Policy Innovation Lab

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Policy Brief on

Flowering Bulb Production in AJK

A Pathway to Rural Prosperity, Women Empowerment, and Youth Employment







Rewiring Minds

Kashmir Institute of Management , Muzaffarabad

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An Introduction:

The Policy Innovation Lab is a groundbreaking initiative of the Kashmir Institute of Management (KIM), conceived in line with the mandate of the KIM Act I of 2014, Section 4, Clause (k), which envisions KIM

> "to serve as a research institute for the Government on matters of public policy and to advise the Government on such public policy matters as may be referred to it."

Endorsed by the Board of Governors in its 17th meeting held on 7th August 2025, this initiative marks a forward-looking step with constructive thinking towards transforming KIM into a hub of applied policy research, innovation, and leadership development—not only for AJ&K but also for the entire country. Designed as a low-cost, high-impact platform, the Policy Innovation Lab will nurture fresh ideas, bridge the gap between research and practice, and generate policy solutions and proposals for the ministries and departments at the AJ&K and national levels, serving as a think tank by bringing together policy practitioners, academia, and professionals who are experts in the field to respond to the evolving innovations in the context of AI revolution and challenges of governance, economic development, and public service delivery in order to uplift citizens' standards of living.

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Preface

The Kashmir Institute of Management (KIM), Azad Jammu & Kashmir, is committed to advancing evidence-based policymaking and promoting inclusive economic development through research, innovation, and institutional capacity building. This policy report titled *"Promoting Flowering Bulb Production in AJK: A Pathway to Rural Prosperity, Women Empowerment, and Youth Employment"* is a forward-looking initiative aimed at transforming the rural economy of AJK through sustainable floriculture and horticultural entrepreneurship.

Azad Jammu & Kashmir possesses a unique agro-climatic advantage, characterized by fertile valleys, moderate temperatures, and high-altitude terrains conducive to the cultivation of high-value flowering bulbs such as tulips, daffodils, gladiolus, narcissus, and lilies. However, despite these natural endowments, the region's floriculture sector remains underdeveloped, and the potential of flower and bulb production as a source of rural income, women's empowerment, and youth employment remains largely untapped.

Recognizing this opportunity, this policy report provides a comprehensive technical and economic assessment of the feasibility of establishing a flowering bulb production culture in AJK. It integrates analysis across multiple dimensions—**agro-climatic suitability, market potential, production systems, infrastructure and investment requirements, and socio-economic impacts**—to support the formulation of a practical, evidence-based roadmap for the government, development partners, and private sector stakeholders.

The report begins with an overview of the **technical and climatic suitability** of AJK for bulb and flower cultivation, identifying key environmental and soil factors that support the sustainable growth of floriculture crops. It then explores the **economic and market potential**, analyzing domestic and international trends, price dynamics, and export opportunities. Detailed sections on **production systems and technical specifications** outline the cultivation practices, pest management, harvesting protocols, and post-harvest handling necessary to ensure high-quality yields.

Furthermore, the report identifies the **infrastructure, investment, and capacity-building needs** essential to developing an integrated value chain for floriculture in AJK. The **socio-economic analysis** emphasizes the transformative potential of this initiative for poverty alleviation, gender inclusion, and rural employment—particularly for women and youth who can benefit from home-based, small-scale bulb and flower enterprises.

A key contribution of this report is its focus on **implementation, risk assessment, and monitoring frameworks**, providing policymakers and practitioners with actionable guidance for phased rollout and performance tracking. It underscores the importance of public-private

partnerships, community engagement, and targeted technical assistance as critical enablers of success.

Through this study, KIM aims to catalyze a policy dialogue around floriculture as a viable pathway for **inclusive, green, and sustainable rural development**. The proposed interventions align with the broader development objectives of the Government of AJK—especially in the domains of **poverty reduction, women's economic participation, and youth entrepreneurship**—and contribute to Pakistan's national vision for agricultural diversification and export-led growth.

We hope that this report will serve as a foundation for collaborative action among policymakers, researchers, farmers, and private sector actors toward building a resilient and competitive floriculture industry in Azad Jammu & Kashmir—one that not only enhances local livelihoods but also celebrates the region's natural beauty and potential as the "Valley of Flowers."

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Promoting Flowering Bulb Production in AJK: A Pathway to Rural Prosperity, Women Empowerment, and Youth Employment

Pakistan's floriculture sector holds immense untapped potential, yet the country continues to rely heavily on imported flowering bulbs and cut flowers. In 2023 alone, Pakistan imported approximately USD 538,920 worth of fresh cut flowers and buds, totaling more than 133,000 kilograms, primarily from Kenya and other flower-exporting countries. Similarly, a large volume of flowering bulbs and ornamental plants are imported annually to meet the demand of high-end markets in cities such as Lahore, Karachi, and Islamabad. Conversely, the export of domestically produced bulbs, tubers, and cut flowers remains modest—valued at only USD 696,790 in 2023, with the main destinations being UAE, Kuwait, Qatar, the USA, and Iraq. The overall floriculture export earnings of Pakistan stood at USD 1.6 million in FY 2020–21, reflecting a small and underdeveloped industry that relies far more on imports than exports.

