DIRECTORATE GENERAL OF SCIENCE AND TECHNOLOGY (DOST)
GOVERNMENT OF KHYBER PAKHTUNKHWA

KHYBER PAKHTUNKHWA
SCIENCE AGENDA

DEPARTMENT OF
SCIENCE & TECHNOLOGY
AND INFORMATION TECHNOLOGY
GOVERNMENT OF KHYBER PAKHTUNKHWA

GEMSTONES

The worldclass gemstone deposits of KP include

- Emeralds, Garnet & Quartz (Merged Areas)
- Emeralds & Quartz (Swat & Mingora)
- Topaz, Aquamarine, Tourmaline & Emeralds (Dasu)

TASKFORCE REPORT

Gemstones Sector in Khyber Pakhtunkhwa: Sectoral Analysis, Local Challenges, Strategic Insights and Recommendations

2023

FOREWORD

In alignment with the Science Agenda for Khyber Pakhtunkhwa, the Directorate General of Science & Technology initiated a landmark effort to identify and advance priority areas where science, technology, and innovation can meaningfully contribute to the province's socio-economic development. We present to you the sectoral reports in key natural resource areas that are ideally unique to Khyber Pakhtunkhwa and have been identified for R&D investments. Each of these sectoral reports marks an important milestone in advancing scientific understanding and strategic development within Khyber Pakhtunkhwa's natural resource sectors, through focused inquiry and collaborative expertise. These reports, developed by thematic Task Forces constituted under the Directorate General of Science & Technology, are foundational efforts under the broader Science Agenda for Khyber Pakhtunkhwa , a transformative initiative that seeks to reposition the province as a regional leader in science, technology, and innovation as we explore the potential of Khyber Pakhtunkhwa's rich natural resource landscape.

Under the Science Agenda, we hold a bold and pragmatic approach: to build on the province's existing strengths while investing in the future. The identification of eight natural resource areas; from gemstones and herbs to fisheries, fruits and vegetables, bees and honey, micro-hydro power, archaeology, and the urban environment, presents a unique opportunity for science-led value addition and sustainable economic growth. Each thematic area represents not just a resource, but a vibrant ecosystem of challenges and opportunities, waiting to be enhanced through strategic interventions in research, development, and innovation. These reports are the outcome of months of rigorous consultation, deep research, and collaborative ideation by multidisciplinary experts drawn from academia, industry, public sector, and civil society. The Task Forces were entrusted with the mission to map the current landscape, articulate key challenges, and recommend high-impact R&D pathways that can guide smart investment in the sector. This body of work now forms a scientific and strategic blueprint for stakeholders across sectors to drive meaningful change.

This initiative is aligned with our core vision to move Khyber Pakhtunkhwa from being a consumer of technologies to a creator of solutions — driven by our local talent, informed by global best practices, and anchored in our unique natural endowments. Through this endeavor, we reaffirm our commitment to building a culture of science that is inclusive, collaborative, and forward-looking.
I extend my deepest appreciation to all members of the Task Forces, as well as the wider science and innovation ecosystem that supported this effort. We look forward to translating the insights from these reports into tangible programs, R&D investments, and partnerships that uplift livelihoods, enhance competitiveness, and leave a lasting impact on the province's development trajectory.

Sajid Hussain Shah
Director General
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The report is the outcome of a time-bound effort by a dedicated Task Force constituted for this thematic area, comprising local experts from diverse institutional backgrounds, including academia, government, industry, and the development sector. The Task Force worked collaboratively through multiple rounds of consultations to undertake a deep-dive analysis, identify context-specific challenges, and offer actionable insights to guide future scientific, technological, and policy interventions. The Directorate General of Science & Technology gratefully acknowledges the Minerals Development Department, Government of Khyber Pakhtunkhwa, for their valued insights.

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Resurrecting the Gemstone Industry in Khyber Pakhtunkhwa to Increase Employment and Revenue by Mechanization of Production and Commercialization of the Industry

1 Introduction & Background

1.1 The Global Landscape of the Subsector (Gemstone) Market

The gemstone market is segmented by nature, type, product, and end use. Natural gemstones include natural and synthetic, precious and semi-precious, jewelry and decorations, and luxury arts. Popular gemstones include diamonds, emeralds, rubies, sapphires, alexandrite, and topaz. Growth in distinct segments helps you understand market growth factors. Country, nature, type, product, and end-user are evaluated for the gemstone market. The gemstone market is estimated to expand 4.90% during 2021–2028 (Bridge, 2021). The market is fueled by rising disposable income and expanding decoration use in ceremonies. Easy availability of defensive items, rising labor costs, inflation affecting jewelry pricing, and rigorous government controls would limit the gemstone industry (Bridge, 2021). The rise in astrology and fashion jewelry adoption, as well as consumer belief, should create new prospects, and Asia-Pacific is expected to grow quickly because of rising demand from China and India (Bridge, 2021).

