Public Policy Note

Policy Innovation Lab
KIM Muzaffarabad

Rewiring Minds

Following Chinese Path of Economic Development

" Reverse Engineering Model "

For AJK's Economic, Industrial, and Agricultural Development



Courtesy: Kashmir Institute of Management, Muzaffarabad

PREFACE

It is with a profound sense of responsibility and optimism that I present this policy proposal titled **"From Imitation to Innovation: Lessons from China's Reverse Engineering Model for Economic, Industrial, and Agricultural Development – A Guiding Framework for Pakistan and AJK's Science, Technology, and Innovation Policy 2026."**

As Director General Kashmir Institute of Management (KIM and Chief Coordinator of Policy Innovation Lab, I have long observed that Azad Jammu & Kashmir (AJK), despite its abundant natural resources, strategic location, and talented youth, remains trapped in a cycle of technological dependence and imported solutions. Our industries import machinery at exorbitant costs, our farmers rely on outdated tools and seeds developed elsewhere, and our universities—brimming with potential—remain disconnected from the real needs of our economy. This status quo is neither sustainable nor befitting a region that aspires to contribute meaningfully to Pakistan's progress.

History offers us a powerful counter-example. In just four decades, China transformed itself from a nation that openly copied foreign technology into the world's most prolific innovator and manufacturer. The foundational pillar of that transformation was neither unlimited capital nor blind luck—it was a deliberate, state-supported, and systematically executed policy of **reverse engineering**, followed by absorption, adaptation, and ultimately indigenous innovation. China proved that latecomers need not remain perpetual followers; with the right framework, they can leapfrog decades of development.

AJK is uniquely and fortunately positioned to adopt this proven pathway with unprecedented speed. Unlike the Islamic Republic of Pakistan, the Government of Azad Jammu & Kashmir is not a signatory to any international copyright, patent, or intellectual-property enforcement agreements with foreign nations, including membership in the World Intellectual Property Organization (WIPO), the Paris Convention, the Berne Convention, or the TRIPS Agreement under WTO. This legal reality provides AJK with a decisive strategic advantage: the ability to systematically pursue reverse engineering, product replication, and rapid technology absorption without the legal hurdles, sanctions, or retaliatory measures that constrain fully sovereign WTO-member states. This is not an invitation to irresponsibility, but a rare window of opportunity that must be utilized intelligently and temporarily—until AJK itself achieves technological maturity and voluntarily aligns with global IP norms from a position of strength rather than weakness.

This policy note firmly asserts that **AJK can—and must—seize this historic opening**. We do not need to reinvent the wheel; we need to understand it, improve it, produce it locally at lower cost, and eventually design a better one. The proposed model places our universities and R&D institutions at the very center of this effort, converts curiosity-driven academic research into market-ready products, and creates a self-sustaining financial ecosystem where profits from commercialized innovations are ploughed back into students, faculty, laboratories, and long-term research endowments.

By establishing dedicated Reverse Engineering Labs, forging unbreakable industry–academia linkages, purchasing benchmark products for systematic study, and distributing commercialization profits equitably among all stakeholders, AJK can achieve in years what would otherwise take generations. From compact tractors and drip-irrigation systems to high-yield hybrid seeds and renewable-energy inverters, the lists of target products and crops presented in this document are not mere wish-lists—they are actionable starting points selected for their immediate relevance to our terrain, climate, and economy.

This is not a proposal for permanent piracy; it is a roadmap for **accelerated learning, lawful adaptation within our current jurisdictional reality, and eventual originality**. The same nations that today criticize reverse engineering once used identical methods during their own rise. AJK now stands at that same inflection point.

The time for tentative pilot projects and endless consultancy reports is over. AJK possesses the human capital, the political will exists at the highest levels, the Chinese model has been stress-tested at continental scale, and—crucially—we face no binding international legal constraints that prevent decisive action.

