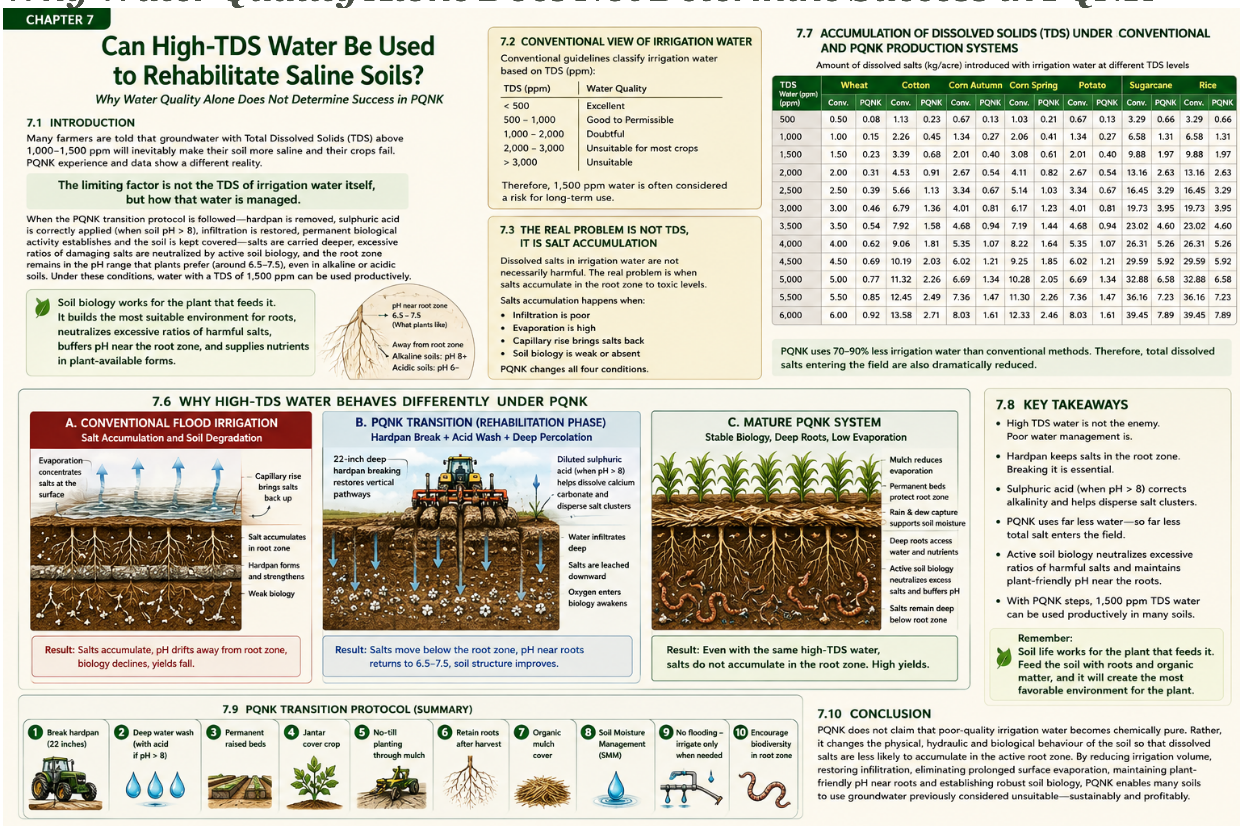
PQNK KNOWLEDGE PAPER

Can High-TDS Water Be Used to Rehabilitate Saline Soils?

Why Water Quality Alone Does Not Determine Success in PQNK



For generations, farmers have been taught that the quality of irrigation water is determined primarily by its Total Dissolved Solids (TDS). The higher the concentration of dissolved salts, the greater the perceived risk to soil health and crop production. Consequently, groundwater containing 1,000 to 2,000 parts per million (ppm) of dissolved solids is often regarded as unsuitable for sustainable agriculture. In many regions, farmers abandon productive land simply because laboratory reports indicate elevated TDS levels.