Figure 1: Source Data Bridge

As stated by Sajjad (2019), Pakistan's main competitors are India, China, Thailand, Sri Lanka, and Afghanistan. So, we will cover these countries to compare Pakistan's gemstones' strengths and weaknesses globally. This may come as a surprise to some consumers, but a very large portion of the jewelry they see in many countries, including the US, the EU, Hong Kong, the Middle East, and Japan, is

made in Thailand. Jewelry and gem products have maintained their position as Thailand's third most important export product, following automobiles and computers (Sakuntanaga, 2021). For the first half of 2020, the export value of Thailand's gem and jewelry goods reached its highest ever, at 10,077.60 million USD (Sakuntanaga, 2021). Jewelry is one of Thailand's top ten exports in terms of how much it sells. Thailand has gained its competitive edge because of its local wisdom in enhancing the quality of gemstones and its skilled, value-adding gem cutters. More than 10,000 skillful gemstone cutters have also created glistening sparkles in the colored stones, and in the last few years, jewelry sales were worth more than $10 billion, and this number is going up (Limsuwan, 2019). India's gemstone and jewelry industry is growing exponentially, mainly because it has bounced back into action after a slump during the pandemic. The market size of Indian gems and jewelry, as far as FY-2021 is concerned, is a whopping $78.50 billion (SBGL). For the reasons mentioned above, India's export value of colored gemstones for the period April 2021 to March 2022 stood at $311.45 million. Jaipur's gemstone industry employs around 1.5 lakh workers and is thus one of the major centers of gems and employment in India (SBGL). As the Pink City (Jaipur) is a well-known gemstone hub, its gemstones, especially emeralds, are also in high demand as they are processed with precision. If Future Market Insights is to be believed, the price of colored gemstones has increased by more than 100% in the last 10 years (SBGL). As per TechSci research, the whole western part of India accounts for 45% of the Indian gem and jewelry market size. Out of this, the western region of India accounts for 25%, and the mid-western part covers 20% of the total market size (9TechSci Research, 2022). In this discussion, you cannot ignore the role of China in colored gemstones and in jewelry, as China is currently the second-largest jewelry consumer in the world and may overtake the U.S. within the next decade (Hsu et al., 2014). The success of e-commerce campaigns, such as Singles' Day, seems almost a foregone conclusion. China's consumption per capita of jewelry is low compared to the United States (Hsu et al., 2014), but it is rising at a dramatic rate. Diamond jewelry has been very popular in China, and diamond fashion jewelry is also considered a new sector for growth. Colored stones, like other sectors of the gem and jewelry industry, have gained great popularity in China over the past several years (Hsu et al., 2014). Keep an eye out for Sajjad (2019), another Pakistani competitor after Thailand, India, and China. Sri Lanka is one of the leading gem-cutting and finishing centers in the world. The value addition to a faceted gemstone per carat varies between 25–30% for imported diamonds and 40–100% for local stones (EDB, 2015). Sri Lanka's import policies were simplified, making the procedure easier and cheaper. Importing rough, prefabricated, and cut stones for cutting, re-cutting, and heat treatment costs $200. The flat rate applies regardless of quantity or value. Foreign buyers buying gemstones worth over $200,000 have been expedited through customs since 2013 (Lucas et al., 2014). Sri Lanka's National Gem and Jewelry Authority (NGJA) was preparing to develop an online system to sell gems and jewelry valued at less than $3,000 to international buyers, and it is expected that Sri Lanka's gem and jewelry exports will reach the US$ 1 billion milestone by 2016 (EDB, 2015).

1.2 KP Gemstones Market (Namak Mandi) hotspot

When arriving in Peshawar for the first time, a visitor from another country might be startled to hear that hidden within the maze of buildings in this ancient city is a significant hub for the trade of precious gems. This market caters to a diverse group of buyers and sellers from Afghanistan, Uzbekistan, Tajikistan, and Iran who trade in gemstones that were mined locally in Azad Jammu and Kashmir, Gilgit-Baltistan, and some regions of Khyber Pakhtunkhwa in Pakistan (figure 1). They might also be shocked to learn that this thriving business center is not known by a more modern name. The name "Namak Mandi" comes from the Urdu word for "salt market," and the complex's initial purpose was to serve as both a marketplace and a warehouse for the commodity (Hussain, 2015). When it was founded fifty years ago, no one could have predicted that it would one day become Pakistan's most important trade hub for rough and faceted gemstones (Rehman, Bilal, Owais, Rahman, & Shen, 2021).. Namak Mandi's ornamental stone dealers mostly deal in lapis lazuli and nephrite. The exquisite color of lapis from Kokcha in Badakhshan Province is especially popular. Most exporters do this type of business because there is almost zero risk of losing their money. Khyber Pakhtunkhwa, Pakistan produces some of the world's most brightly colored emerald green nephrite. Nephrite from the Hamid mine and Siraj mine in the Mohmand region is in especially high demand in China. Chinese consumers desire its emerald green color and the absence of black oxide spots.

Figure 2: In this regional map, red lines trace the routes from the mines of various gemstones to the Namak Mandi market. Abbreviations: KPK = Khyber Pakhtunkhwa; AJK = Azad Jammu and Kashmir (Rehman et al., 2021).