This imbalance highlights both a challenge and an opportunity. While demand for ornamental plants and flowering bulbs continues to rise domestically and globally, local production capacity remains weak. Establishing a flowering bulb production culture in Azad Jammu and Kashmir (AJK) can strategically transform this scenario—creating sustainable livelihoods, empowering women, and generating youth employment in a region blessed with ideal agro-climatic conditions.

Agro-Climatic Advantage of AJK

AJK's temperate climate, fertile soils, and high-altitude valleys provide a natural environment similar to that of world-renowned bulb-producing regions such as the Netherlands and parts of Turkey. The region's mild summers and cool winters are conducive to the growth of bulbs such as tulips, daffodils, hyacinths, gladiolus, narcissus, and lilies. These flowers not only command high market prices but also offer potential for processing, packaging, and value-added exports. Smallholder farmers and rural households in AJK can be trained and supported to produce bulbs and flowers under greenhouse or open-field systems using affordable technology and community-based cooperatives.

Economic and Social Potential

The global floriculture industry is estimated to be worth over USD 60 billion annually, with consistent growth driven by urbanization, rising incomes, and lifestyle changes. Domestically, Pakistan's expanding middle class and growing demand for landscape beautification, event decoration, and religious or cultural festivities provide a stable year-round market. By developing local production clusters in AJK, Pakistan can reduce its import dependency and retain significant value within the local economy.

Each hectare of land under flowering bulb cultivation can generate five to ten times more income than traditional cereal crops, while also requiring less land and water. This presents an ideal opportunity for women and youth-led micro-enterprises. Women, especially in rural AJK, can participate in bulb sorting, packaging, nursery management, and flower processing activities close to home—ensuring both income generation and social inclusion. Similarly, trained youth can engage in greenhouse management, hybridization, marketing, and e-commerce sales of flowers and bulbs.

Poverty Alleviation and Rural Transformation

A community-based bulb production model can significantly contribute to poverty alleviation and rural development. Through training, small credit access, and cooperative marketing, rural households can establish sustainable businesses producing high-value floriculture products. The multiplier effect of this initiative—linking farmers, women's groups, traders, and exporters—would stimulate local economies and promote inclusive growth.

Moreover, integrating AJK's bulb production into eco-tourism and green entrepreneurship initiatives could enhance the region's appeal as a "Valley of Flowers," attracting visitors and investors while creating green jobs. Public-private partnerships and technical support from agricultural universities and development agencies can further strengthen this ecosystem.

The creation of a flowering bulb production culture in AJK is not merely an agricultural intervention—it is a transformative socio-economic strategy. It aligns with national priorities for poverty alleviation, women empowerment, youth employment, and import substitution. With modest investment and strong institutional coordination, AJK can emerge as a floriculture hub of Pakistan, contributing to rural prosperity and sustainable development while positioning Pakistan as a future player in the global floriculture market.

1. Technical and Climatic Suitability of AJK for Flower and Bulb Cultivation

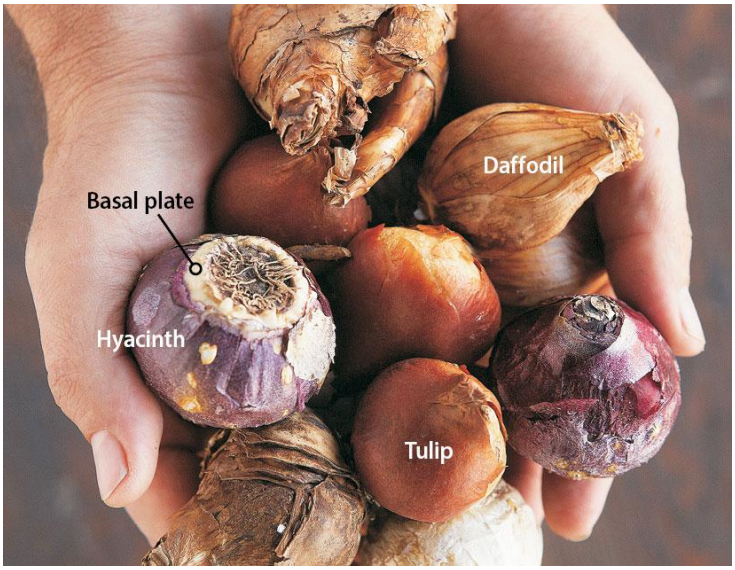
AJK, located in northern Pakistan, spans altitudes from 360 m to 6,325 m above sea level, creating a range of microclimates from sub-tropical humid in lower valleys to temperate and alpine in higher regions. This diversity is advantageous for flowering bulbs, which require specific conditions for growth, including a chilling period for vernalization.