PQNK arrives at a different conclusion. While dissolved salts undoubtedly influence crop production, the decisive factor is not the salt concentration of the irrigation water alone. The real determinant is the physical, hydraulic and biological condition of the soil into which that water is applied. The same groundwater that gradually destroys a conventionally managed field may sustain productive crops under a properly established PQNK system, because the soil behaves fundamentally differently.

This distinction is the foundation of understanding irrigation water quality. Water should never be evaluated independently of the soil system receiving it.

The Misunderstood Problem

The widespread belief that high-TDS water inevitably causes soil salinity is an oversimplification. Dissolved salts do not become harmful merely because they are present in irrigation water. They become harmful only when they accumulate within the active root zone faster than natural biological and hydraulic processes can redistribute or neutralize them.

In conventional agriculture, this accumulation is almost inevitable. Flood irrigation applies very large volumes of water over a compacted soil surface. Because hardpan restricts downward movement, much of the applied water remains near the surface. As evaporation removes pure water, dissolved salts remain behind. Repeated irrigation cycles gradually concentrate these salts within the upper soil profile until root growth, nutrient uptake and soil biological activity begin to decline.

The problem, therefore, is salt accumulation, not simply salt concentration.

How Conventional Irrigation Creates Salinity

The conventional production system unintentionally creates ideal conditions for salt accumulation.

Hardpan forms a nearly impermeable barrier beneath the cultivated layer. Instead of infiltrating deeply, irrigation water spreads laterally across the field and remains within the shallow root zone. Under warm climatic conditions, evaporation begins almost immediately after irrigation. As water evaporates from the soil surface, dissolved salts are left behind. Later, capillary action draws additional saline moisture upward from deeper layers, depositing still more salts as evaporation continues.

Each irrigation cycle adds another layer of dissolved solids to the root zone.

This process repeats season after season. The soil gradually becomes denser, pore spaces collapse, infiltration declines further, and even more water is required to maintain crop growth. Eventually the farmer attributes declining productivity to poor-quality water, while the true cause is the inability of the soil to process that water correctly.

The irrigation water has not changed.

The soil system has failed.

The PQNK Perspective

PQNK begins by asking a different question.

Instead of asking,

“How saline is the irrigation water?”

it asks,

“Why is the soil retaining those salts?”

This change in perspective transforms the entire management strategy.

PQNK does not attempt to change the chemistry of the groundwater. It changes the architecture of the soil ecosystem.

The first requirement is the complete removal of the physical barrier preventing deep water movement. The hardpan is broken with a tine penetrating approximately twenty-two inches into the soil. This restores continuous vertical pathways through which water, air and roots can move freely.

Where alkaline conditions exist, indicated by soil pH values above approximately 8, sulphuric acid is introduced during the deep water washing phase. The purpose is not simply to acidify the soil. Sulphuric acid reacts with calcium carbonate, reduces excessive alkalinity, releases calcium into solution, improves soil aggregation and assists in dispersing compacted salt-rich zones. These changes allow irrigation water to penetrate deeply instead of remaining trapped near the surface.

The process prepares the soil for its most important transformation: the return of permanent biological activity.

Soil Biology Becomes the Primary Regulator

Conventional soil chemistry often treats the soil as a static mixture of minerals. PQNK views it as a living biological ecosystem.

Once permanent raised beds are established, the soil is protected from repeated disturbance. Cover crops such as Jantar produce deep, vigorous root systems that reopen natural pore networks while feeding microorganisms throughout the soil profile. After termination, the roots remain permanently within the soil and the above-ground biomass becomes protective mulch. Each crop contributes additional organic matter without disrupting the developing biological community.

As biological activity increases, the soil begins regulating its own environment.

Plants continuously supply carbohydrates and other organic compounds to microorganisms through their roots. In return, the soil biology works for the plant that feeds it. It reorganizes the rhizosphere into the environment most favourable for healthy plant growth. Nutrients are converted into plant-available forms, soil aggregates become more stable, harmful ion imbalances are moderated, and excessive concentrations of damaging salts are progressively buffered within the active root zone.

This biological regulation explains one of the most remarkable observations repeatedly seen under PQNK.