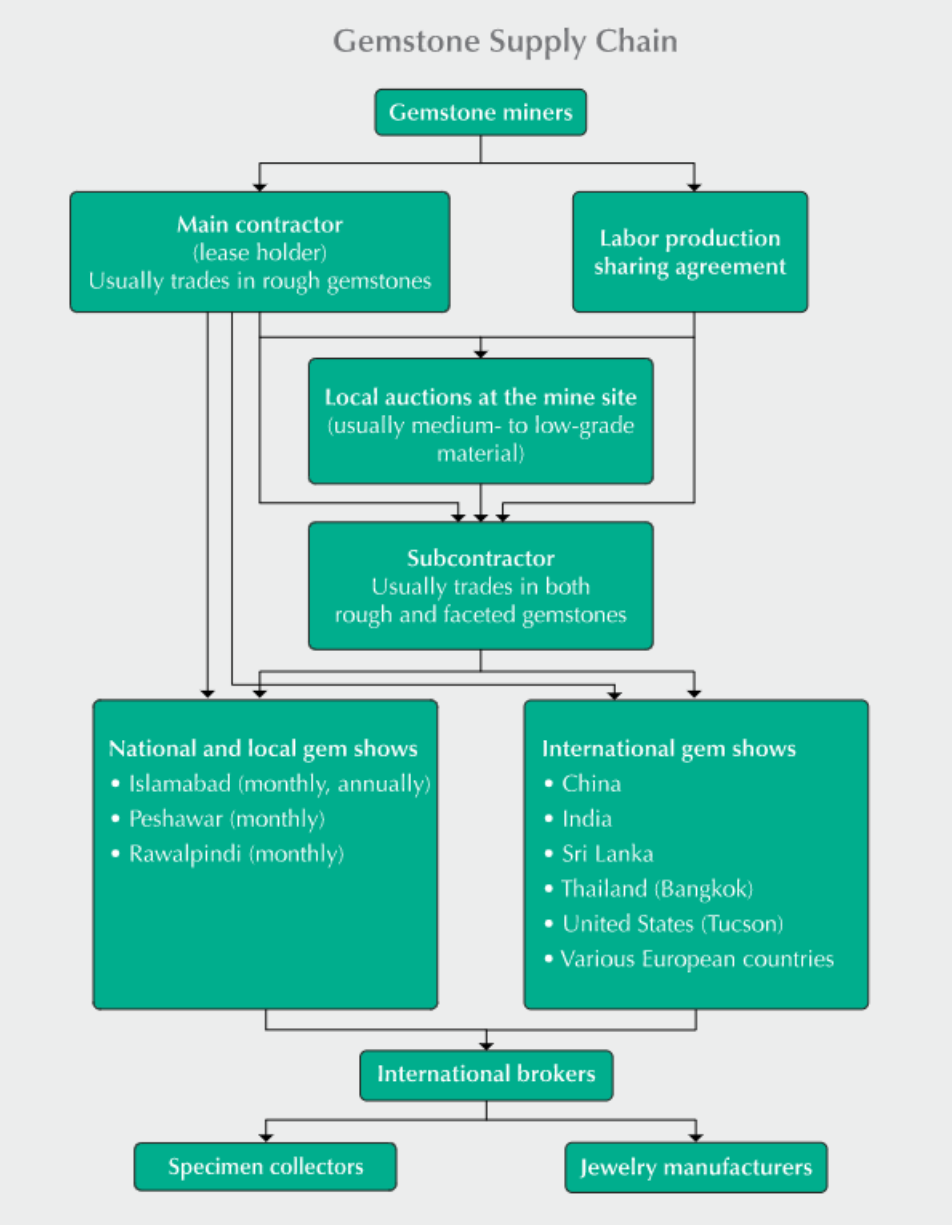


Figure 3:The flow of gemstones in Pakistan from mine to end consumers domestically and internationally (Rehman et al., 2021).

1.3 Pakistan's landscape and size & the KP gemstone market (where we are now)

As mentioned before the gem sector is relatively It is, therefore, hard to avail data for the number of units established. Precious raw gems and gemstones segment is located in the Gilgit-Baltistan, AJK, and KPK while jewelry manufacturing and retail cluster has highest concentration in the urban cities like Karachi and Lahore. which is an estimate as exact data is not available.

The following table provides the registered establishments in the Gemstones Cluster Locations 'Precious Rough Gemstones' Area.

Area Name	No. of Establishment
Peshawar	406
Swat	22
Rawalpindi	22
Lahore	16
Islamabad	15
Abbottabad	9
Nowshera	4
Sakrdu	3
Gilgit	5
Fisalabad	3
Quetta	2
Karachi	2
others	60
Total	**573**

Table 1: Source: Corporate Development Partners

Despite the abundance of precious and semi-precious stones, Pakistan appears to be underutilized in terms of employment, domestic trade, and export earnings. Pakistan's gemstone industry has huge potential in terms of adding to the country's economy, it can export 800,000 carats Ruby, 87,000-carat emerald, and five million carats Peridot annually (PCJCCI, 2019). Pakistan's exports fell sharply after 2014 and never recovered. The United States of America is the second potential market for Pakistani precious and semi-precious stones. There is a big gap and untapped potential for Pakistan. The UAE is considered one of the world's largest markets because it has the highest value addition. Pakistan's gem and jewellery exports increased by 34.92% in 2017 compared to the previous year (TDAP, 2022). The global demand for gems and jewelry increased by nearly $600 billion in 2014-15, whereas exports of Pakistan gemstones have gradually declined since then, reaching a low of $23.75 million in 2017 (TDAP, 2022). However, the yield is much less due to limitations in terms of processing skills and technology (Afsar, 2020). For example, its gemstone export value in 2014 was US$ 8 million, but if the material had been sold after standardized cutting and polishing, the country could have earned more than US$ 800 million (TDAP, 2016: 43). Using the value of US$ 800 million as a constant, Pakistan has lost around US$ 6400 million in the previous eight years (2014–2022). Pakistan's gemstone business has been repeatedly reported to be pregnant with a slew

of issues (see, e.g., Ahmed, 2017; Makki and Ali, 2019). In 2006, the Government of Punjab (GOP) recognized a number of issues and problems facing Pakistan's gems and jewelry sector. It states that Low levels of technology, traditional mining techniques, underdeveloped lapidary facilities and skills, poor international marketing and branding, underdeveloped designing capabilities, limited linkages with domestic and international support infrastructure, limited identification and certification, and lack of hallmarking ... Due to a lack of effective processing facilities and skills, a limited understanding of gemology, and a lack of standardization and certification, roughly 75 percent of Pakistan's exports are unworked stones, resulting in a major loss in value added.

Ironically, very identical results were found in a recent research report by Pakistan's Trade and Development Authority (TDAP, 2016). Similarly, Makki and Ali's (2019) only and most recent academic study on emerald mining in Fiza Ghat in Swat (Khyber Pakhtunkhwa) provided a similar empirical account of the sector.

