ACTIVE PHARMACEUTICAL INGREDIENTS (API) MANUFACTURING: CASE STUDY OF PAKISTAN

Kazi Afaq Ahmed

(CGP # 05-061)

4TH RASTA CONFERENCE

Tuesday, September 03 & Wednesday, September 04, 2024

Roomy Signature Hotel, Islamabad

This document is unedited author's version submitted to RASTA.

RESEARCH FOR SOCIAL TRANSFORMATION & ADVANCEMENT

Competitive Grants Programme for Policy-oriented Research

Pakistan Institute of Development Economics

ABSTRACT

Pakistan's pharmaceutical industry grapples with challenges stemming from its reliance on imported Active Pharmaceutical Ingredients (APIs). This study examines into the root causes obstructing API sector growth, aiming to diminish import dependency and emulate Bangladesh's success as a significant API exporter. Employing a mixed-method approach, including desk reviews, operational investigations, and stakeholder interviews, the study identifies barriers and proposes a strategic framework for domestic API industry growth. Leveraging artificial intelligence tools and feasibility assessments, it seeks to entrench Pakistan's pharmaceutical sector, driving economic advancement while reducing import reliance. The study's key findings offer vital recommendations to fortify Pakistan's pharmaceutical industry and enhance its API sector. It advocates for the establishment of a centralized API research center to address R&D deficiencies and stresses the importance of effective API policy implementation. Engaging pharmaceutical giants in developing local API sources and incentivizing technology transfer for off-patent molecules are highlighted as crucial steps. Moreover, fostering joint ventures with other countries and improving ease of doing business are essential to strengthen API manufacturing. Capacity building for regulatory staff and alignment with international quality standards are imperative to enhance export capabilities. Transitioning the Drug Regulatory Authority from policing to facilitation and leveraging the Higher Education Commission to bridge industry-academia gaps are crucial for industry advancement. The study's implications are vast, providing actionable insights for investors, policymakers, and regulatory bodies. It enables informed decision-making, facilitates regulatory reforms, and underscores the importance of collaboration between industry and academia. By optimizing R&D capacities and promoting commercial research, Pakistan can propel its pharmaceutical sector forward, contributing to economic growth and competitiveness in the global market.

PREFACE

It brings me great pleasure to introduce "API Manufacturing - Case Study of Pakistan" to investors, legislators, regulators, and readers with a keen interest in the pharmaceutical and API manufacturing sectors. As associate professor, senior consultant and lead researcher, at the Institute of Business Management, with over three decades of experience spanning various industries, and having served on numerous industrial forums and committees such as the Standing Committee on Higher Education and Science and Technology at FPCCI (2024-25), I have had the privilege of delving deep into contemporary industry issues.

Having closely observed the pharmaceutical sector, I have witnessed its remarkable capacity, exceptional talent, and best management practices, which have propelled national pharmaceutical companies to the forefront. However, despite these strengths, the sector has yet to fully tap into its export potential and access the USD 1.57 trillion global pharmaceutical market and the USD 193 billion API market, unlike its counterparts in India and Bangladesh.

The impetus behind this study was to explore and uncover the untapped opportunities within the pharmaceutical and API sectors, and to outline strategic priorities along with proposing a feasible implementation framework for the development and promotion of the API industry, which forms the backbone of the pharmaceutical sector. Drawing inspiration from Bangladesh's remarkable success story, where the nation transformed from being 97% import-dependent to a key API exporter within six years, it became evident that Pakistan, with its considerable capacity, could seize similar opportunities, provided the pertinent challenges are addressed.

The actionable insights provided in this study are intended to benefit investors, policymakers, regulators, academia, and existing API and pharmaceutical industry players, encouraging their active involvement in fostering the API industry's growth in Pakistan.

The journey of this study was not devoid of challenges. However, with the unwavering support of professional bodies, trade organizations, regulators, scientists, academia, and industry professionals, significant progress was achieved. Special acknowledgment is extended to the Pakistan Institute of Development Economics, Islamabad, for their generous grant that facilitated this research study. Furthermore, gratitude is expressed to mentors for their invaluable guidance and PIDE project director and his team for their support during this research endevour.

Finally, I extend my appreciation to my team whose collective efforts made this challenging undertaking possible.

ACKNOWLEDGEMENT

We extend our sincere appreciation to the following individuals whose contributions were pivotal in the success of this research study:

Stakeholder Interviews

Pervaiz Hussain Sufi - CEO, PharmaGen
Rizwan Sheikh CEO, Citi Pharma and his team
Jalal ud Din Zafar - CEO, Nabi Qasim & Surge Pharma Group
Syed Kazmi - CEO, Saakh Pharma
Zulfiqar Hussain - CEO, Ressichem Private Limited
Aslam Sheikh – Former CEO, Lundbeck Pharma
Mehtab Aman - DG, PCSIR and his team
Obaidullah - Director of Pharmaceutical Services, DRAP
Shakil Ahmed - Director, HEJ, UoK
Mehwish Khan - Ophth Pharma / Co-chairperson PPMA
Anwar Jamal- General Manager Quality Operation, Searle Pharma
Farooq Bukhari / Mr. Tauqeer – Pakistan pharmaceutical Manufacturer Association
Ishaq Maseer - Head of SCM, PharmEvo
Ahmed Jamal Qudsi – Head of Supply Chain and Logistics, Bayer Pharma
Muhammad Sajid - International Business Development and R&D, Searle Pharma
Shayan Khan - Martin Dow Pharma
Yasir Hashmi – Martin Dow
Sarah - Head of Regulatory Medicine, Searle Pharma
Shariq Mehmood - Scilife Pharma

We are deeply grateful to our team members for their unwavering support and dedication. Special thanks to:

Zulfiqar Hussain Koka Wala, Founder & CEO Polymer Access, Hutab International and Ressichem Private Limited for his most valued insights on chemical industry and his support in sourcing of the data.

Maheen Salman, CEO Global Management Consulting and Chairperson FPCCI standing committee on higher education, science, and technology, former Senior Vice president KATI, for her instrumental role in connecting with industry and academia, facilitating the onboarding process of stakeholders for interviews.

Ayaz Shareef, General Manager Marketing Pharm EVO Pakistan for his support in data collection and stakeholder interviews.

Noor Alam, Associate Professor & Retired Civil Servant (Grade 21) for his support in providing insights on data and public policies.

Sohaib Alam, Technical Manager, carry for, for his substantial contribution in collecting information on the API manufacturing process and plant operations.

Research Assistant, Zargul Ansari, NED University, whose expertise was instrumental in preparing the dashboard and developing insights.

Hira Rawoof, M. Phil Scholar at Institute of Business Management and independent Researcher, and her team for their invaluable assistance in conducting interviews and qualitative assessments of the stakeholders.

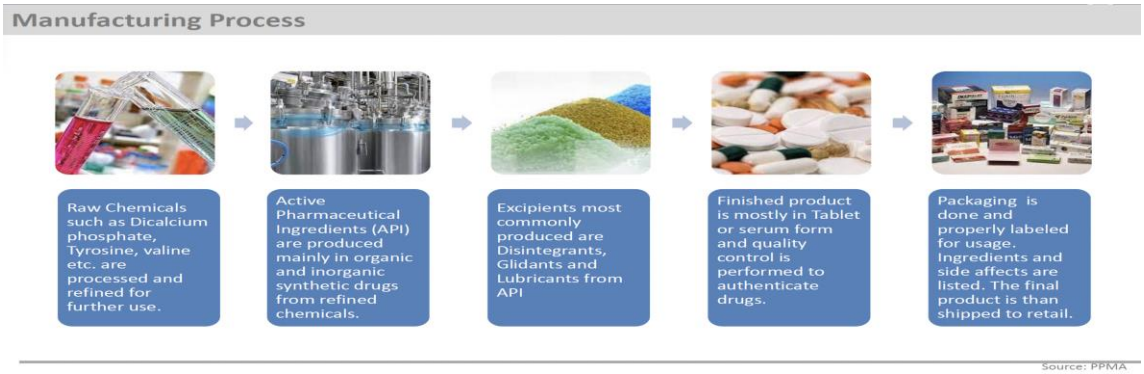
Farah Attique, Economic Analyst– Policy Research Unit, Policy Advisory Board Federation of Pakistan Chambers of Commerce and Industry (FPCCI), for her invaluable assistance in connecting with the stakeholders.

We extend our gratitude to our mentors Ahmed Waqar Qasim, Senior Research Economist, and Shahid Mehmood, Research Fellow, PIDE Islamabad for their candid feedback, guidance and support during the research endeavor. Our appreciation also goes to PIDE project director Faheem Jahangir Khan and his team for their assistance in project management and completion.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

PHARMACEUTICAL & API SECTOR



1.1 Pharmaceutical Sector

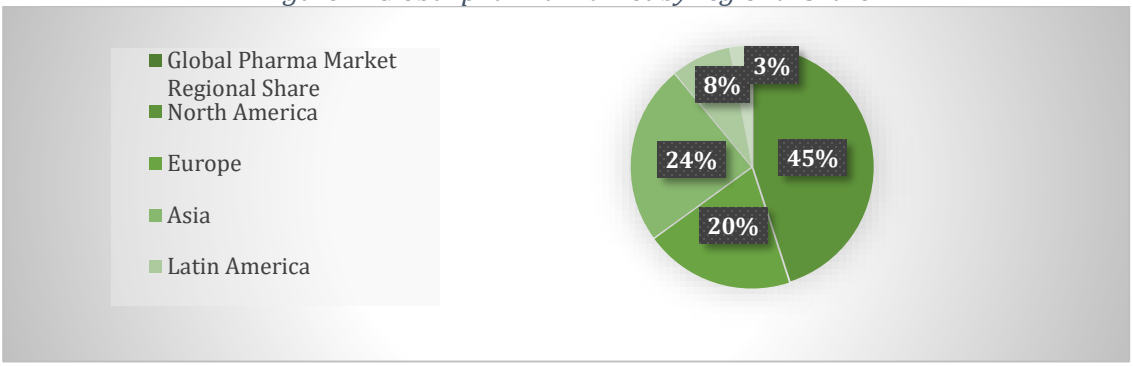
1.1.1 Global Pharmaceutical Sector

In recent years, the pharmaceutical industry has witnessed significant expansion propelled by new market entrants, innovative therapeutic avenues, and evolving consumer demands. As of 2022, the global pharmaceutical market was valued at USD 1.48 trillion, projected to reach USD 1.57 trillion by the end of 2023, and anticipated to surpass USD 1.7 trillion by 2025. Dominated by the United States and China, these two countries are poised to command over half of the market. North America is expected to maintain its lead with a 45% market share in 2023, while Europe's share is predicted to decline to 20%. The Asia Pacific region is set to retain its position as the second-largest market with a 24% share in 2023. Latin America and the Middle East and Africa (MEA) are forecasted to hold 8% and 3% of the global pharmaceutical market, respectively, in 2023. (VIS Credit Rating Agency pharma sector report October 2023).

Figure 1: Global pharma market

Source: VIS Credit Rating Company Limited (2023).

Figure 2: Global pharma market by regional share



Source: VIS Credit Rating Company Limited (2023).

1.1.1.1 Top Global Players (Concentration)

The pharmaceutical industry is characterized by a concentration of established players, with the top 10 firms generating more than a third (35%) of global revenue in 2022. The United States remains the primary contributor to global pharmaceutical revenue, accounting for nearly 45% in the same year. Notably, China's share of global revenue has been steadily growing, reaching almost 10% by 2022, positioning it as a significant player in the industry. This trend reflects not only China's population growth but also its emergence as a leader in various aspects of pharmaceutical production and innovation.

Table 1: Global top 10 pharmaceutical companies

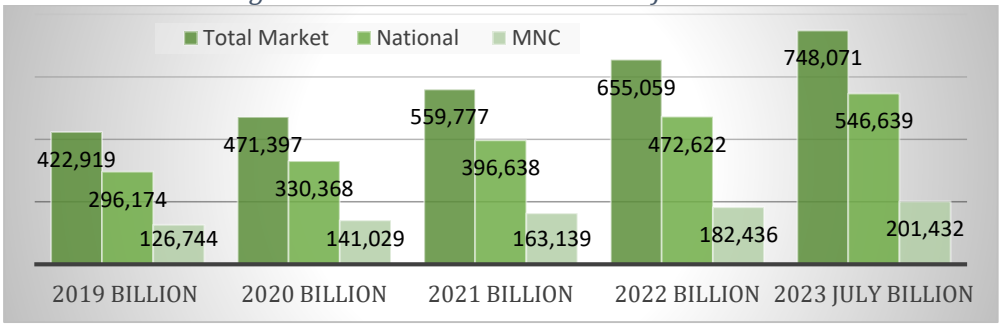
Rank	Company	Revenue 2022 USD Billion
1	Pfizer Inc. USA	100.33
2	Johnson & Johnson, USA	94.94
3	Sinopharm, China	80.19
4	F. Hoffman-La Roche Ltd. Switzerland	69.77
5	Merck & Co., USA	59.28
6	AbbVie Inc., USA	58.05
7	Bayer, Germany	53.88
8	Novartis, Switzerland	50.55
9	Sanofi-Aventis, France	46.86
10	Bristol Myer Squibb, USA	46.16

Source: VIS Credit Rating Company Limited (2023).

1.1.2 Pakistan Pharmaceutical Sector

Pakistan's pharmaceutical sector has undergone remarkable growth and evolution recently, focusing primarily on drug formulation rather than ground breaking innovation. Despite this formulation-centric approach, the industry is dynamic and expanding rapidly to meet healthcare demands. Locally manufactured pharmaceuticals, especially generic drugs, dominate the market, satisfying about 70% of the nation's needs, while multinational companies (MNCs) and imports cover the remaining 30%. (economies). This growth has been accompanied by significant changes, providing essential healthcare products and introducing revolutionary pharmaceutical preparations. Currently, there are 639 pharmaceutical manufacturing units in Pakistan, employing around 240,000 people and exporting products worth over $200 million to more than 60 countries. However, despite its rapid expansion and extensive reach, the industry faces challenges such as drug pricing, limited intellectual property rights protection, delayed regulatory approvals, and insufficient investments in research and technological upgrades.

Figure 3: Pharmaceutical market of Pakistan



Source: VIS Credit Rating Company Limited (2023).

1.1.2.1 Top Pakistani Players (Concentration)

The market structure is heavily skewed, with the top 10 firms commanding 49% and the top 25 firms holding 75% of the market share. This concentration leaves over 614 small and medium-sized enterprises competing for the remaining 25%, posing implications for quality, technological advancement, and the viability of smaller firms. Despite these challenges, the pharmaceutical sector in Pakistan continues to grow, with domestic sales outpacing multinational companies. With over 639 pharmaceutical formulation units, including facilities operated by 25 multinationals, the sector's value is projected to reach close to PKR one trillion by 2025, driven by increasing local production and healthcare expenditure. Pakistan's pharmaceutical industry is characterized by its emphasis on formulation and the dominance of locally manufactured generic drugs. However, challenges such as reliance on imports and market concentration among top firms persist, influencing the industry's dynamics and growth trajectory.

Table 2: Pakistan's top 10 companies

TOP 10 COMPANIES SALE VALUE DEC 2023					
Category	Company	Value Rs. (in Billion)	Units (in Million)	Value Share (%)	CAGR 2023vs2019
Total Pharma Market (Dec 2023)		828			16.14
National	Getz pharma	58.2	154.0	7.03	21.07
National	Sami	51.7	205.9	6.24	11.44
Multinational	GlaxoSmithKline	49.9	370.4	6.03	15.77
Multinational	Abbott Lab Pak Ltd	48.0	234.5	5.79	17.51
National	The Searle Company	46.7	247.4	5.64	15.78
National	Martin Dow Limited	34.0	135.6	4.11	23.85
National	Hilton	32.6	76.4	3.93	12.44
National	OBS	29.8	108.9	3.60	16.86
National	High-q Intl	28.7	90.3	3.46	19.32
Multinational	Haleon Pak Ltd.	27.1	136.5	3.27	18.89
Total		406.7		49.10	17.38(avg)

Source: IQVIA (2023).

Table 3: Top 25 companies' sale, December 2023

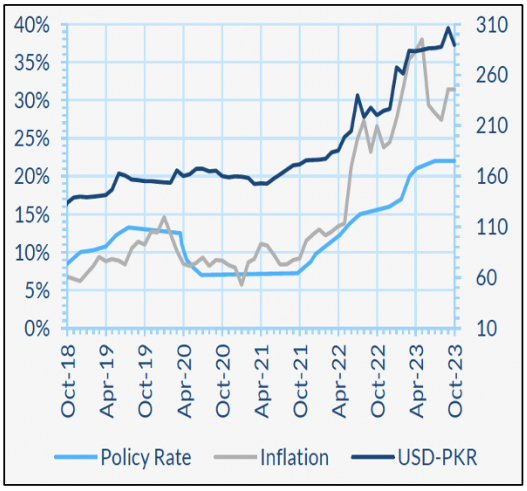
TOP 25 COMPANIES SALES VALUE DEC 2023					
Category	Company	Value Rs. (in Billion)	Units (in Million)	Value Share (%)	Value Growth (%)
Total Pharma Market		828	3634	100	17.59
National	Getz Pharma	58.2	154.0	7.03	28.83
National	Sami	51.7	205.9	6.24	20.75
Mncs	GlaxoSmithKline	49.9	370.4	6.03	16.92
National	Abbott Lab Pak Ltd	48.0	234.5	5.79	12.43
National	The Searle company	46.7	247.4	5.64	17.18
National	Martin Dow limited	34.0	135.6	4.11	18.97
National	Hilton	32.6	76.4	3.93	30.83
National	OBS	29.8	108.9	3.60	14.14
National	High Q international	28.7	90.3	3.46	32.02
Mncs	Haleon Pakistan Ltd.	27.1	136.5	3.27	18.89
Mncs	Bosch	21.8	94.5	2.63	15.75
National	Highnoon	21.1	84.1	2.55	22.82
Mncs	Sanofi-Aventis Pakistan	19.8	69.6	2.40	17.21
National	CCL	18.9	53.6	2.28	43.34
National	Atco	18.8	119.7	2.27	24.83
National	Barrett Hodgson	16.5	116.7	1.99	17.74
National	Pharm Evo Pvt. Ltd.	13.1	38.7	1.58	28.27
National	Nestle Pakistan Ltd	13.0	50.8	1.57	5.70
National	Nabi Qasim	12.1	69.1	1.46	15.31
National	ICI	11.7	75.2	1.42	11.40
Mncs	Pfizer Inc	11.5	32.7	1.38	7.03
National	Ferozsons	9.9	34.6	1.20	50.58
Mncs	Novartis Ph. Pak Ltd	9.4	19.9	1.13	-1.69
National	Novo Nordisk	8.9	8.7	1.08	19.81
National	Macter	8.9	25.3	1.07	21.74
Total		622.1	2653.3	75.11	

Source: IQVIA (2023).

1.1.2.2 Pakistan Economic Perspective

Over the past twenty years, there has been a noticeable shift in global economic growth towards Asia, particularly in the vicinity of Pakistan. Since 2003, countries neighboring Pakistan, namely China, India, Iran, and Afghanistan (CIIA), have experienced a substantial increase in their global export market share by 216%. Similarly, the South Asian Association for Regional Cooperation (SAARC) region and the Economic Cooperation Organization (ECO) have seen significant growth in their market shares by 186% and 127%, respectively. However, Pakistan's export share in the global market has declined by 19% during the same period. If Pakistan had matched the export growth pace of CIIA countries, its annual exports in FY 2019 would have reached US$ 55 billion, far surpassing the actual figure of US$ 23 billion (GOP, 2019).

Box 1: Current state of Pakistan's economy



Pakistan – Declined by 19%

China, India, Iran, and Afghanistan (CIIA), have experienced a substantial increase in their global market share by 216%. Pakistan's share in the global market has declined by 19% during the same period.

Pakistan Economy Under Severe Stress

due to a combination of domestic and external factors. GDP growth has fallen to just 0.29% in FY23 down from 5.7% in FY22; however, the same is expected to improve to 3.5% during FY24.

Pharmaceutical Industry Support Economic Stability

- Direct Employment = 90,000 workers and Indirect Support = 150,000 Jobs.
- Contribution < 1% of GDP
- Annual Saving by Import Substitution = USD 2 billion
- Large Manufacturing Sector Out Put Contribution = 4.2%

Sources: GOP (2023) and VIS Credit Rating Company Limited (2023).

Despite these economic challenges, the pharmaceutical sector remains a crucial component of Pakistan's economy. It contributes over one percent to the GDP and accounts for approximately one percent of total exports. By focusing on import substitution, the pharmaceutical industry saves over USD two billion annually and contributes around 4.2% to the output of the country's largest manufacturing sector. With direct employment of approximately 90,000 workers and indirect support for 150,000 jobs, the pharmaceutical industry plays a significant role in employment generation and economic stability. The Pakistani economy is facing significant challenges due to both domestic and external factors, resulting in severe stress. Import restrictions, aimed at preserving foreign exchange reserves, have further exacerbated shortages and disruptions in various industries, notably impacting the availability and pricing of medicines (VIS Credit Rating Company Limited, 2023).

1.1.2.3 Healthcare expenditure

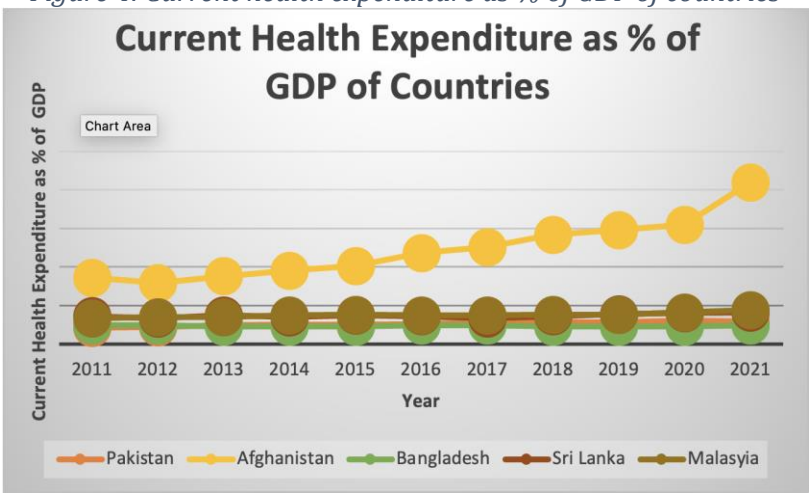
Per Capita Expenditure on Healthcare 2022

Pakistan is the lowest in the region, standing at USD 38, compared to USD 56.63 in India, USD 51 in Sri Lanka, and USD 50.66 in Bangladesh.

Source: VIS Credit Rating Company Limited (2023).

