. Typically, selected plants are propagated through asexual means like cuttings, grafting and budding. Cuttings are selected from mature trees, generally around six years old, for the propagation process. A fully established oil bearing rose garden can yield abundant harvests for as long as four decades. To maintain its vitality and youthful vigor, the rose is pruned

nearly to the ground every 8 years (Mileva, 2021).

When establishing a new rose garden, careful attention is given to its layout, typically oriented along the north-south axis. This design maximizes sunlight exposure, believed to enhanced bud and flower production (Peavey et al., 2020). Selecting fertile soil is crucial, with high water retention, good drainage, and a pH range of 6-6.5. Prepare the land for oil bearing rose cultivation by thorough plowing and tilling in late summer. About 45 days before planting, in early autumn, long, parallel trenches 45-50 meters wide, spaced 2-3 meters apart are created, allowing for solar sterilization of the soil. Maintaining proper plant nutrition is vital. Apply nitrogen, phosphorus, sulfur, and potassium fertilizers judiciously after a soil nutrient analysis to ensure optimal supplementation (Baydar ve Kazaz, 2013).

Oil bearing rose typically bloom in early summer, starting in March as buds begin to form and reaching full bloom in April. The pick of this transformation occurs around May 15-20, when the vibrant pink-hued blossoms forth, signaling the start of harvesting. The collection of fragrance oil bearing rose flowers is a delicate choreography due to their intricately structured petals that emit a robust aroma (Izgi, 2022). These oil bearing rose thrive in mild, temperate climates with warm air and dry, cool regions are their preferred habitat. Conditions of humidity, cloud cover, precipitation, and gentle winds in May and June are crucial for optimal flowering and high-quality rose oil extraction (Vikrant *et al*., 2022; Baydar ve Kazaz, 2013).

After rose flowers bloom, there is a critical 45-day period for harvesting. The collection begins just before sunset, lasting until 10:30 am to preserve the essence of the flowers. Swift harvesting is essential to prevent evaporation of the valuable compounds. The fully bloomed flower is gently clasped and severed. An experienced worker can collect up to 60 kilograms of blooms daily. Early in the season, the rate of bud exploration may be relatively low but increases with time. Harvested flowers are packed into sacks for further processing. External factors like strong winds or late spring frosts can impact rose oil quality. Drought and excessive daytime heat shorten the flowering period, leading to oil loss. Conversely, temperate, humid conditions extend flowering period, enhancing oil yield and quality (Fereidani el al., 2023; Baydar ve Kazaz, 2013).

6. COMPARISON OF PLANTING COSTS FOR OPIUM POPPIES AND OIL BEARING ROSE

This study employed a combination of primary and secondary data sources. Primary data was gathered through in-person interviews with farmers who were involved in both rose and poppy cultivation on their arable land. Secondary data was obtained from published research articles, reviews, and various official sources, including the Ministry of Agriculture, Irrigation, and Livestock, the World Bank, German Agro Action (GAA), the International Center for Agricultural Research in Dry Areas (ICARDA), and official reports published by international organizations. This section presents the results and provides a comprehensive comparison of expense patterns. To enhance the clarity of the topic, we have included an analysis of poppy and rose cultivation alongside other cash crop plants like wheat, onion, and potato for supplementary information. This evaluation provides valuable information insights into the dynamics within these two sectors, allowing us to identify differences in consumption habits and economic outcomes. By examining the intricacies of consumption and income generation, we gain a deeper understanding of the underlying factors shaping these agricultural domains. These insights are not only for farmers and agribusinesses but also for researchers and policymakers seeking to optimize productivity and economic prosperity within these sectors.

The cultivation of poppy, like other cereal or leguminous plants, can be accomplished using straightforward and simple tools and methods. Poppy cultivation involves soil preparation, seed selection, the application of chemical and organic fertilizers, weeding, hoeing, as well as proper irrigation practices but establishing an oil bearing rose garden differs significantly from cultivating poppy fields or other grain crops (Evered, 2011). Similar to setting up a horticultural fruit garden, creating a rose garden demands substantial initial investment, particularly within the first three years. Essential steps in this process include carefully selecting the garden site, preparing the land, choosing suitable plants or grafted plants, designing the layout, planting the chosen plant, acquiring necessary machinery, and erecting protective fencing to prevent animals intrusions, which initial expenses is counted up to 50.000 Afghanis. A rose garden necessitates intensive care and training during its initial three years.