This sector is comprised of 5,000 operational mines with more than 50,000 SMEs, and average annual production of 68.52 million metric tons per year and direct employment of 300,000 workers.

According to the Pakistan Bureau of Statistics, in the years 2021–22, Pakistan exported $ 20 million worth of jewelry and rough gemstones, which is way below the potential. In comparison to Pakistan, India exported approximately $40 billion in jewelry and gemstones (Source: www.ibef.org), while Sri Lanka exported approximately $200 million (Source: Sri Lanka National Gem and Jewelry Authority). According to McKinsey research, the global trade in jewelry for the year 2019 was 280 billion USD and is set to increase to 340–360 billion USD by the year 2025. Pakistan has a measly $14 million share in the jewelry trade. In the year 2020, the total trade of colored gemstones was $4.37 billion (Source: www.oec.world), while Pakistan exported measly 1.5 million dollars' worth of gemstones. Below is a table of gemstone and jewelry export figures for a few countries:

Leading exporting countries of gems and jewelry worldwide in 2020(In $)	
China	17 Billion
Switzerland	8.2 Billion
India	7.8 Billion
USA	6.6 Billion
UAE	6.5 Billion
Italy	5.7 Billion
France	5.1 Billion
Pakistan	3.2 Million

Table 2: Source; Statista.com

The pilot study revealed that whatever barometer we use to judge the performance, Pakistan comes out to be behind in every aspect. Pakistan not only lacks advanced gemstone cutting facilities but also jewelry manufacturing units. Karachi, Lahore, Peshawar, and Sargodha are centers of gemstone cutting and jewelry manufacturing. Karachi is the biggest hub of all and is known for its many jewelry manufacturing units. Jewelry artisans in Karachi are poorly trained and use outdated methods and equipment to produce jewelry for the local market and Pakistani diaspora. Karachi does not have any manufacturing facilities which can compete with the facilities in India, Thailand, and China. Locally made jewelry casting machines are used for manufacturing, while a few manufacturers are using imported machines from China, Turkey, and Thailand. Pakistan's main competitors are India, China, Thailand, Sri Lanka, and Afghanistan. However, Pakistan loses money on rough gemstone exports since its processing sector is inadequate. 75% of all gemstones are shipped in rough form, 25% are treated domestically, and 60% are squandered due to insufficient technology (Sajjad, 2019). In 2017, Pakistan's gemstone share in the international market was 0.03 percent, which is negligible when compared to its output. When compared to 2003, it has climbed 1.5 times in 2017. FROM $2 MILLION TO $3 MILLION This definitely indicates that the demand for Pakistani diamonds has increased (Sajjad, 2019).

1.4 Where we can be, or should be

Pakistan has the fifth largest reservoir of gemstones in the world, and country exports gemstones worth at least$3.7 billion annually (Afsar, 2020). The potential of Pakistan's gemstone industry is huge when it comes to adding to the country's economy. However, the yield is much less due to limitations in terms of mining and processing skills and technology. Our pilot study and literature revealed that Pakistan can certainly bring in a large amount of foreign exchange by developing its gemstone industry. Gilgit-Baltistan, Baluchistan, and Khyber Pakhtunkhwa have rich reserves of gemstones for both local and international markets. Due to high demand, it can export 800,000 carats Ruby, 87,000-carat emerald, and five million carats Peridot annually (PCJCCI, 2019). if an investment is made in the processing department, the gemstones may certainly be promoted at much higher prices. The gemstone industry in Pakistan has huge potential for profitability and value addition, but it is far behind its competitors in the world. it can export 800,000 carats Ruby, 87,000-carat emerald, and five million carats Peridot annually (PCJCCI, 2019). The development of the sector will certainly have a significant impact on the economy of the country when it comes to job creation, promoting entrepreneurship, and increasing the exports of gemstones. For this sector to grow even more, it needs to be extracted, cut, polished, sold, and certified in a modern way. The government should take action like the government of Namibia. I like the Namibian government better because it is less developed than Pakistan's, but they still invested in gems because they knew that one day it would pay off and help the economy. We can save around US$ 6400 million which we have lost in the

previous eight years (2014–2022) as stated above due to lack of technology and unskilled person and lack of government support.

In light of the aforementioned challenges and the primary challenges that have hindered the growth of the gemstones industry, the following problems will be elaborated upon in further detail.

2 Problem Statements

2.1 Statement of the Problem

2.1.1 Low or outdated technology in cutting and polishing, and the beads industry

According to Ahmad (2017), Pakistan's gem industry has enormous potential but is unable to function due to a lack of resources and technical expertise. Sri Lanka, Jaipur, Bangkok, and China are the most important foreign cutting centers for colored stones and rough stones from Pakistan like Swat emerald is known for its high quality; Indian buyers purchase, cut, and polish it. We lack the creativity to advertise Pakistan's stones overseas (Mehsud, 2019). The government seems reluctant in engaging with businessmen, despite significant treasury remittances (Mehsud, 2019). Domestic and export markets are unable to provide standardized and consistent quality products due to antiquated technology in processing sub-sectors. In Pakistan, quarry waste reaches 75%, compared to an international average of up to 45%. (Shah, 2018). Millions of people in mineral-rich areas of poorer countries contribute to global production of minerals, metals, and gemstones; paradoxically, millions of poor people in these countries benefit from the informal sector (Lahiri-Dutt & Brown, 2017).