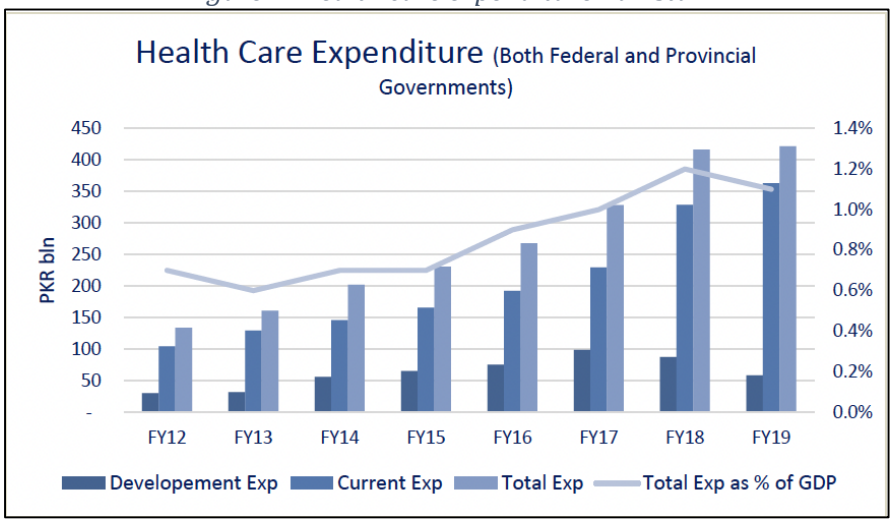
Healthcare spending in Pakistan is low compared to global standards. In 2022, it amounted to 1.4% of GDP, totaling around Rs 920 billion. Per capita spending on healthcare is the lowest in the region at USD 38, compared to USD 56.63 in India, USD 51 in Sri Lanka, and USD 50.66 in Bangladesh. Despite a young population, pharmaceutical consumption is relatively low, but as income levels rise and awareness improves, there's potential for significant growth in this sector.

Figure 4: Current health expenditure as % of GDP of countries



Source: World Bank (2024).

Figure 5: Health care expenditure Pakistan



Source: PACRA (2021).

Healthcare spending in Pakistan relies heavily on out-of-pocket expenses, but public facilities offer free or low-cost treatment, and health insurance is emerging. Public-private partnerships are increasing, with pharmaceutical companies collaborating to improve access to essential medicines. The Drug Regulatory Authority of Pakistan oversees the sector, regulating new medicines, manufacturing sites, and setting maximum retail prices.

1.1.2.4 Opportunities

Pakistan's pharmaceutical industry is poised for growth due to its large population, high disease burden, and export potential. However, it faces challenges like the lack of FDA-approved manufacturing plants. By improving regulations, infrastructure, and incentives, Pakistan can attract investments, obtain FDA certification, and become a major player in the global pharmaceutical market, potentially reaching billion-dollar exports within 2-3 years.

1.1.2.5 Challenges

Pakistan's pharmaceutical sector faces critical challenges hindering its growth and impacting healthcare. Price controls, import dependence, currency fluctuations, and high utility costs squeeze profits, leading to medicine shortages and the exit of multinational companies. Lengthy registration processes and currency depreciation delay new medicine introductions, affecting patient access and profitability. Heavy reliance on imported active pharmaceutical ingredients (APIs) from China and India poses geopolitical risks and drains foreign exchange. Encouraging domestic API manufacturing through government incentives can mitigate these risks and create jobs. Collaboration among the government, regulatory bodies, and pharmaceutical companies is essential to streamline processes, ensure affordability, and improve access to quality medicines. Overcoming these hurdles could significantly boost the industry's growth and contribution to healthcare (ICAP, 2020).

1.2 API Sector

Active Pharmaceutical Ingredient (API) means any substance that is intended for incorporation into a finished drug product and is intended to furnish pharmacological activity or other direct effect in the diagnosis, cure, mitigation, treatment, or prevention of disease, or to affect the structure or any function of the body.

1.2.1 Global Perspective

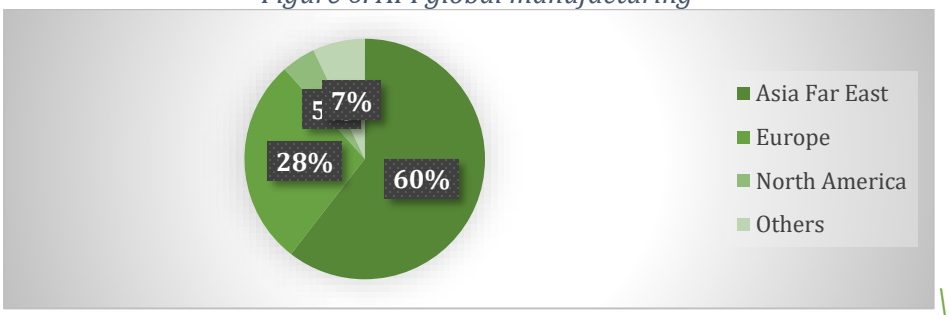
As per projections by Mordor Intelligence (2023), the active pharmaceutical ingredients (API) market is anticipated to witness a significant rise, climbing from USD 216 billion in 2024 to approximately USD 306 billion by 2029. According to IQVIA (2020), Asia Far East accounts for 60.5% of global API production, followed by Western Europe with 27.9%, North America with 4.6%, and the remaining 7% from other regions. Presently, China and India stand as the primary providers of pharmaceutical raw materials and excipients on a global scale.

Table 4: API global market

Market-2024	*Anticipated Market-2028*	*Anticipated CAGR*
216 billion	*306 billion*	*7.22%*

Source: Mordor Intelligence (2023).

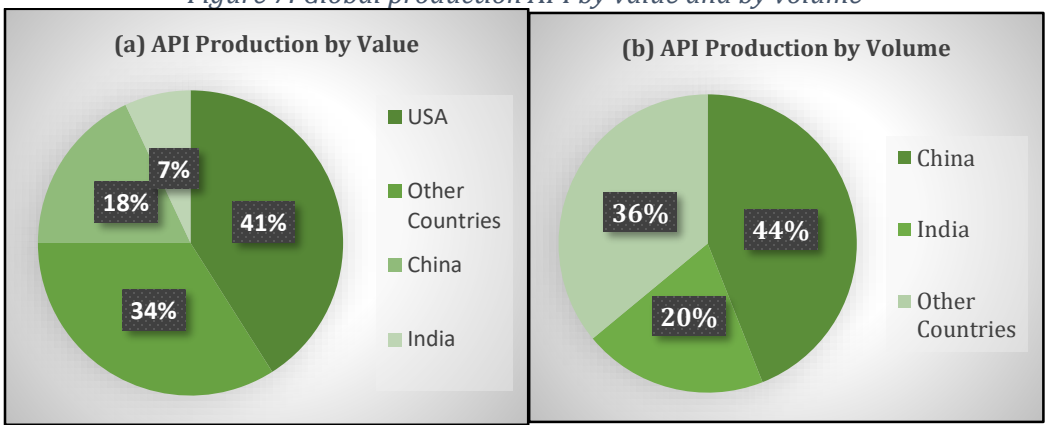
Figure 6: API global manufacturing



Source: IQVIA (2020).

Around 72% APIs are imported by US from China. China is one of the main suppliers supplying 13% of API to US. 83% of medicines in US had no US source of API out of 100 generic medicines (Sardella, 2021). Figure 2 shows China is the biggest supplier of raw materials for Active Pharmaceutical Ingredients (Cherian et al., 2021). India accounts for 20% of the global production by volume and 7% for value (Cherian et al., 2021). According to report by Sardella (2021). Figure I indicate China is the largest producer of API however USA is the largest producer of API by value followed by China.

Figure 7: Global production API by value and by volume



Source: Cherian et al. (2021).

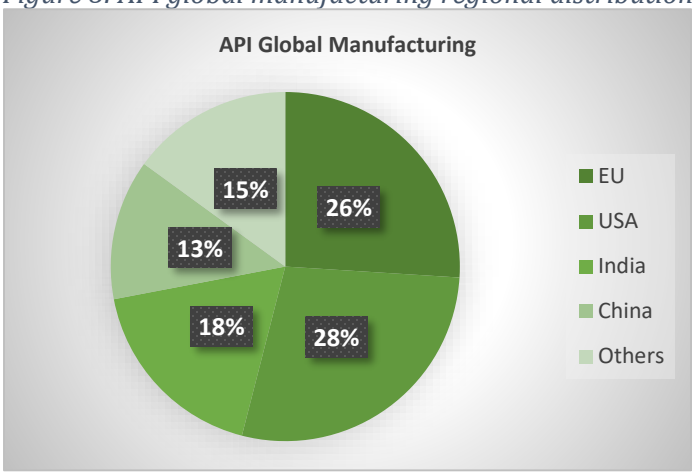
The graph represents the API production globally for the USA, China, India and other countries, in terms of (a) value and (b) volume.

Before the 1950s, Europe held the mantle as the primary global hub for pharmaceutical manufacturing. However, during the 1960s, the burgeoning economies of India and China began establishing their own pharmaceutical production capabilities, aiming to achieve self-sufficiency and reduce dependency on Western nations like Europe and the USA. With time, manufacturers from India and China emerged as formidable competitors in the global market, exerting significant price pressure on Western counterparts. Consequently, there was a notable shift of pharmaceutical production, including APIs, towards Asia.

> *"Within the next three years, more than 60% of European and US manufacturing firms plan to onshore or re-shore portions of their Asian production."*

Source: Fischer et al. (2023).

Figure 8: API global manufacturing regional distribution



Source: Fischer et al. (2023).

This heavy reliance on external sources prompted initiatives by the US and EU governments to bring back API manufacturing sites domestically. Consequently, there is a noticeable trend towards relocating manufacturing operations back to Europe, with pharmaceutical manufacturing included. Fischer et al. (2023) highlight that within the next three years, more than 60% of European and US manufacturing firms plan to onshore or re-shore portions of their Asian production. To facilitate this transition, European governments are providing both financial and non-financial incentives, alongside streamlining administrative and regulatory processes. For example, the Austrian and French governments have supported the expansion of local API production (Fischer et al., 2023).

1.2.2 China Case: Success Story

China maintains its dominant position in the global market for bulk drugs, largely due to extensive infrastructure investment, large-scale manufacturing capacity, cost efficiency, technical capability, and supportive government policies. To bolster its pharmaceutical and associated raw material industry, China has implemented policy and infrastructure reforms aimed at encouraging innovation, streamlining approval processes, optimizing efficiencies, and providing utilities at discounted rates. Notably, the Chinese government has made substantial investments in biologics and biosimilars, allocating approximately USD 1.6 billion for new drug development (PwC, 2020). Through initiatives like the 'Thousand Talents Plan', China aims to attract international talent by offering research funding and fostering collaborative research ecosystems (PwC, 2020). Clusters within China's pharmaceutical industry benefit from proximity to ports and airports, facilitating logistics support. Historically, the industry was state-owned, with the government offering incentives such as special industrial zones with provisions for low-cost land purchase and infrastructure development. China's focus on producing basic chemicals and active pharmaceutical ingredients (APIs) has propelled it to become the leading supplier of APIs globally by volume. Moreover, the Chinese government's encouragement of research and development, particularly in biotechnology and biosimilar product capacity, underscores its commitment to industry advancement. Financial, tax, and related incentives play a crucial role in promoting pharmaceutical manufacturing, with industrial zones providing shared infrastructure and environmental support serving as a successful model for other regions.

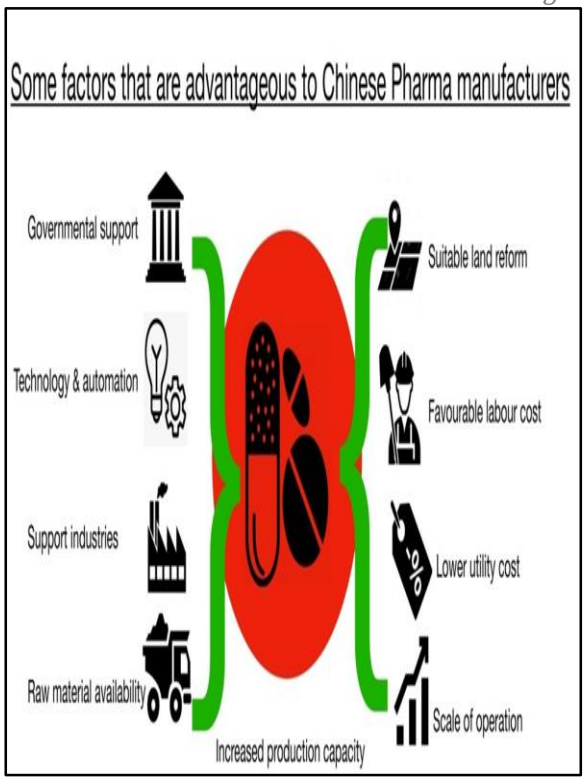
Table 5: API development model China

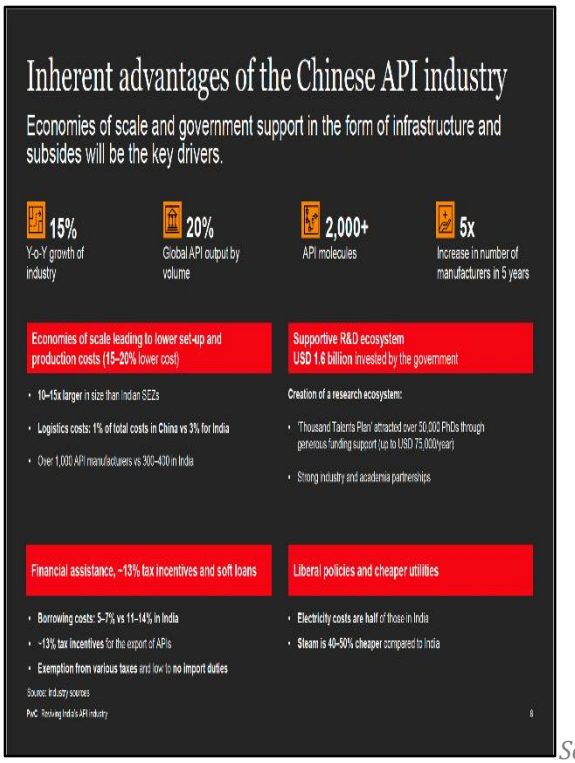
API Development Model-China		
S. N	Initiatives	Impact
1	Infrastructure Investment	Development of specialized industrial zones with provisions for low-cost land purchase and infrastructure development leading to cost optimization.
2	Large-Scale Manufacturing Capacity	Build large-scale manufacturing facilities to meet APIs local and international demand and through economy of scale and cost efficiency.
3	Cost Efficiency	Policies and initiatives to optimize efficiencies in API production processes, thereby reducing costs and enhancing competitiveness in the global market.
4	Technical Capability	Developed technical expertise and capabilities through investments in research and development, as well as initiatives like the 'Thousand Talents Plan' aimed at attracting international talent.
5	Supportive Government Policies	Policies to encourage innovation, streamline approval processes, and provide incentives for API manufacturers, fostering a conducive environment for industry growth.
6	Investment in Biologics and Biosimilars:	Recognizing the importance of next-generation drugs, China has allocated substantial investments, such as USD 1.6 billion for new drug development, to advance biologics and biosimilars within the API industry.
7	Proximity to Logistics Support:	Clusters within China's pharmaceutical industry benefit from proximity to ports and airports, facilitating efficient logistics support for API production and distribution.
8	Success factors	Dominance in the global API market by enhancing infrastructure, capabilities, and competitiveness.

Source: Author illustration.

Chinese manufacturers enjoy low utility cost compared to India. They have massive scales of operations which gives them competitive advantage. They get significant subsidies in terms of export rebates that equals to 10 to 15% of their revenues. Other advantages comprise technology and automation, support industries, availability of raw materials, suitable land reforms, labour cost at low prices, lower cost of utilities, and large scale of operations (Cherian et al., 2021) In China, the API industry has advantage of increased economies of scale and support from government in the form of financial incentives, infrastructural facilities, and regulatory policies.

Box 2: Advantages of Chinese API industry





Source: Cherian et al. (2021) and PwC (2020).

1.2.3 Indian Case: Success Story

India holds a significant position in the global pharmaceutical market, ranking third in terms of volume and thirteenth in value (Singh & Popli, 2021). The country's Active Pharmaceutical Ingredient (API) industry has evolved from producing basic molecules to manufacturing complex compounds, with the sector projected to reach a value of around Rs. 1109 billion by 2024. APIs currently constitute a quarter of India's pharmaceutical market, with exports expected to reach Rs. 303 billion in 2020-21. India supplies 20% of global demand for generic drugs and over 60% for certain immunizations and antiretroviral drugs (Singh & Popli, 2021). Notably, 57% of APIs listed by the World Health Organization originate from India (Singh & Popli, 2021). Despite its prominence, the Indian API industry remains fragmented, with approximately 1,500 units operating, and the top companies accounting for only 16-17% of the market share (CII, 2020). However, propelled by adherence to international standards and the establishment of large-scale manufacturing facilities, the sector has witnessed significant growth. India boasts the highest number of abbreviated new drug applications approved by the US FDA, with 665 plants sanctioned by the regulatory body. To bolster API manufacturing, India has implemented various initiatives. These include the establishment of API manufacturing clusters, providing dedicated zones with common utilities and infrastructure to enhance operational efficiency. Additionally, the government has introduced incentives to encourage investment in mega parks, such as waivers on stamp duty, subsidies on water and electricity, SGST reimbursement, and subsidies for quality certification and patent registration expenses.

Indian API sector scoreboard

- Supplies 20% of global demand for generic drugs and over 60% for certain immunizations and antiretroviral drugs
- 57% of API listed by the World Health Organization originate from India
- API sector is projected to reach a value of around Rs. 1109 billion by 2024
- Highest number of abbreviated new drug applications approved by the US FDA, with 665 plants sanctioned by the regulatory body

Source: PwC (2020).

Policy frameworks supporting domestic production have also been put in place, focusing on incentivizing environmental compliance, expedited land clearance, and ensuring access to land, power, and water at affordable rates. Financial assistance in the form of loans, subsidies, and duty exemptions has been provided to stimulate API production (Singh & Polpi, 2021). Initiatives aimed at lowering raw material costs through the expansion of petrochemical companies and optimization of existing facilities have been undertaken. Short-term strategies involve identifying willing Indian pharmaceutical companies and revitalizing brown field pharma units to augment production capacity (Cherian et al., 2021).

To monitor progress and enhance transparency, efforts are being made to develop performance measures and indicators. Collaborations with institutions like NIPER and CSIR aim to improve process technologies (Singh & Popli, 2021). The implementation of the Production Linked Incentive (PLI) scheme further incentivizes domestic manufacturing, emphasizing the "Make in India" approach to boost API production. Moreover, SMEs receive support through the Technology Upgradation Assistance Scheme, facilitating their adherence to WHO GMP standards. These

concerted efforts underscore India's commitment to fortifying its API industry, paving the way for self-reliance and sustainability in the pharmaceutical sector

Table 6: API industry development model: India-A

API Industry Development Model – India							
Initiatives	*Capacity*	*Cost of production*	*Quality*	*Compliance*	*API Export*	*Global Competitiveness*	*Import Dependence*
Establishment of Large-Scale Manufacturing Facilities	↑	↓	↑	↑	↑	↑	↓
Regulatory Compliance (US, FDA approved facilities)	*N/A*	↑	↑	↑	↑	↑	↓
Adoption of International Standards (Accreditations)	*N/A*	↑	↑	↑	↑	↑	↓
Promotion of Domestic API Manufacturing	↑	↓	*N/A*	*N/A*	↑	↑	↓
Shift from basic to high value API Manufacturing	↑	↑	*N/A*	*N/A*	↑	↑	↓
Government Incentives	↑	↓	↑	↑	↑	↑	↓
Establishment of API Manufacturing Clusters	↑	↓	*N/A*	↑	↑	↑	↓
Incentives for Investment in Mega Parks	↑	↓	*N/A*	↑	↑	↑	↓
Policy Support for Domestic Production	↑	↓	*N/A*	*N/A*	↑	↑	↓
Financial Support	↑	↓	↑	↑	↑	↑	↓
Efforts to Lower Raw Material Costs	↑	↓	*N/A*	*N/A*	↑	↑	↓
Identification and Revival of Existing Units	↑	↓	*N/A*	*N/A*	↑	↑	↓
Development of Performance Indicators	↑	↓	↑	↑	↑	↑	↓
Industry -Academia Collaboration	↑	↓	↑	↑	↑	↑	↓
Clusters and Production Linked Incentive (PLI)	↑	↓	*N/A*	*N/A*	↑	↑	↓
Technology Upgradation Assistance Scheme	↑	↓	↑	↑	↑	↑	↓

Source: Author's illustration.

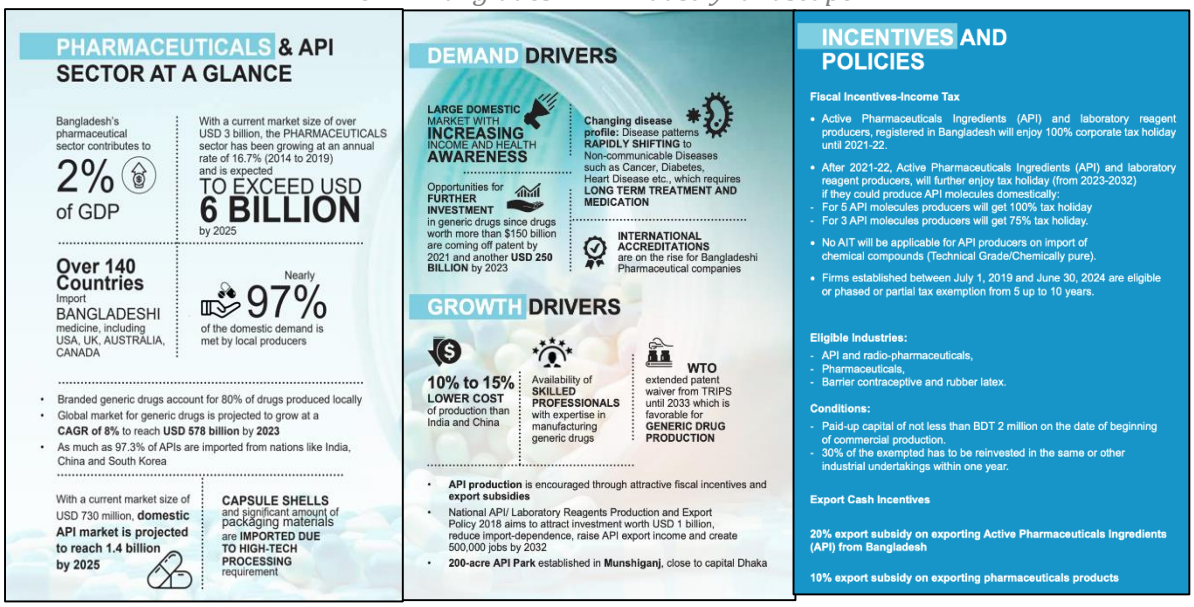
Table 7: API industry development model: India-B

API Industry Development Model - India		
SN	**Initiative**	**Impact**
1	Establishment of Large-Scale Manufacturing Facilities	Invested in the development of large-scale manufacturing facilities for API production, bolstering its capacity to meet domestic and international demand
2	Regulatory Compliance	India boasts the highest number of abbreviated new drug applications approved by the US FDA, indicating a commitment to maintaining regulatory compliance and quality standards in API manufacturing
3	Adoption of International Standards	contributing to improved product quality, regulatory compliance, and global acceptance of Indian-made pharmaceutical products
4	Promotion of Domestic API Manufacturing	The Indian government actively promotes domestic API manufacturing to reduce reliance on imports and enhance self-sufficiency in producing essential medicines
5	Transformation of API Manufacturing	Transitioned from producing basic API molecules to manufacturing high-value and intricate API compounds
6	Government Incentives	Federal and state governments have established excise duty-free zones to support pharmaceutical manufacturers, encouraging production and investment in API manufacturing
8	Incentives for Investment in Mega Parks	Included stamp duty waivers, subsidies on water and electricity, SGST reimbursement, and subsidies for quality certification and patent registration expenses (PWC).
9	Policy Support for Domestic Production	Incentives for environmental compliance and land clearance, as well as ensuring accessible land, power, and water supply at low prices (PWC).
10	Financial Support	loans, subsidies, duty exemptions, and affordable interest rates is provided to increase API production
12	Identification and Revival of Existing Units	Identified Indian pharmaceutical companies willing to manufacture essential medicines and reviving brown field pharma units to increase capacity (Cherian et al., 2021).
13	Development of Performance Measures and Indicators	To monitor stakeholders' progress, improve transparency, and expedite payment cycles in medicine procurement systems.
14	Encouragement of Industry -Academia Collaboration	Collaboration with institutions like NIPER and CSIR is encouraged to enhance process technologies (Singh & Popli, 2021).
15	Clusters and Production Linked Incentive (PLI) Scheme:	The PLI scheme incentivizes domestic manufacturers through "Make in India" approach, promoting domestic production of APIs and drug intermediaries (PWC).
16	Technology Upgradation Assistance Scheme	SMEs receive interest subventions on loans for technology and infrastructure development to meet WHO GMP standards.
17	Fragmentation Mitigation	Approximately 1,500 units operate within the sector, initiatives are underway to enhance collaboration and efficiency among industry players

Source: Author's illustration.