I urge the Government of Azad Jammu & Kashmir to treat this framework not as one policy option among many, but as the cornerstone of our **Science, Technology, and Innovation Policy 2026**. Let us launch the first Reverse Engineering Units in our leading universities in the coming fiscal year, demonstrate tangible results within twenty-four months, and position AJK as Pakistan's laboratory for technological self-reliance.

The journey from imitation to innovation begins with a single, bold step. Let AJK take that step—today.

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November 2025

Public Policy Note:
From Imitation to Innovation:
Lessons from China's
Reverse Engineering Model
for Economic, Industrial, and Agricultural Development –

"A Guiding Framework for Pakistan and AJK's Science, Technology, and Innovation Policy 2026"

Introduction

China's transformation from an imitator of foreign technology to a global innovation powerhouse provides valuable lessons for Pakistan, particularly for AJK. This process evolved through three key stages:

1. **Early Imitation** – Copying and replicating existing foreign technologies.
2. **Technology Absorption and Adaptation** – Modifying and improving imported technologies.
3. **Independent Innovation** – Developing indigenous, cutting-edge solutions.

AJK must strategically adopt **reverse engineering** as a core pillar of its **Science, Technology, and Innovation Policy 2026** to accelerate industrial, economic, and agricultural development. This will require a structured approach involving universities, R&D institutions, and the private sector to create a sustainable ecosystem for technological innovation.

Strategic Framework for Reverse Engineering in AJK

1. Establishing Reverse Engineering Units in Universities and R&D Institutions

- University departments in **science, technology, engineering, and agriculture** will set up specialized **Reverse Engineering Labs (RELs)**.
- These labs will focus on identifying, analyzing, and replicating advanced technologies from global markets, particularly China.
- Faculty and students will collaborate with government-funded R&D entities to enhance local technological capacity.

2. Industry-Academia Collaboration & Business Model

- The AJK government will **purchase selected products for reverse engineering**.
- University and R&D centers will **disassemble, analyze, and develop improved versions** of these products.
- Universities will work in partnership with **the AJK Chamber of Commerce and Industry** to **mass-produce and commercialize** reverse-engineered products.
- Local industries will be encouraged to adopt these innovations for large-scale production.

3. Financial Model and Profit Distribution

Profits from commercialization will be distributed as follows:

- **25% to Students** (Encouraging research and innovation among youth)
- **25% to Faculty Members** (Incentivizing academic contributions)
- **25% to University Departments** (Enhancing lab infrastructure and research facilities)
- **25% to Research Endowment Fund** (Sustaining long-term innovation initiatives)

4. Implementation Plan and Targets

- **Year 1:** Reverse engineering of **50 products**.
- **Year 2-3:** Scale up to **300 products** in various industries, including **agriculture, manufacturing, energy, and digital technologies**.
- **Year 4+**: Transition from imitation to product innovation and commercialization at a global scale.

Expected Outcomes

1. **Technological self-reliance** – Reduced dependency on imported technology.
2. **Industrial Growth** – Strengthening of local manufacturing and SME sectors.
3. **Job Creation & Skill Development** – Hands-on training for students and professionals.
4. **Economic Growth** – Higher exports through indigenous technological advancements.

Reverse engineering has been a critical tool in China's economic rise, and AJK can leverage this model to drive its own **technological and industrial transformation**. Through university-led R&D, strong industry linkages, and a structured financial model, AJK can move from **imitation to innovation**, setting a new direction for Pakistan's economic and technological future.

Action Plan: The AJK government should immediately launch a **pilot project** in key universities to test and refine this model before full-scale implementation. By aligning academic research with industrial needs, AJK can establish itself as a center of technological excellence in Pakistan.

China's Transformation: From Technology Imitation to Innovation Leadership

China's journey from imitating foreign technology to driving innovation can be broadly divided into three stages: early imitation, technology absorption and adaptation, and independent innovation; with the early stages heavily focused on copying existing technologies, gradually transitioning to modifying and improving them, and finally reaching a point where China is actively developing cutting-edge technologies of its own.

