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Knowledge Paper
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PQNK - The Natural Ecosystem Science of Production Agriculture

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Rice Is Not the Problem. The Way We Grow Rice Is.

From the 2009-2011 Mechanised SRI Trial to Direct-Seeded Rice on Mature, Mulch-Covered PQNK Beds

Rice needs water. It does not need a flooded field.

CURRENT PQNK FIELD COMPARISON	PQNK	CONVENTIONAL
Rice production	1,600 kg/acre (40 maunds)	1,400 kg/acre (35 maunds)
Applied crop-life water	513,950 L	6,579,200 L
Applied water per kg rice	321 L/kg	4,699 L/kg
Relative water used	7%	100%

The 2011 trial was the beginning. Mature PQNK rice now uses direct seeding, permanent mulch-covered beds and Soil Moisture Management.

Rice on PQNK is grown on raised beds - not in inundated soil

1. The Question Has Changed

Claims that rice "wastes" thousands of litres of water per kilogram, that flooded rice loses enormous quantities of water, that white rice is associated with metabolic disease, and that milling removes much of the grain's nutritional value point toward real problems. But they can also lead to the wrong conclusion. Rice itself is not the problem. The production and processing system built around rice is the problem.

PQNK asks a more useful question: what does the rice plant actually require, and how much of conventional rice cultivation exists because the plant needs it rather than because agriculture has become accustomed to doing it? That distinction is the foundation of this paper.

Our own rice work provides an unusually clear historical record of how that question evolved. The peer-reviewed paper published in Paddy and Water Environment in 2011 reported the first stage: mechanised SRI on newly formed raised beds. That work was important, but it was not present-day PQNK. The production system has advanced substantially since then.

2. The 2011 Paper Was the First Step, Not the Final System

The 2011 paper, "Technical adaptations for mechanized SRI production to achieve water saving and increased profitability in Punjab, Pakistan," reported work that began in 2009. Its central achievement was to challenge the assumption that rice had to be grown under continuous inundation. The paper reported an average yield of 12.84 t/ha in the first-season trial and approximately 70% lower irrigation-water application than conventional practice. It also recorded major reductions in labour requirements.

But the agronomy described in that paper must be understood in its historical context. Ten-day-old nursery seedlings were transplanted onto newly made raised beds. The field was still in transition from conventional cultivation. The first irrigation overtopped the beds to settle the transplanted seedlings. Subsequent irrigations were applied through furrows. Fertilizer and compost were banded mechanically. Weeds were suppressed with a tractor-mounted precision Weeder Aerator, which also disturbed the surface to aerate the soil.

The paper itself anticipated further evolution. It stated that the beds were intended to become permanent, that transition away from extensive tillage takes time, and that as soil structure, organic matter and biodiversity improved, mechanical soil-aerating weeding would become less necessary. Those observations are important today because that is precisely the direction in which the system subsequently developed.

3. From MSRI to Mature PQNK Rice

2009-2011 MSRI	Mature PQNK Rice	What Changed
Young seedlings transplanted	Direct seeding	Nursery and transplanting eliminated
Newly formed raised beds	Mature permanent raised beds	Soil architecture preserved crop after crop
No mature mulch system	Permanent organic mulch cover	Evaporation reduced and soil buffered
Mechanical Weeder Aerator	Biological cover and system management	Routine soil disturbance no longer required
Fertilizer + compost banding	Biological nutrient cycling	Purchased inputs no longer form the production foundation
Initial bed-overtopping irrigation	No inundation	Water supplied according to soil moisture need
SRI-inspired water management	PQNK Soil Moisture Management	Irrigation responds to root-zone condition

4. The Water Number Has Changed With the Production System

The current PQNK comparison records 1,600 kg of rice per acre (40 maunds) using approximately 513,950 litres of water over the crop life. That is about 321 litres of applied water per kilogram of rice. The conventional comparison uses 1,400 kg per acre (35 maunds) and approximately 6,579,200 litres, or 4,699 litres per kilogram.