1.2.4 Bangladesh Case: Success Story

Box-3: Bangladesh API industry landscape



Source: BIDA (n.d.).

Bangladesh API scorecard

- Shifted from 97% API imports in 2016 to30% API Exports 2022
- Ramped up local API production from 41 in 2017 to 370 molecules by 2032, fostering competitiveness
- Domestics API market is projected to reach USD 1.4 Billion by 2025, up from the existing USD 730 million.

Source: BIDA (n.d.).

Bangladesh's pharmaceutical industry has made significant progress, by strategic initiatives and favorable policies. The Drugs (Control) Ordinance of 1982 laid the groundwork for this progress, while the abolition of the product patent system in 2008 fueled further advancements, similar to the ordinance's impact on generics. Presently, Bangladesh hosts eight API manufacturing firms, signaling its growing presence in the global pharmaceutical landscape. Supported by initiatives such as the approval of an API Park in Munshi Ganj and the implementation of the National API and Laboratory Reagents Production and Export Policy in 2018, the country is poised to enhance competitiveness and expand its export potential. Projections indicate a promising direction, with the domestic API market projected to reach USD 1.4 billion by 2025, up from its current USD 730 million. The government's introduction of various incentives and tax exemptions underscores its commitment to reducing import reliance and bolstering export competitiveness. Aligned with these goals, Bangladesh aims to significantly ramp up the production of locally manufactured API molecules and reagents, from 41 in 2017 to 370 by 2032, positioning the industry for sustained growth and global competitiveness in the pharmaceutical arena (*The Daily Star*, 2021). To support the development of the API industry, Bangladesh has implemented a range of measures and policies accessible to all readers. The promotion of local firms' policy has enabled progress, particularly in the pre-TRIPs era, although challenges persist in leveraging the absence of product patents. Additionally, the technology

development policy underscores investment in research and development to enhance API manufacturing technologies. The abolition of product patent protection has facilitated the manufacturing of complex products, with local firms making strides in technology transfer agreements. Strict regulatory control on the import of APIs ensures transparency and fosters the development of generics. Measures such as the establishment of API parks, common effluent plants, and incentives for API production, including tax holidays, VAT waivers, and financial facilities, further bolster the sector's growth and competitiveness. These collective efforts highlight Bangladesh's dedication to emerging as a significant player in the API industry, paving the way for enhanced self-sufficiency and economic prosperity in the pharmaceutical sector.

Table 8: Bangladesh API development model

Bangladesh API Development Model		
S.N	Initiatives	Impact
1	Abolish the product patent system in 2008.	Laid the foundation for innovation and growth in the API industry.
2	National API and Laboratory Reagents Production and Export Policy in 2018.	Promoted local firms and enhance competitiveness in the API market.
3	Policies supporting local firms.	Enabled progress, especially in the pre-TRIPs era and enhanced Investment in Technology Development.
4	Promotion of Local Firms Policy.	Prioritization of technology development in API manufacturing through investments in research and development.
5	Strict regulatory control on the import of APIs.	Ensured transparency and facilitated the development of generics.
6	Establishment of API Parks.	Provided infrastructural support for the API industry and Common Effluent Plant.
7	Commitment to establishing a common effluent treatment plant and yard for waste disposal.	Ensured environmental sustainability in API manufacturing and Incentives for API Production.
8	Provision of incentives such as tax holidays, VAT waivers, and financial facilities for API manufacturers.	Stimulated API production and enhanced competitiveness (Chaudhuri et al., 2020).

Source: Author's illustration.

1.2.5 Pakistan Case

The global pharmaceutical landscape is undergoing significant changes, providing Pakistan with a strategic opportunity to enter the lucrative off-patent drugs market, which is projected to reach USD 700 billion in branded generics and USD 381 billion in generics by 2025. However, Pakistan currently relies on importing 90% of raw materials for drug manufacturing, primarily from overseas sources, exposing the vulnerability of its pharmaceutical sector. Despite having over 639 pharmaceutical companies. only 6-7 local manufacturers produce a limited range of active pharmaceutical ingredients (APIs). Pakistan's domestic active pharmaceutical ingredient (API) market is valued at approximately $175 million. Currently, 39 APIs are licensed for production through basic manufacturing, and 117 APIs through semi-basic methods (DRAP, 2022). Local firms produce approximately 15% of the required APIs, with national demand for 16 APIs being met locally. Many leading brands use these locally produced APIs in their products, indicating their widespread integration into the pharmaceutical sector. Recent political tensions with India, a significant API

supplier, have further underscored the need for Pakistan to enhance its API production capabilities. Despite previous trade bans, concerns about potential shortages, particularly of life-saving drugs, led to the lifting of restrictions on the import of medicines and medicinal raw materials from India. To seize the opportunities in the global pharmaceutical market and mitigate supply chain disruption risk, Pakistan must prioritize the development of its API industry. This necessitates implementing sectoral growth strategies, regulatory reforms, investment incentives, and infrastructure development. By addressing these challenges and fostering the growth of the API industry, Pakistan can reduce its dependency on imported raw materials, enhance its export capabilities, and establish itself as a significant player in the global pharmaceutical supply chain.

The inability of Pakistan to manufacture sophisticated drugs like cancer treatments domestically stems from a lack of research incentives, infrastructure, and regulatory support. Examples such as the failed 'interferon' drug initiative and attempts to produce APIs from local resources highlight the challenges. The discontinuation of promised funding, regulatory barriers, and reactive policymaking contribute to the problem. Overall, the country's reliance on imports persists due to systemic issues hindering domestic API production (Mehmood, 2022).

Local production of Active Pharmaceutical Ingredients (APIs) in Pakistan offers substantial economic benefits. By manufacturing 70 percent of the required APIs domestically, the country could achieve import substitution worth approximately US$ 500 million annually. This shift would not only generate statistical gains but also drive industrialization, create employment opportunities, foster skill development, and bolster the economy. Additionally, a robust API manufacturing base would enhance self-reliance in the pharmaceutical and health sectors, leading to price stabilization and mitigating supply chain disruptions, such as those exacerbated by the COVID-19 pandemic and regional instabilities. To fully capitalize on the economic potential of local API manufacturing, Pakistan urgently needs a comprehensive API policy supported by the federal government. With the right policies and governmental backing, local API manufacturers could target a domestic market worth around Rs. 130 billion annually, initially focusing on import substitution and gradually expanding export potential. These measures are crucial for Pakistan to compete globally and fortify its pharmaceutical industry in the long run (Global Village Space, 2022).

1.2.5.1 Pakistan Export Strategy Pharmaceuticals 2023 -27

Box 4: Export strategy

"To increase the international market share by innovation and compliance with international quality standards."

THE STRATEGIC OBJECTIVES

The plan of action (PoA) will respond to this vision by addressing the sector's constraints and leveraging opportunities in a comprehensive manner. The PoA will be structured around the following strategic objectives, agreed with all sector stakeholders.

Strategic Objective 1: Improve the national framework for regulatory and institutional management, as well as the business environment governing the pharmaceutical sector	• 1.1. Revisions of laws and policies governing the sector • 1.2. Support a stable regulatory regime by redefining the roles of agencies in the sector • 1.3. Improve the overall business environment by encouraging policy coherence and facilitating investments in the sector
Strategic Objective 2: Strengthen the export competitiveness of Pakistani pharmaceutical companies	• 2.1. Facilitate access to and development of new products • 2.2. Define the positioning of pharmaceutical products in the target export markets • 2.3. Develop market intelligence and information services on target export markets • 2.4. Build company capacities to enter domestic and international market
Strategic Objective 3: Domestically support the development and upscaling of the Pakistani pharmaceutical sector to be more compliant	• 3.1. Compliance with international production standards • 3.2. Attract investment to foster innovation and technological upgrading to strengthen firm capacities • 3.3. Establish internationally accredited laboratories to maintain quality control • 3.4. Invest in scientific, technical and managerial training to strengthen skills and know-how and build linkages with universities

Source: GOP (2022b).

The strategic framework outlined by the Government of Pakistan for the pharmaceutical sector rightfully emphasizes the crucial role of enhancing quality and compliance standards to propel the growth of the pharmaceutical sector that includes and applies on API (Active Pharmaceutical Ingredient) industry. APIs serve as the foundation of pharmaceutical manufacturing, yet current quality constraints pose significant hurdles, particularly in meeting stringent export requirements and gaining local acceptance by multinational corporations (MNCs) and reputable firms. Aligning with strategic objectives to bolster regulatory frameworks and compliance is essential for Pakistan to position itself as a dependable supplier of high-quality APIs globally, driving export revenues and bolstering economic standing. Moreover, meeting these standards is pivotal for local industry growth, enabling collaboration with international partners and fostering innovation. To capitalize on API export potential, Pakistan must invest in technology and infrastructure upgrades while ensuring regulatory compliance through institutions like the Drug Regulatory Authority of Pakistan (DRAP). By achieving these objectives, Pakistan can attract investments, drive technological advancements, and establish a competitive foothold in the global pharmaceutical market, fostering overall economic advancement.

1.2.5.2 Promotion and Growth of API Industry in Pakistan Policy 2022

midst the dynamic landscape of Pakistan's pharmaceutical industry, the government has unveiled a transformative initiative, the API Promotion & Growth Policy, following extensive consultations with industry stakeholders. With the pharmaceutical sector boasting a formidable worth of PKR 828 billion and a commendable Compound Annual Growth Rate (CAGR) of 14%, supported by 639 active pharmaceutical companies meeting 70% of local demand, the industry exhibits promising export potential. However, the sector grapples with a stark reality: 90% dependency on imported Active Pharmaceutical Ingredients (APIs), posing significant risks of supply chain disruptions and affordability concerns. In response, the API Promotion & Growth Policy emerges as a strategic roadmap to mitigate dependency, bolster local API production, and catalyze its expansion into export markets. This policy aims not only to fortify Pakistan's pharmaceutical autonomy but also to address critical issues surrounding medicine accessibility and affordability, thereby charting a course towards sustainable growth and global competitiveness.

However, despite its potential to fortify Pakistan's pharmaceutical autonomy and stimulate economic growth, the policy's implementation status remains stagnant even after two years of its promulgation. Key initiatives outlined in the policy, such as reducing customs duty, combating dumping practices, establishment of facilitation center by Drug Regulatory Authority (DRAP), Establishment of API Mega Parks and facilitating financing facilities, have encountered significant hurdles, impeding progress. The lack of coordination among regulatory bodies, industry stakeholders, and government entities has contributed to the policy's underwhelming implementation, with less than 20% of its objectives achieved thus far. Consequently, the sector continues to grapple with high dependency on imported APIs, posing risks of supply chain disruptions and affordability concerns. Efforts towards addressing these challenges and unlocking the policy's full potential demand enhanced collaboration.

Box 5: API policy

Promotion and Growth APIs Policy Pakistan" February 15, 2022

Short Term

1. Reduction in custom duty: on those starting & intermediate materials chemicals, and machinery item by Terrif Policy Board for five years which are used in basic and semi basic manufacturing but not are locally manufactured.
2. Reduction in import prices (dumping prices): of the material manufactured in Pakistan, by the foreign supplier should immediate be supported through levy of Ant- Dumping Duty.
3. Financing facility: API manufacturers can avail the financing facility already available under Export Finance Scheme (EFS) provided by state bank of Pakistan
4. Retain Export Earning: Allowing API manufacturers to retain export earning to the tune of 15% of FOB value of their export proceeds.
5. Tariff structure of APIs will be reviewed by the Terrif Policy Board,
6. DRAP will establish a cell for guidance to applicants / investors, and to coordinate with relevant ministries on timely completion of the requisites for issuance of licenses and registration applied to it on fast-track basis.
7. Establish linkage between academia and basic and semi basic API manufacturers for funding of related research projects from higher education Commission, Pakistan Science Foundation / DRAP CRF/international donor agencies.

Long term

8. Establishment of API Mega Parks with all the required facilities including but not limited to common wastage and effluent treatment plant, power house, distillation plant and environmental control.
9. Ministry of Industries shall develop a policy to incentivize Naphtha Cracking Plant for promoting Basic chemical and pharmaceutical industries.

Source: GOP (2022a).

1.2.5.3 API Policy Implementation - Status Update

1. Reduction in Customs Duty: Customs duty reduction plan for essential starting materials, intermediates, and machinery remains pending despite API Manufacturers' efforts since 2023. Proposal awaits DRAP endorsement, NTC approval, and FBR implementation for timely execution.
2. Reduction in Import Prices (Dumping Prices): The policy proposes imposing Anti-Dumping Duty on imported materials already made in Pakistan to protect local manufacturers. Currently, no such duty has been enforced on Active Pharmaceutical Ingredients (APIs). To implement this, a thorough evaluation of API manufacturers is needed to identify products and companies warranting protection against dumping. This ensures fair trade and safeguards domestic producers.
3. Financing Facility: The policy aims to provide API manufacturers with financing through the Export Finance Scheme (EFS) by the State Bank of Pakistan. However, there has been no progress in implementing this policy. Action is needed to collaborate with the Drug Regulatory Authority of Pakistan (DRAP) and other relevant departments to move forward.
4. Retention of Export Earnings: The policy proposes allowing API manufacturers to retain 15% of FOB export earnings to stimulate API exports, but it hasn't been implemented due to no exports. DRAP and API Manufacturers need to work together to strategize on boosting exports by addressing barriers, improving competitiveness, and simplifying regulations.

5. Tariff Structure of APIs: The government revises tariffs for certain Active Pharmaceutical Ingredients (APIs) through the Tariff Policy Board, with about 15 APIs currently receiving support. Recently, tariffs on two new APIs, Sitagliptin and Moxifloxacin, were set at 20% in the 2023 budget. While progress has been made, there's a need for faster and transparent procedures to ensure adequate tariff support for new APIs, facilitating local manufacturing.
6. Facilitation Cell by DRAP: The policy proposes establishing a facilitation cell within DRAP to assist applicants and investors, ensuring timely completion of licensing and registration requirements. However, this cell has not been set up yet, hindering progress. Its establishment is vital for enhancing pharmaceutical investment and innovation in Pakistan. Prompt implementation is essential for improving regulatory efficiency and creating a favorable investment climate.
7. Linkage Between Academia and Industry: The policy suggests connecting academia with basic and semi-basic Active Pharmaceutical Ingredient (API) manufacturers to fund research. Funding sources include the Higher Education Commission, Pakistan Science Foundation, DRAP CRF, and international donors. However, there's been no real progress in implementing this. To make it work, academia, API makers, regulatory bodies like DRAP, and funding agencies need to collaborate. This collaboration can help fund research projects and tackle industry challenges.
8. API Mega Parks: The API Mega Parks policy suggests creating large parks with all necessary facilities for API manufacturers, like common wastage and effluent treatment plants, powerhouses, distillation plants, and environmental controls. These parks would help these manufacturers grow and innovate by sharing resources. But, there hasn't been any progress on this policy yet. To make it happen, everyone involved needs to take action. This means the government, regulators, investors, and industry need to work together. This would make the pharmaceutical sector more competitive and sustainable.
9. Naphtha Cracking Plant: The policy directive requires the Ministry of Industries to formulate a policy aimed at incentivizing Naphtha Cracking Plants to promote basic chemical and pharmaceutical industries. So far, there hasn't been much progress on this. We need action from everyone involved. The Ministry of Industries, along with regulatory bodies, industry groups, and private investors, should work together to make a clear plan.

Table 9: API policy implementation status: Pakistan

Promotion and Growth Policy of API industry in Pakistan February 15, 2022			
Policy Implementation Status - April 2024			
S,No	**Policy**	**Implementation Status**	**Suggestions**
Short Term			
1	**Reduction in custom duty** on those starting & intermediate materials chemicals, and machinery item by Terrif Policy Board for five years which are used in basic and semi basic manufacturing but not are locally manufactured.	**No implemented** No reduction in Custom's Duty on raw material and machinery announced	Detailed proposal of API Manufacturers for 2023 needs implementation in 2024 budget based on DRAP recommendation and approval by NTC and implementation by FBR.
2	**Reduction in import prices (dumping prices)** of the material manufactured in Pakistan, by the foreign supplier should immediate be supported through levy of Ant- Dumping Duty.	**No Implemented** No anti dumping duty imposed on any API to-date	API Manufacturers to assess on product wise basis.
3	**Financing facility** API manufacturers can avail the financing facility already available under Export Finance Scheme (EFS) provided by state bank of Pakistan Financing facility	**No-Implemented** No facility made available	API producers and DRAP need to assess way forward and liaise with relevant departments.
4	**Retain Export Earning** Allowing API manufacturers to retain export earning to the tune of 15% of FOB value of their export proceeds. Export Earning Retention Retention of export earning up to 15 of FOB	**No export of API done**	DRAP and API Manufacturers to devise a joint strategy to promote API exports.
5	**Tariff Structure** of APIs will be reviewed by the Terrif Policy Board Review of tariff structure	**Implemented** Around 15 APIs enjoying tariff support . Tariff structure on 2 new APIs reviewed and implemented in 2023 budget with CD revised to 20% on Sitagliptin and Moxifloxacin	Fast track and transparent SOPs need to be implemented to ensure new APIs get adequate tariff support to encourage their local manufacture.
6	**DRAP will establish a cell** for guidance to applicants / investors, and to coordinate with relevant ministries on timely completion of the requisites for issuance of licenses and registration applied to it on fast-track basis.	**No Implemented** No Facilitation Cell set up	Needs to be done by DRAP soonest.
7	**Academia - API manufacturing companies:** Establish linkage between academia and basic and semi basic API manufacturers for funding of related research projects from higher education Commission, Pakistan Science Foundation / DRAP CRF/international donor agencies.	**No Implemented** No meaningful linkages established to-date	Way forward needs to be discussed and implemented between all stakeholders.
Long Term			
8	**Establishment of API Mega Parks** with all the required facilities including but not limited to common wastage and effluent treatment plant, power house, distillation plant and environmental control.	**No Implemented** No API Parks initiated	Needs action by all relevant stakeholders.
9	**Naphtha Cracking Plant:** Ministry of Industries shall develop a policy to incentivize Naphtha Cracking Plant for promoting Basic chemical and pharmaceutical industries.	No-Implementation - No meaningful policy ptomulgated to-date	Needs action by all relevant stakeholders.
Author illustration based on stakeholder's feedback			

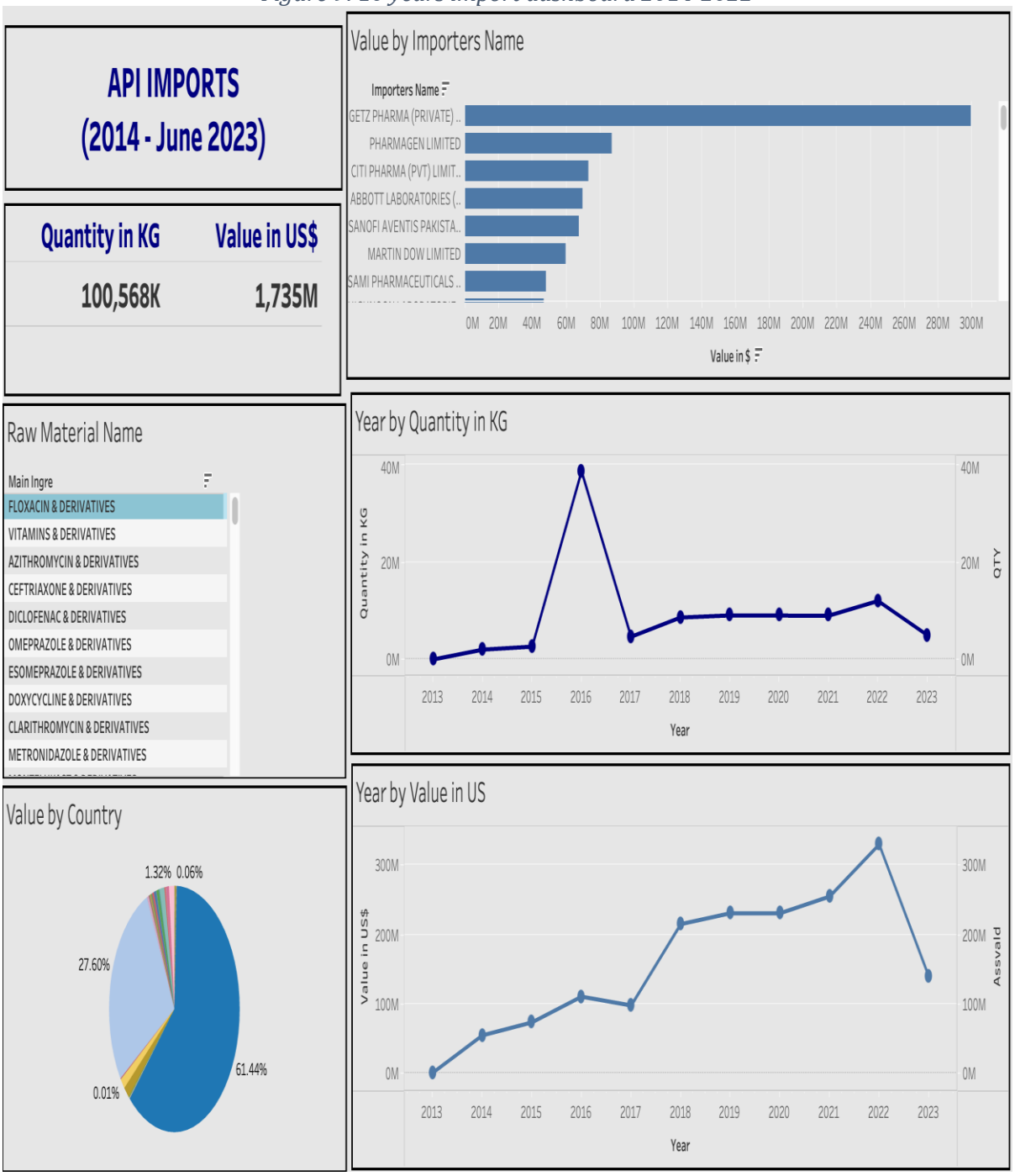
Source: GOP 2022a.