In contrast to Pakistan, India, Sri Lanka, Thailand, China, and Namibia have either already achieved world class status as centers for gemstone processing and business or have embarked upon reforms for becoming regional and global leaders. It should not be surprising to find that “most of today’s cutting and polishing of colored stones takes place in Asia, with India (Jaipur), Thailand (Bangkok) and China being the furthermost named lapidary hubs” (Collet, Curtz, & Reed, 2013: 76). Thailand, considered to be the world’s leading gemstone cutting and trading center, exported an estimated $650 million worth of gemstones during 2012 (Newman, 2018). Likewise, India’s Gems and Jewelry industry is an important contributor to its economy, employing over 10 million people (Devgun & Bhatnagar, 2019: 78). Sri Lanka too started gemstone cutting early in the 1980s and its “development since then has resulted in dramatic improvements in the faceting of stones there” (Prim, 2019: 301). No wonder India, China and Thailand are the “beneficiation hubs” that are quite dominant in the industry (Makki and Ali, 2019: 168; see also, Cartier, 2019; Lawson, 2019).

2.1.2 Pilot Study for Statement of the Problem

Nonetheless, participants in pilot research in Peshawar's Namak Mandi bazar repeatedly complained about problems on all fronts. Some of the issues raised by the interviewees include: a lack of government and/or private sector support; defrauding in cutting, faceting, pricing, and selling; the use of outdated and substandard cutting and faceting technology; low quality tools, or even none at all. The wholesale and retail business of carving beads and other decorative and ceremonial pieces out of precious and semi-precious gemstones is done through traditional tools, equipment, and skills. Primary data revealed that Some bead manufacturing units producing 100-200 beads per day, which diminished their ability to generate enough cash to sustain future operations. Poor skill sets of artisans coupled with a lack of quality control will result in beads being produced which will be rejected in foreign markets. It was noted that some machinery units became inoperable as the replacement tools were not available on the market and owners lacked the ability to procure new ones or have the old ones fixed. Pilot data suggests that it has at least three vital and negative implications. First, it is too time-consuming to produce goods in larger quantity. Second, the hand-made gemstone items do not have as accurate and precise dimensions as a machine-carved item. a lack of diversity in the design, marketing, and sale of gemstone goods. Third, there is a huge health risk One of the interviewees stated that they occasionally cut their fingers and that stones grains enter their eyes, causing severe pain. as a result of these and other issues, given the above context, one would anticipate several areas that, if addressed properly, may revitalize KP's gemstone industry. The sector is not an industry in the conventional sense for the reasons stated above (Michelou, 2006). However, the above statements believe there to be an almost emergency need for mechanization of the production (i.e., cutting and carving), packaging, and marketing of gemstones. The KP government needs to believe that modernizing the production, packaging, marketing, and sale of machine-carved and faceted decorative gemstone items such as faceted stones, beads, tumbled towers, bangles, statues, table tops, and so on is feasible here and will yield a huge return like what Namibia and other African countries did for their people. For instance, the government and donors have heavily funded or subsidized Namibia's colored gemstone sector, including equipment and technical support. However, the government generates a minimal profit from the gemstone business compared to the cost of providing these services to gemstone miners. The bulk of gemstones are exported in raw form, which hurts local value addition and employment growth. Namibia's gemstone business is cost-based with low government returns, and the colorful gemstone sector in Namibia can reduce unemployment and improve people's lives (Musiyarira et al., 2019). If the above-mentioned pilot study addressed Increasing the value of gemstones would create employment for young people in lapidary shops while also generating revenue for the government. As a consequence, the value addition would further boost the country's net GDP (Mengich et al. 2019). To become internationally as competitive as these countries are, the afore-mentioned problems percolating Pakistan’s gemstone industry should be addressed.

2.2 Statement of the Problem

2.2.1 A Deficiency in a Technologically Advanced Gemology Laboratory

Certifications provide consumers with assurance and approval of their purchases (Iris). If you want to buy a gem, you should probably choose one that has been certified first, right? In light of the fact that they don't actually come for the cost of candies, this explanation makes a lot of sense. In most cases, an examination of a gemstone will consist of the points for instance Its origin (synthetic or natural), information about the stone's shape, color, transparency, and cut, and Important data such as measures, weight, and so on. As the number of techniques for modifying gems expands with technology, therefore, it becomes increasingly important for gem buyers and merchants to distinguish artificial gems from natural to avoid fraud and loss (Goldman, Davis, & Clifford, 2009). however, to figure out these features, you need advanced gemological tools and a high level of knowledge. This information is significant since it influences the asset's financial value, as well as its durability, attractiveness, And market or trader's reputation (Goldman, Davis, & Clifford, 2009).

2.2.2 Pilot Study for Statement of the Problem

The gemstone business in Pakistan, especially online business, is nothing without lab certification, and this concept of certification arose abruptly during COVID-19 because everything was online and the stone business boosted up in COVID-19. Since at first Pakistan's reputation has been harmed due to fraudulent acts committed by local dealers who cheated them with incorrect descriptions of stones, or sometimes they did not know properly about that gemstone specification due to a lack of lab certification. Our pilot study found that certification of gemstone labs is desperately needed in Pakistan because customers did not believe, and even if they did, they did not believe the Pakistani lab report at first. A pilot study revealed that foreign customers don't trust Pakistan labs, not because all of them are cheaters, but because of a lack of instruments. Sometimes they ask for two labs' certification to compare the results, and sometimes they certify it again to check the Pakistani Labs. Online gemstone trade in Pakistan is reliant on certification, and gemstone laboratories are reliant on online trading since online selling directly raises certification numbers. Online gemstone auctioneers such as Gem Rock only accept lab certificates whose validity has been verified by Gem Rock, and only two labs from Pakistan have been approved by this auctioneer, *Himalaya Gem Testing Lab* and *CIGTL*. When we talk about the tools or sophisticated instruments for labs, we are far behind because no one can afford such expensive instruments. And there are no government-level labs available for gemstones, GRS, GIA, LOTUS, GRA, AIG, etc. use such a highly sophisticated and advanced equipment.