In alkaline soils where the bulk soil may remain at pH 8 or higher, measurements close to actively growing roots commonly indicate a pH approaching the range preferred by the plant, approximately neutral. Likewise, in acidic soils where the surrounding soil may remain below pH 6, the immediate rhizosphere often shifts toward a more favourable environment.

The bulk soil has not suddenly become chemically uniform.

Rather, the living biological community has modified the root environment into one better suited for plant growth.

The plant feeds the biology.

The biology protects the plant.

This relationship cannot develop where soil disturbance, prolonged flooding or the absence of organic cover repeatedly destroy biological communities.

Why High-TDS Water Behaves Differently Under PQNK

Once the soil becomes biologically active and physically open, irrigation water behaves differently.

Instead of spreading across the surface and evaporating, it infiltrates rapidly through deep pore networks created by roots, soil fauna and permanent structure. Because Soil Moisture Management applies only the quantity of water actually required by the crop, irrigation volumes are dramatically reduced. Less water enters the field, and therefore fewer dissolved salts enter with it.

Any dissolved salts that do enter the soil are no longer concentrated by prolonged surface evaporation. They move downward with infiltrating water, away from the active root zone, while biological processes continue maintaining favourable conditions around living roots.

Thus, identical irrigation water produces two entirely different outcomes.

In the conventional field, salts accumulate.

In the PQNK field, salts continue moving.

The difference lies not in the water, but in the soil system receiving it.

Understanding the Salt Load

The accompanying data illustrate an important but frequently overlooked principle.

Every irrigation introduces dissolved solids into the field. The total quantity depends upon two factors: the concentration of dissolved solids in the water, and the total volume of water applied.

Conventional agriculture applies several million litres of water per hectare or acre during a growing season. Even groundwater containing only moderate TDS therefore introduces enormous quantities of dissolved salts into the field.

PQNK changes this equation dramatically.

Because irrigation volumes are reduced by approximately seventy to ninety percent, the total mass of dissolved solids entering the field declines proportionally. The same groundwater that would introduce many tonnes of dissolved salts under conventional irrigation contributes only a fraction of that amount under PQNK management.

This reduction in salt loading is achieved not by changing the groundwater source, but by changing irrigation practice.

Accumulation of dissolved solids at various TDS level on Conventional and PQNK methods of crop production

	1000 Lit @ 2000 TDS = 2 Kg	Wheat		Cotton		Corn Autumn		Corn Spring		Potato		Sugarcane		Rice	
TDS Water	Weight of	Crop - Con	Crop - PQNK	Crop - Con	Crop - PQNK	Crop - Con	Crop - PQNK	Crop - Con	Crop - PQNK	Crop - Con	Crop - PQNK	Crop - Con	Crop - PQNK	Crop - Con	Crop - PQNK
Water PPM	Solids in G	1,644,800	308,370	2,261,600	513,950	1,336,400	308,370	2,056,000	411,160	1,336,400	308,370	6,579,200	822,321	6,579,200	513,950
500	0.50	822	154	1,131	257	668	154	1,028	206	668	154	3,290	411	3,290	257
1,000	1.00	1,645	308	2,262	514	1,336	308	2,056	411	1,336	308	6,579	822	6,579	514
1,500	1.50	2,467	463	3,392	771	2,005	463	3,084	617	2,005	463	9,869	1,233	9,869	771
2,000	2.00	3,290	617	4,523	1,028	2,673	617	4,112	822	2,673	617	13,158	1,645	13,158	1,028
2,500	2.50	4,112	771	5,654	1,285	3,341	771	5,140	1,028	3,341	771	16,448	2,056	16,448	1,285
3,000	3.00	4,934	925	6,785	1,542	4,009	925	6,168	1,233	4,009	925	19,738	2,467	19,738	1,542
3,500	3.50	5,757	1,079	7,916	1,799	4,677	1,079	7,196	1,439	4,677	1,079	23,027	2,878	23,027	1,799
4,000	4.00	6,579	1,233	9,046	2,056	5,346	1,233	8,224	1,645	5,346	1,233	26,317	3,289	26,317	2,056
4,500	4.50	7,402	1,388	10,177	2,313	6,014	1,388	9,252	1,850	6,014	1,388	29,606	3,700	29,606	2,313
5,000	5.00	8,224	1,542	11,308	2,570	6,682	1,542	10,280	2,056	6,682	1,542	32,896	4,112	32,896	2,570
5,500	5.50	9,046	1,696	12,439	2,827	7,350	1,696	11,308	2,261	7,350	1,696	36,186	4,523	36,186	2,827
6,000	6.00	9,869	1,850	13,570	3,084	8,018	1,850	12,336	2,467	8,018	1,850	39,475	4,934	39,475	3,084