Once established, the garden becomes productive for up to three years. In the fourth and fifth years, productivity reaches its peaks, with the oil bearing rose plants yielding their highest output. Remarkably, a well-maintained rose garden can productive for as long as four decades. This analysis focuses on the cultivation expenses over the past three years since the garden's establishment, excluding the calculation of costs for the initial three years.

Table 1 displays the specific expenses associated with cultivating one hectare of poppy and oil rose. The total expenses for poppy cultivation exceed those for rose cultivation by 69.000 Afghanis. For poppy cultivation, 5.000 Afghanis were spent on seed acquisition, while 500 rose seedlings worth 15.000 Afghanis were obtained for the rose garden, which is considered part of the garden's initial expenses and not separately accounted for here. In terms of fertilizers, poppy cultivation involved the use of 10.000 Afghanis worth of urea and 9.000 Afghanis worth of DAP (Diammonium phosphate). In contrast, oil bearing rose cultivation followed organic practices and didn't involve the use of any chemicals. Similarly, 8.000 Afghanis were allocated for FYM (Farm Yard manure) in poppy cultivation, while 10.000 Afghanis were used for FYM due to the organic approach in oil bearing rose cultivation. Irrigation costs amounted to 15.000 Afghanis for the poppy field and 12.000 Afghanis for the oil bearing rose garden. Notably, due to the poppy plant's high sensitivity and the organic nature of oil bearing rose cultivation, no pesticides were employed.

Collecting poppy latex from opium poppies and harvesting oil bearing rose flowers are complex tasks that require skilled and professional laborers. The cost for collecting opium latex from a poppy field was 26.000 Afghanis, while plucking flowers from a rose garden amounted to 21.000 Afghanis. The land rental cost remained consistent for both crops. In summary, the total expenses from poppy cultivation to harvest amounted to 145.000 Afghanis, while the rose garden in a season incurred a total of

Table 1. Cost of production of opium poppy, oil bearing rose, wheat, onion and potato in Nangarhar province

Production Costs (AFN/ha[1])					
Particulars	**Opium poppy**	**Oil rose**	**Wheat**	**Onion**	**Potato**
A. Operating cost					
land preparation	3.500	1.500	3.500	7.000	7.000
Seed/Seedling	5.000	0	8.000	4.000	32.200
Urea	10.000	0	8.000	10.000	12.000
DAP	9.000	0	6.200	8.250	9.500
FYM	8.000	10.000	6.000	8.000	8.000
Irrigation	15.000	12.000	14.000	15.000	15.000
Weeding	15.000	3.000	2.100	5.400	5.400
Pesticides	0	0	3.000	3.000	2.400
Harvesting	30.000	21.000	5.000	5.400	5.400
Sacks	1.500	2.000	1.000	2.000	2.000
Total operating costs	**98.000**	**49.500**	**56.800**	**68.050**	**98.900**
B. Faxed costs					
Land cost	25.000	25.000	25.000	25.000	25.000
C. Owner-labor and living	**1.500**	**1.200**	**1.200**	**1.200**	**1.200**
Total B & C costs	**26.500**	**26.200**	**26.200**	**26.200**	**26.200**
Total costs	**124.500**	**75.700**	**83.000**	**94.250**	**125.100**

Source: Face-to-face interview with farmers related to costs and production. [1] AFN: Afghani currency.

75.700 Afghanis up to its harvest. Consequently, the cost perspective for rose cultivation is lower compared to poppy cultivation.