API IMPORTS

2.1 API Imports Dashboard 2014-22

The API Imports Dashboard offers a comprehensive analysis of Active Pharmaceutical Ingredient (API) import in Pakistan from 2014 to 2022, aimed at informing strategic decisions regarding import substitution and local manufacturing. Utilizing AI-based techniques in Python and visualization tools like Tableau, the dashboard presents interactive visualizations highlighting import trends, top importers, supplier dynamics, and key metrics. Insights derived from the analysis provide stakeholders, including policymakers, investors, and pharmaceutical companies, with actionable information to enhance understanding and facilitate decision-making. Notable trends such as the increase in API imports, changing dynamics among top importers and supplier nations, and the diversified portfolio of pharmaceutical products are illuminated, underlining the industry's resilience and adaptability.

Figure 9: 10 years import dashboard 2014-2022

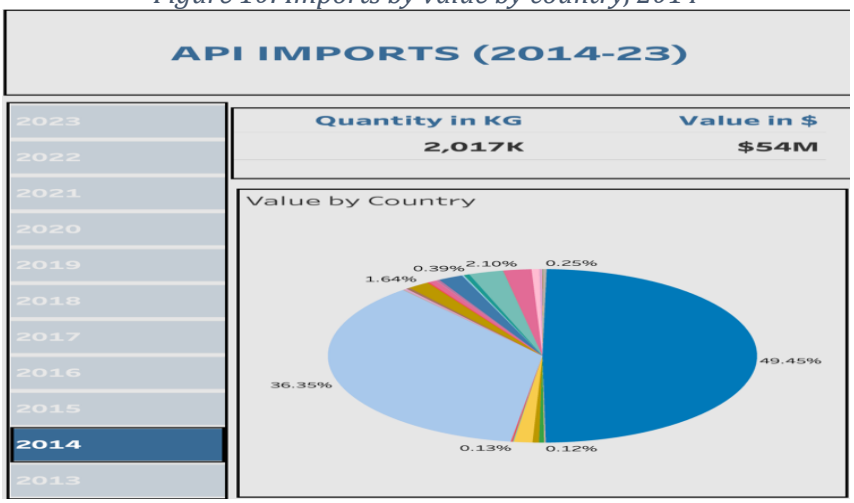


Source: GOP 2023.

2.2 Total API Imports by Value by Country (2014 vs 2022)

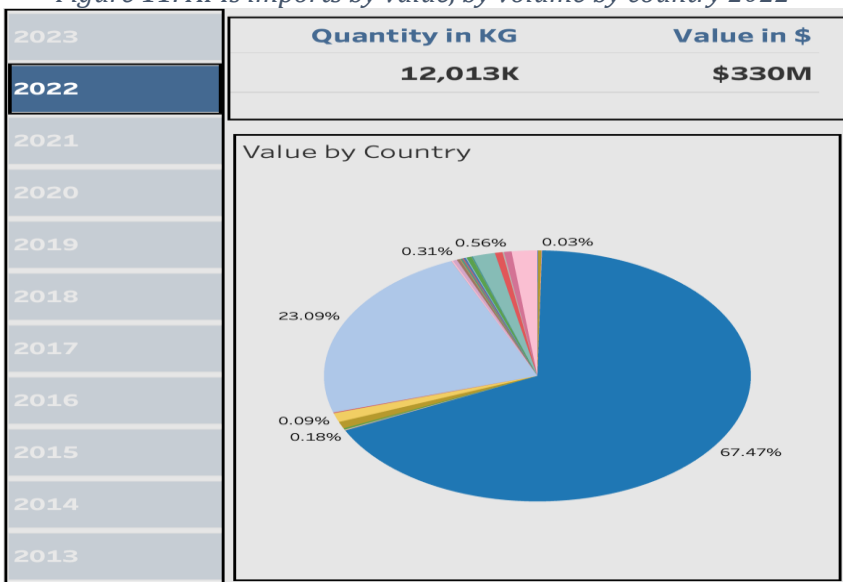
Commencing at a modest USD 54 million in 2014, the API imports in Pakistan have witnessed an extraordinary escalation, soaring to an impressive USD 330 million in 2022. This exceptional growth underscores the robust demand for pharmaceutical active raw materials within the country, indicating a thriving and expanding pharmaceutical sector.

Figure 10: Imports by value by country, 2014



Source: GOP 2023.

Figure 11: APIs imports by value, by volume by country 2022



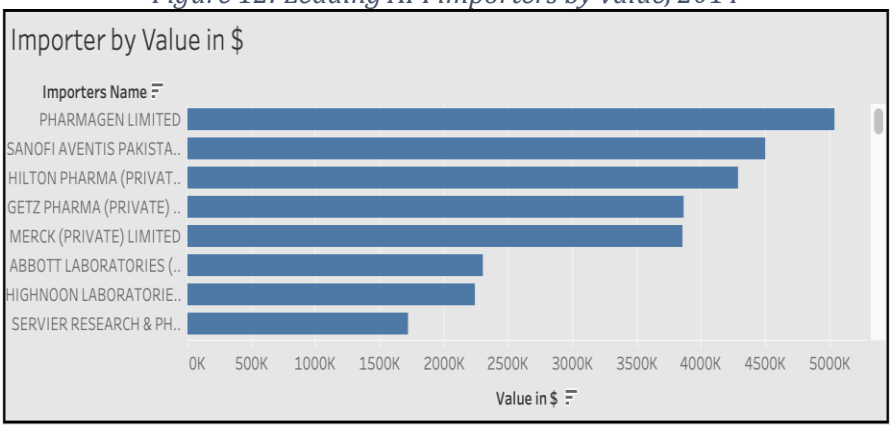
Source: GOP 2023.

The above chart depicts, in 2014, China held a dominant position as the top API supplier to Pakistan, contributing 49% of the total imports followed by India 36%. In 2022, there has been a notable shift, with China continue commanding the top position, contributing 67.47% of the total imports, followed by India, Taiwan, and the European Union at 23.09%, 0.56%, and 0.09%, respectively. This dynamic supplier landscape underscores strategic partnerships between Pakistan and key global players in the pharmaceutical supply chain.

2.3 Top API Importers by Value (2014 -2022)

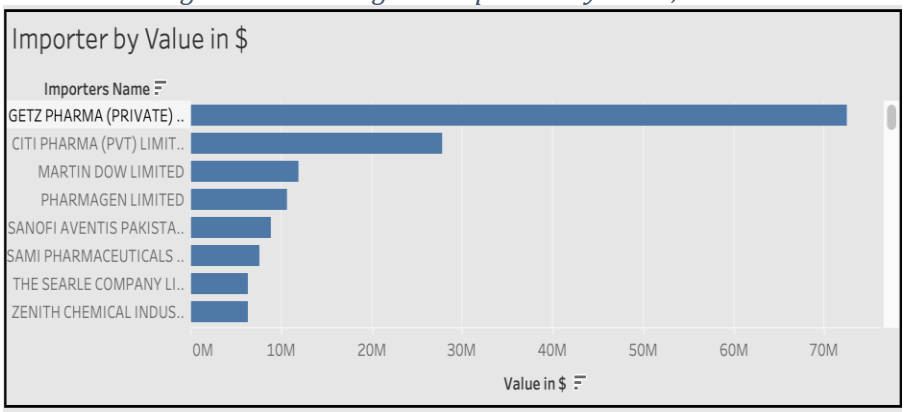
In 2014, industry giants such as Pharmagen, dominated the API import landscape. Fast forward to 2022, a notable shift in leadership is evident, with Getz Pharma, CITI Pharma, Martin DOW, Pharmagin, and Sanofi Aventis emerging as the new frontrunners. This evolving scenario highlights the industry's dynamism and the emergence of key players over the years, showcasing adaptability and resilience.

Figure 12: Leading API importers by value, 2014



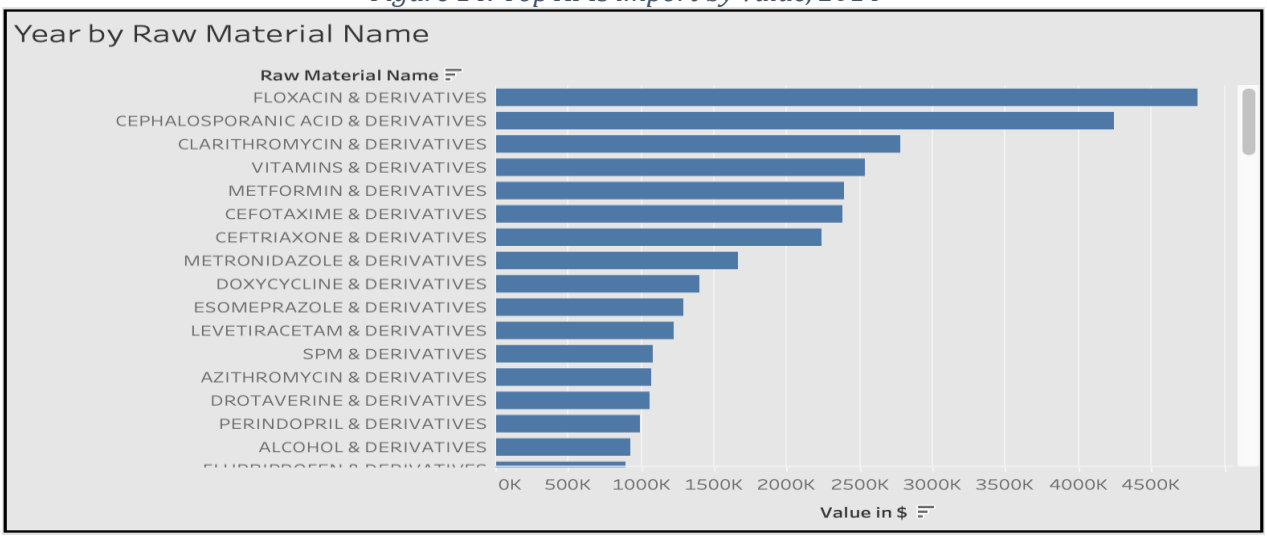
Source: GOP 2023.

Figure 13: Leading API importers by value, 2022



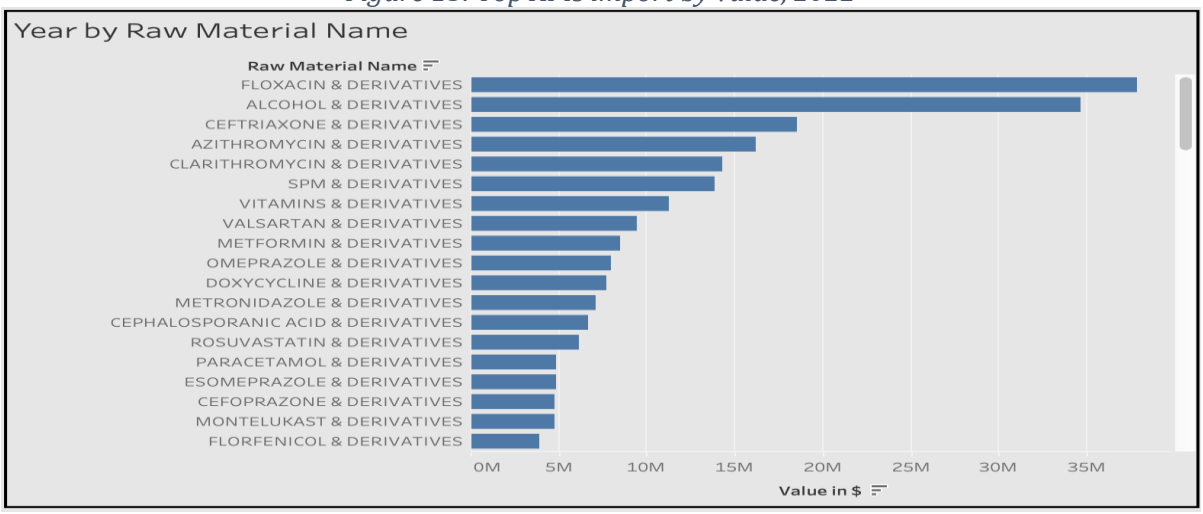
Source: GOP 2023.

Figure 14: Top APIs import by value, 2014



Source: GOP 2023.

Figure 15: Top APIs import by value, 2022



Source: GOP 2023.

2.4 Imports Dashboard- Key Reflections

2.4.1 Finding 1 (F1): API Imports Analysis and Import Substitution Potential

Pakistan should capitalize on its capability to produce certain APIs domestically, which already accounts for USD 124 million of its USD 330 million API import bill in 2022. By incentivizing pharmaceutical companies to source these APIs locally, Pakistan can reduce import expenditures significantly. Emulating Bangladesh's successful reduction in API imports, Pakistan should consider imposing targeted restrictions on the importation of APIs that can feasibly be manufactured within the country. However, ensuring stringent adherence to quality, compliance, and cost-efficiency standards in local production is essential before implementing any restrictions.

2.4.2 Finding 2 (F2): Dominance of Chinese and Indian API Imports

In 2022, 68% of API imports were from China, and 23% from India. Overreliance on cheaper Chinese APIs poses quality risks. Diversifying sources could mitigate these risks.

2.4.3 Finding 3 (F3): Significance of Six Key Pharmaceutical Companies

Six companies accounted for 40% of total API imports in 2022. Encouraging import substitution efforts with these companies could significantly reduce the import bill and boost the local economy.

This analysis outlines a roadmap for the pharmaceutical sector in Pakistan, stressing the need for import substitution, quality assurance, and collaboration with key industry players. Implementing these recommendations can enhance the sector's resilience and contribute to economic growth.

2.5 Substitution of Imported APIs with Locally Produced APIs

Despite possessing the capacity to produce numerous Active Pharmaceutical Ingredients (APIs), Pakistan continues to rely heavily on imports, particularly from China and India. This reliance has resulted in a substantial import bill, amounting to USD 330 million in 2022. This document presents a compelling case for the government to monitor and regulate the import of APIs that are locally produced, thereby unlocking the untapped potential of Pakistan's API industry. Pakistan boasts the capability to manufacture approximately 26 different molecules locally. Despite this, the country's import expenditure on pharmaceutical raw materials remains alarmingly high. Specific molecules such as Floxacin & Derivatives, Cefadroxil, Azithromycin, and their derivatives constitute a significant portion of this import bill.

Table 10: APIs manufactured in Pakistan

APIs MANUFACTURED - PAKISTAN		
	API NAME	COMPANY NAME
1	Iron(III) Hydroxide Polymaltose Complex	Chemanol
2	Iron Sucrose Complex	
3	Iron Polysaccharide	
4	Azithromycin Dihydrate USP	Citi Pharma
5	Cefixime Trihydrate (Compacted) BP/USP	
6	Cefixime Trihydrate (Micronized) USP/BP	
7	Aminophylline	
8	Ranitidine as Hcl	
9	Montelukast Sodium	
10	Ciprofloxacin HCl USP	
11	Cefixime Trihydrate (Micronized) USP/BP	Pharmagen
12	Cefixime Trihydrate (Compacted) BP/USP	
13	Moxifloxacin HCl BP	
14	Azithromycin Dihydrate USP	
15	Sitagliptin Phosphate Monohydrate	
16	Amoxicillin	
17	Ampicillin	
18	Cefadroxil	
19	Ceftriaxone	
20	Cephalin	
21	Cephalin Sterile	
22	Cephalexin	
23	Cloxacillin	
24	Empagliflozin	
25	Ibuprofen	
26	Montelukast Sodium	
27	Paracetamol	
28	Cefixime Trihydrate (Micronized) USP/BP	Saakh Pharma
29	Cefixime Trihydrate (Compacted) BP/USP	
30	Ciprofloxacin HCl USP	
31	Sitagliptin Phosphate Monohydrate	
32	Azithromycin 22.2% (W/w) Granules	
33	Esomeprazole EC Pellets 22.5%	Surge Laboratories
34	DE lansoprazole DDR Pellets 22.5%	
35	Orlistat Pellets	
36	DE lansoprazole DDR Pellets 22.5%	Vision Pharmaceuticals
37	Esomeprazole EC Pellets 22.5%	
38	Orlistat Pellets	
39	Ciprofloxacin HCl USP	Zenith Chemical Industries
40	Moxifloxacin HCl BP	
41	Sitagliptin Phosphate Monohydrate	
42	Paracetamol	
43	Ibuprofen	
44	Alprazolam	
45	Diazepam	
46	Ketamine	

Source: Author's illustration based on interviews.

Imposing restrictions on the import of locally produced molecules presents a significant opportunity for cost savings. The analysis indicates that such measures could potentially reduce the import bill by a substantial 38%, equivalent to USD 125 million in 2022 alone. These savings would not only alleviate the financial burden on the economy but also stimulate the growth of the local API industry.

Table 11: Import of locally manufactured APIs

APIS MANUFACTURED IN PAKISTAN		
S.NO	**API Manufcaturing - Pakistan**	**Import 2022- USD million**
1	Amoxicillin	0.31
2	Azithromycin 22.2% (W/w) Granules	16.16
3	Cefadroxil	18.56
4	Cefixime Trihydrate (Compacted)/Micronised BP/USP	6.64
5	Ceftriaxone	18.6
6	Cephradine	6.43
7	Esomeprazole EC Pellets 22.5%	4.81
8	Ibuprofen	3.85
9	Montelukast Sodium/Aminophylline	4.73
10	Moxifloxacin HCl BP	37.86
11	Paracetamol	4.86
12	Dexlansoprazole DDR Pellets 22.5%(pentoprazole)	2.21
Total Value		125.02
Total APIs import 2022		330
Locally produced APIs Imports		38%

Source: GOP 2023.

2.6 Challenges and Issues

It is crucial to investigate the following key challenges and issues contribute to this reliance:

Cost Viability: It is crucial to investigate whether local API production is cost-effective compared to imports. Factors such as economies of scale, production efficiency, and infrastructure costs play a role.

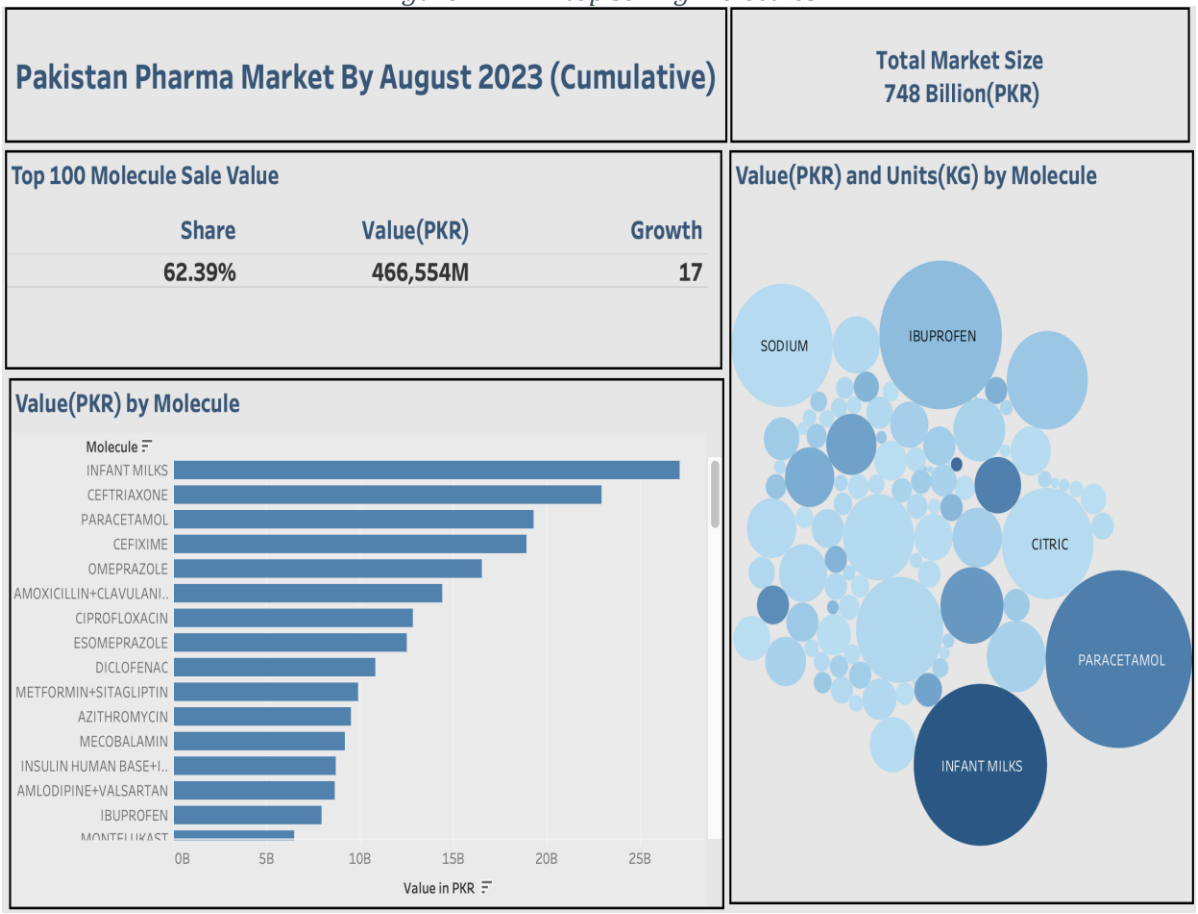
Quality Concerns: The perceived quality of locally manufactured APIs may be a barrier. Ensuring that local products meet international quality standards is imperative for gaining the trust of pharmaceutical companies.

Capacity Limitations: Assessing the existing capacity and identifying areas for improvement can address concerns related to production scalability.

TOP SELLING APIS IN PAKISTAN

August 2023 Pakistan Pharmaceutical Market Dashboard, showcasing a growth of 14.2% with a total market value reaching PKR 748.26 billion. This comprehensive overview provides a detailed breakdown of the top 100 selling molecules that capture 62% of the total market with 467 billion sales and average growth rate of 17%.

Figure 16: 100 top selling molecules



Source: IQVIA (2023).

A closer examination of the top 25 selling molecules that contribute 36% of the total pharmaceutical market share reveals a dynamic landscape, with individual molecules demonstrating substantial growth rates. However, a notable challenge lies in the fact that 95% of the Active Pharmaceutical Ingredients (APIs) for these molecules are imported, that include high value 9 molecules already manufactured in Pakistan leading to concerns such as an increase in the import bill, disruptions in the supply chain, and challenges in ensuring medicine affordability.