LA-ICP-MS, XRF, XRD, RAMAN, and FTIR are the instruments utilized in them, and clearly, if you don't have such instruments, you won't be able to compete with the rest of the world. GIA Lab has a branch in India,

but they refuse to open one in Pakistan for unknown reasons. As mentioned by Michelou (2006), Pakistan did not consider its gemstone business to be an industry. The gemstone sector is not regarded as an industry in general in Pakistan. PGDC stated on their official website that five fully operational and well-equipped gem identification labs are located near Karachi, Lahore, Gilgit, and Peshawar, whereas the pilot data revealed that almost all labs for gem and jewelry identification in Pakistan have been closed due to non-technical staff shortages, lack of government interest, or lack of funding. There is no academic research on gemstones in Pakistan, and a pilot study discovered that Pakistan has only one PhD in Gemology, so revenue from this area is difficult to foresee. For business reasons, this industry is divided into three sections.

1. Gemstones Business (Physical /Online)
2. Bead and gemstone cutting industries
3. Advanced Gemstone Testing Laboratories

You cannot run this sector properly if one of the above categorizations is missing or weak. The government should not look to profit at first, just like Namibia's gemstone sector is currently a cost-based industry with little government returns (Musiyarira et al., 2019). However, it is good to see that some private labs are working in the Namak Mandi Gemstones market and have currently made a little repo of Pakistan, but it would be more fruitful if the government took the initiative to create an advanced level gemstone certification lab which includes research-level instruments and makes the Pakistani gemstones a brand which will gradually compete with world-class labs like GEM-A, GRS, GIA, LOTUS, and so on. An accredited gemstone testing lab needs to be set up as soon as possible. This could be the first step toward modernizing the gemstone industry as a whole.

2.3 Statement of the problem

2.3.1 Lack of E-commerce Platform (Online Gemstone Auctioneer)

As a Micro, Small and Medium Enterprises (MSMEs) gemstone business could be a source of considerable employment and revenue for the government as MSMEs are considered the backbone of many economies in terms of creating revenue and employment for millions of people (Shafi, 2020). In Pakistan, MSMEs account for over 90% of the country's estimated 3.2 million enterprises, 40% of GDP, and 40% of export revenues (Shafi, 2020). In this digital era, some Pakistani talented freelancers are also looking forward to contributing efficiently and effectively for the betterment of the national economy (Qazi, 2019). Ecommerce has been slow to change the gemstone and jewelry market in a big way. But many industry experts think it's getting close to a tipping point, after which it will gain a lot of speed over the next few years. National Gem and Jewelry Authority (NGJA), was attempting to develop an online platform for local dealers to stimulate the Sri Lankan economy, with the goal of earning $1 billion USD by the end of 2022 (Xinhua, 2022). While Pakistan is significantly wealthier in gemstones, and traders are really fast, so imagine where the

country's GDP would go. Pakistan's e-commerce market is projected to generate US$7.666 billion in revenue in 2022. Between 2022 and 2025, revenue is expected to show an annual growth rate of 6.09 percent. Pakistan is the fifth most populous country in the world, with a youth population of 64% (Bashir, 2022). The eCommerce sector of Pakistan does not even occupy a one percent share in the retail market of Pakistan. This very fact throws light that there is a huge space for growth in the ecommerce sector in Pakistan. It is projected that the eCommerce market of Asia will reach a valuation of US $2,093 billion this year itself, and Pakistan has a huge potential to contribute to this valuation (Daily Times, 2022). A pilot study in Namak Mandi gemstones market revealed that the online gemstone business in Peshawar is growing by the day; 90% of young dealers sell their stones at unimaginably high rates, and they deal in a much larger volume. There are a few online auctioneers like eBay, Gem Rock, Cata Wiki, and some social media apps like Facebook, and Instagram. Today, Gem Rock is the top online auctioneer website in the world, and every online dealer wishes to have an account there. (Gem Rock) also put a restriction on Pakistan and refused to open accounts from the country due to some reason, and Pakistan does not consider the gemstones sector as an industry (Michelou, 2006), who deal the matter on official level. Along with that, the payment issue is hindering this business so much, PayPal's contribution to improving the socioeconomic conditions of the local populace cannot be underestimated (Qazi, 2019). Namak Mandi Gemstones traders create accounts in other countries, spend millions of dollars, and profit enormously, yet the host country receives no tax money from the sale of these precious stones through online payment. Small orders from gemstone exporters are proving tough to handle online due to the lack of a PayPal account (Siddiqui, 2016). Primary data revealed that following one of the first lockdowns, the online gemstone business flourished dramatically since individuals were constrained to their houses. The online business reached its height because physical trading was impossible and every country was locked. According to primary data, there is 70% online trade and 30% physical trading. DHL courier service claims to send 50 million to 100 million PKR worth of stones per week, and only two young traders paid 50 million PKR each for courier expenses to DHL in COVID-19. Keeping in view the above statements If the government set up an online auction site like Gem Rock along with the facilitation of online payment (the alternative of PayPal like Pioneer), there would be very little chance of fraud. It would also give young people a huge chance to start their own businesses and it will generate a huge revenue through remittances, taxes, and courier services for the government. So far, there hasn't been anyone like this, so it would be a positive factor and win situation for the gemstone's traders and KP government.