Key Factors:

- **Temperature**: Average annual temperatures vary by location. In higher altitudes like Sharda, it averages 2.4°C, with cold winters (January averages 2.21°C in Bagh). Tulips, daffodils, hyacinths, and narcissus thrive in regions with winter lows of 0–10°C for 12–16 weeks, similar to Himalayan areas like Jammu & Kashmir (J&K), where tulips are successfully cultivated. Lower AJK areas (e.g., Kotli) have milder winters but can support forced production.
- **Rainfall**: Annual precipitation averages 1,400–1,800 mm, with peaks in July (up to 251 mm in Nikyal). This supports rain-fed cultivation, but supplemental irrigation is needed during dry spells (December averages 41 mm). Bulbs prefer well-drained conditions to avoid rot.
- **Soil**: Soils are fertile, loamy, and well-drained in many areas, with pH 6.0–7.5 ideal for bulbs. Higher altitudes have organic-rich soils from forest cover, suitable for narcissus and daffodils, which prefer slightly acidic conditions.
- **Altitude**: Mid-to-high elevations (1,000–3,000 m) mimic native habitats of these bulbs in the Himalayas, enabling natural growth without extensive greenhouses. Studies in northern Indian Himalayas show strong performance of tulip cultivars at varying altitudes.

Overall, AJK is highly suitable, particularly in districts like Muzaffarabad and Bagh, comparable to successful tulip production in Kashmir.




Daffodil
Basal plate
Hyacinth
Tulip



2. Economic and Market Potential

Pakistan's floriculture sector is expanding, with exports of live plants and bulbs at US$3.39 million in 2024, but untapped potential exceeds US$729 million in horticulture. By 2025, the flower seed market is projected to grow at 0.14%, driven by domestic demand and exports.

- **Domestic Market**: Urban centers like Lahore and Karachi consume cut flowers and bulbs, with Pattoki's rose market gaining global attention. AJK can supply seasonal blooms, reducing imports (e.g., tulips from abroad).
- **Export Potential**: Gulf countries offer high demand for fresh and potted flowers, with Pakistan targeting US$2 billion in horticulture exports by 2028. Collaboration with China could enhance technology transfer. AJK's proximity to ports via improved roads supports this.

Profitability: Average bulb growers earn $300,000 annually globally; in Pakistan, small-scale operations yield 20–30% margins after costs.

3. Detailed Production Systems

Site Selection

Choose well-drained, sunny sites at 1,000–2,500 m altitude with loamy soil (pH 6.0–7.0). Avoid waterlogged areas to prevent bulb rot.

Propagation

Primarily from bulbs and offsets. Tulips and hyacinths use pre-chilled bulbs planted in autumn; daffodils and narcissus multiply naturally. Tissue culture for scaling up.

Irrigation

Drip systems for efficient water use (500–700 mm/season), supplementing rainfall.

Pest Management

Integrated approaches: Monitor for aphids, botrytis; use neem-based pesticides. Remove diseased plants.

Harvesting

Cut flowers at bud stage; lift bulbs post-flowering (June–July for tulips).

Post-Harvest Handling

Cool storage at 2–5°C; avoid mixing narcissus with other flowers due to sap toxicity.

4. Infrastructure, Investment, and Capacity-Building Requirements

- **Infrastructure**: Drip irrigation, storage sheds, basic greenhouses for forcing (PKR 200,000–500,000/ha). Roads and cold chains essential.
- **Investment**: Initial costs for 1 ha: PKR 500,000 (bulbs/seeds PKR 100,000, tools/irrigation PKR 200,000, labor PKR 200,000). Scale to PKR 1–2 million for commercial setup.
- **Capacity-Building**: Training programs on propagation and pest management via agricultural extensions; partnerships with SKUAST (Kashmir) for expertise. Focus on women's groups for participation.

5. Socio-Economic Impact

Floriculture can employ 150,000+ in similar districts, generating income and alleviating poverty. In AJK, with female unemployment at 23–53%, it promotes women's empowerment in agriculture, enhancing food security and rural development. Agriculture contributes to GDP growth and poverty reduction in rural Pakistan.

Impact Area	Description	Estimated Benefits in AJK
Employment	Labor-intensive; 10–20 jobs/ha	Reduces rural unemployment (current 20%+ for women)
Poverty Alleviation	Income from sales (PKR 200,000–)	Lifts 20–30% of participating households above poverty line
Women's Participation	Flexible home-based roles	Increases female labor force from 7.9% to 15–20% in project areas

2 Technical Feasibility and Climatic Suitability

2.1 Agro-Climatic Conditions

- **Temperature Requirements**: Flowering bulbs such as tulips, daffodils, and hyacinths require distinct seasonal variations with cold winters for proper vernalization and moderate summers for growth. AJK's temperate climate, with winter temperatures frequently dropping below 5°C, provides **ideal conditions** for the natural chilling process essential for bulb development. The region's summer temperatures typically ranging between 20–25°C create favorable conditions for vegetative growth and flowering without the heat stress experienced in Pakistan's plains.

- **Altitude Considerations**: Different altitudes within AJK offer **microclimatic advantages** for various production aspects. Lower valleys (1,000–1,500 meters) are suitable for early-season production, while mid-altitude areas (1,500–2,000 meters) work well for main-season crops. Higher elevations (2,000–2,500 meters) can be utilized for late-season production and **bulb multiplication**, leveraging the cooler temperatures that prevent virus buildup and enhance bulb quality.

