

Suggested Proposal: Integrated Common Treatment Model for the Restoration of Buddha Darya, Ludhiana

A Decentralized, Sustainable and Zero Liquid Discharge (ZLD) Approach

Submitted to

The Government of Punjab

Submitted by

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Executive Summary

Buddha Darya has long been subjected to severe pollution arising from untreated domestic sewage, industrial effluents, dairy waste, agricultural runoff and solid waste. Existing treatment infrastructure, although substantial, has not fully achieved the desired environmental outcomes due to centralized loading, residual pollution, inadequate interception of drains and inconsistent treatment efficiency.

This proposal recommends an Integrated Common Treatment Model (ICTM) based on the guiding principle:

"Decentralize → Pre-treat → Combine → Polish → Reuse."

Instead of depending upon one or two large treatment plants, the proposal advocates establishing a network of decentralized treatment nodes located close to major Pollution Vulnerable Areas (VAs) and Vulnerable Points (VPs). This integrated approach combines engineering solutions, ecological restoration, digital monitoring, community participation and effective governance to achieve Zero Liquid Discharge (ZLD) into Buddha Darya and ultimately the River Satluj.

Objectives

The proposed model aims to:

Restore the ecological health of Buddha Darya.

Eliminate direct discharge of untreated sewage and industrial effluents.

Reduce Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

Remove toxic industrial pollutants and heavy metals.

Promote recycling and reuse of treated wastewater.

Generate renewable energy through dairy waste biogas systems.

Strengthen environmental governance through real-time monitoring and accountability.

Support sustainable urban development in Ludhiana.

Identification of Pollution Vulnerable Areas

Zone 1: Koom Kallan – Dhanansu

Major Pollution Sources

Dairy waste

Cow dung and urine

Organic load

Rural wastewater

Proposed Integrated Zone

Near Dhanansu Industrial Park

Zone 2: Dhanansu – Tajpur

Major Pollution Sources

Domestic sewage

Grey water

Mixed industrial discharge

Dairy waste

Proposed Integrated Zone

Near Bhamian Kallan/Tajpur

Zone 3: Tajpur – Haibowal Dairy Complex Bridge-II

Major Pollution Sources

Residual untreated waste

Sludge deposits

225 MLD STP discharge

Industrial CETPs (40 MLD + 50 MLD)

Dairy ETP (4 MLD)

Proposed Integrated Zone

Near Landfill Site/Central Jail

Zone 4: Haibowal Dairy Complex – Balloke

Major Pollution Sources

Industrial effluents mixed

Residual STP discharge

Dairy wastewater

Organic pollution

Proposed Integrated Zone

Near Balloke STPs

Zone 5: Bhattian

Major Pollution Sources

Residual STP discharge

Industrial chemicals

CETP discharge (15 MLD)

Proposed Integrated Zone

Near Bhattian

Dedicated Industrial Treatment Nodes

Separate Integrated Treatment Nodes should also be established for:

Dhanansu Integrated

Industrial Park

Focal Point

Industrial Area A

Industrial Area B

Industrial Area C

All other existing and future industrial estates developed under the Ludhiana Master Plan

Integrated Treatment Architecture

Stage I – Mandatory Decentralized Pre-Treatment

Dairy Clusters

Installation of:

Biogas plants

Solid-liquid separators

Slurry management systems

Outputs:

Renewable energy

Organic fertilizer

Elimination of raw dairy waste entering Buddha Darya

Industrial Units

Mandatory installation and operation of:

Individual Effluent Treatment Plants (ETPs)

Common Effluent Treatment Plants (CETPs)

Primary removal of:

Heavy metals

Toxic chemicals

Hazardous industrial contaminants

Domestic Sewage

Preliminary treatment including:

Screening

Grit removal

Oil and grease traps

Stage II – Interception and Diversion

Construction of interceptor drains along both sides of

Buddha Darya to:

Capture every discharge point

Divert wastewater to Integrated Treatment Nodes

Completely eliminate direct discharge into the drain

Stage III – Common Integrated Treatment Plants (CTPs)

Instead of one oversized facility, establish multiple modular treatment plants incorporating:

Equalization Tanks

Balancing hydraulic and pollution loads.

Primary Treatment

Removal of suspended solids.

Biological Treatment

Appropriate technology may include:

Activated Sludge Process (ASP)

Moving Bed Biofilm Reactor (MBBR)

Membrane Bioreactor (MBR), where economically feasible

These systems significantly reduce:

BOD

COD

Organic pollutants

Chemical Treatment

Coagulation and flocculation for removal of:

Colour

Heavy metals

Residual industrial contaminants

Stage IV – Advanced Polishing

Depending upon pollution intensity:

Sand filtration

Activated carbon filters

UV disinfection

Ozonation

Reverse Osmosis (RO) for highly polluted streams

Zero Liquid Discharge (ZLD) systems

Stage V – Nature-Based Ecological Polishing

Development of Constructed Wetlands near identified Vulnerable Areas.

These wetlands should include:

Reed beds

Native aquatic vegetation

Bio-remediation zones

Ecological polishing ponds

Benefits include:

Additional nutrient removal

Biodiversity restoration

Improved landscape aesthetics

Reduced operational costs

Public awareness and participation

Treated water should then be stored in designated reuse reservoirs instead of being discharged into Buddha Darya or the River Satluj.

Reuse of Treated Water

The proposal recommends maximum utilization of treated water for:

Agricultural irrigation

Industrial processes

Urban landscaping

Construction activities

Fire-fighting reserves

The long-term objective is Zero Discharge into the Buddha Darya and River Satluj.

Integrated Sludge Management

Sustainable sludge management shall include:

Sludge drying beds

Composting of organic sludge

Biogas generation

Secure disposal of hazardous industrial sludge in engineered landfills

Real-Time Environmental Monitoring

Continuous online monitoring should be established for:

BOD

COD

pH

Dissolved Oxygen

Heavy metals

Flow measurement

The monitoring network should be integrated with:

Punjab Pollution Control Board

Municipal Corporation Ludhiana

Drainage Department

State Water Resources Department

Public dashboards may be introduced to enhance transparency and accountability.

Governance Framework

The project should be implemented through a collaborative institutional mechanism involving:

Government of Punjab

Municipal Corporation Ludhiana

Punjab Pollution Control Board

Department of Water Resources

Department of Local Government

Industry Associations

Academic Institutions

Environmental NGOs

Citizen Volunteers

The Polluter Pays

Principle and Public–Private Partnership (PPP) model should be adopted to ensure financial sustainability and long-term operation.

Expected Outcomes

Implementation of the Integrated Common Treatment Model is expected to achieve:

Zero pollution entering Buddha Darya.

Improved water quality and ecological restoration.

Revival of aquatic biodiversity.

Enhanced public health.

Recovery and reuse of valuable water resources.

Renewable energy generation through dairy waste.

Reduced burden on centralized treatment plants.

Sustainable industrial and urban development.

Protection of the River Satluj from downstream pollution.

Conclusion

The restoration of Buddha Darya requires a paradigm shift from isolated treatment facilities to an integrated network of decentralized treatment systems. By combining advanced engineering, ecological restoration, digital monitoring, community participation and responsible governance, Punjab can transform Buddha Darya into a model of sustainable urban river rejuvenation.

This proposal offers a practical, scalable and future-ready roadmap towards achieving Zero Liquid Discharge, restoring environmental integrity and securing water resources for future generations.

"Buddha Darya cannot be cleaned by one treatment plant. It requires a coordinated system of systems—where technology, ecology, governance and community participation work together to restore one of Punjab's most important urban waterways."