3 Case Studies

3.1 Case Study - Sri-Lanka

[1]Sri Lanka, a small island country, is a center for gemstone cutting and polishing. The sector has around 300 registered exporters of gems, diamonds and jewelry products and employs 650,000 workers, including miners, cutters, craftsmen, and jewelry designers. The export performance of Sri Lanka for the last few years is as follows:

Description	**US Million**		
	2019	**2020**	**2021**
Diamonds	118.7	74.3	121.5
Gems	181.1	65.6	156.3
Jewelry	13.9	8.2	14.7

Table 3: Source: Sri-Lanka Customs

Sri-Lanka has rich deposits of precious and semi-precious stones just like Pakistan. Starting in the late 80s and early 90s, Sri Lanka started to revamp the gemstone and jewelry sector. New, import and export-friendly laws were introduced and a new curriculum for gemstones and jewelry was developed in the local language, Sinhala. A National Gems and Jewelry Authority was setup to regulate the sector. Taking a leaf out of Thailand, Sri Lanka invested heavily in training and setting up manufacturing facilities. Extensive marketing and branding exercises were undertaken to show local gemstone material as premium quality. Sapphire is being mined in many countries, but "Ceylon Sapphire" from Sri Lanka commands the highest dollar. Sri Lanka is not only world renowned as a center of gemstone processing but also a manufacturer of gemstone cutting and polishing equipment. The industry uses advanced technology in the cutting of gems and diamonds as well as jewelry manufacturing. No industry can compete internationally if it cannot produce locally manufactured machines and tools. Thus, one pillar of the Sri-Lanka experiment was to invest in indigenous capacity for manufacturing machinery. Today, the country not only manufactures gemstone cutting tools and polishing materials for the consumption of its local industry, but it also exports its gemstone cutting machines and tools to the outside world. Currently, Sri-Lankan businesses have branched out into precision cutting of gemstone cutting stones as small as 2 mm and are competing directly with India for a slice of a huge market share. Precision cutting requires highly skilled labor and specialized machinery and tools, and the island country has the ability to produce both.

[1] Lucas, A., Sammoon, A., Jayarajah, A. P., Hsu, T., & Padua, P. (2014). SRI LANKA: EXPEDITION TO THE ISLAND OF JEWELS. *Gems & Gemology*, *50*(3).

Figure 4: (Left) Source-Andrew Lucas, GIA. This sapphire's girdle outline is being cut to precise calibrated measurements for jewelry production. Right -Source; Andrew Lucas. GIA. When recutting sapphire (left), it takes a lot of skill to close windows, improve symmetry, lose as little weight as possible, and keep the color depth. The star sapphires (on the right) are being recut so that the effect is better placed.

Figure 5: Source: Andrew Lucas, GIA. At Swiss Cut Lapidary, Saman Amarasena conducts quality control for the fitting of gemstones in a watch bezel.

3.2 Case study - China

[2]China is the powerhouse of global manufacturing. The rapid pace of industrialization in the last 30 years has propelled China to the forefront of almost every manufacturing sector.The gemstone and jewelry

[2] Hsu, T., Lucas, A., Qiu, Z., Li, M., & Yu, Q. (2014). EXPLORING THE CHINESE GEM AND JEWELRY INDUSTRY. *Gems & Gemology*, *50*(1).

industries experienced a rapid expansion in the early 1990's. State-owned manufacturing and trading companies were setup flush with money to invest in human resources and technology. These state-owned companies collaborated with foreign companies to bring new technology and expertise to China. Foreign jewelry companies were enticed to move their production to China. This was possible because China had established jewelry manufacturing training centers, stone-cutting schools, and technical institutes to educate its people. Hence, the entrance of foreign manufacturing units was made easy as there was a highly trained workforce ready to enter the jewelry manufacturing field. Jewelry trading, manufacturing, and cutting facilities were setup in different areas of the country, providing jobs to millions.

Ketang is a small town a few hours' driving distance from Guangzhou and Shenzhen. The town is a powerhouse of gemstone cutting and gemstone machinery manufacturing and is a world-renowned trading hub. The town, where hardly anyone can converse in English, houses hundreds of units working 24 hours producing finished gemstone products. A state-of-the-art factory, manufacturing machinery and tools for local and export, is right next to the many small industries. From a small diamond needle to custom-made diamond wheels, everything is readily and cheaply available. Three massive malls have been constructed, with thousands of vendors selling every imaginable gemstone product. Dealers from Pakistan have also setup shops in the town, supplying rough material. Ketang is one of many high-performance manufacturing centers set up in China.

Figure 6: Source: Eric Welch. GIA. The Pingzhou area of Guangzhou is known for manufacturing jadeite bangle bracelets. This man is drilling the shape from a precut circular piece of jadeite.

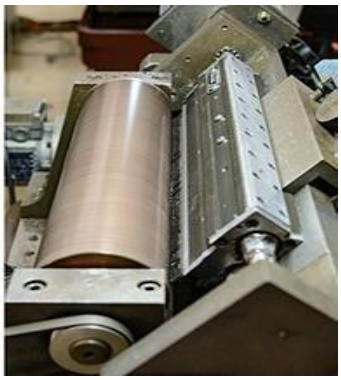
China	**US Billion**	
	2020	**2021**
Gemstone and Jewelry Export	18.4	29.03

Table 4: Source: www.statista.com

3.3 Case Study-India

[3]India is world renowned for its gemstones and jewelry products. India is the powerhouse engine of the world jewelry industry. from high-end premium jewelry, fashion jewelry, diamond/colored stone cutting and polishing, and manufacturing of jewelry and gemstone equipment. India is without a doubt the undisputed leader in this field.In the last 1980's, India and Pakistan were on a similar trajectory with respect to the gemstone and jewelry industry, and fast forward 3 decades, India has left Pakistan far behind. India started revamping its export/import laws, updating its gold policy and creating a jewelry authority but dominated by private sector enterprises. The jewelry curriculum was updated, new manufacturing centers for machinery and tools were commissioned, and massive marketing and branding initiatives were launched. Just like China, India has setup 10 special economic zones for the gems and jewelry industry. 500 private sector enterprises are working in these 10 zones and contribute around 30% of India's total exports (Source: www.ibef.org). India has very few varieties of natural gem resources and relies exclusively on importing rough diamonds and precious and semi-precious stones. There are around 15 national brands in India, with multiple retail locations all over the country, and some have set up retail locations outside the country. These brands are worth billions of dollars and create huge employment opportunities for the population.