Rainfall and Water Resources: AJK receives **ample precipitation** distributed across various seasons, with annual rainfall between 1,000–1,500 mm in most areas. This natural water availability reduces irrigation requirements during much of the growing season. However, **supplemental irrigation** is necessary during critical growth phases, particularly for commercial-scale production. The region's extensive river systems and natural water sources provide adequate resources for drip irrigation systems, ensuring **water use efficiency** and conservation.

2.2 Soil Requirements and Site Selection

- **Soil Characteristics**: Flowering bulbs thrive in **well-drained soils** with good organic matter content and a slightly acidic to neutral pH (6.0–7.0). Research from similar Himalayan regions indicates that soils in AJK can be modified to meet these specifications through the addition of sand (20–30%) and organic matter (15–20 kg/m^2), significantly improving soil structure and fertility for optimal bulb development. The incorporation of **leaf manure** and **farmyard manure** (FYM) has proven effective in creating the light, well-aerated soil conditions that bulbs require for proper formation and expansion.

- **Land Preparation**: Successful bulb production requires **thorough land preparation** beginning 2–3 months before planting. This process includes deep plowing (30–40 cm), removal of stones and debris, incorporation of organic amendments, and bed formation. Research from Rawalpindi demonstrates that proper soil modification with organic matter can create optimal growing conditions, even in initially marginal soils. Raised beds with **adequate drainage** are essential to prevent bulb rot, particularly during the monsoon season, with recommended bed heights of 15–20 cm above ground level.

Table: Optimal Growing Conditions for Selected Flower Bulbs in AJK

Bulb Type	Optimal Altitude (meters)	Planting season	Harvest Period	Soil pH Range	Chilling Requirement (weeks at <5°C)
Tulip	1,500–2,500	Nov-Dec	Mar-Apr	6.0–7.0	12–16
Daffo	1,200–2,200	Sep-Oct	Apr-May	6.0–6.5	8–12
Hyacinth	1,300–2,300	Oct-Nov	Mar-Apr	6.5–7.0	10–14
Narci	1,200–2,200	Sep-Oct	Apr-May	6.0–6.5	8–12

3 Economic Viability and Market Analysis

3.1 Market Potential and Opportunities

- **Domestic Market Potential**: Pakistan currently **imports 100%** of its tulip bulbs from the Netherlands, creating an immediate domestic market opportunity for locally produced bulbs estimated at approximately 20 crore rupees annually, based on import patterns from similar regions. The domestic cut flower market in major urban centers like Islamabad, Rawalpindi, and Lahore is expanding rapidly, driven by **rising disposable incomes** and changing consumption patterns. With proper production planning, AJK growers could potentially supply 25–30% of Pakistan's domestic bulb requirement within five years, significantly reducing import dependence and retaining valuable foreign exchange within the country.

- **Export Opportunities**: The **strategic positioning** of AJK provides potential access to multiple export markets, including the Gulf Cooperation Council (GCC) countries, where demand for flowers and ornamental plants is growing at approximately 15% annually. Saudi Arabia's NEOM mega-project represents a particularly promising market, having generated substantial demand for diverse flora including roses, jasmine, and desert-tolerant plants. Additionally, price advantages stemming from **lower labor costs** in Pakistan (estimated at 40–50% below European levels) could make AJK-produced bulbs competitive in international markets, especially in South and Southeast Asia where similar climate adaptation is required.

- **Value-Addition Potential**: Beyond raw bulb production, significant opportunities exist for **value addition** through several channels. These include the production of pre-treated and pre-sprouted bulbs commanding premium prices, cut flowers for specialty markets, and dried flower products for the herbal cosmetics industry, where Pakistan already exports roses to Japan and Europe. The development of **secondary products** such as essential oils, particularly from narcissus and hyacinth, could further enhance revenue streams and create additional processing employment, especially for women in rural areas.

Bulb Price Table (PKR per 10 bulbs):

Bulb Type	Price Range (PKR)
Allium	800 - 1,500
Amaryllis (local)	2,500 - 3,000
Amaryllis (imported)	4,000 - 7,000
Anemone	200 - 400
Begonia	1,000 - 2,000
Caladium	1,500 - 2,500
Calla Lily	1,200 - 2,000
Canna Lily	500 - 1,000
Crocus	800 - 1,500
Crown Imperial (Fritillaria imperials)	3,000 - 5,000
Crimum Lily	2,900 - 3,500
Cyclamen	1,500 - 2,500
Daffodil (local Narcissus)	590 - 700
Daffodil (imported)	1,000 - 2,000
Dahlia (decorative)	800 - 1,500
Dutch Iris	400 - 800
Freesia (single)	800 - 1,200
Freesia (double)	1,000 - 1,500
Fritillaria (various)	2,000 - 4,000
Galanthus (Snowdrop)	1,000 - 1,800
Gladiolus (local mix)	300 - 500
Gladiolus (imported, specific colors)	600 - 1,000
Gloriosa Lily (Glory Lily)	2,000 - 3,500
Gloxinia	1,500 - 2,500
Hyacinth	1,200 - 2,000
Hymenocallis (Spider Lily)	1,000 - 1,800
Ipheion (Starflower)	500 - 900
Iris (Bearded)	1,500 - 3,000 (per rhizome, price for 10 estimated)
Iris (Siberian)	1,200 - 2,500 (per rhizome, price for 10 estimated)
Ixia (Corn Lily)	400 - 700
Liatris (Blazing Star)	800 - 1,500