Note: formula used is Weight of TDS (in grams) = TDS concentration (in ppm) x volume of water (in liters) / 1,000. Figures represent kg of dissolved solids carried by water to the field at various levels

Figure 1. Accumulation of dissolved solids at various TDS levels, conventional vs. PQNK production, by crop.

Can Water Containing 1,500 ppm TDS Be Used?

The answer is yes, but only within the context of a correctly established PQNK system.

PQNK does not claim that water containing 1,500 ppm dissolved solids suddenly becomes chemically pure or universally safe under all conditions. Rather, it demonstrates that the risks associated with such water are greatly reduced when the soil is physically rehabilitated, biologically active and managed through Soil Moisture Management.

Where hardpan has been removed, alkaline conditions corrected where necessary, permanent raised beds established, biological cover maintained and irrigation carefully controlled, groundwater previously considered unsuitable may often become a productive resource.

This conclusion does not eliminate the importance of water analysis.

Instead, it places water analysis within the broader context of soil function.

The Living Soil Determines the Outcome

Perhaps the greatest lesson of PQNK is that soil should no longer be viewed as an inert growing medium requiring constant chemical correction. It is a living ecosystem capable of regulating itself when its natural processes are restored.

Healthy soil biology does far more than decompose organic matter. It moderates the chemical environment surrounding roots, buffers excessive ratios of harmful salts, maintains plant-friendly conditions within the rhizosphere and continuously supplies nutrients in forms that plants can absorb efficiently. It performs these functions because the plant continuously feeds it through root exudates.

The biology works for the plant.

But it can only do so when the farmer first works for the biology.

That is why PQNK insists upon the complete sequence of transition: breaking the hardpan, correcting excessive alkalinity where required, constructing permanent raised beds, establishing continuous biological cover, retaining roots, protecting the soil with mulch, avoiding flooding and maintaining Soil Moisture Management.

Only when these principles are implemented together does the soil recover its ability to regulate water, salts, nutrients and plant health.

Conclusion

The question is not whether irrigation water contains dissolved salts.

Every natural water source contains dissolved minerals.

The real question is whether the soil ecosystem possesses the physical structure and biological capacity to manage them.

Conventional agriculture frequently creates conditions that trap salts within the root zone, making irrigation water appear to be the problem. PQNK removes the barriers responsible for that accumulation. Through deep infiltration, permanent biological activity, greatly reduced irrigation volumes and active rhizosphere regulation, the soil itself becomes the primary defence against salt stress.

High-TDS water is therefore not the enemy.

A biologically inactive, physically damaged soil is.

When the soil is restored, water once considered unsuitable can often become an asset rather than a limitation, demonstrating once again that successful agriculture depends not upon overpowering nature, but upon restoring the natural processes that have sustained terrestrial ecosystems for hundreds of millions of years.

Applying PQNK without understanding nature's operating system will not deliver abundance, stability, or nutrient density.

PQNK (pronounced “picnic”), the regenerative & sustainable Pristine Organic Farming System, is grounded in Natural Ecosystem Science. This science employs perennial biodiversity, protects soil with organic mulch, and avoids practices such as water inundation, tillage disturbance, and leaving soil bare.

It is the process that matters most. PQNK is a pristine production system designed not merely for yield, but for optimal, balanced output, where quality, sustainability, and ecological harmony emerge from a self-regulated, zero-external-input methodology.

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