Table 12: 25 top selling molecules (APIs) in Pakistan

25 Top Selling Molecules - Pakistan		
Pharma Market - 748 billion Growth 14.23		
Molecule	**Value**	**Growth**
INFANT MILKS	27,096,134,228	-2.39
CEFTRIAXONE	22,923,015,012	19.36
PARACETAMOL	19,296,583,786	25.68
CEFIXIME	18,916,836,332	18.46
OMEPRAZOLE	16,528,663,763	11.93
AMOXICILLIN+CLAVULANIC ACID	14,395,775,605	18.13
CIPROFLOXACIN	12,822,600,210	21.08
ESOMEPRAZOLE	12,462,646,235	15.21
DICLOFENAC	10,810,480,682	13.67
METFORMIN+SITAGLIPTIN	9,858,033,577	10.17
AZITHROMYCIN	9,493,018,027	15.56
MECOBALAMIN	9,176,550,223	22.52
INSULIN HUMAN BASE+INSULIN HUMAN ISOPHANE	8,698,974,907	13.45
AMLODIPINE+VALSARTAN	8,650,946,566	25.83
IBUPROFEN	7,925,322,995	28.33
MONTELUKAST	6,465,902,925	13.99
COLECALCIFEROL	6,371,262,280	15.73
ROSUVASTATIN	6,043,600,772	18.04
METRONIDAZOLE	5,894,475,525	20.80
IRON FERRIC	5,550,438,179	23.40
MEROPENEM	5,466,028,446	0.59
CLARITHROMYCIN	5,450,971,181	10.84
LEVOFLOXACIN	5,321,361,619	14.92
ORPHENADRINE+PARACETAMOL	5,306,962,866	57.83
PREGABALIN	5,243,370,869	35.40
Sub Total	266,169,956,810	18.74 avg

Source: IQVIA (2023).

The fast growth of the Pakistani pharmaceutical market, particularly in the top 25 selling molecules, presents a compelling case for local API production. The challenges posed by the current import-dependent model can be effectively addressed by promoting domestic manufacturing of APIs by putting ban on the APIs already manufactured in Pakistan worth USD 125 million (2022 import) besides setting up new plants. This strategic shift not only mitigates economic challenges and ensures supply chain resilience but also contributes to the overall well-being and accessibility of healthcare for the people of Pakistan. The growth trajectory of the market demands a proactive approach, and local API production emerges as a key driver for sustainable and robust pharmaceutical development in the country.

API MANUFACTURING IN PAKISTAN

4.1 Background

Since the 1960s, Pakistan's API manufacturing industry has struggled to develop, despite sporadic government recognition of its importance. Despite the formulation of a comprehensive policy in February 2022 aimed at promoting API growth, implementation has been largely ineffective, with only minimal progress observed, such as duty exemptions on select APIs. The failure to implement key policy measures has been attributed to coordination issues among government departments and a lack of interest. Despite the urgency, the delay in policy implementation would have adverse economic consequences, particularly in a fast-paced global environment where new markets emerge rapidly (Global Village Space, 2022).

Out of 23 licenses for API manufacturing in Pakistan, only 7 companies are operational, according to the Drug Regulatory Authority of Pakistan (DRAP). This operational shortfall means just 15% of local API demand is met domestically, leaving the pharmaceutical sector heavily reliant on imports. This dependence not only impacts the economy but also has wider implications including geopolitical dynamics, trade imbalances, and strain on foreign exchange reserves, particularly amid a current account deficit.

4.2 API Manufacturing Companies in Pakistan

Table 13: API manufacturing companies in Pakistan

API MANUFACTURING COMPANIES - PAKISTAN			
	NAME	STATUS	LOCATION
1	Saakh Pharma	operational	Karachi
2	CITI Pharma	operational	Kasur
3	Pharmagen	operational	Lahore
4	Unichem Pharmaceuticals Pakistan	operational	Islamabad
5	Zenith Chemical Industries (Pvt) Ltd.	operational	Lahore
6	Zafa Chemie	operational	Lahore
7	Vision pharma	operational	Islamabad
8	carryfor Pharmaceuticals	operational	Karachi
8	Health Capsule Pakistan	online available	Faisalabad
9	M/s Himont Pharmaceuticals (Pvt) Ltd.	online available	Lahore
10	Alpha Chemicals (Pvt) Ltd.	online available	Lahore
11	Chemiworld (Pvt) Ltd	online available	Peshawar
12	Surge Laboratories (Pvt) Ltd.	online available	Faisalabad
13	National Institute of Health	online available	Islamabad
14	M/s Pharma Zone Chemicals (Pvt) Ltd.	online available	Lahore
15	Neutro Pharma (Pvt) Ltd.	online available	Lahore
16	Sami Pharmaceuticals (Pvt) Ltd	online available	Karachi
17	Anthro API-Gen (Pvt) Ltd.	online available	Rawat
18	Herbion Pakistan (Pvt) Ltd.	Not confirmed	Islamabad
19	M/s Pakcure Pharma	Not confirmed	Rawat
20	Werrick Pharmaceuticals	Not confirmed	Islamabad
22	Multi Caps	Not confirmed	Karachi
23	Zafa Pharmaceutical Lab (Pvt) Ltd.	Not confirmed	Karachi
21	DRUG PHARMA	closed	Karachi

Source: Author's illustration.

4.3 API Manufacturing Challenges

The API manufacturing industry in Pakistan faces a multitude of challenges that hinder its growth and development. These challenges span various aspects mentioned below.

1. Regulatory Hurdles: Regulatory hurdles pose significant obstacles to API manufacturing. The tightly regulated policy environment creates uncertainty and negatively impacts the economy. Despite government extraction of funds from the pharmaceutical industry for infrastructure development, such as drug testing laboratories, the absence of facilities meeting FDA-level criteria persists, reflecting a failure to utilize allocated resources effectively (Mehmood, 2022).

2. Heavy Reliance on India and China: The heavy reliance on imports from countries like India and China has led to a neglect of R&D infrastructure for API manufacturing within Pakistan. Despite approval for API manufacturing licenses, essential research infrastructure comprising high-quality, internationally accredited laboratories remain lacking, resulting in abandoned projects and regulatory barriers (Mehmood, 2022).

3. Shortage of Bioequivalence Labs: The shortage of bioequivalence labs further exacerbates the challenges faced by the pharmaceutical industry. Bioequivalence labs play a crucial role in ensuring the quality of pharmaceutical products, and their scarcity impedes growth and improvement within the sector, contrasting with the thriving pharmaceutical industries of India and China (Mehmood, 2022).

4. DRAP Capacity: Additionally, the regulatory capacity of the Drug Regulatory Authority of Pakistan (DRAP) requires enhancement to address the shortcomings in drug registration and manufacturing site oversight. Despite reforms aimed at delivering safe medicines and achieving WHO membership, Pakistan continues to experience drug shortages, especially for critical/life-saving drugs, highlighting the inefficiencies and adverse effects of regulations on industry performance (Rasheed et al., 2019).

5. Delayed Approvals: Delays in approval processes exacerbate the challenges faced by pharmaceutical companies, slowing down production and hindering business growth.

6. Antagonistic Regulatory Environment: The regulatory environment, represented by the Drug Regulatory Authority of Pakistan (DRAP), poses a significant challenge to the development of the API industry. DRAP, instead of appreciating endeavors and initiatives for the growth of the API industry, continues their regulatory approach that discourages investors and further complicates efforts for local API production by pharmaceutical companies, rather than supporting them.

7. National Policy on API: It has been proposed that mere Statutory Regulatory Orders (SROs) are insufficient, necessitating the formulation of a robust API policy (Mehmood, 2022).

8. Operational Discrepancies: A significant gap exists between the number of licenses issued for API manufacturing and the operational facilities, indicating inefficiencies in translating licenses into viable production units.

9. Tax Regime Disparity: The private sector's reluctance to invest in API manufacturing is partly due to a tax regime that favors importing finished APIs over locally produced ones.

10. Cumbersome Licensing Process: The licensing process for API manufacturing is burdensome and time-consuming, discouraging potential investors from entering the market.

11. Global Competition: Countries like India and Bangladesh, with similar demographics and tropical conditions, have emerged as major suppliers of APIs, intensified global competition and underscored the need for Pakistan to assert itself as a competitive player.

4.4 Recommendations

1. National Policy on APIs: The absence of a comprehensive policy framework undermines confidence and hampers strategic planning, leading to a persistent import-centric approach. It has been proposed that mere Statutory Regulatory Orders (SROs) are insufficient, necessitating the formulation of a robust API policy (Mehmood, 2022).

2. Policy Implementation: To address these challenges, the government must adopt the new API policy promptly and ensure its effective implementation through DRAP. Moreover, constructive negotiations with external stakeholders, particularly China, are crucial to fostering a mutually beneficial environment (Global Village Space, 2022). The delay in policy implementation not only threatens economic benefits but also undermines Pakistan's competitiveness in a fast-paced global market (Global Village Space, 2022).

3. Reform Committee: Efforts to expedite policy implementation include the formation of a committee tasked with monitoring comparative incentives with those of China and India, as well as global markets and opportunities (Kaleem, 2022).

4. Regulatory Framework: Collaboration with international agencies such as WHO can provide valuable insights and best practices for improving regulatory frameworks and ensuring the quality and safety of pharmaceutical products (Mehmood, 2022; Rasheed et al., 2019).

5. DRAP Capacity Building: Regulatory capacity building within DRAP is essential to streamline drug registration processes and enhance oversight of manufacturing sites.

6. Quality Infrastructure: There is a critical need to invest in quality infrastructure, including drug testing laboratories meeting international standards.

7. R&D Infrastructure: Efforts should focus on developing R&D infrastructure to support local API manufacturing, reducing reliance on imports.

8. Skill Development: Invest in training programs and skill development initiatives to enhance the technical expertise of the workforce in the local API industry.

9. Public-Private Partnership: Foster collaborations between the government and pharmaceutical industry stakeholders to jointly address challenges and create a conducive environment for local API production.

4.5 A Thematic Analysis of Stakeholder Interviews: Challenges & Opportunities in API Manufacturing in Pakistan:

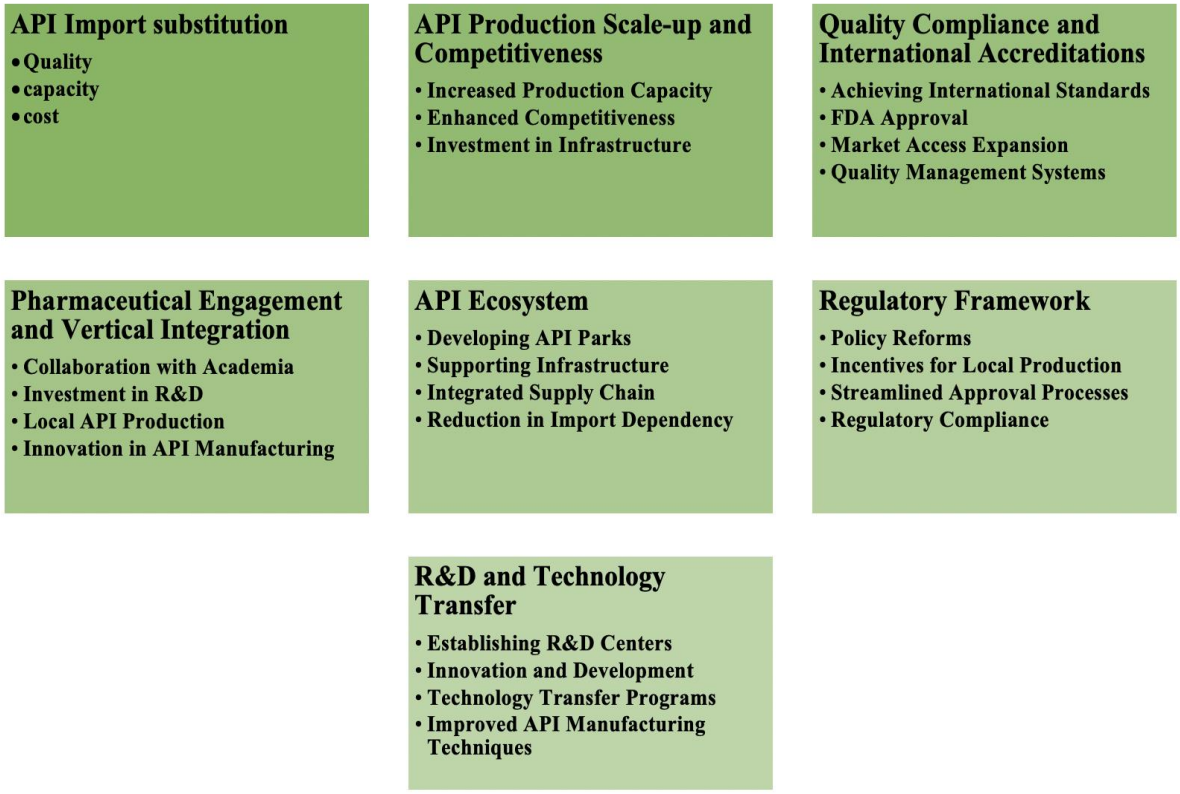
The in-depth interviews with 20 stakeholders from various sectors, including pharmaceutical companies, API manufacturers, government regulatory authorities, and research and development institutions, the study identifies following critical themes and offers actionable insights. The findings suggest a multifaceted approach to overcoming the challenges in API manufacturing in Pakistan. Recommendations include strengthening collaboration between academia and industry, enhancing regulatory support, investing in infrastructure, research and technology, and adopting international best practices for quality and compliance. These measures aim to build a sustainable and competitive API manufacturing sector, contributing to the overall growth of the pharmaceutical industry in Pakistan.

4.5.1 Thematic Analysis: Themes and Sub-themes

The recent trends evolving through the interviews conducted with all the stakeholders in the API manufacturing industry in Pakistan represent a clear picture of the industry’s current condition and

where it is heading. A blend of market dynamics, regulatory frameworks, industry practices, and technology factors largely determines these trends.

Figure 17: Themes & sub themes derived from stakeholder interviews



4.5.2 Interviewee Profile

Table 14: Interviewee profile

Interviewee Profile

Interviewee	Affiliation	Sector	Interview No
Mr. Anwar Jamal	GM, Quality Operation, Searle Pharma	Pharma	Interview 1
Mr. Aslam Shiekh	CEO, Lundbeck Pharma	Pharma	Interview 2
Dr. Obaidullah	Director of Pharmaceutical Services, DRAP	Govt. Regulatory	Interview 3
Mr. Farooq Bukhari/ Mr. Tauqeer	PPMA	Govt. Regulatory	Interview 4
Mr. Ishaq Maseer	Head of SCM, PharmEvo	Pharma	Interview 5
Mr. Ahmed Jamal Qudsi	Head of Supply and Logistics, Bayer Pharma	Pharma	Interview 6
Mr. Muhammad Sajid	International Business Development and R&D, Searle Pharma	Pharma	Interview 7
Dr Syed Hussain Abidi/ Dr Mehtab Aman	DG accompanied by marketing officer, PCSIR	Govt. Regulatory	Interview 8
Mr. Syed Kazmi	CEO, Saakh pharmaceutical	API	Interview 10
Mr. Shayan Khan	Martin Dow Pharma	Pharma	Interview 11
Mr. Yasir Hashmi	Head of Regulatory Medicine, PhsrmEvo	Pharma	Interview 12
Dr. Sarah	Head of Regulatory Medicine, Searle Pharma	Pharma	Interview 14
Dr. Mehwish Khan	Ophth Pharma/ co-chairperson PPMA	Pharma/Govt. Regulatory	Interview 15
Mr. Pervaiz Hussain Sufi	CEO, PharmaGen	API	Interview 16
Dr. Shakil Ahmed	Director, HEJ, UoK	Research & Academia	Interview 17
Mr Jalal ud Din Zafar	CEO, Nabiqasim & Surge pharmaceuticalGroup	API	Interview 18
Mr. Shariq Mehmood	Scilife Pharma	Pharma	Interview 19
Mr. Rizwan Sheikh	CEO, Citi Pharma	API	Interview 20

OFF PATENT APIS

5.1 Opportunity

The global pharmaceutical landscape is undergoing transformative shifts, presenting Pakistan with a strategic window to enter the lucrative off-patent drugs market. Projections indicate that by 2025, the market for branded generics will soar to USD 700 billion, while generics going off patent is worth USD 381 billion. A comprehensive study focusing on off-patent molecules expiring by 2025 unveils a substantial opportunity for Pakistan's pharmaceutical sector. Through meticulous research, vital information has been compiled to assist investors and stakeholders in making well-informed decisions.

Box 6: Window of opportunities

API INDUSTRY DEVELOPMENT - WINDOW OF OPPORTUNITES FOR PAKISTAN

- As of 2022, the global pharmaceutical market was valued at USD 1.48 trillion, projected to reach USD 1.57 trillion by the end of 2023, and anticipated to surpass USD 1.7 trillion by 2025.
- The Active pharmaceutical ingredients (API) market is anticipated to witness a significant rise, climbing from USD 193.15 billion in 2023 to approximately USD 285.29 billion by 2028.
- Asia Far East accounts for 60.5% of global API production, India accounts for 20% of the global production by volume and 7% for value.
- Notably, 57% of APIs listed by the World Health Organization originate from India
- Bangladesh aims to significantly ramp up the production of locally manufactured API molecules and reagents, from 41 in 2017 to 370 by 2032, positioning the industry for sustained growth and global competitiveness in the pharmaceutical arena
- STPF) has identified pharmaceuticals as a priority sector for growth and development, aiming to leverage its $3.29 billion industry with double-digit growth over the last five years.
- The Strategic Trade Policy Framework (By manufacturing 70 percent of the required APIs domestically, the country could achieve import substitution worth approximately US$ 500 million annually.
- With the right policies and governmental backing, local API manufacturers could target a domestic market worth around Rs. 130 billion annually, initially focusing on import substitution and gradually expanding export potential.
- Currently, there are 639 pharmaceutical manufacturing units in Pakistan, employing around 240,000 people and exporting products worth over $200 million to more than 60 countries. Pakistan pharm sector has minimum export potential of 1 billion in 2-3 years.
- Strategic opportunity to enter the lucrative off-patent drugs market, which is projected to reach USD 700 billion in branded generics and USD 381 billion will become off patent by 2025
- China and India shifting focus on high value molecules that pose opportunity for new players in API industry.
- Invested in the development of large-scale manufacturing facilities for API production, bolstering its capacity to meet domestic and international demand

Source: Author's illustration.

5.2 Off Patent APIs List

This information is invaluable for stakeholders as it provides insights into emerging market trends, potential investment opportunities, and strategic partnerships. By understanding which APIs are going off patent and their technical specifications, stakeholders can identify areas for development, assess market demand, and tailor their strategies accordingly. Additionally, knowledge of the competitive landscape allows stakeholders to position themselves advantageously in the market, fostering growth and innovation within the pharmaceutical sector. List of Off-Patent APIs going off patent by 2025 with technical details including company name, brand name, generic name and available formulation is given hereunder.

Table 15: List of APIs going off patent by 2025, brand name, generic name and formulation

"OFF PATENT APIS - 2025" BRAND NAME & FORMULATION			
COMPANY NAME	BRAND NAME	GENERIC NAME	FORMULATION
ABBVIE	Tilapia	FENOFIBRATE	200 MG CAPSULES
AKARX, INC	Notelet	AVATROMBOPAG	20 mg Tablets
ALLERGAN	Viberzi	ELUXADOLINE	75 mg and 100 mg tablets
ALMIRALL, S.A	Duaklir	ACLIDINIUM	Tablets and 6 mcg nasal inhalors
ALNYLAM PHARMACEUTICALS	Onpattro	PATISIRAN	homogeneous solution
AMGEN INC.	Kyprolis	CARFILZOMIB	Injection 60mg/vial
AMRING PHARMACEUTICALS INC	Lysteda	TRANEXAMIC ACID	500mg tablets/capsules/Inj
ASTELLAS PHARMA US INC	Cresemba	ISAVUCONAZONIUM SULFATE	Each vial contains 372.6 mg
BAUSCH & LOMB	Vyzulta	LATANOPROSTENE BUNOD	Opthalmic Solution
BAUSCH AND LOMB INC	Bepreve	BEPOTASTINE BESILATE	10 mg tablets & 1.5% oph. solution
BOEHRINGER INGELHEIM	Jentadueto	LINAGLIPTIN/METFORMIN	2.5 & 5mg Tablets
BRISTOL MYERS SQUIBB CO	Sprycel	DASATINIB	Dasatinib 20mg, 50mg 70mg Tablets
COLLEGIUM PHARMACEUTICAL INC	Nucynta	TAPENTADOL HCL	Tabs SR:50/100/& 50 mg capsules
ELI LILLY AND COMPANY	Reyvow	LASMIDITAN	50mg and 100 mg Oral Tablets
ESPERION THERAPEUTICS INC	Nexlizet	BEMPEDOIC ACID, EZETIMIBE	180 mg tablets
FRESENIUS KABI	Diprivan	PROPOFOL	IV infusion
FRESENIUS KABI USA LLC	Omegaven	FISH OIL TRIGLYCERIDES	1000 mg softgel capsules
GILEAD SCIENCE	Biktarvy	BICTEGRAVIR/EMTRICITABIN E	25 MG TABLETS
JOHNSON & JOHNSON	Olysio	SIMEPREVIR	150mg simeprevir capsule
KYOWA KIRIN INC	Sancuso	GRANISETRON U	3 mg Injection
LUPIN INC	Antara	FENOFIBRATE	200 MG CAPSULES
MERCK & CO	Glucophage	METFORMIN	Tablets 500mg/850mg/1000 mg
MYLAN	Yupelri	REVEFENACIN	Each vial contains **175 micrograms**
NAVIDEA BIOPHARMACEUTICALS	Lymphoseek	TECHNETIUM TC 99M	Injection
NOVARTIS	Arcapta	INDACATEROL	Rotacapsules 150mcg & 300 mcg
PFIZER	Xalkori	CRIZOTINIB	Crizocent 250 MG capsules
PFIZER	Inlyta	AXITINIB	5mg Tablets
PFIZER	Camptosar	IRINOTECAN	100MG INJECTION
SAREPTA THERAPEUTICS, INC.	Exondys 51	ETEPLIRSEN	100MG INJECTION/2 ML
SAREPTA THERAPEUTICS, U INC.	Amondys 45	CASIMERSEN	100MG INJECTION/2 ML
SEBELA PHARMACEUTICAL	Pexeva	PAROXETINE MESYLATE	10 & 12.5 MG Tablets
TAKEDA PHARMACEUTICAL	Edarbi	AZILSARTAN	40 and 80 mg Tablets
TAKEDA PHARMACEUTICALS	Kazano	ALOGLIPTIN/METFORMIN	Tabs 12.5 mg/500 mg, 12.5 mg
VIVUS INC.	Spedra	AVANAFIL	200 mg tablets
XANODYNE PHARMACEUTICALS	Roxicodone	OXYCODONE	5mg, 10mg, 15mg, 20mg, 30mg

Source: IQVIA (2023).

5.3 Market Information

This data includes details such as the company name, brand name, prices in USDs, global sales figures, prices in Pakistan, and the total market size in Pakistan for each API. This comprehensive dataset serves as a crucial tool for investors to evaluate the market value of each brand, assess its potential for local consumption, and gauge its prospects for export. Armed with this information, investors can make informed decisions regarding their investments in the pharmaceutical sector.