7. ANALYSIS OF INCOME FOR OPIUM POPPY AND OIL BEARING ROSE

Provide a more comprehensive and elucidating understanding within this section, we have extended our analysis beyond the comparison of poppy and rose income to include other cereal and cash crops like wheat, onions, and potatoes, which are cultivated within the same season alongside poppies and rose. This in-depth exploration involves the calculation of their respective consumption costs as well as the income derived from their cultivation. This broader perspective enhances the overall clarity of our examination, allowing for a more informed evaluation of the economic dynamics and prospects of various crops.

Afghanis. Wheat cultivation, incurs cost of 83.000 Afghanis per hectare, with a net profit of 157.000 Afghanis. When it comes to onions, the investment for a hectare amounts to 94.250 Afghanis, resulting in a significant net profit of 220.750 Afghanis. Meanwhile, cultivating potatoes necessitates 125.100 Afghanis per hectare and leads to a net profit of 234.900 Afghanis.

In terms of net profits, oil bearing roses claim the top position, followed by poppy, potatoes, onions, and wheat. The ranking shifts slightly when considering the benefit-cost ratio, which places oil bearing rose at the forefront (4.54), followed by onions (3.34), poppy (3.13), potatoes (2.88), and wheat (2.89).

The analysis underscores the superiority of oil bearing rose in terms of both field expense and net benefits, surpassing all other plants,

Table 2. Profitability analysis of opium poppy, oil rose, wheat onion and potato[1]

	Opium poppy	Oil rose	Wheat	Onion	Potato
Estimated Farmgate					
Target Price (AFN) per unit	15.000	8.000	32.000	15.000	18.000
Target Yield / ha	26	43	7.5	21	20
Unit type (kg, quintal or ton)	Kg	Q	Ton	Ton	Ton
Gross Revenue / ha	390.000	344.000	240.000	315.000	360.000
Operating Expense Ratio	25.13	14.39	23.67	21.60	27.47
Marginal Returns					
Over Operating Costs	292.000	294.500	183.200	246.950	261.100
Over Total Costs (Net Profit)	265.500	268.300	157.000	220.750	234.900
Profitability Ranking	2	1	5	4	3
Return on Investment (ROI)	2.13	3.54	1.89	2.34	1.88
Benefit cost ratio	3.13	4.54	2.89	3.34	2.88

[1] **Profitability Analysis Formulas:**

1. Gross Revenue = Price per unit x Yield per ha
2. Net Profit = Gross Revenue - Total Cost
3. Operating Expense Ratio = (Operating Cost / Gross Revenue) x 100
4. Over Operating Costs= Gross Revenue - Operating cost
5. Over Total Costs (Net Profit) = Gross Revenue - Total Cost
6. Return on Investment (ROI) = (Gross Revenue - Total Cost) / Total Cost
7. B:C ratio= Gross Revenue/ Total Cost.

Among the various crop types considered, the cost and profitability analysis reveals intriguing findings. The investment required to cultivate one hectare of poppy stands at 124.500 Afghanis, yielding a net profit of 265.500 Afghanis. Similarly, oil bearing rose cultivation requires an expenditure of 75.700 Afghanis per hectare, resulting in a net profit of 268.300

including poppy. As a result, rose emerge as a promising and ethical alternative to poppy cultivation, particularly in light of the legal prohibitions and restrictions surrounding poppy due to its illicit uses. To further diversify the range of alternatives, onions, potatoes, and wheat can be considered as viable substitutes,

given their net profitability and legal cultivation status.

8. DISCUSSION

The cultivation of opium poppy has long been a widespread practice in regions like Nangarhar Province, Afghanistan, primarily due to its economic appeal. However, the illicit nature of opium production and its adverse societal impacts have prompted the need for sustainable and ethical alternatives (Arogya et al., 2024). Among these alternatives, the cultivation of oil bearing rose (*Rosa damascena*) stand out as a noteworthy contender. This discussion delves into the intriguing findings of a cost and profitability analysis comparing various agricultural plant types, to reveal the potential of oil bearing rose as a promising substitute to opium poppy (Mansfield, 2020).