1. Early Imitation (Pre-Reform Era):

- **Focus on basic manufacturing:**

  During the early post-revolution period, China primarily concentrated on replicating basic industrial technologies from abroad to build its manufacturing base, often through joint ventures with foreign companies.

- **Low R&D investment:**

Research and development activities were limited, with the main focus on understanding and adapting existing technologies.

- **Quality control issues:**
  Due to the emphasis on quick replication, initial products often faced concerns regarding quality and reliability.

2. Technology Absorption and Adaptation (Reform Era):

- **Increased R&D investment:**

  Following economic reforms in the 1980s, China started investing more significantly in research and development, focusing on improving existing technologies and developing localized variations.

- **Reverse engineering:**

  A common practice where Chinese companies would disassemble foreign products to understand their design and functionality, then modify and improve upon them.

- **Focus on cost-effectiveness:**
  The goal was to produce high-quality products at competitive prices by optimizing production processes and materials.

3. Independent Innovation (Present Day):

- **National Innovation Strategy:**

  The Chinese government actively promotes a "national innovation-driven development strategy" aiming to move beyond imitation and become a leader in key technological fields.

- **High-tech sectors:**

  Investment in emerging technologies like artificial intelligence, renewable energy, biotechnology, and advanced manufacturing is significantly increasing.

- **Intellectual property focus:**

  Greater emphasis on developing and protecting intellectual property rights to incentivize original research and development.

- **Global competition:**
  Chinese companies are now actively competing on the international stage with their own innovative products and technologies.

Key factors contributing to China's shift from imitation to innovation:

- **Government support:**

  Significant government funding and policy initiatives directed towards research and development

- **Education development:**

  Focus on building a strong scientific and technical workforce

- **Market size:**

  A large domestic market provides incentives for companies to invest in innovation

- **International collaboration:**
  Partnerships with foreign companies and research institutions facilitate knowledge transfer

A list of agricultural machinery suitable for reverse engineering:

1. Tractors and Power Units

- **Compact Utility Tractors** (for small-scale farming)
- **Row-Crop Tractors** (for fieldwork)
- **Four-Wheel Drive Tractors** (for heavy-duty farming)
- **Mini Tractors** (for orchards and vineyards)
- **Electric Tractors** (for sustainable farming)

2. Tillage Equipment

- **Plows** (Moldboard, Disc, Chisel)
- **Rotavators** (Rotary Tillers)
- **Harrows** (Disc Harrow, Chain Harrow)
- **Subsoilers** (for deep tillage)

3. Planting and Seeding Equipment

- **Seed Drills** (Pneumatic, Mechanical)
- **Planters** (Row Planters, Precision Planters)
- **Transplanters** (for rice, vegetables)
- **Broadcast Seeders**

4. Irrigation Equipment

- **Sprinkler Systems**
- **Drip Irrigation Systems**
- **Center Pivot Irrigation Systems**
- **Irrigation Pumps** (Diesel, Electric)

5. Harvesting Machinery

- **Combine Harvesters** (Wheat, Rice, Corn)
- **Forage Harvesters** (Choppers, Silage Machines)
- **Sugarcane Harvesters**
- **Cotton Pickers**
- **Potato & Root Crop Harvesters**

6. Crop Processing Machinery

- **Threshers** (Multi-crop, Paddy, Maize)
- **Milling Machines** (Rice Mill, Flour Mill)
- **Grain Cleaning and Sorting Machines**
- **Oil Expellers** (for oilseed extraction)

7. Fertilizer and Pesticide Application Equipment

- **Fertilizer Spreaders** (Broadcast, Precision)
- **Boom Sprayers**
- **Drone Sprayers** (for precision agriculture)

- **Hand-Held and Tractor-Mounted Sprayers**

8. Hay and Forage Equipment

- **Balers** (Round, Square)
- **Mowers** (Sickle Bar, Rotary)
- **Hay Rakes and Tedders**
- **Silage Packing Machines**

9. Post-Harvest Processing Equipment

- **Grain Dryers**
- **Cold Storage Units**
- **Fruit and Vegetable Grading Machines**
- **Packaging Machines**