Lilium (Asiatic)	1,500 - 2,500
Lilium (Oriental)	2,000 - 3,500
Lilium (Trumpet)	1,800 - 3,000
Muscari (Grape Hyacinth)	500 - 900
Ornithogalum (Star of Bethlehem)	600 - 1,200
Oxalis	500 - 1,000
Polianthes (Tuberose)	400 - 800
Ranunculus	400 - 800
Scilla (Squill)	600 - 1,200
Sparaxis (Harlequin Flower)	500 - 900
Sprekelia (Aztec Lily)	1,500 - 2,500
Tigridia (Tiger Flower)	800 - 1,500
Tulip (Darwin Hybrid)	1,500 - 2,500
Tulip (Triumph)	1,500 - 2,500
Tulip (Parrot)	1,800 - 3,000
Tulip (Fringed)	1,800 - 3,000
Watsonia (Bugle Lily)	800 - 1,500
Zephyranthes (Rain Lily)	300 - 600
Zantedeschia (Calla Lily)	1,200 - 2,000

3.2 Financial Projections and Economic Indicators

- **Investment Requirements**: Establishing a commercially viable bulb industry in AJK will require **substantial upfront investment** in several key areas. Critical infrastructure needs include cold storage facilities (estimated at Rs. 15-20 million for a medium-sized unit), protected cultivation structures (Rs. 3-5 million per hectare for greenhouses with climate control), and bulb processing and packaging units (Rs. 8-12 million for automated cleaning, grading, and treatment facilities). Additional investment will be needed for irrigation systems, refrigeration transport, and laboratory facilities for quality control and virus testing.

- **Revenue Streams**: A diversified bulb farming operation can generate income through **multiple channels** including sale of quality planting material (premium bulbs for commercial growers), cut flowers for domestic florist markets, value-added products (dried flowers, essential oils), and contract multiplication services for international breeders. Based on production data from similar regions, projected revenue per hectare for a mixed bulb operation is estimated at Rs. 1.2-1.5 million annually once full production is achieved, with cut flowers contributing 40%, bulb sales 50%, and value-added products 10% of total revenues.

- **Cost-Benefit Analysis**: Financial modeling based on research from comparable Himalayan regions indicates that a **medium-scale bulb farm** of 4 hectares could achieve breakeven within 3-4 years of operation, with net profits reaching 25-30% of investment by year 5. The internal rate of return (IRR) is projected at 22-28%, making the venture financially attractive compared to many other agricultural investments. Primary economic benefits include **import substitution** (potential savings of Rs. 15-20 crore annually in five years), **export earnings** (potential of $2-3 million annually within five years), and **employment generation** (estimated at 15-20 jobs per hectare in production, plus additional positions in processing and marketing).

4 Production System and Technical Specifications

4.1 Propagation and Cultivation Practices

- **Bulb Selection and Treatment**: Successful commercial production begins with **selection of appropriate varieties** demonstrated to perform well in similar climatic conditions. Research from Rawalpindi indicates that tulip varieties 'Antarctica' and 'Oxford' showed excellent performance with 100% bulb germination and superior morphological characteristics including scape length (29.92 cm for 'Antarctica') and flower size (71.5 mm for 'Oxford'). All imported planting material should undergo **strict quarantine protocols** to prevent introduction of pathogens, with an initial 2-3 week isolation period followed by treatment with appropriate fungicides (thiophanate-methyl or carbendazim) and insecticides (imidacloprid) before planting.

- **Planting Protocols**: Optimal planting time for most spring-flowering bulbs in AJK is from **September to November**, depending on specific species and local climatic conditions. Recommended planting densities vary by species: tulips at 15-20 cm between bulbs and 8-10 cm within rows, daffodils at 20-25 cm between bulbs and 10-12 cm within rows, hyacinths at 15-20 cm between bulbs and 8-10 cm within rows, and narcissus at 20-25 cm between bulbs and 10-12 cm within rows. Planting depth should generally be **three times the bulb height**, with adjustments for soil type (deeper in sandy soils, shallower in clay soils).

- **Nutrition and Irrigation Management**: Bulb crops require **balanced nutrition** with emphasis on potassium for bulb development and phosphorus for root formation. Recommended application rates per hectare include 120-150 kg N, 80-100 kg P_2O_5, and 150-180 kg K_2O, with nitrogen applied in split doses during active growth phases. **Drip irrigation systems** provide the most efficient water delivery, with requirements varying from 25-30 mm per week during initial root establishment to 35-40 mm per week during active growth and flowering stages. Careful **water management** is critical, especially during the final 4-6 weeks before harvest when over-irrigation can promote disease and under-irrigation may reduce bulb size.