Table 16: List of APIs going off patent by 2025, local & global prices and total sale

"OFF PETENT APIS 2025" - PRICE & MARKET						
	Company	Brand Name	PRICE USD	USD SALES- GLOBAL	PKR PRICE (AVG)	PKR SALES
1	ABBVIE	Trilipix	USD 295(90) capsules	USD 46.22 million in 2022	335 RUPEES	277,281,647
2	AKARX, INC	Doptelet	USD 12,393 (30) tablets	USD 3.5 million, 2019	N/A in Pakistan	N/A in Pakistan
3	ALLERGAN	Viberzi	USD1,615 (60) tablets	USD 554 million 2016	N/A in Pakistan	N/A in Pakistan
4	ALMIRALL, S.A	Duaklir	£32.50 / 30 days based on 2 puffs	USD 299 million 2021	850 Rupees	5,417,434
5	ALNYLAM PHARMA	Onpattro	USD 10,313 for a supply of 5 milliliters	US$ 35.8 million in 2018	N/A in Pakistan	N/A in Pakistan
6	AMGEN INC.	Kyprolis	10 mg is around $532	USD 232 million by 2028	N/A in Pakistan	N/A in Pakistan
7	AMRING PHARMACEUTICALS INC	Lysteda	520.79 per 100 tablets	US$ 84 million in 2022	560 Rupees	1,507,513,865
8	ASTELLAS PHARMA INC	Cresemba	powder for injection		N/A	N/A in Pakistan
9	BAUSCH & LOMB	Vyzulta	$263 for a supply of 2.5 milliliters		280 Rupees	202,594,950
10	BAUSCH AND LOMB INC	Bepreve	$295 for a supply of 5 milliliters	2013 for $8.57 billion	N/A	N/A in Pakistan
11	BOEHRINGER INGELHEIM	Jentadueto	$562 for a supply of 60 tablets		300 Rupees	33,221,638
12	BRISTOL MYERS SQUIBB CO	Sprycel	10,066 for a supply of 60 tablets	$4.25 billion in 2020	16th August 2023	N/A in Pakistan
13	COLLEGIUM PHARMA	Nucynta	$1,024 for a supply of 100 tablets	USD 3,238.77 Million in 2020	300 RUPEES	141,157,807
14	ELI LILLY AND COMPANY	Reyvow	$790 for a supply of 8 tablets	$584m by 2025	N/A in Pakistan	N/A in Pakistan
15	ESPERION THERAPEUTICS INC	Nexlizet	$426 for a supply of 30 tablets	450 Million US Dollors	N/A in Pakistan	N/A in Pakistan
16	FRESENIUS KABI	100 milliliters		USD 873.77 million in 2022	2,500 Rupees	373,945,225
17	FRESENIUS KABI USA LLC	Omegaven	$626 for 500ml	US$ 2.3 billion	Rs.190 Dec 2023	N/A in Pakistan
18	GILEAD SCIENCE	Biktarvy	$4,006 for a supply of 30 tablets		3500 Rupees	565,216,037
19	JOHNSON & JOHNSON	Olysio	28-days supply of simeprevir is $22,120		N/A in Pakistan	N/A in Pakistan
20	KYOWA KIRIN INC	Sancuso	$701 for a supply of 1 films	the forecast period from 2021-	600 Rupees	50,771,457
21	LUPIN INC	Antara	544 for a supply of 30 capsules	USD 46.22 million in 2022	335 RUPEES	277,281,647
22	MERCK & CO	Glucophage	$39 for 30 tablets	USD 4,028 million in 2022	200 Rupees	1,469,796,252
23	MYLAN	Yupelri	1380 for 90ml	2023 net sale $567 million	N/A	N/A in Pakistan
24	NAVIDEA BIOPHARMACEUTICALS	Lymphoseek	$300 per patient	4.7 million	N/A in Pakistan	N/A in Pakistan
25	NOVARTIS	Arcapta	$278 for a supply of 30 capsules		4000 rupees	6,517,125
27	PFIZER	Xalkori	$130 per tablet	USD 524 million	105000 /pack Dec 2022	N/A in Pakistan
28	PFIZER	Inlyta	$21,014 for a supply of 180 tablets	USD 614 million in 2018	N/A in Pakistan	N/A in Pakistan
29	PFIZER	Camptosar	$39 for 2 ml		14,000	31,305,723
30	SAREPTA THERAPEUTICS, INC.	Exondys 51	around $1,694 for a supply of 2 milliliters	dystrophy market across the	N/A in Pakistan	N/A in Pakistan
31	SAREPTA THERAPEUTICS, U INC.	Amondys 45	$1,694 for a supply of 2 milliliters	dystrophy market across the	N/A in Pakistan	N/A in Pakistan
32	SEBELA PHARMACEUTICAL	Pexeva	$460 for a supply of 30 tablets		350 Rupees	1,516,772,821
33	TAKEDA PHARMACEUTICAL	Edarbi	$237 for a supply of 30 tablets	14.27 Million in 2021-2022	N/A in Pakistan	N/A in Pakistan
34	TAKEDA PHARMACEUTICALS	Kazano	$440 for a supply of 60 tablets			
35	VIVUS INC.	Spedra	RS 2000 for 20 tablets	USD 3.65 billion in 2021	N/A in Pakistan	N/A in Pakistan
36	XANODYNE PHARMACEUTICALS	Roxicodone		US$ 8.9 Billion in 2023	N/A in Pakistan	N/A in Pakistan

Source: IQVIA (2023).

5.4 Indications

The table provided presents a comprehensive list of off-patent Active Pharmaceutical Ingredients (APIs) along with their respective indications, showcasing a diverse array of therapeutic uses. These APIs target a spectrum of complex diseases, ranging from chronic conditions like cancer, hypercholesterolemia and diabetes to more acute ailments such as severe pain and migraine headaches. For generic manufacturers, this compilation represents a significant opportunity. With

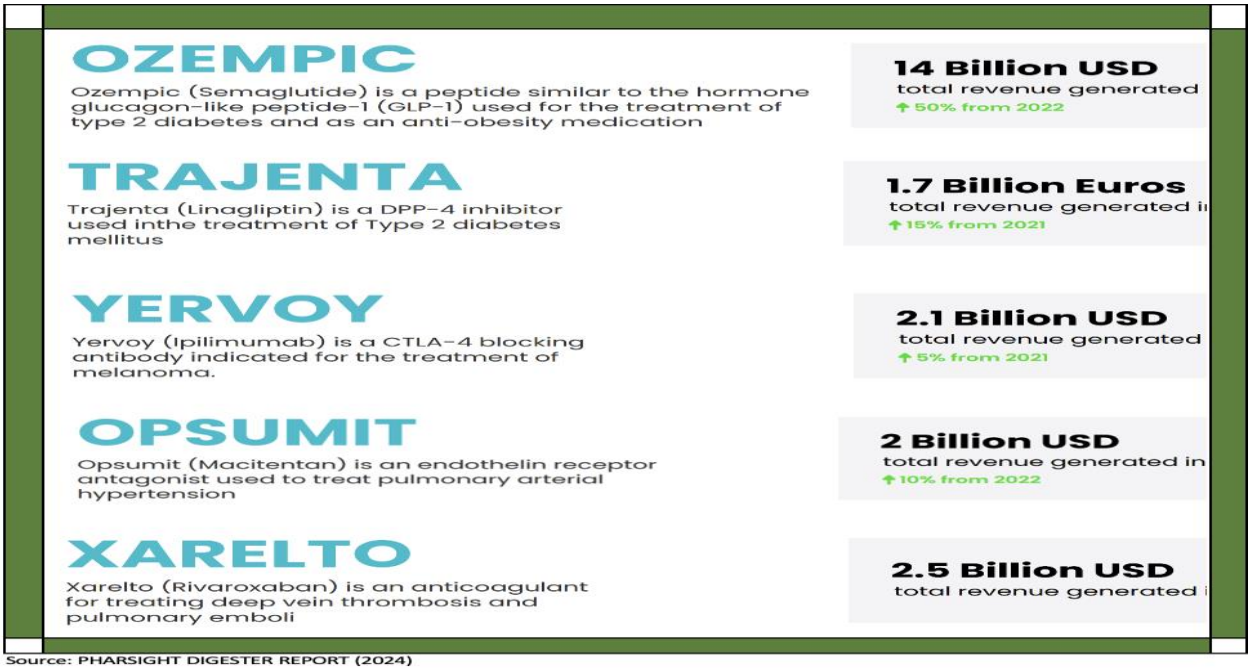
these APIs go off patent by 2025, generic manufacturers can capitalize on producing cost-effective alternatives to brand-name medications. By manufacturing these APIs, generic companies can contribute to increasing access to essential treatments for patients worldwide while fostering competition in the pharmaceutical market.

Table 17: Off patent APIs: Indications

OFF PETENT APIS 2025 - INDICATIONS			
	Company	Brand Name	INDICATIONS
1	ABBVIE	Trilipix	Hypercholesterolemia, or mixed dyslipidemia
2	AKARX, INC	Doptelet	Avatrombopag is used to treat thrombocytopenia
3	ALLERGAN	Viberzi	used to treat irritable bowel syndrome with diarrhea
4	ALMIRALL, S.A	Duaklir	Treat asthma and prevent bronchospasm in patients with asthma
5	ALNYLAM PHARMA	Onpattro	treatment of polyneuropathy in people with hereditary transthyretin-mediated amyloidosis,
6	AMGEN INC.	Kyprolis	multiple myeloma, targets a specific protein within cancer cells and stops the cancer cells from growing
7	AMRING PHARMACEUTICALS INC	Lysteda	tranexamic acid (TXA) is for heavy menstrual bleeding and short-term prevention in patients with hemophilia
8	ASTELLAS PHARMA INC	Cresemba	Isavuconazonium is used to treat serious fungal infections such as invasive aspergillosis
9	BAUSCH & LOMB	Vyzulta	reduction of intraocular pressure (IOP) in patients with ocular hypertension (OHT) or open-angle glaucoma (OAG)
10	BAUSCH AND LOMB INC	Bepreve	This medication is used to treat itching of the eyes due to allergies. **Bepotastine** is an antihistamine
11	BOEHRINGER INGELHEIM	Jentadueto	Oral Anti diabetes
12	BRISTOL MYERS SQUIBB CO	Sprycel	Dasatinib is used to treat a certain type of chronic myeloid leukemia (CML; a type of cancer of the white blood cells)
13	COLLEGIUM PHARMA	Nucynta	treat moderate to severe acute pain (pain that begins suddenly, has a specific cause, …..
14	ELI LILLY AND COMPANY	Reyvow	Lasmiditan is used to treat the symptoms of migraine headaches
15	ESPERION THERAPEUTICS INC	Nexlizet	cholesterol-lowering
16	FRESENIUS KABI	100 milliliters	used for procedural sedation, during monitored anesthesia care, or as an induction agent for general anesthesia
17	FRESENIUS KABI USA LLC	Omegaven	There's strong evidence that omega-3 fatty acids can significantly reduce blood triglyceride levels.
18	GILEAD SCIENCE	Biktarvy	Tenofovir alafenamide is used to treat chronic hepatitis B infection, a viral infection of the liver
19	JOHNSON & JOHNSON	Olysio	used for hepatitis C genotype 1 and 4
20	KYOWA KIRIN INC	Sancuso	prevent nausea and vomiting that may occur after treatment with cancer medicines (chemotherapy or radiation),..
21	LUPIN INC	Antara	treatment of hypertriglyceridemia, primary hypercholesterolemia, or mixed dyslipidemia
22	MERCK & CO	Glucophage	Oral anti-diabetes
23	MYLAN	Yupelri	treat chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema
24	NAVIDEA BIOPHARMACEUTICALS	Lymphoseek	used to find lymph nodes in patients with solid tumors.
25	NOVARTIS	Arcapta	bronchodilator are breathed in through the mouth to open up the bronchial tubes (air passages) in the lungs
27	PFIZER	Xalkori	treat metastatic (cancer that has already spread) non-small cell lung cancer (NSCLC)
28	PFIZER	Inlyta	treat advanced renal cell carcinoma
29	PFIZER	Camptosar	treat colon or rectal cancer
30	SAREPTA THERAPEUTICS, INC.	Exondys 51	used to treat Duchenne muscular dystrophy (DMD) in patients with a confirmed specific genetic mutation.
31	SAREPTA THERAPEUTICS, U INC.	Amondys 45	used to treat Duchenne muscular dystrophy (DMD) in patients with a confirmed specific genetic mutation.
32	SEBELA PHARMACEUTICAL	Pexeva	Paroxetine is a type of antidepressant known as a selective serotonin reuptake inhibitor (SSRI).
33	TAKEDA PHARMACEUTICAL	Edarbi	used in the management and treatment of hypertension
34	TAKEDA PHARMACEUTICALS	Kazano	Oral Anti diabetes
35	VIVUS INC.	Spedra	Avanafil is used to treat male sexual function problems (impotence or erectile dysfunction-ED)
36	XANODYNE PHARMACEUTICALS	Roxicodone	Oxycodone is used to relieve moderate to severe pain

Source: IQVIA (2023).

Box 7: Soon-to-expire blockbusters



5.5 API Research & Development Ecosystem – Current State

Pakistan's pharmaceutical sector is at a critical juncture, facing challenges in research and development (R&D) infrastructure, particularly regarding Active Pharmaceutical Ingredients (APIs). Addressing the following challenges in Pakistan's pharmaceutical R&D infrastructure is essential for capitalizing on the opportunity of manufacturing off-patent molecules.

Lack of Centralized R&D Centers: Unlike neighboring countries, Pakistan lacks dedicated API research centers, hindering industry innovation and growth.

Limited Dedicated Research Facilities: Existing labs primarily focus on routine quality tests rather than pioneering R&D efforts due to financial constraints.

Dependency on Intermediates: Heavy reliance on intermediates as raw materials hampers self-reliance and local innovation within the API industry.

Weak Academia-Industry Linkage: Doubts persist regarding academia's capacity to effectively address industry-specific research challenges, leading to minimal collaboration.

Accessibility Issues with Government Labs: Despite efforts to bolster R&D, industry players hesitate to utilize government facilities due to confidence issues and accessibility barriers.

5.6 Proposed Solutions

HEC Research Grant: Joint research grant proposals between industry and academia will foster off-patent molecules development, leveraging expertise and resources.

HEC Research Facilitation Portal: Establishing a portal connecting industry stakeholders with relevant academic institutions will streamline collaboration efforts.

Government Policy Change: Prioritizing high-value off-patent molecule manufacturing, streamlining approval processes, and offering incentives will incentivize local production and reduce import dependency.

5.7 Attraction of Foreign Direct Investment (FDI)

Actively seeking FDI through diplomatic channels and investment promotion bodies will fund API development projects and enhance research efforts.

5.8 Talent Cultivation

Strengthening industry-academia collaboration and developing tailored training programs will address skill shortages and nurture a skilled workforce.

RESEARCH METHODOLOGY

6.1 Desk Review

The desk review methodology involved a thorough search on ResearchGate and other online sources for information on Pakistan's API manufacturing industry. Despite limited data, valuable insights were gathered from professional reports, policy papers, and consulting documents. The review also included a global perspective, focusing on India and Bangladesh as benchmarks. The literature review covered the industry's size, significance, opportunities, challenges, government policies, regulator roles, and future directions. The study aimed to consolidate available data and provide strategic insights for developing API policies in Pakistan. An analysis identified key challenges, opportunities, proposed solutions, and outlined a strategic direction for industry growth. This methodology follows best practices, offering a structured approach to information gathering and analysis.

6.2 API Manufacturing Plant Feasibility Studies

This study used a qualitative approach, interviewing API industry experts and managers to understand API manufacturing deeply. Through semi-structured interviews, experienced professionals shared insights on plant infrastructure, equipment, processes, and challenges. The iterative process refined questions and explored emerging themes. Confidentiality and ethics were priorities. The final report "API Manufacturing Feasibility" provides a thorough overview of API manufacturing informed by expert perspectives, covering plant operations, equipment, processes, R&D, investments and challenges.

6.3 Pharmaceutical & API Market Analysis

In analyzing the Pharmaceutical Market in Pakistan for the year ending August 2022-23, we gathered primary data from the IMS (Intercontinental Marketing Services) database. This data covered total market size, sales by Active Pharmaceutical Ingredient (API) molecules, and the performance of the top 500, top 100, and top 25 selling molecules over a year. We carefully cleaned the raw data to remove inaccuracies, outliers, and missing values, then structured it for consistency. Key variables like total market size and API molecules were clearly defined for clarity. We chose to use both Tableau and Power BI as analytical tools due to their complementary features, providing a comprehensive view of market dynamics. Using these tools, we assessed overall market size, trends, year-over-year growth, and detailed sales by API molecules. We created visualizations and dashboards to highlight the performance, growth rates, and market share of the top-selling molecules. Individual growth rates were calculated to offer insights into relative performance and market dynamics. Various visualization techniques such as bar charts and heatmaps were employed for easy interpretation. Cross-validation of findings from both tools ensured consistency and accuracy in our analysis. We documented all steps and analyses performed comprehensively to ensure transparency and replicability. Finally, we drew conclusions based on the analyzed data.

6.4 APIs Import Data Analysis: Artificial Intelligence Tool

In our analysis of API imports into Pakistan (2014-June 2022), we used reliable customs data. After meticulous cleaning to address missing values and anomalies, we transformed the dataset for analysis while maintaining consistency. We employed Tableau and Power BI for dynamic visualization, exploring trends, comparisons, and patterns in API imports. We examined imports by molecule, company, and country of origin, conducting quantitative and value-based assessments

using various Dashboards. Cross-validation and sensitivity analyses ensured validation of our findings, refining visualizations to accurately depict the API import landscape in Pakistan.

6.5 Qualitative Analysis

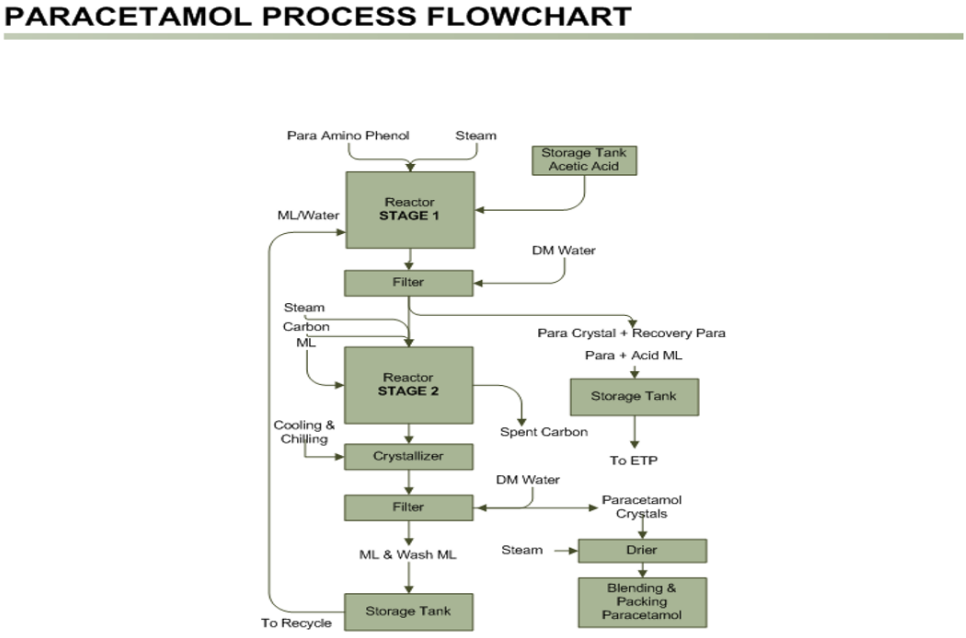
This study utilized qualitative analysis, desk reviews, data analysis, and advanced AI techniques to comprehensively understand Pakistan's API industry. Through individual and focus group interviews with diverse stakeholders, including trade bodies, research institutes, universities, and industry experts, key insights were extracted. Thematic analysis, facilitated by cutting-edge software, validated earlier findings and uncovered new insights crucial for shaping the industry's future. The engagement of professionals across various domains highlighted challenges, opportunities, and strategic imperatives, including collaborative policymaking, enhancing local manufacturing, and fostering innovation. Stakeholder input refined research findings, leading to actionable policy recommendations. Overall, this methodological approach provided a deeper understanding of the industry dynamics and laid a solid foundation for informed decision-making and strategic interventions to foster industry growth and competitiveness.

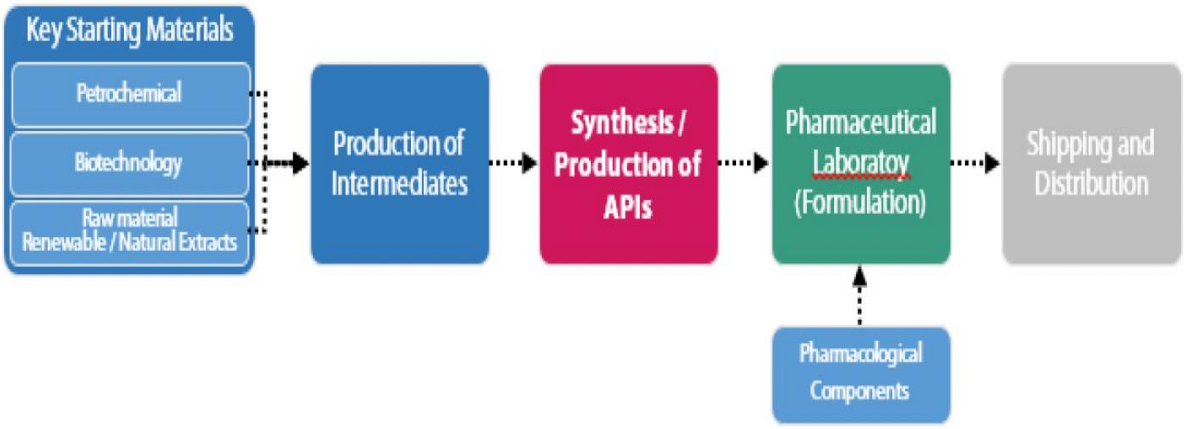
API MANUFACTUIRNG PLANT FEASIBILITY STUDY

7.1 API Manufacturing Plant

The study offers a thorough exploration of API manufacturing, using the establishment of a Paracetamol plant in Pakistan as a case study. We provide essential insights for investors to navigate the dynamic pharmaceutical landscape. Through detailed examination of equipment, processes, and quality standards, we empower investors to make informed decisions. The estimated cost of the plant, excluding land and infrastructure, is approximately PKR 44 million for equipment and PKR 41 million for laboratory gear. While these figures are subject to economic fluctuations, Annexure A provides a detailed breakdown for further analysis.