The analysis presents a compelling comparison of the investment and net profits associated with cultivating of various plants per-hectare. It becomes evident that while opium poppy generates a substantial net profit of 265.500 Afghanis, oil bearing rose presents a slightly greater net profit of 268.300 Afghanis per hectare, despite the lower initial investment needed. This revelation not only underscores the economic feasibility of oil bearing rose cultivation but also emphasizes its potential to surpass the returns from opium poppy without the ethical and legal concerns associated with the latter, this supported by Gul et al., (2015).

Furthermore, the benefit-cost ratio serves as an enlightening measure to evaluate the efficiency of each plant type. In this context, oil bearing rose take a notable lead with a benefit-cost ratio of 4.54, indicating a favorable return on investment. This finding is closely followed by onions (3.34), poppy (3.13), wheat (2.89) and potatoes (2.88). This ranking underscores the multifaceted benefits of oil bearing rose cultivation, which extends beyond financial profits to encompass ecological, social, and legal benefits (Mahboubi, 2015; Bauer, 2019).

The most significant finding gleaned from this analysis is the realization of oil bearing roses' dominance in terms of net benefits, surpassing even opium poppy. This revelation holds significant implications for the agricultural dynamics of Nangarhar Province and beyond. Opting to cultivate oil bearing rose instead of opium poppy, not only contribute to a legal and ethical marketplace but also promotes a positive impact on the environment and society.

Considering the strict legal prohibitions and social repercussions associated with opium poppy cultivation, oil bearing rose emerge as an ethical, sustainable, and promising alternative. Their impressive net profitability, combined with their potential to enhance the region's socioeconomic landscape, make them an attractive proposition for both farmers and policymakers (Mileva, 2021). Nevertheless, it's important to acknowledge that diversifying the spectrum of alternatives further strengthens the region's agricultural resilience. Onions, potatoes, and wheat, with their considerable net profits and legal cultivation status, present viable substitutes that can be explored to stimulate economic growth and alleviate the adverse effects associated with opium poppy cultivation (Mollafilabi and Aslami, 2020).

In the end, the findings of the cost and profitability analysis emphasizes the potential of oil bearing rose cultivation as a promising alternative for opium poppy in Nangarhar Province, Afghanistan. The combination of economic viability, legal compliance, and positive societal impact positions oil rose as a symbol of transformation in a region striving for sustainable development. As stakeholders and communities consider the implications of their agricultural choices, the embrace of oil rose could signal a crucial transition towards a brighter, more prosperous future (Gutiérrez, 2021).

9. CONCLUSION

In conclusion, the complex agricultural scenario in Afghanistan, particularly in Nangarhar province, has been deeply influenced by historical, socio-economic, and geopolitical factors. While opium poppy cultivation provided income for many farmers, has also brought about significant challenges, including public health issues, security concerns, and economic complications. This study has explored the potential of transitioning from poppy cultivation to oil-bearing rose as a feasible and ethical alternative.

The history of poppy cultivation in Afghanistan is complex, influenced by various historical and political factors. While poppy has served as a crucial source of funding for resistance movements and providing income, it has also contributed to societal challenges and instability (Pain, 2023).

The socio-economic impact of opium poppy cultivation is profound, with both positive and

negative consequences. While it provides income for many, it also contributes to addiction, criminal networks, and corruption. Transitioning from poppy to rose offers an opportunity to tackle these issues while simultaneously promoting environmental sustainability, poverty reduction, and cultural enrichment.

Rose hold a rich historical significance in Afghanistan, symbolizing beauty and love. Their products, including rose oil and other derivatives, have diverse applications in the culinary and health related industries. Oil-bearing rose, particularly *Rosa damascena*, present a promising opportunity for agriculture development.

When comparing the cultivation costs of poppy and rose, it becomes evident that rose cultivation offers a financially sustainable alternative. The initial investment in a rose garden is higher, but the long-term benefits outweigh the costs. The transition to rose can have positive economic outcomes for farmers.

Furthermore, when analyzing income generated from various crops, oil-bearing rose prove to be the most profitable option, surpassing even poppy cultivation. This demonstrates the economic potential of rose as a viable alternative to illicit poppy farming. Additionally, other legal crops like onions, potatoes, and wheat also offer profitable opportunity for farmers to explore.