4.2 Pest and Disease Management

- **Common Pathogens**: Bulb crops are susceptible to several fungal pathogens including Fusarium oxysporum (bulb rot), Botrytis tulipae (fire disease), and Pythium species (root rot). Implementation of a comprehensive integrated pest management (IPM) program is essential, including cultural practices (crop rotation, proper sanitation), biological controls (Trichoderma applications, Bacillus subtilis treatments), and chemical interventions when necessary with targeted fungicides applied at specific growth stages.

- **Insect Pests**: Primary insect threats include aphids (virus vectors), thrips (flower damage), and nematodes (bulb damage). Monitoring through yellow sticky traps and regular field scouting enables early detection. Control measures include application of compatible insecticides, introduction of biological controls such as ladybugs and lacewings for aphid management, and soil treatments with appropriate nematicides where nematode populations exceed economic thresholds.

- **Viral Diseases**: Virus infections represent a serious threat to bulb production systems, with Tulip Breaking Virus (TBV), Narcissus Yellow Stripe Virus (NYSV), and Arabis Mosaic Virus common concerns. Control strategies focus on use of virus-free planting stock, rigorous aphid control to prevent transmission, prompt removal and destruction of infected plants, and implementation of a certification program to maintain stock health through subsequent multiplication cycles.

4.3 Harvesting and Post-Harvest Management

- **Harvest Timing and Techniques**: Proper harvest timing is critical for optimal bulb quality and storage life. For cut flowers, harvesting should occur in the early morning when flowers are in the colored-bud stage, with immediate placement in clean water containing floral preservatives. Bulbs are harvested when foliage begins to yellow but before complete senescence, typically 4-6 weeks after flowering. Careful handling during harvest is essential to prevent bruising and damage that can serve as entry points for pathogens during storage.

- **Curing and Storage**: Freshly harvested bulbs require proper curing under well-ventilated conditions at temperatures of 20-25°C for 7-10 days to dry outer scales and heal minor injuries. Following curing, bulbs should be cleaned of soil debris and sorted by size. Research from Rawalpindi demonstrates that bulbs stored at 5±2°C for 12-15 weeks maintain viability without fungal development or quality deterioration. Implementation of a temperature-controlled storage system with humidity maintained at 60-70% is essential for preserving bulb quality and ensuring proper floral initiation.

- **Grading and Packaging**: Commercial viability depends on consistent grading according to international standards. Bulbs should be sorted into premium (>12 cm circumference), standard (10-12 cm), and landscape grades (8-10 cm), with pricing structured accordingly. Packaging materials must provide protection during transport while allowing adequate ventilation, with mesh bags being standard for most bulb types. All packaging should be clearly labeled with variety name, size grade, quantity, and production date to meet market requirements.

Table: Post-Harvest Handling Protocol for Flower Bulbs

Harvesting	Lift bulbs carefully, remove soil, retain protective scales	Soil moderately dry, avoid direct sun	No mechanical damage, intact basal plate
Curing	Dry in single layers with good air circulation	20-25°C, 60-70% RH, 7-10 days	Outer scales papery, neck sealed
Cleaning	Remove soil debris, old roots, loose scales	Well-ventilated area	Clean surface, minimal handling
Grading	Sort by size, weight, eliminate defects	Cool environment (15-18°C)	Uniform size within grades, disease-free
Pre-storage Treatment	Fungicide application if needed, dusting	According to product label	Even coverage, proper drying
Storage	Ventilated containers, controlled environment	5±2°C, 60-70% RH, 12-15 weeks	No sprouting, firm texture, no mold

5 Infrastructure, Investment and Capacity Building

5.1 Infrastructure Requirements

- **Production Infrastructure**: Commercial bulb production requires **specialized infrastructure** including climate-controlled greenhouses for initial propagation, particularly for temperature-sensitive phases of growth. These structures should be equipped with automated ventilation, shading systems, and irrigation systems to maintain optimal growing conditions. For field production, investments in **drainage systems** are critical, as bulb crops cannot tolerate waterlogged conditions. Additional necessary infrastructure includes fencing for security, irrigation reservoirs or wells, and operational buildings for equipment storage and worker facilities.

- **Post-Harvest Facilities**: The bulb industry demands **capital-intensive post-harvest infrastructure** to maintain product quality. This includes cold storage units with precise temperature and humidity control, grading and packaging areas with appropriate worktables and sorting equipment, and pre-cooling facilities to rapidly lower field heat after harvest. Processing facilities should be designed with a logical product flow from receiving through cleaning, grading, treatment, and packaging stations to maximize efficiency and minimize damage during handling.

- **Laboratory and Quality Control**: To support a sustainable bulb industry, AJK will need to establish **basic laboratory facilities** for quality control and virus testing. This infrastructure should include equipment for basic tissue culture operations to maintain foundation stock, microscopy for pest and disease identification, and cold storage for maintaining mother bulb collections. These facilities could be established as shared resources through industry associations or government support to make them accessible to multiple growers rather than requiring individual investments.