India followed the same game plan as other successful nations by investing in training, setting up export-oriented units, locally manufacturing machinery and tools and simplifying import and export policies. India, unlike China, did not invite foreign jewelry companies to setup manufacturing units but instead facilitated its local jewelry companies to become export-oriented. Surat is known as a diamond cutting hub and is going to get its own diamond exchange. Mumbai is known for its high-end jewelry manufacturing setups, and Jaipur is a hub of stone cutting and fashion jewelry manufacturers.



[3] Lucas, A., Bhatt, N., Singhania, M., Sachdeva, K., Hsu, T., & Padua, P. (2016). JAIPUR, INDIA: THE GLOBAL GEM AND JEWELRY POWER OF THE PINK CITY. *Gems & Gemology*, *52*(4).

Figure 7: Source; Andrew Lucas, GIA. Numerous calibrated preforms are placed on a computerized faceting machine for final calibration, faceting, and polishing at RMC.

India	US Billion	
	2020	2021
Gemstone and Jewelry Exports	35.6	39.4

Table 5: Source: www.ibef.org

3.4 Case Study -Thailand

[4]Thailand is one of the main gems and jewelry centers, with decades of experience as a center for trading, manufacturing and gem labs. It is world renowned for its many gemstone heat treatment facilities, and many of the heat treatment procedures were pioneered in Thailand. The City of Bangkok and Chanthaburi are the main hubs of gemstone and jewelry manufacturing activities. Bangkok boosts state-of-the-art production facilities, trade centers, and dealers/buyers from all over the world. Many dealers from Peshawar have made Bangkok the hub of their export activities by setting up offices in the city. Bangkok's gain is Peshawar's loss. Many leading gem and jewelry manufacturers and suppliers have long operated their manufacturing centers in Thailand. Perhaps best known for manufacturing in Thailand is the jewelry brand Pandora. Thailand, like China, invited foreign companies to set up units in the country. This was made possible as Thailand has invested heavily in training, generous tax breaks, simple export/import procedures, and setting up gemstone and jewelry equipment manufacturing units, which complement its jewelry manufacturing activities. Thailand is one of the leading suppliers of jewelry and gemstone cutting machinery and tools. Bangkok organizes two of the most famous and visited trade shows every year, bringing in hundreds of vendors and visitors from around the world.

[4] GIT. (2021, May 21). The Art of Handcrafting in Thailand's Gem and Jewelry Industry. https://infocenter.git.or.th/en/article/article-20210521.

Figure 8:Source: GIT- Gem Testing Laboratory

4 Beneficiaries / successors

Peshawar has always been a gemstone trading hub. Rough gemstone traders from Pakistan, Afghanistan, and Central Asia have been visiting Peshawar to trade. Members of the task force hope that the examples provided above will assist the provincial administration in making key choices that will help Peshawar become a center for the production of gemstones and jewelry. The provincial government must highlight the need for establishing machinery, tools, and tool manufacturing units alongside machinery manufacturing units since both are complementary. The online selling and purchasing platform or auctioneer, as well as advanced or sophisticated gemstone certification instruments,

The above problem statement's solution direct beneficiaries will be the existing traders at Namak Mandi who use "traditional" techniques and tools for the production and/or sale of gemstone and decorative stuff, for instance the local cutters, the lack of an online gemstone auctioneer, and the non-standardized gemstone lab, Second, through boosting individuals' skills, employability, and income, the government indirectly benefits. Demonstrating government support for sustainable gemstone business concepts can boost KP's image compared to other provinces and the federal government/department (s). When the initiative develops a market niche, it will immediately benefit the government by generating money (sales tax, income tax, etc.) and creating jobs for deserving and relevant individuals. Third, the initiative would boost the self-esteem of gemstone artisans and dealers in Peshawar, especially at Namak Mandi. This will make people desire to duplicate the initiative or adapt its business strategy to match their needs.

5 Output/ outcomes

The project envisions to achieve the following outputs/outcomes:

1. First, install machinery and equipment for making automated gemstone artifacts in partnership with a professional gemstone laboratory operator(s) and/or Namak Mandi Market dealer.
2. Secondly, Install the machinery in an accessible, appealing location for future investors and other stakeholders.
3. Third, locate and educate volunteers to operate machine-based gemstone artefacts. Promoting factory products (Physically and online).
4. Fourth, find, contact, and enter into contracts with possible online and offline buyers of factory items.
5. Finally, to assist new entrants into the retail gemstone market in establishing physical and/or online shop floors for selling factory/machine products.

We believe the above mechanization and modernization interventions for production and sale (both physical and online) will illustrate a realistic and reproducible model of creative enterprise development that will provide income for employees and dealers. By establishing and successfully running a small factory for gemstone artefact production in a commercially viable but attractive, marketable, and presentable location near/around Namak Mandi, this will be a game changer in educating and sensitizing the current gemstone traders in Namak Mandi who do business secretly that it always pays off quicker and better to do business in an attractive location. This will encourage young investors to test out creative business concepts. Khyber Pakhtunkhwa might replicate the approach in other cities/regions where gemstones are traditionally produced and sold.

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