7.2 Manufacturing Process





7.3. API Plant & Machinery Cost

Table 18: API plant equipment, current cost estimates

PLANT & MACHINERY - SAMPLE PLANT (PARACETAMOL)			
	MACHINERY NAME	CAPACITY	PRICES 2023 PKR
1	Boiler	2 ton (2)	3,600,000
2	Fluid Bed Dryer (ss316 L)	100 kg	2,000,000
3	Milling Machine (ss316 L)	1400 rpm	500,000
4	Centrifuge (ss316 L)	300 kg	500,000
5	Hot Water Tank (ss304)	5000 L	3,000,000
6	Buchner Filter (ss304)	125 kg 5'x10'x4'	1,750,000
7	Candle Filter	300 kg carbon(2)	1,000,000
8	Chiller		3,400,000
9	Cooling Tower		
10	Charging Vessel (ss316L)	7.5' x 14' DxL	8,200,000
11	Carbon Vessel (ss316L)	7.5' x 14' DxL	8,200,000
12	Crystallizer (ss316L)	7.5' x 14' DxL	8,200,000
13	Vacuum Pump	7.5 hp	150,000
14	Carbon Slurry Transfer Pump	10 hp	200,000
15	Charging Vessel Gear Motor	10 hp motor 15 hp gear	180,000
16	Carbon Vessel Gear Motor	10 hp motor 15 hp gear	180,000
17	Crystallizer Gear Motor	10 hp motor 15 hp gear	180,000
18	Condenser	1 ton	1,400,000
19	Process Pipeline (ss 304)	300' - 400'	600,000
20	Flange, Nipple , Valve etc		600,000
21	dry powder trolley (ss316L)		400,000
22	Total cost		44,240,000

Source: Author's illustration based on interviews.

7.4. R&D and Quality Lab Equipment Cost

Table 19: API lab equipment, current cost estimates

API - LAB EQUIPMENT				
	NAME	MODEL	COST RANGE	
1	Gradient HPLC System (Quaternary) -Shimadzu	SIL-HTC/10Avp (Refurb)	3,000,000	7,200,000
1a	Gradient HPLC System (Quaternary)-Shimadzu	Sil-10ADVP (Refurbished)	2,600,000	2,600,000
2	FT-NIR Spectrometer- Bruker	MPA (Refurbished)	5,500,000	5,500,000
3	UV/Visible Double Beam Spectrophotometer -Shimadzu	UV-1601(Refurbished)	700,000	1,400,000
4	Karl Fischer Titrator	DL-38 (Refurbished)	800,000	1,400,000
5	GC with Head Spacer -Shimadzu	GC-2010 (refurbished)	5,000,000	3,000,000
6	Stability Chamber (Accelerated)	750 L (new)	5,600,000	1,000,000
7	Stability Chamber (Real Time)	750 L (New)	5,600,000	1,000,000
8	Analytical Balance -Shimadzu	ATX-224 (new)	425,000	425,000
9	Top Loading Balance -Shimadzu	720 Gram (New)	100,000	100,000
10	Moisture Analyzer -Shimadzu	Moc-63U (new)	4,750,000	4,750,000
11	Automatic Polarimeter -Optical Activity UK	AA-10 (refurb)	700,000	700,000
12	Bench pH Meter -Hanna	HI2210(New)	200,000	350,000
12a	Bench pH meter Thermos/Fisher/Acumen	Refurb	75,000	75,000
13	Portable pH Meter -Hanna	HI-8424(new)	150,000	150,000
14	Conductometer -Thermos	StarA112(new)	285,000	425,000
15	Vacuum Drying Oven -Emmert	U55 (new)	490,000	135,000
16	General Incubator -China	30 Ltr SS Inner (new)	100,000	100,000
17	Melting Point Apparatus	SMP20 (New)	320,000	150,000
18	Particle Size Analyzers -China	USD 33000/	9,405,000	9,405,000
19	Digital Autoclave - China	50 Liter	600,000	1,250,000
20	Water Distillation Apparatus -China/India	China Metal body	45,000	105,000
21	Ultra Sonic Bath/ Sonicator -China	3 Litre	45,000	120,000
22	Hot Plate with Magnetic Stirrer -China	78-1/79-1	222,500	165,000
23	Suction / Vacuum Pump -China	AS20	35,000	35,000
24	Filtration Assembly -China	All Glass	15,000	15,000
25	Laminar Air Flow Hood (Sterility Test Room) local	2 x 4	225,000	225,000
26	Muffle Furnace -China			
27	Temp. Controller of Muffle Furnace -China			
28	Suction / Vacuum Pump -China	AS20	35,000	35,000
29	Colony Counter -China	J3	48,000	48,000
30	Thermometer (-10°C to 110°C)			
31	Thermometer (-10°C to 110°C)			
32	Thermometer (-10°C to 110°C)			
33	Thermometer (-10°C to 360°C)			
34	Digital Thermometer (-50°C to 300°C)			
	TOTAL		47,070,500	41,863,000

Source: Author's illustration based on interviews.

7.5 API Plant Mandatory Environmental Approvals

Table 20: Mandatory requirements: Environment protection

ENVIRONMENT IMPACT ASSESSMENT (SEPA Act IEEEIA Regulations 2021)		
CHEMICAL MANUFACTURING COMPANIES (Schedule III Regulation 5 C2)		
	MANDATORY REQUIREMENT	**TEST DETAILS**
Phase 1	Water quality analysis (Daily)	pH, hardness,TDS, turbidity,color,odour etc
	Air quality analysis (Daily)	SOx, NOx, PM , Lead
	Noise (Daily)	65 db seqs
	Solid Waste (Daily)	Source , type , sludge produced
Phase 2	**Licensing Requirement**	
	Mandatory Requirement	**Detail**
	Hazard identification (Source)	Chemical solvents, powders , hazardous waste
	Mitigation measures	PPEs, fresh air systems, eye wash stations , fire extinguishers, hazardous waste mangement
	Follow up	Log books audit , area audit
Phase 3	**Pre-Approval Application Process**	
	Hiring consultant	Consultation for better environmental management solutions
	EIA report ,EMP, Mitigation plan	Prepared together with consultant help
	Submits EIA report to EPA	Fees Submission
	Application filing	Schedule 5 Regulation 9 2a SEPA ACT IEEEIA Regulations 2021
	Newspaper AD	To inform all stakeholders of public hearing
	Public hearing by SEPA	Observations / Recommendations
	Presentation by proponent/consultant	Company Presentation
	Experts comittee meeting	If recommendations are not critical, NOC is issued
	NOC issued	Proceed to operations

Source: Author's illustration.

FINDINGS AND DISUCSSION

8.1 Active Pharmaceutical Ingredients (APIs) Import

The findings of the analysis on the Pharmaceutical Market and Active Pharmaceutical Ingredient (API) imports in Pakistan present a comprehensive overview of the current scenario, highlighting key areas for potential improvement and strategic interventions.

Finding 1 (F1): API Imports Analysis and Substitution Potential: In 2022, Pakistan imported APIs amounting to USD 330 million. Among these, USD 125 million worth of APIs were for molecules already manufactured domestically. Drawing inspiration from Bangladesh's successful transition from 97% API import dependency in 2016 to a 30% exporter in 2022, imposing restrictions on the import of APIs manufactured domestically could significantly reduce the import bill and offer substantial cost-saving opportunities.

Finding 2 (F2): Reluctance to Use Locally Produced APIs: Despite potential benefits, multinational corporations (MNCs) and national pharmaceutical companies exhibit reluctance in adopting locally produced APIs due to concerns regarding quality assurance, compliance standards, supply chain reliability, and requisite documentation (DMF).

Finding 3 (F3): Pharmaceutical Market Insights and API Localization Opportunities: An examination of the pharmaceutical market, focusing on the top 25 selling molecules in 2023 valued at PKR 206 billion (38%) out of a total market of PKR 748 billion, reveals that 12 APIs out of the top 25 are produced locally. Surprisingly, high-value APIs like Floxacrine, Ceftriaxone, and Azithromycin are being imported in significant quantities despite local production capabilities. This underscores the need for targeted measures to encourage the use of domestically manufactured APIs, potentially enhancing self-reliance.

Finding 4 (F4): Dominance of Chinese and Indian on API Imports: In 2022, 68% of API imports were from China, while 23% were from India. The reliance on Chinese APIs, known for their lower costs, raises concerns about quality, impacting both domestic pharmaceutical export and the overall quality of medicines.

Finding 5 (F5): Significance of Six Key Pharmaceutical Companies: Six pharmaceutical companies accounted for USD 133 million, constituting 40% of the total API imports in 2022. Recognizing the pivotal role of these companies, immediate measures focused on import substitution could be

initiated to curtail the overall import bill. Engaging these companies in the pursuit of localized production development of APIs could yield significant economic benefits.

8.2 API Manufacturing Companies in Pakistan

Finding 1 (F): Discrepancy in API Manufacturing Licenses and Operations: Out of the 23 licenses issued by the Drug Regulatory Authority of Pakistan (DRAP) for API manufacturing, only 7 companies are currently operational. Strikingly, these licensed companies are not actively engaged in API production; instead, importing subsidized raw materials and intermediates. To address this issue, a robust policy must be promulgated and closely monitored. The policy should mandate that raw materials imported under API licenses are converted into APIs and subsequently sold. This approach aims to eliminate misappropriation and reduce the import bill by ensuring compliance with tax-exempted rates.

Finding 2 (F): Opportunity in Off-Patent APIs: A promising prospect emerges as 66 high-value APIs, collectively valued at USD 380 billion, are set to go off-patent by 2025. This presents Pakistan with a golden opportunity to venture into the manufacturing of these molecules and actively participate in the global API market.

Finding 3 (F): Research & Development (Capacity and Resource Challenges): Existing governmental labs like Central Drug Laboratories and research centers, lack resources for rigorous R&D. Significant investment is essential for upgrading equipment, adopting new technology, and enhancing staff capabilities. This investment is crucial to reduce reliance on imported intermediates and to establish basic API manufacturing capabilities.

Suggestion 1 (S): Establishing Centralized API Research & Development Centre: Recognizing the centrality of Research and Development (R&D) in the API industry, a pivotal recommendation is to establish a centralized "API Research & Development Centre." This entity, equipped with the requisite ecosystem, would operate independently and have a focused five-year agenda for developing off-patent molecules.

Suggestion 2 (S): R&D Fund Allocation: To finance the API Research & Development Centre, 1% of the gross profit contributed by pharmaceutical companies to be allocated. This fund, will be utilized by an independent body comprising industry key contributors, academia, and government representatives, would ensure sustained operation and innovation.

Suggestion 3 (S): FDI Attraction and HEC Collaboration: To further bolster resources, the government should actively seek Foreign Direct Investment (FDI) through embassies and investment promotion bodies. Simultaneously, the Higher Education Commission (HEC) can play a pivotal role by issuing research grant proposals for off-patent molecules, collaborating with industry and donor agencies to secure funding.

8.3 API Manufacturing Process

Investigations into API manufacturing processes, plant equipment costs, machinery, and the establishment of quality and R&D labs were conducted. Regulatory and environmental protection approval complexities were also examined.

Finding (F-1): R&D Challenges in API Industry: R&D labs within the API industry face limitations in equipment and testing capabilities, leading to a decline in research efforts and development of new molecules. API companies are dependent on intermediate suppliers for their R&D needs and reluctant to invest in Research & Development.

Finding (F-2): use of Intermediates for API production: Existing API companies contribute minimally to local API demand and rely heavily on imported intermediates from India and China. The production of API is restricted to few steps (N-1, N-2), limiting the benefits of API industry.

Finding (F-3): Unused Basic Manufacturing Licenses: Out of 23 licenses, 5 companies are licensed for basic manufacturing for 39 APIs, however, no company is engaging in producing APIs by way of basic manufacturing. licenses issued mostly remain unused, indicating the need for stricter regulatory oversight to ensure operational compliance.

Suggestion (S-1): Government Support and Regulatory Frameworks: The government should incentivize and allow duty exemptions and rebates on machines, equipment and reagents for setting up of R&D facilities and introduce regulatory frameworks to link the incentives with deliverable (KPIs,) and monitor

Suggestion (S-2): Localization Policy: Engage, incentivize, and facilitate the giant companies in the pharmaceutical sector to introduce a localization policy. Mutually set workable localization targets with Key Performance Indicators (KPIs) to make tangible progress. Make it a priority for these companies to develop local sources of raw materials through direct investment in API manufacturing or joint ventures with API manufacturing companies. Tax exemptions and rebates for API companies should be linked with vertical integration of processes and a gradual shift from intermediate to basic manufacturing.

8.4 Industry-Academia Collaboration

Finding (F-1): Academia's Role in R&D: Collaboration between industry and academia is identified as a key factor for success. Research centers, universities, and laboratories possess basic research facilities and human resources for R&D however, major investment is required to upgrade the equipment and train the human resources to make these facilities productive.

Finding (F-2) Export Potential and FDA Approval: The presence of FDA-approved facilities, international accreditations, compliance and certification are mandatory to unleash pharmaceutical & API exports potential, as demonstrated by Bangladesh's success. Pakistan lack FDA approved facilities and international accreditations.

Finding (F-3) Trust Deficit and Disconnect between Academia and Industry: Universities and research centers have the capacity to contribute and support industry in R&D however Industry lack awareness about the research equipment and expertise available in universities leading to disconnect and lack of interest. Lack of dedication and spirit by academia, to showcase their capacity to resolve industry problems.

Suggestion (S-1): Centralized Database by HEC: HEC should create a centralized database cataloging equipment, testing, and R&D facilities available in universities and research centers. This database will facilitate industry-academia collaborations by providing awareness and easy access to academia's resources.

Suggestion (S-2): Pursuit of International Standards: To enhance the competitiveness of Pakistan's pharmaceutical industry, it is imperative for the Drug Regulatory Authority of Pakistan (DRAP) to align product registration and compliance requirements with international standards. This alignment will facilitate smoother access to global markets and streamline processes for obtaining FDA approvals and international accreditations. The government should incentivize industry players to upgrade their facilities and meet compliance requirements by offering exemptions and fast-track approval processes. These incentives will encourage companies to invest in infrastructure and technology upgrades, ensuring adherence to international quality standards.

STRATEGY IMPLEMENTATION FRAMEWORK

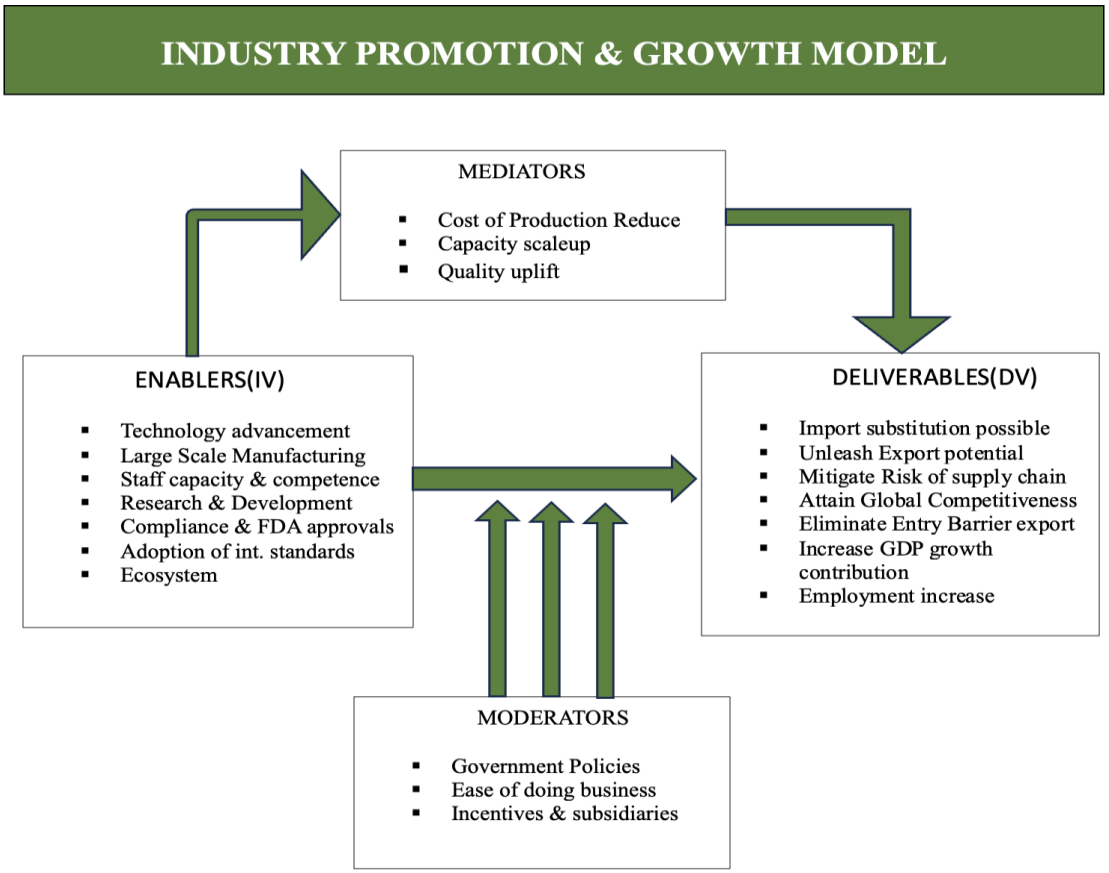
9.1 API Industry Strengths, Weaknesses, Opportunities and Threats (SWOT)

Figure 18: API industry development: SWOT Pakistan

PAKISTAN API INDUSTRY DEVELOPMENT – SWOT	
STRENGTHS	**WEAKNESSES**
▪ Experience and capacity to produce generic APIs. ▪ API industry has capability and Potential to scale up production meeting local and international demand. ▪ Availability of trained API industry technical experts & professionals to fuel expansion. ▪ Existing research centers have basic R&D infrastructure that can be scale up for setting R&D center for APIs development. ▪ Favorable labor cost and availability of young work force ▪ Fast Growing pharmaceutical industry with tremendous export potential	▪ No "National Strategy" on API industry development and defined KPIs. ▪ Lack of ownership for policy implementation due leadership and coordination crises between various government ministries, DRAP and industry stakeholders. ▪ Poor Ecosystem for API industry growth. ▪ Concerns on adoption of International Standards in Pakistan, is potential entry barrier for exports. ▪ Lack FDA approved facilities and limited bioequivalence labs, is barrier in exports ▪ R&D is backbone of API industry, Pakistan has no API Research and Development Centre. ▪ No contribution of universities in applied research due poor linkage between Academia & Industry. ▪ No focus on transfer of technology and advancement, negatively impacting on industry viability and competitiveness. ▪ APIs industry using intermediates, lack backward integration and use of KSM.
OPPORTUNITIES	**THREATS**
▪ 828 billion pharma market (CAGR 14%) consistently increasing local demand for APIs. ▪ By manufacturing 70 percent of the required APIs domestically, the country could achieve import substitution worth approximately US$ 500 million annually. ▪ local API manufacturers could target a domestic market worth around Rs. 130 billion annually, initially focusing on import substitution and gradually expanding export. ▪ Entry in the lucrative off-patent drugs market, which is projected to reach USD 700 billion in branded generics and USD 381 billion will become off patent by 2025 ▪ China and India shifting focus on high value molecules that pose opportunity for new players in API industry ▪ Large-scale manufacturing of API will increase competitiveness in domestic and international market.	▪ 95% dependence on imported APIs pose the threat of "Supply Chain Disruption" leading to medicine shortages and higher prices. ▪ Pakistan Pharmaceutical Industry global competitiveness in exports will further decline as compared with regional players India and Bangladesh with strong API industry. ▪ High Value off patented APIs if not developed locally, medicine prices will continue unaffordable and face shortages for patients such as Cancer medicines. ▪ Lacking in adoption of international quality standards, approvals by US, FDA and stringent compliance, will eliminate Pakistan from lucrative export markets even from developing countries. ▪ Ease of doing business – poor ranking continues decline of the API industry development

9.2 API Industry Promotion & Growth Model: Proposed

Figure 19: API industry promotion and growth model: Proposed



9.3 API Promotion & Growth Strategy Proposed

Figure 20: API Promotion and growth strategy: Proposed

9.4 API Industry Development: Strategy Implementation Framework

Figure 21: API industry development: Strategy implementation framework

API INDUSTRY DEVELOPMENT – STRATEGY IMPLEMENTATION FRAMEWORK		
STRATEGIC FOCUS	**CHANGE DRIVERS**	**KEY INITIATIVES**
▪ Import Substitution (currently 95% dependence on import for APIs) ▪ Unleash API export potential (193.15 billion in 2023 to approximately USD 285.29 billion by 2028) ▪ Unleash Export potential of Pharmaceutical Products (USD 200 million to 1 billion in 2-3 years. ▪ Making API industry Globally competitive ▪ Eliminating entry barriers in developed countries exports (quality & compliance standards) ▪ API industry viability (Scaleup capacity and reduce cost) ▪ Vertical integration of pharmaceutical sector (key pharma player)	**Technology advancement** **Research & Development** **Ecosystem for API industry** **Adoption of International Standards**	▪ Incentivize MNCs operating in Pakistan to transfer technology of their off-patent APIs production ▪ Encourage & incentivize Local key pharma payer to invest in vertical integration (API) industry ▪ Joint venture agreement country level for technology Transfer ▪ Tax & duty exemption on import of machinery ▪ Soft loans & incentives on technology upgrade ▪ Facilitate Joint Venture between Industry and investors to attract FDI through BOI and other relevant forums. ▪ Establish centralized API Research & development Center for APIs ▪ Allocate Research Fund (@1% of revenue) already collected from pharma industry for R&D Center ▪ HEC call for grant proposal (Academia – industry collaboration) for development of high value API going off patent by 2025 ▪ HEC launch portal "Research Equipment & Expertise" available in universities and Research centers for industry awareness ▪ Lucrative Incentives for scientist for development and commercialization of APIs. ▪ Tax exemption for industry on R&D investment and funding to Research centers. ▪ Facilitate consistent supply of electricity, water and other utilities ▪ Establish Production clusters and provide centralized effluent treatment, environment protection and other support services. ▪ API Mega Parks ▪ Provide Low priced land ▪ Facilitate and incentivize establishment of bioequivalence labs ▪ Product registration requirement in Pakistan need closer alignment with product registration needed in developing countries for export. ▪ More stringent and robust implementation of international quality standards in Pakistan by DRAP. ▪ Training of DRAP and Industry professionals on international standards ▪ Investment on labs equipment and standards for testing impurities.
▪ Vertical Integration of API industry and gradual shift for intermediate to KSM for API manufacturing) ▪ Support large Scale Manufacturing	**Compliance & FDA approvals** **Ease of doing business** Large Scale Manufacturing Staff capacity & competence	▪ FDA approval Facilitation Cell (Training, Consulting Services, and fast tract approvals for industry) ▪ Capacity Building of DRAP staff ▪ Financial Incentives to encourage FDA approvals ▪ FDA approval consulting services Capacity Building and awareness ▪ Establish Facilitation Centre for fast tract registration, licensing, regulatory approvals and eliminate bureaucracy hurdles. ▪ DRAP role and approvals licensing to eliminate bureaucracy hurdles to DRAPfacilitation Centre one window - Production Incentive to scale up production

CONCLUSION

The impetus behind this study was to explore and uncover the untapped opportunities within the pharmaceutical and API sectors, and to outline strategic priorities along with proposing a feasible implementation framework for the development and promotion of the API industry, which forms the backbone of the pharmaceutical sector. Drawing inspiration from Bangladesh's remarkable success story, where the nation transformed from being 97% import-dependent to a key API exporter within six years, it became evident that Pakistan, with its considerable capacity, could seize similar opportunities, provided the pertinent challenges are addressed.

The actionable insights provided hereunder, in this study are intended to benefit investors, policymakers, regulators, academia, and existing API and pharmaceutical industry players, encouraging their active involvement in fostering the API industry's growth in Pakistan. Pakistan's pharmaceutical sector is well developed meeting national demand and have the capacity to increase its export from USD200 million to USD 1 billion within 2-3 years. Challenges persist, particularly in accessing developed markets due to FDA approval hurdles. To fully capitalize on its potential, Pakistan's pharmaceutical sector must address regulatory barriers and enhance compliance with international quality standards.