5.3 Capacity Building and Technical Assistance

- **Skill Development Programs**: Success in the specialized bulb industry requires **comprehensive training** programs targeting various stakeholders. For growers and field technicians, practical modules should cover bulb handling, soil preparation, planting techniques, integrated pest management, irrigation scheduling, and harvest timing. For post-harvest technicians, specialized training in grading standards, cold chain management, and quality control procedures is essential. These programs should combine **classroom instruction** with hands-on demonstration in field settings, initially leveraging international expertise with gradual transition to local master trainers.

- **Knowledge Transfer Partnerships**: Establishing **collaborative relationships** with international bulb production centers, particularly in the Netherlands, Kenya, and India, will accelerate learning and technology adoption. These partnerships could include study tours for AJK technicians and officials to successful operations, virtual knowledge exchange programs using digital platforms, and possibly secondment programs where international experts spend extended periods in AJK providing on-the-ground guidance during critical production phases.

- **Farmer Field Schools and Demonstration Plots**: Creating a network of **demonstration units** across different altitudinal zones in AJK will provide practical learning platforms for prospective bulb growers. These facilities should showcase best practices in bulb production, including soil preparation techniques, irrigation systems, integrated pest management approaches, and post-harvest handling methods. Regular field days and hands-on training sessions at these sites can build confidence among potential adopters and accelerate technology transfer from research to practice.

6 Socio-economic Impact and Community Engagement

6.1 Poverty Alleviation and Employment Generation

The establishment of a commercial bulb industry in AJK holds significant potential for **poverty reduction** through the creation of diverse employment opportunities across the production chain. Labor requirements for bulb production are substantial, estimated at 15-20 workers per hectare under cultivation, significantly higher than many traditional crops. This employment generation is particularly valuable in rural areas where underemployment remains a persistent challenge. The industry will create jobs not only in direct production activities but also in ancillary services including transportation, packaging materials

manufacturing, marketing, and retail, creating a **multiplier effect** throughout the local economy.

The experience from Ethiopia's floriculture industry offers important lessons about potential socioeconomic challenges that must be proactively addressed. Research from the Sululta District in Ethiopia revealed that floriculture industries sometimes control land and water resources in ways that affect smallholder farmers' access, potentially leading to social insecurity and forcing farmers to shift to daily labor. To prevent such negative outcomes, AJK's bulb industry development should incorporate **community benefit agreements** that ensure local populations share in the economic benefits through preferred hiring, support for local entrepreneurs, and protection of common property resources.

6.2 Gender Inclusion and Women's Empowerment

The floriculture sector offers significant opportunities for **women's economic participation** through both direct employment and support enterprises. The experience from Jammu and Kashmir in India demonstrates that floriculture initiatives can specifically target the empowerment of women, youth, and small landholding farmers. In AJK, women already possess substantial knowledge of horticultural practices that can be leveraged for commercial bulb production. Special measures should be implemented to ensure women's inclusion, such as establishing women-operated bulb producer groups, providing gender-segregated training facilities, developing women-friendly tools and equipment, and creating flexible work arrangements that accommodate domestic responsibilities.

Beyond production roles, women can be actively encouraged to participate in value-addition enterprises such as dried flower production, bouquet making, and essential oil extraction, which typically offer higher profit margins than primary production. The development of the bulb industry should specifically allocate resources for women's entrepreneurship development, including access to microcredit facilities, business management training, and market linkage support. These initiatives should be designed with women's participation to ensure they address real constraints and opportunities faced by rural women in AJK.

6.3 Rural Development and Youth Engagement

The bulb industry presents a promising avenue for engaging rural youth who often migrate to urban areas due to limited economic opportunities in traditional agriculture. With around 250,000 youth unemployed in the broader Jammu and Kashmir region, innovative agricultural initiatives are urgently needed. Floriculture offers higher returns per unit area than traditional crops and incorporates technological elements that may appeal to younger generations. Specific programs should be developed to attract youth participation, including startup support for young entrepreneurs, training in digital marketing for floriculture products, and integration of bulb production into agricultural education curricula.

The industry's development can also stimulate broader rural development through infrastructure improvements such as enhanced road networks for market access, reliable

electricity supplies for cold storage facilities, and expanded mobile connectivity for market information access. These improvements would benefit multiple sectors beyond floriculture, creating a positive development spiral in rural areas of AJK. Additionally, the aesthetic improvement from expanded flower cultivation could potentially boost rural tourism, creating additional entrepreneurial opportunities for local residents in hospitality and services.

7 Implementation Plan, Risk Assessment and Mitigation

7.1 Phased Implementation Strategy

- **Phase 1: Foundation Building (Years 0-2)**: The initial phase should focus on establishing demonstration units across 10-15 hectares in selected areas of AJK with proven suitability for bulb production. Primary activities during this period include site selection and preparation, importation of foundation stock, establishment of basic cold storage facilities, and intensive training programs for technical staff and potential growers. This phase should also involve market testing with domestic buyers, development of preliminary branding concepts, and establishment of the organizational structure for industry coordination. Success in this phase should be measured by successful demonstration of technical viability, establishment of trained core teams, and confirmation of market interest.