10. Smart and Autonomous Agriculture Equipment

- **GPS-Guided Tractors**
- **Automated Greenhouse Systems**
- **Agricultural Drones** (for monitoring, spraying)
- **AI-Based Weed Removal Robots**

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A list of technology products suitable for reverse engineering across different domains:

1. Consumer Electronics

- **Smartphones** (Apple, Samsung, Xiaomi, etc.)
- **Tablets & Laptops** (MacBook, Surface, Thinkpad)
- **Smartwatches & Wearables** (Apple Watch, Fitbit)
- **Wireless Earbuds & Headphones** (AirPods, Bose, Sony)
- **Gaming Consoles** (PlayStation, Xbox, Nintendo Switch)
- **Smart TVs & Display Panels**
- **VR & AR Headsets** (Meta Quest, HTC Vive)

2. Computer Hardware

- **Microprocessors (CPUs, GPUs)** (Intel, AMD, NVIDIA)
- **Motherboards & Chipsets**
- **Solid-State Drives (SSD), Hard Drives (HDD)**
- **RAM Modules (DDR4, DDR5)**
- **Graphics Cards**
- **Power Supply Units (PSU)**

3. Networking & Communication Devices

- **Wi-Fi Routers & Mesh Networks**
- **Modems & Optical Fiber Transceivers**
- **5G Base Stations & Small Cells**
- **Satellite Communication Equipment**

- **IoT Gateways & Smart Home Hubs**

4. Industrial & Embedded Systems

- **Microcontrollers & Development Boards** (Arduino, Raspberry Pi)
- **Programmable Logic Controllers (PLC)**
- **Sensors & Actuators (LiDAR, Ultrasonic, IR)**
- **Automated Robotic Arms**
- **Industrial Drones**

5. Automotive & Transportation Technology

- **Electric Vehicle (EV) Batteries & BMS**
- **EV Motor Controllers & Power Electronics**
- **Autonomous Driving Systems (Tesla, Waymo)**
- **Infotainment & Navigation Systems**
- **LiDAR & Radar Systems**

6. Medical & Health Tech

- **MRI & CT Scanners**
- **Blood Glucose Monitors**
- **Portable ECG Devices**
- **Smart Insulin Pumps**
- **Wearable Health Trackers**

7. Renewable Energy & Power Tech

- **Solar Inverters & Microinverters**
- **Wind Turbine Control Systems**
- **Energy Storage Systems (Battery, Hydrogen Fuel Cells)**
- **Smart Grid Technologies**

8. Security & Surveillance Tech

- **Biometric Authentication Systems (Fingerprint, Face Recognition)**
- **CCTV & AI-Powered Surveillance Cameras**
- **Smart Door Locks & Access Control Systems**
- **Cybersecurity Hardware (Firewalls, VPN Devices)**

9. Military & Aerospace Technology

- **Drones & UAVs (Reaper, Bayraktar TB2)**
- **Missile Guidance Systems**
- **Radar & Sonar Systems**
- **Jet Engine Components**
- **Satellite Navigation Systems (GPS, Galileo, BeiDou)**

10. AI & Cloud Computing Hardware

- **AI Accelerator Chips (TPUs, NPUs)**
- **Edge AI Devices (Jetson, Coral)**
- **Quantum Computing Processors**
- **Data Center Servers & Storage Systems**

A List of Targeted Food Crops and Fruits for Reverse Engineering: A Categorized Approach to Gene Copying and Modification

1. Staple Food Crops (Grains & Cereals)

Crop	Leading Country	Traits for Reverse Engineering
Hybrid Rice (Super Rice)	China, Vietnam	High yield, drought resistance
Genetically Modified Corn (GM Maize)	USA, Brazil	Pest resistance (Bt Corn), drought tolerance
Wheat (Drought-Tolerant Varieties)	USA, China	Climate resilience, rust resistance
Sorghum (High-yield Varieties)	USA, Brazil	Heat tolerance, high biomass production
Barley (Malt & Feed Varieties)	USA, China	Disease resistance, cold tolerance