Pakistan's API industry is in its early stages, mainly relying on imports to meet demand. However, local manufacturing units have the potential to ramp up production to fulfill domestic needs and tap into the API export market. The investigation into the import data has revealed that Pakistan is already manufacturing 32 APIs that includes the API currently imported, the immediate significant import substitution is possible if the local pharma industry start sourcing these APIs from the local manufacturers. The local pharma industry is hesitant to procure domestically manufactured APIs due to quality, compliance and consistent supply concerns. Addressing these apprehensions is pivotal for fostering import substitution and sustainable growth. Regulation from the Drug Regulatory Authority of Pakistan (DRAP), mandating the pharmaceutical sector to prioritize local sourcing, alongside urging the API industry to enhance quality standards, documentation, and sustainable supply practices, is necessary.

The analysis of the APIs sales in Pakistan has identified the top selling APIs capturing lions share in Pakistan pharmaceutical market. This finding is crucial for potential investors eyeing API manufacturing plants, highlighting the opportunity to capitalize on both local demand and the potential for API exports. The examination of the current state of the API industry revealed that manufacturing licenses issued for API manufacturing through intermediates and basic sector faces significant challenges, with only seven out of 23 companies operational. These operational firms heavily rely on imported intermediates from India and China and execute limited process steps. To our understanding the basic manufacturing licenses are unused.

The study highlight high-value APIs set to lose patent protection by 2025 and blockbuster APIs by 2027, guiding investors in preparing for entry into the lucrative API market. Detailed information on availability, pricing, growth prospects, and therapeutic indications were made available to assist investors in seizing upcoming opportunities. The study of the API manufacturing facilities in Pakistan developed the insights into establishing an API manufacturing plant, covering processes, technology, equipment, and associated costs. It addresses environmental protection requirements and identifies bottlenecks like licensing, registration, and bureaucratic hurdles. The objective was to inform investors about required investment and potential challenges in setting up a basic API plant.

Research & Development is the backbone of API industry, existing research facilities require significant upgrades in equipment, technology, and heavy investment to meet the R&D needs of generic manufacturing. Without these upgrades, the progress in the pharmaceutical sector, particularly in API development, remains stagnant. Despite possessing basic infrastructure and

trained personnel, these facilities lack the necessary resources to effectively engage with industry demands. Urgent action is crucial. Establishing a dedicated API Research & Development Centre is imperative to consolidate resources and foster innovation. The Higher Education Commission (HEC) can play a pivotal role in promoting commercialized research through industry collaboration. Government intervention is vital to prioritize local API manufacturing through incentives and regulatory support. Multinational pharmaceutical companies, can be incentivize to transfer off patent APIs technology and nurturing talent.

The policy's implementation status remains stagnant even after two years of its promulgation. Key initiatives outlined in the policy, such as reducing customs duty, combating dumping practices, establishment of facilitation center by Drug Regulatory Authority (DRAP), Establishment of API Mega Parks and facilitating financing facilities, have encountered significant hurdles, impeding progress. The lack of coordination among regulatory bodies, industry stakeholders, and government entities has contributed to the policy's underwhelming implementation, with less than 20% thus far.

The study's key findings offer vital recommendations to fortify Pakistan's pharmaceutical industry and enhance its API sector. It advocates for the establishment of a centralized API research center to address R&D deficiencies and stresses the importance of effective API policy implementation. Engaging pharmaceutical giants in developing local API sources and incentivizing technology transfer for off-patent molecules are highlighted as crucial steps. Moreover, fostering joint ventures with other countries and improving ease of doing business are essential to strengthen API manufacturing. Capacity building for regulatory staff and alignment with international quality standards are imperative to enhance export capabilities. Transitioning the Drug Regulatory Authority from policing to facilitation and leveraging the Higher Education Commission to bridge industry-academia gaps are crucial for industry advancement.

RECOMMENDATIONS AND POLICY IMPLICATIONS

11.1 API Policy Implementation

11.1.1 Current Status

The API policy, promulgated over two years ago, has seen minimal implementation progress, likely not exceeding 20%. Consequently, promised benefits and infrastructure development initiatives such as setting up of facilitation center, API parks and the feasibility study for a Naphtha Cracking plant remain stagnant. This stagnation has led to a decline in industry growth, causing potential investors to withdraw. Stakeholder interviews have revealed concerns regarding the lack of an ecosystem necessary for API industry development, including low-cost utilities, land availability, electricity supply, production clusters, and API parks etc.

11.1.2 Issue

Minimal progress in API policy implementation hindering industry growth in Pakistan.

11.1.3 Recommendation

Establishing a Special Task Force for effective Implementation of the API Policy and development of ecosystem for industry development.

11.1.4 Policy Implications

- Accelerated Implementation: Task Force to expedite approvals, resolve coordination issues, and fast-track establishment of API parks and the Naphtha Cracking plant.
- Stakeholder Engagement: Collaboration with key industry players to formulate a Localization Policy, incentivizing production localization.
- Accountability: Setting time-bound objectives and KPIs for monitoring progress ensures accountability.
- Regulatory Support: Task Force to provide regulatory assistance and infrastructure development for industry facilitation.
- Resilient Industry: Implementation drives industry resilience and sustainability.

Task Force establishment and action implementation crucial for driving policy effectiveness and industry growth in Pakistan's pharmaceutical sector.

11.1.5 Role of Special Task Force

The primary role the Special Task Force is to develop and implement a comprehensive policy implementation framework within a defined timeframe. Additionally, the task force will monitor progress through Key Performance Indicators (KPIs) to ensure accountability and measure the success of implementation efforts.

11.1.6 Scope of Work

Assure Policy Implementation

- Establishment of “API Manufacturing Facilitation Centre”
- Arrange and mobilize resource allocation, expedite approvals, overcome hurdles
- Resolution of coordination issues among various ministries & stakeholder
- Set realistic time bound objectives & KPI and monitor progress
- Expedite API Parks
- Expedite Naphtha Cracking plant

.

Composition of Taskforce

- Representatives from Pharma / API industry (CEO/Directors)
- Chief Executive Officer/ Director DRAP (provincial /federal)
- Chairman/Director Board of Investment (BOI)
- Others as needed

11.1.7 Stakeholders Engagement

- Initiate Collaboration: Establish dialogue with the top 10 pharmaceutical companies and API suppliers to discuss the benefits and feasibility of localizing raw material sourcing and basic manufacturing.
- Formulate Localization Policy: Develop a clear policy framework for localizing raw material procurement and basic manufacturing processes. This policy should outline the benefits, incentives, and obligations for stakeholders involved.
- Incentivize Industry Engagement: Design a framework of incentives tied to achieving specific, time-bound milestones in localizing production. These incentives should be attractive enough to motivate participation while ensuring accountability.
- Facilitate Implementation: Provide necessary support and resources to facilitate the implementation of the localization policy, including regulatory assistance, infrastructure development, and skill enhancement programs.
- Monitor Progress: Establish a mechanism for monitoring and evaluating progress towards localization goals. Regular assessments will help identify challenges and opportunities for refinement.

By following these actionable steps, we can foster collaboration among key stakeholders, incentivize industry engagement, and facilitate the localization of pharmaceutical production, thereby enhancing the resilience and sustainability of the Pakistan pharma market.

11.2 Quality, Compliance and Accreditations

11.2.1 Current Status

A comprehensive review, focusing particularly on successful endeavors in India and Bangladesh, underscores the pivotal role of "Quality, Compliance, International Accreditation, and FDA Approval" for entry into API & Pharmaceuticals export markets. Interviews with industry experts further validate concerns within the pharmaceutical sector regarding the utilization of locally manufactured APIs due to apprehensions related to quality, consistency, compliance, and accreditation. Notably, the import substitution of high-value APIs is impeded by the substantial investment required to enhance infrastructure and cultivate an ecosystem conducive to quality, compliance, and accreditation. Additionally, the competitiveness of the API industry is intricately linked with the scaling up of production and export, necessitating FDA approvals, accreditation, compliance, and adherence to quality standards. Recognizing Pakistan's potential to tap into the USD 193 billion API export market like Bangladesh and India, addressing these barriers is imperative.

11.2.2 Issue

Quality, compliance, and accreditation barriers hinder Pakistan's entry into international pharmaceutical & API markets and minimize local consumption.

11.2.3 Recommendation

Establish a Quality, Compliance, and Accreditation Upgrade Cell to address industry concerns and facilitate market entry.

11.2.4 Policy Implications

- Market Competitiveness: Overcoming barriers aligns Pakistan with global standards, enhancing competitiveness in the pharmaceutical & API markets.
- Economic Contribution: Entry into export markets boosts the economy and supports the public health sector.
- Import Substitution Opportunities: Utilizing locally produced APIs can substitute imports, reducing dependency and stimulating local industry growth.

11.2.5 Cell's Scope of Work

- Gap Identification: Analyse existing protocols, assess DRAP's role, and address industry disinterest in FDA approval and accreditation.
- Strategic Roadmap: Upgrade DRAP protocols, propose policy reforms, and align with export market prerequisites.
- Policy Implementation Framework: Develop a pragmatic framework with realistic time lines and resource allocations.
- Stakeholder Engagement: Collaborate with industry leaders to develop an ecosystem conducive to quality enhancement.
- Formulate Policy: Create a robust localization & export policy incentivizing quality enhancement and international accreditation.

11.2.6 Cell Composition

DRAP, API and pharmaceutical industry representatives, academia, and research centers.

11.2.7 Deliverable

Implementing this plan will position Pakistan favorably in the global pharmaceutical market, promoting sustainable growth and innovation.

11.3. Research and Development

11.3.1 Current Status

The API industry in Pakistan faces a critical need for robust research infrastructure to meet growing demands. Existing governmental labs like Central Drug Laboratories and research centers, lack resources for rigorous R&D. Significant investment is essential for upgrading equipment, adopting new technology, and enhancing staff capabilities. This investment is crucial to reduce reliance on imported intermediates and to establish basic API manufacturing capabilities. Stakeholder interviews emphasize the necessity of dedicated research centers, citing the success of such centers in India and Bangladesh. With high-value API patents expiring soon, proactive investment in research and development is imperative. Establishing an API research center is not an option but a vital step for Pakistan's pharmaceutical growth.

11.3.2 Issue

The insufficient research infrastructure, hindering Pakistan's API industry development and necessitating significant investment in upgrading equipment and staff capabilities.

11.3.3 Recommendation

Establish Active Pharmaceutical Ingredients (API) Research & Development Center

11.3.4 Policy Implications

- Enhanced Research Capabilities: The establishment of an API Research and Development Center, will significantly enhance Pakistan's research capabilities. This will facilitate the development of innovative processes and technologies for API manufacturing.
- Increased Production Efficiency: Upgrading equipment and adopting cutting-edge technology will improve production efficiency within the API industry. This will lead to a reduction in manufacturing costs and an increase in production capacity, allowing Pakistan to meet both domestic and international demand for APIs.
- Reduced Reliance on Imports: By promoting indigenous API production, Pakistan will reduce its reliance on imported intermediates and final products. This will enhance the country's self-sufficiency in pharmaceutical manufacturing and contribute to a more stable supply chain.
- Strengthened Regulatory Compliance: The implementation of training programs and streamlined regulatory frameworks will improve compliance with quality standards and regulatory requirements. This will enhance the reputation of Pakistani APIs in the global market and increase export opportunities.
- Promotion of Public-Private Partnership: Collaboration between government agencies, private industry, and academic institutions will foster innovation and knowledge exchange within the API industry. This will create a conducive environment for research and development, leading to the discovery of new drugs and therapies.
- Long-Term Economic Growth: The growth of the API industry will have positive spillover effects on the broader economy, including job creation, technology transfer, and increased investment in related sectors. This will contribute to long-term economic growth and development in Pakistan.

Overall, the implementation of these recommendations will position Pakistan as a competitive player in the global API market, driving innovation, economic growth, and healthcare advancement in the country.

11.3.5 Scope of Research & Development Centre

- Research & Development of off-patent high-value generics APIs, for local manufacturing to meet local and international demand
- Facilitating technology transfer for scale-up and new APIs production.
- Facilitating vertical integration in the API industry by promoting basic drug manufacturing and phase out use of intermediates.
- Facilitate API manufacturers in enhancing quality, compliance, and obtaining FDA approvals.
- Capacity building and training for academia, regulators, and industry professionals.
- Optimizing formulations for improved efficacy, stability, and compliance.

11.3.6 Management

The Research & Development Center will operate autonomously with an independent board representing, Pharmaceutical and API industries, Academia and research centers, Donor agencies, and government. This structure ensures transparent, accountable decision-making.

11.3.7 Funding Options

- Allocation of pharmaceutical research fund collected from the industry
- Seeking support from donor agencies and foundations
- Establishing partnerships with industry stakeholders for mutual funding.

11.3.8 Sustainability- Commercialization Strategy

This ensures sustainable financial support for operations and growth following options may be used at affordable price adopting not for profit approach.

- License and transfer proprietary technologies to industry partners
- Provide consultancy services on API development, manufacturing, and regulatory compliance.
- Offer R&D services tailored to industry needs, including formulation development, testing, and process optimization.
- Conduct training programs to build industry capacity and skills
- Implement a fee-for-service model for affordability and accessibility.

By aligning our research and commercialization efforts, the Pakistan API Research & Development Center will not only achieve self-sustainability but also drive significant growth and innovation in the pharmaceutical industry, benefiting both local and international markets.

11.4 Future Research: Case Study on API Quality and Compliance Standards in Pakistan

11.4.1 International Standards Applicable to API

- H Q7: Good Manufacturing Practice Guidance for Active Pharmaceutical Ingredients: - Provides comprehensive guidelines on GMP for API manufacturing.
- EU GMP for APIs: Specifies basic requirements for active substances used as starting materials.
- DA Regulations (21 CFR 210 and 211): Applicable to API manufacturing in the United States.
- WHO Good Manufacturing Practices: Includes guidelines on validation, distribution, and handling of APIs.
- PIC (Active Pharmaceutical Ingredients Committee) Guidelines: Various documents on GMP, quality management, cleaning validation, computer validation, and more specific to API manufacturing.
- PIC/S (Pharmaceutical Inspection Co-operation Scheme) Guidelines: Provides guidance on inspection and GMP for medicinal products.

11.4.2 Compliance Framework Overview

Drug Master File (DMF) serves as a globally accepted framework for ensuring compliance with regulatory and quality standards in the pharmaceutical industry. It encompasses all aspects of the API (Active Pharmaceutical Ingredient) supply chain, from sourcing raw materials to facility management, adhering to Good Manufacturing Practices (GMP), and meeting international guidelines.

11.4.3 Status of Compliance in Pakistan

Imports of APIs into Pakistan from countries like India, China, and Bangladesh etc. require DMF and various certifications. APIs manufactured in these countries are accepted globally due to compliance with international standards and the provision of DMF for regulatory registrations in other countries. APIs manufactured in Pakistan also strive to meet global standards; however, availability of DMF is limited for many APIs. This limitation prevents medicines made with these APIs from being registered internationally, affecting export potential.

11.4.4 API Challenges: Pakistan

Drug Master File (DMF)

- Limited Availability: DMF for every API is not available due to the high cost of upgrading facilities to meet international standards.
- Credibility Concerns: Local API manufacturers often fail vendor qualification audits required to validate DMF documentation, hindering local adoption and trust in domestic APIs.

Compliance Gaps

- Despite alignment with international guidelines by the Drug Regulatory Authority of Pakistan (DRAP), maintaining consistent quality according to GMP standards remains a challenge.
- Facilities often fall short in infrastructure, technology, and trained personnel required for comprehensive compliance.

Infrastructure Cost

- Upgrading facilities to meet FDA, EU, and other global standards demands substantial investments that may not be economically feasible for many local companies.
- Improved compliance could potentially unlock larger export markets, but the initial investment poses a significant barrier.

Research and Development Shortcomings

- Insufficient bioequivalence labs and R&D capabilities hinder thorough impurity testing and product development against international benchmarks.
- Strengthening R&D structures is crucial for maintaining quality and compliance throughout production phases.

11.4.5 Recommendation

A research study focusing on API compliance in Pakistan is crucial for assessing current challenges, identifying improvement opportunities, and fostering regulatory alignment with global standards. This approach not only enhances industry credibility but also supports sustainable growth in the pharmaceutical sector.

11.4.6 Why Research Study is Needed

Understanding Compliance Status

- A comprehensive research study can provide an updated assessment of the current compliance status of API manufacturing in Pakistan.
- It can identify specific gaps in meeting international quality standards and the regulatory challenges faced by local manufacturers.

Identifying Strategic Interventions

- Research findings can highlight strategic interventions needed to enhance compliance, such as targeted investments in infrastructure and technology.
- Insights into regulatory alignment and vendor qualification processes can inform policy adjustments for smoother integration into global supply chains.

Promoting Industry Competitiveness

- By addressing compliance challenges through research-backed initiatives, Pakistan's API industry can improve competitiveness in global markets.

- Facilitating better alignment with international standards can open up export opportunities and strengthen economic contributions from pharmaceutical exports.

11.4.7 Deliverables

- Recommend Solutions and Stakeholder Roles: Propose actionable recommendations for bridging these gaps. Define roles for stakeholders including DRAP, industry, pharmaceutical companies, R&D institutions, and others to strengthen API quality infrastructure.
- Develop a National Strategic Implementation Framework: Formulate a strategic framework outlining priorities and timelines for implementation. Address policy and legislative needs to support the growth of the API industry in Pakistan and facilitate export potential.

11.4.8 Impact

- Enhancing Export Potential: By ensuring APIs meet international standards, Pakistan can access lucrative global markets, boosting economic growth.
- Improving Healthcare Quality: High-quality APIs contribute to safer and more effective pharmaceutical products, benefiting public health domestically and globally.
- Attracting Investment: Clear standards and robust infrastructure attract foreign investment in Pakistan's pharmaceutical sector, creating jobs and fostering innovation.

REFERENCES

BIDA (Bangladesh Investment Development Authority). (n.d). *Pharmaceuticals & API healthy living for all*. https://bida.gov.bd/storage/app/uploads/public/625/65e/892/62565e892e47b690594923.pdf

Cherian, J. J., Rahi, M., Singh, S., Reddy, S. E., Gupta, Y. K., Katoch, V. M., ... & Bhargava, B. (2021). India's road to independence in manufacturing active pharmaceutical ingredients: Focus on essential medicines. *Economies*, *9*(2), 71.

CII (Confederation of Indian Industry). (2020). *Indian API industry - Reaching the full potential*. KPMG in India, CII report.

DRAP (Drug Regulatory Authority of Pakistan). (2022, March 15). *Promotion and growth of active pharmaceutical ingredient (API) industry in Pakistan*. https://www.dra.gov.pk/about_us/legislation/sros/promotion-and-growth-of-active-pharmaceutical-ingredient-api-industry-in-pakistan/

Fischer, S., Knoll, V., Alleweldt, F. & Vogler, S. (2023). *Potential measures to facilitate the production of active pharmaceutical ingredients (APIs)*. European Union.

PwC (PricewaterhouseCoopers). (2020). *Reviving India's API industry: From the viewpoint of the COVID-19 outbreak*. https://www.pwc.in/assets/pdfs/industries/pharmaceuticals-and-life-sciences/reviving-indias-api-industry.pdf

Global Village Space. (2022, February 07). Pakistan needs a road map and a clear API policy. https://www.globalvillagespace.com/pakistan-needs-a-road-map-and-a-clear-api-policy/

GOP (Government of Pakistan). (2019). *National tariff policy 2019-24*. Islamabad: Commerce Division, Ministry of Commerce & Textile.

GOP (Government of Pakistan). (2022a). *Notification No.F.1-2/2022-CEO-DRAP*. Drug Regulatory Authority of Pakistan. https://www.dra.gov.pk/wp-content/uploads/2022/05/API-promotion-policy-DRAP-2032022.pdf

GOP (Government of Pakistan). (2022b). *Pakistan export strategy business process outsourcing 2023-2027*. Islamabad: Trade Development Authority of Pakistan.

GOP (Government of Pakistan). (2023). *Pharmaceutical raw material imports data 2014-2022: Chapter 29*. Federal Board of Revenue.

ICAP (The Institute of Chartered Accountants of Pakistan). (2020, July 10) *Pharmaceutical and healthcare industry challenges & opportunities* [ICAP webinar]. https://icap.org.pk/paib/pdf/PharmaceuticalHchallengesOpportunities.pdf

IQVIA. (2020, December 11). IQVIA. (2023). *EU fine chemical commercial KPI: Executive summary*. https://efcg.cefic.org/wp-content/uploads/2021/06/20201211_IQVIA-for-EFCG_Executive-summary.pdf

IQVIA. (2023). *Pharmaceutical market data 2023*. Access restricted to clients only. https://www.iqvia.com/locations/pakistan

Kaleem, M. F. (2022, March 04). DRAP approves API policy to make pharma industry on a par with global standards. *Daily Times*. https://dailytimes.com.pk/895239/drap-approves-api-policy-to-make-pharma-industry-on-a-par-with-global-standards/

Mehmood, S. (2022). Regulating the pharmaceutical industry: An analysis of the Drug Regulatory Authority of Pakistan (DRAP). In F. Zulfiqar (Ed.), *Evaluations of regulatory authorities,*

government packages, and policies. Islamabad: Pakistan Institute of Development Economis.

Mordor Intelligence. (2023). *Active pharmaceutical ingredients (API) market size & share analysis - growth trends & forecasts (2024 - 2029)*. https://www.mordorintelligence.com/industry-reports/global-active-pharmaceutical-ingredients-api-market

PACRA (The Pakistan Credit RatingAgency Limited). (2021, May). *Pharmaceutical sector study*. https://www.pacra.com/sector_research/PACRA%20Research%20-%20Pharmaceutical%20-%20May'21.pdf

Rasheed, H., Hoellein, L., Bukhari, K. S., & Holzgrabe, U. (2019). Regulatory framework in Pakistan: situation analysis of medicine quality and future recommendations. *Journal of Pharmaceutical Policy and Practice*, *12*, 1-15.

Sardella, A. (2021). *The US active pharmaceutical ingredient infrastructure: The current state and considerations to increase US healthcare security*. Washington University in St Louis.

Singh, S., & Popli, H. (2021). indian active pharmaceutical ingredient (API) industry: An overview on challenges, opportunities & regulatory prerequisites. *International Journal of Drug Regulatory Affairs*, *9*(2), 66-76.

The Daily Star. (2021, October 13). Pharma raw material makers get tax exemption until 2032. https://www.thedailystar.net/business/economy/industries/tax-customes/news/pharma-raw-material-makers-get-tax-exemption-until-2032-2197101

VIS Credit Rating Company Limited. (2023, October). Pharmaceutical sector report. https://docs.vis.com.pk/docs/PakistanPharmaceuticalSectorReport-Oct-2023.pdf

World Bank. (2024). Current health expenditure per capita (current US$). https://data.worldbank.org/indicator/SH.XPD.CHEX.PC.CD?skipRedirection=true&view=map