- **Phase 2: Expansion and Consolidation (Years 2-4)**: Building on lessons from the initial phase, this period should focus on expanding production area to 50-60 hectares across multiple districts of AJK. Key activities include development of local bulb multiplication programs to reduce import dependency, investment in improved processing facilities, active pursuit of export market opportunities, and establishment of a quality certification system. This phase should also see the formation of **producer organizations** to represent grower interests and the development of specialized service providers in areas such as pest management, soil testing, and post-harvest handling. Success indicators include achieving 30-40% domestic market share for certain bulb types, establishing consistent export channels, and developing sustainable local multiplication capabilities.

- **Phase 3: Commercial Scaling and Diversification (Year 5+)**: The final implementation phase should focus on **achieving commercial scale** with 100+ hectares under production and development of diversified product lines. Primary activities include investment in advanced processing facilities for value-added products, development of specialized breeding programs for unique varieties suited to AJK conditions, establishment of AJK as a recognized brand in international markets, and creation of integrated tourism-floriculture experiences. This phase should also include systematic **knowledge export** initiatives where AJK develops expertise that can be marketed to other emerging bulb-producing regions. Success would be measured by achieving significant export volumes, developing recognizable brand identity, and creating sustainable rural employment across the value chain.

7.2 Risk Assessment and Mitigation Strategies

Production Risks:

Bulb cultivation faces several **biological threats** including disease outbreaks, pest infestations, climate variability, and genetic degradation of planting material. Mitigation strategies include implementing strict phytosanitary measures, maintaining foundation stock under protected conditions, diversifying production across multiple locations with different microclimates, and developing climate-resilient production protocols. Insurance products specifically designed for floriculture operations should be developed in partnership with financial institutions to provide additional risk transfer mechanisms for growers.

Market Risks:

The specialty bulb market faces potential challenges including **price volatility**, intense international competition, changing consumer preferences, and trade barriers. Risk mitigation approaches include product diversification across multiple bulb types and market segments, development of contractual arrangements with buyers, investment in brand development to create customer loyalty, and active participation in international trade fairs to maintain market awareness. Additionally, the development of domestic market applications for bulbs that do not meet export standards can provide a valuable buffer against market fluctuations.

Implementation Risks:

Project execution faces potential hurdles including **inadequate technical capacity**, insufficient participation from local communities, bureaucratic delays, and funding shortfalls. Mitigation strategies include phased implementation to allow for learning and adjustment, development of strong community engagement plans from the outset, establishment of clear governmental support mechanisms, and creation of diversified funding sources including public, private, and international development resources. Regular monitoring and evaluation with key performance indicators will allow for timely corrective actions throughout the implementation process.

7.3 Monitoring and Evaluation Framework

A robust **monitoring system** should be established from the outset to track progress against established indicators and facilitate evidence-based decision making. Key performance indicators should include production metrics (hectares under cultivation, bulb yields, quality grades), economic indicators (farmer incomes, employment generated, export revenues), social indicators (women's participation, youth engagement, beneficiary satisfaction), and environmental indicators (water use efficiency, chemical input reduction, soil health maintenance). Regular independent evaluations should be conducted at the conclusion of

each implementation phase to assess overall impact and inform planning for subsequent phases.

8 Conclusion and Recommendations

The establishment of a **commercial flower bulb industry** in Azad Jammu & Kashmir represents a viable opportunity with significant potential for economic growth, job creation, and sustainable development. The region's **favorable agro-climatic conditions** create natural advantages for producing quality bulbs that can compete in both domestic and international markets. The proposed initiative aligns with broader national goals of **agricultural diversification**, **export enhancement**, and **rural poverty reduction** while building on global examples of successful floriculture development in similar regions.

Based on the comprehensive assessment contained in this report, the following key recommendations are offered:

- **Immediate Action**: Establish demonstration plots using imported foundation stock in selected areas of AJK to provide proof of concept and build technical capacity.
- **Policy Support**: Develop a specific floriculture policy for AJK that includes incentives for bulb production, infrastructure support, and streamlined regulatory processes.
- **Stakeholder Engagement**: Create multi-stakeholder platforms involving government agencies, research institutions, private sector participants, and community representatives to guide sector development.
- **Investment Promotion**: Develop attractive investment packages for private sector participation in bulb production, processing, and marketing ventures.
- **International Partnerships**: Establish technical cooperation agreements with leading bulb-producing countries to accelerate knowledge transfer and technology adoption.

With strategic implementation of these recommendations, AJK has the potential to develop a **sustainable and competitive bulb industry** that generates substantial economic benefits while enhancing the region's natural beauty and supporting the livelihoods of its rural population. The success of this initiative could serve as a model for other temperate regions of Pakistan seeking to diversify their agricultural economies through high-value horticultural production.