

The Alluvial Renaissance

Anchoring Punjab's Future in its Deep-Time Wisdom

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AFTER a decade-long teaching and research on the secrets of rocks, silt and vegetation, we have come to realise that the soil of Punjab is more than a resource; it is our greatest teacher. By inspecting the vast geological history of our “alluvial blanket,” we find that the solutions to our modern socio-economic issues are not buried in robotics or AI, but in the deep-time civilisation wisdom of the land itself.

Nearly four crore years ago, the Indian tectonic plate collided with Eurasia at a glacial pace to create the Himalayas. In its shadow, the Indo-Gangetic Foreland Basin was born where Punjab now stands. Prehistoric Punjab had a landscape of subtropical thorn vegetation and savannahs. As such, life here thrived on the “boom and bust” cycles of semi-arid heat and riverine flooding for thousands of years. Deep taproot systems of “well-driller” plants like the *Jand*, *Kikar*, and *Ber* developed thirty metres down into the aquifer to reach water, while salt-tolerant shrubs like *Van* anchored the saline ridges. During the floods, the landscape would transform into algal fields where stoneworts would sporadically bloom. Prehistoric giants once freely roamed this area, including long-necked plant-eating Titanosaurs, car-sized tortoises, prehistoric giraffe, and hippopotamus.

Before the 1960s, agriculture in Punjab had been in equilibrium with the long-term geological context of this land. Farmers not only grew deep-rooted native crops such as *Vadanak* and *Daudkhani* wheat landraces, but also followed a multi-crop rotation like maize with wheat or cotton with gram. “*Makke dee Roti and Sarson da Saag*” — a famous delicacy of Punjab, doesn't just capture our traditional ethos but also a relic from those innocent days of equilibrium with nature. Pulses, oilseeds and millets like *Bajra* and *Jowar*, provided natural nitrogen fixation, maintaining the fertility of the soil.

While the Green Revolution was the heroic solution for national food security, it has since become an environmental disaster, a literal “Success Trap”. By replacing native deep-rooted wheats with industrial varieties that have shallow roots and replacing native semi-arid wheats and grasses with a water-intensive tropical grass, rice, we created a geological anomaly.

The physics behind this battle is nothing short of remarkable. Hydro-geological data from 2025 indicates that 80% of Punjab's administrative units are now “over-exploited”. The production of one kilogram of rice in these arid conditions requires 3000 to 5000 litres of water — a completely irrational impossibility for a semi-arid area. Puddling for rice not only reduces aquifer levels but also increases soil acidity, which leads to toxic metals such as lead and uranium dissolving into water and leaching into aquifers, poisoning groundwater. As stated in the 2025 Annual

Groundwater Quality report, Punjab has the highest Uranium-contaminated groundwater levels. In addition, agricultural runoff of excess nitrogen and phosphorus is causing anoxic “fish kills” in Punjab's rivers.

When we apply First Principles Thinking, we will be able to identify the underlying truth: we need to go back to nature — the elimination of artificial inputs and the removal of the paddy-wheat duopoly. Consider our “geographical twins”: areas such as California's Central Valley, Spain's Ebro Basin, and the Nile Delta that have been successful in decoupling wealth creation from environmental degradation by transitioning towards high-value, drought-tolerant perennials.

In 2026, Punjab need a strategic policy shift. The low-input high-value oilseeds Pistachio and Camelina can be grown in Bathinda and Fazilka, as the saline alkaline soils prevalent in this area are conducive to their growth. Amritsar and Nawanshahr have a significant amount of winter chill to allow for the cultivation of specific high-value almond varieties. A similar transition occurred in Australia with respect to the “Mallee Model”, where restorative rotations of oats, clover and pulses successfully disconnected production from reliance on chemicals.

Oats are preferable to rice or wheat because they require substantially less water owing to their extensive root system reminiscent of prehistoric native plants of this region. Varieties like OL-9 and Weston-11 can be cultivated in Ludhiana, Patiala, and Hoshiarpur. Rotating it with clover (berseem) approach is what is now called the Soil 3.0 approach, as pulse-legume cycle can lower urea requirements by up to 40%. In addition, planting the native trees from prehistoric times, like *Jand*, *Kikar*, *Ber*, and *Van* in the farmland further expands the ecological harmony by providing a safe habitat for insectivorous birds- nature's “pesticide” and supporting pollinators like honeybees and butterflies. Planting *Aak* (*Madar*) plants, often mislabelled as a weed, is another masterstroke for ecological restoration as it can act like a magnet for butterflies and other pollinators.

This diversification also provides a lasting solution to stubble burning and associated air pollution. Burning is often labelled a moral failure, when in fact, it is because of an extremely narrow mechanical window of 14 days between harvesting Pusa-44 paddy and planting their wheat crop. Shifting from rice to other crops such as oats, maize, mustard, or pulses will create a new temporal rhythm for the farm that eliminates this bottleneck. The success of the Green Revolution in Punjab was due to the determination of our farmers; this same resoluteness, combined with government support for similar initiatives, can reclaim ecological restoration here.

We must also explore “niche arbitrage” in our “geological failures”. For example, the alkaline and waterlogged “Bet”