In conclusion, transitioning from poppy cultivation to oil-bearing rose presents a promising and morally sound direction for Afghanistan. This transition not only addresses the challenges associated with poppy cultivation but also offers economic, environmental, and cultural benefits. The government's support and strategic policies can play a crucial role in facilitating this transition and promoting sustainable development in the region.

10. SUGGESTIONS

The subsequent suggestions play a vital role in providing guidance and implementing a path towards sustainable development in Nangarhar province, Afghanistan. These recommendations are strategically designed to ease the transition from opium poppy cultivation to the nurturing of oil-bearing rose and other viable alternative crops. Embracing these suggestions, offers an opportunity for stakeholders to collaborate toward attaining economic stability, environmental preservation, and social progress in the region. Each of these recommendation serves as constructive step on the path towards a more prosperous and sustainable agricultural future for Nangarhar province

- Government Support and Policy Implementation: it is imperative that afghan government proactively promotes and support the cultivation of oil-bearing rose as a viable alternative to poppy cultivation. Policymakers should craft and execute favorable policies aimed at providing financial aids, offering incentives, and supplying essential agricultural resources to facilitate the transition towards rose cultivation. Enforcement stringent bans and robust measures against opium poppy cultivation, production, transportation, and trade should be put in place to ensure a clear stance against this threat.
- Community Engagement: Encourage active involvement and collaboration among farmers and local communities in the transition from poppy to rose cultivation. This can be achieved initiative aimed at raising awareness about the benefits of rose cultivation and providing training programs to equip communities with the knowledge and skills required for successful cultivation. Building trust and cooperation among community members is vital for a smooth transition.
- Research and Innovation: Invest in research and development efforts focused on improving rose cultivation techniques. This includes investigations into disease resistance, optimizing yield, and improving post-harvest processing methods. Collaborate with research institutions and agricultural experts to ensure the integration of best practices into rose cultivation, ultimately leading to long-term success and sustainability.
- Diversification of Alternative Crops: In parallel with cultivating oil-bearing rose, explore the cultivation of other alternative crops such as onions, potatoes, and wheat. These crops have demonstrated promising net profitability and are legally cultivated, making them viable options to further reduce dependency on poppy cultivation. Encourage farmers to diversify their crops to enhance economic stability within the region.
- Marketing and Value Addition: Promote the market demand for rose oil and its value-added products. facilitate the growth of local industries specializing in processing rose-related products, such as, rose oil, rose

concrete, rose absolute, rose water and culinary applications. Enhance market access and provide comprehensive support to farmers in marketing their rose products to ensure sustained profitability.

- Environmental Considerations: Emphasize the environmental benefits linked with rose cultivation. In contrast to poppy farming, rose cultivation reduces land degradation and has a positive impact on the ecosystem. Promote sustainable agricultural practices that protect the environment and foster long-term environmental stability.
- Security and Stability: Recognize the role of rose cultivation in contributing to regional security and stability. By reducing the influence of the opium trade and its related criminal activities, rose cultivation can facilitate the creation of safer and more stable communities. Enhanced security measures should be put in place to protect rose farms and ensure a secure environment for farmers.
- International Collaboration: Seek and promote international cooperation and partnerships to support the transition from poppy to rose cultivation. Collaborate with foreign institutions, NGOs, and organizations specializing in agriculture and rural development. Leverage their resources, knowledge, and experience to accelerate the growth of rose cultivation in Nangarhar province.
- Long-term Vision: Develop a comprehensive, long-term vision for the cultivation of oil-bearing roses in Nangarhar province. This vision should encompass socio-cultural, economic, and political transformation and guarantee that policies and initiatives are in harmony with this overarching goal for the region's development.
- Monitoring and Evaluation: Establish a robust system for continuous monitoring and assessment of the advancement of rose cultivation programs. Conduct regularly assess to gauge their effects on local communities, the reduction in poppy cultivation, and the overall socio-economic development in Nangarhar province. Use these assessments to make well-informed adjustments and advancement to cultivation strategies and policies.

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