On this comparison, PQNK uses about 7% as much applied irrigation water as the conventional reference, a reduction of approximately 93%. This is much greater than the water saving reported in the first MSRI trial. That difference is not an inconsistency. It records the development of the production system from newly constructed, relatively bare beds with transplanted seedlings and mechanical weeding to mature, permanently covered, direct-seeded PQNK beds.

These figures are Pedaver/PQNK field data for the stated production comparison, not a universal water requirement for every rice field. Soil texture, rainfall, climate, groundwater contribution, crop duration, yield and measurement boundaries all affect water-use figures.

5. Rice Does Not Require Inundation

Rice is exceptionally tolerant of flooded conditions, but tolerance is not the same as requirement. The 2011 work explicitly began from the recognition that rice is not an aquatic plant and can be productive in moist, aerated soil. In the original trial, furrow irrigation kept the raised-bed root zone moist without maintaining standing water after establishment.

PQNK now carries this principle further. Water is applied to the furrows only when the root-zone moisture condition indicates a need. It moves laterally into the permanent bed. The objective is not to fill the soil pore system with water, but to maintain the moist and aerated environment in which roots and soil biology can function.

This is Soil Moisture Management (SMM). It replaces the calendar question, “When is the next irrigation turn?” with the biological question, “Does the root zone need water?” The farmer’s ball test is a practical field indicator within this management approach.

6. Why Mature Mulch-Covered Beds Need Still Less Water

The first MSRI field did not yet possess the mature surface protection and biological structure of present PQNK fields. A mature PQNK bed remains covered with retained organic material. That cover shields the soil from direct solar radiation and wind, reduces direct soil evaporation, moderates temperature and protects the pore architecture through which water and air move.

Roots from successive crops remain in the soil rather than being repeatedly uprooted by tillage. Biological channels, aggregates and fungal networks are therefore allowed to persist and develop. Controlled traffic confines machinery to the furrows. Once the bed has matured, the production system is no longer rebuilt before every crop.

Direct seeding is a crucial part of this progression. The nursery, uprooting, transport and transplanting stages disappear. There is no requirement to flood the field to establish transplanted seedlings. Seed is placed directly into the protected bed with minimum disturbance.

7. What Does “4,000 Litres per Kilogram” Actually Mean?

Published estimates for rice water use vary widely because different studies measure different things. Some count irrigation applied at field level; others count evapotranspiration, rainfall, seepage, percolation or wider water-footprint components. These figures are useful for particular purposes, but they are not interchangeable.

A headline figure such as 4,000 litres per kilogram therefore cannot be treated as the fixed physiological requirement of the rice plant. The PQNK comparison asks a narrower field question: how much irrigation water is actually applied to produce the crop under a defined production system? In the current comparison that figure is 321 litres per kilogram.

The number matters, but the larger lesson matters more: water use changes when the production architecture changes.

8. Evaporation: Correct the System, Not the Statistic

It is unsafe to state universally that "60% of rice water is lost to evaporation." Evaporation, transpiration, seepage, percolation and drainage vary greatly between environments and production systems. What can be stated with confidence is that maintaining exposed standing water creates a large non-productive evaporation surface.

PQNK attacks the cause directly: no inundation, permanent mulch cover, moist rather than saturated soil, and irrigation only when required.

9. Rice and Diabetes: Do Not Blame the Crop

The statement that "rice causes diabetes" is scientifically too broad. Type 2 diabetes is multifactorial. The form in which rice is processed and the quantity consumed within the total diet do matter, and high consumption of refined white rice has been associated in observational research with higher type 2 diabetes risk.

The distinction is important for PQNK. The plant produces a grain. Human processing then determines how much of that grain remains in the food. Polishing white rice removes bran and germ and leaves the starch-rich endosperm as the dominant fraction.

For the same reason, the claim that milling causes exactly "75% nutrient loss" should not be repeated as a universal figure. Nutrients are distributed differently within the grain and losses depend on the degree and method of milling. The defensible statement is that extensive polishing removes nutritionally valuable bran and germ fractions and substantially changes the nutritional composition of the edible grain.