2. Legumes & Protein-Rich Crops

Crop	Leading Country	Traits for Reverse Engineering
Soybeans (GM & Hybrid Varieties)	USA, Brazil, China	Herbicide tolerance, high protein content
Peanuts (Aflatoxin-Resistant Varieties)	China, USA	Disease resistance, improved oil content
Lentils & Chickpeas (Drought-Resistant Varieties)	USA, China	Heat & drought tolerance
Black Beans & Red Kidney Beans	Brazil, USA	High protein yield

3. Root & Tuber Crops

Crop	Leading Country	Traits for Reverse Engineering
GM Potatoes (Pest-Resistant Varieties)	USA	Late blight resistance
Cassava (High Starch Varieties)	Brazil, Thailand	Disease resistance, improved productivity
Sweet Potatoes (Nutrient-Enriched Varieties)	China, USA	High beta-carotene content

4. Oilseed Crops

Crop	Leading Country	Traits for Reverse Engineering
Canola (GM Varieties with Omega-3 Enrichment)	USA, China	High oil content, herbicide resistance
Palm Oil (Hybrid Varieties)	Thailand, Brazil	High oil yield, pest resistance
Sunflower (Drought-Resistant Hybrid)	USA, China	High oil yield

5. Fruits (Tropical & Temperate)

Crop	Leading Country	Traits for Reverse Engineering
Banana (Disease-Resistant Varieties)	Thailand, Brazil	Fusarium wilt resistance
Mango (Hybrid & Export-Quality Varieties)	Thailand, Brazil	Long shelf life, high sugar content
Pineapple (Sweet & Juicy Varieties)	Thailand, Brazil	High yield, disease resistance
Dragon Fruit (Red & White Flesh Varieties)	Vietnam, Thailand	High antioxidant content
Durian (Non-Odorous & Export-Friendly Varieties)	Thailand	Improved shelf life
Strawberries (GM Large Berry Varieties)	USA	Extended shelf life, climate resilience
Apples (GM Varieties - Arctic Apple)	USA, China	Non-browning, extended freshness
Grapes (Wine & Table Varieties)	USA, China	Pest resistance, high sugar content

6. Cash Crops (High-Value Agriculture)

Crop	Leading Country	Traits for Reverse Engineering
Coffee (Disease-Resistant Arabica & Robusta)	Brazil, Vietnam	Rust resistance, climate adaptation
Cocoa (High-Yield Varieties)	Brazil, USA	Disease resistance, enhanced flavor
Tea (High-Quality Green & Black Varieties)	China, Vietnam	Increased antioxidants, pest resistance
Sugarcane (High Sucrose Content Varieties)	Brazil, Thailand	High sugar recovery rate
Cotton (GM Bt Cotton)	USA, China	Pest-resistant, high fiber quality

7. Vegetables (Hybrid & GM Varieties)

Crop	Leading Country	Traits for Reverse Engineering
Tomatoes (Non-Spoiling GM Varieties)	USA, China	Longer shelf life, disease resistance
Capsicum (High Vitamin C Varieties)	China, Thailand	Improved taste, pest resistance
Carrots (Beta-Carotene-Rich Varieties)	USA, China	Higher nutritional value
Onions (Disease-Resistant & Non-Tearing Varieties)	USA, Brazil	High yield, better storage
Cabbage (Heat-Resistant Hybrid Varieties)	China, Vietnam	Pest-resistant, high yield

Reverse Engineering Approach:

- **Gene Sequencing & CRISPR Technology:** Identify genes responsible for desirable traits in target crops and apply gene editing to local varieties.
- **Hybridization & Selective Breeding:** Cross-breed high-performing strains for higher yield and resistance.
- **Biotechnology & GMO Replication:** Copy proven GMOs from **USA, Brazil, China** for commercialization.
- **Climate Adaptation:** Modify genes to suit local climates for **drought, pest, and disease resistance**.