10. PQNK Extends the Nutrition Question Back to the Root

Most discussion of rice nutrition begins after harvest. PQNK begins before the seed is planted. Grain composition and quality emerge from genetics interacting with the production environment. Root-zone aeration, moisture, biological nutrient cycling, temperature, crop health, harvest maturity and post-harvest handling all matter.

This gives us two separate questions: how much nutrition did the plant place in the grain, and how much of that nutrition did processing subsequently remove? Future comparison of PQNK and conventional rice should therefore extend beyond yield and irrigation water to grain filling, husk-to-kernel ratio, head-rice recovery, breakage, protein and mineral profiles, aroma, cooking quality and nutrition produced per unit of water.

11. The 2011 Paper Now Has a Different Meaning

Read today, the 2011 paper should not be presented as the description of current PQNK rice production. It is more valuable than that. It is a documented early stage in the scientific and engineering journey.

It recorded the break from continuous flooding, the move onto raised beds, controlled furrow irrigation, precision crop establishment, mechanical weed suppression and the recognition that soil biology and aeration mattered. It also explicitly anticipated permanent beds, increasing organic matter, reduced soil disturbance and declining need for mechanical weeding as the biological system improved.

Present-day PQNK rice shows where that progression led: direct seeding into mature permanent beds, continuous mulch cover, no inundation, no routine tillage, no transplanting, Soil Moisture Management and a production environment designed to let the living system do more of the work.

12. Conclusion: Change the Production System, Not the Crop

When rice is said to consume thousands of litres of water per kilogram, the first question should be: under which production system? When white rice is associated with metabolic risk, the question should be: in what form, quantity and dietary context? When milling is blamed for nutrient loss, the question should be: how much of the whole grain was removed?

PQNK connects these questions across the entire chain: soil, water, biology, plant, grain, processing, food and human nutrition.

Rice does not demand continuous flooding. Rice does not demand puddling. Rice does not demand transplanting. Rice does not demand bare soil. Rice does not demand repeated tillage. These are production choices.

The first mechanised SRI trials showed that one of the strongest conventions in agriculture could be broken. Mature PQNK now goes much further. The field is no longer reconstructed for the rice crop. The rice crop is inserted into an already functioning, protected biological production system.

That is why the present PQNK water figure should not be viewed merely as another irrigation-efficiency statistic. It represents the cumulative effect of changing the architecture of production.

The 2011 question was: Can rice be produced with much less water?

The PQNK question is now: How little external intervention is necessary when the production system itself is functioning?

Key Propositions

- The 2011 mechanised SRI trial was an early transition stage, not the present PQNK rice system.
- Current PQNK rice is direct-seeded into mature, permanently mulch-covered raised beds.
- The present field comparison records 321 litres of applied water per kg of rice versus 4,699 litres/kg in the conventional reference.
- Rice requires water, but continuous inundation is not a biological requirement.
- Water-use figures must state what is being measured; a universal “4,000 litres/kg” claim is misleading without an accounting boundary.
- A universal “60% evaporation loss” claim should not be repeated without context.
- Rice should not be described as a cause of diabetes; processing, quantity and total dietary pattern matter.
- Milling and polishing remove nutritionally valuable grain fractions, but “75% nutrient loss” is not a universal value.
- PQNK evaluates the whole chain from soil and water to grain, processing, food quality and human nutrition.

Source and Editorial Note

This Knowledge Paper responds to public claims about rice water use, evaporation, diabetes and milling losses through the PQNK framework. The 2011 peer-reviewed paper by Asif Sharif is used as the historical baseline for the first mechanised SRI trial. Present PQNK field-water figures are supplied by Pedaver and describe the stated comparison; they should be documented crop by crop and should not be treated as universal guarantees for every soil, climate or season.

Historical source: Sharif, A. (2011). Technical adaptations for mechanized SRI production to achieve water saving and increased profitability in Punjab, Pakistan. Paddy and Water Environment 9:111-119. DOI 10.1007/s10333-010-0223-5.

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