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FARO 71 AND FARO 72 ZINC-BIOFORTIFIED RICE IN NIGERIA: A CRITICAL REVIEW OF AGRONOMIC, NUTRITIONAL AND SEED-SYSTEM EVIDENCE FOR LOWLAND RICE PRODUCTION

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ABSTRACT

Rice is a major staple and livelihood crop in Nigeria, and zinc deficiency remains a public health concern, particularly among women and young children. In April 2025, Nigeria released FARO 71 and FARO 72, described as the first zinc-biofortified rice varieties in Nigeria and Africa. This critical narrative review assesses the evidence on their agronomic performance, nutritional value, resilience claims and seed-system readiness. Sources comprised official release statements, the national variety catalogue, institutional and media reports, and open-access literature on zinc rice identified through web-based searches in October 2026. Official sources report grain zinc of 24.18 mg/kg for FARO 71 and about 25.2 mg/kg for FARO 72, potential yields of 9.6 and 9.8 t/ha, and registration for savanna and rainforest ecologies. However, the grain basis of the zinc values, farm-level yields, plant height and tillering were not reported in the sources reviewed. Evidence from other rice systems shows that milling and

cooking reduce grain zinc, that phytate limits absorption, and that a nine-month trial in Bangladeshi children found no significant change in plasma zinc. Claims of drought tolerance and pest and disease resistance were not supported by published comparative data that could be located. Experience from Bangladesh indicates that seed availability, farmer awareness, grain quality and market demand strongly influence adoption. The review identifies priority research and policy actions for Nigerian farmers, seed producers, extension services, and policymakers, and recommends treating nutritional benefits as potential until confirmed by local evidence.

KEYWORDS: Adoption; Biofortification; FARO 71; FARO 72; Rice; Zinc

INTRODUCTION

Rice (*Oryza sativa* L.) occupies an important position in Nigeria's food system. Rising demand has strengthened its role as both a staple food and a commercial commodity, and rice production supports employment and income along a value chain of farmers, labourers, processors, traders and consumers (Musa *et al*., 2024). Beyond the quantity of grain produced, crop improvement programmes increasingly seek combinations of productivity, adaptation, grain quality and nutritional value. Farmers, processors and consumers may value different varietal traits, and these preferences influence whether improved varieties succeed (Custodio *et al*., 2023).

Zinc deficiency is a recognised nutritional concern in Nigeria. A systematic review of studies among pregnant women and children under five reported pooled anaemia prevalence of 54–56% and, in certain regions, zinc deficiency prevalence as high as 86.4%, although estimates varied widely between studies ("Micronutrient Deficiencies," 2025). The 2021 National Food Consumption and Micronutrient Survey identified zinc deficiency as a determinant of anaemia among women of reproductive age and preschool children (Federal Republic of Nigeria, 2024). These findings provide a nutritional rationale for biofortification, although they do not, by themselves, show that a given biofortified variety will improve zinc status.

Biofortification increases the concentration or bioavailability of essential micronutrients in staple crops through crop improvement, rather than through post-harvest fortification. For populations that eat rice frequently, raising grain zinc offers a way to pursue a nutritional objective within an existing food system without asking consumers to change their staple. In April 2025, the Federal Ministry of Agriculture and Food Security announced the release of FARO 71 and FARO 72 in collaboration with HarvestPlus and the National Cereals Research Institute (NCRI), describing them as the first biofortified, zinc-enriched rice varieties in Nigeria and Africa (Federal Ministry of Agriculture and Food Security, 2025). The release raises questions that announcements alone cannot answer. What verified evidence supports the reported zinc and yield figures? How much of the grain zinc survives milling and cooking, and how much is absorbed? Is there evidence for the stress tolerance attributed to the varieties? What does experience from countries with longer histories of zinc rice suggest about seed supply, adoption, and market acceptance?

This paper therefore reviews critically the available evidence on FARO 71 and FARO 72 and on zinc-biofortified rice more broadly. It aims to (i) compile verified varietal characteristics and identify what is not yet reported; (ii) examine the nutritional implications of the reported grain zinc concentrations; (iii) assess the evidence for resilience claims; (iv) draw lessons for seed systems, adoption and value-chain development; and (v) identify research gaps and policy implications for Nigeria.

METHODOLOGY

This is a critical narrative review, not a systematic review. No protocol was registered, no formal risk-of-bias tool was applied, and no meta-analysis was attempted.

Sources and search. Searches were run through a general web search engine in October 2026. They covered official government and institutional releases, the national variety catalogue, news reports of the release, and open-access scientific literature, working papers and trial registry records. Six main query sets were used: (a) “FARO 71 FARO 72 zinc rice Nigeria HarvestPlus release”; (b) “BRRI dhan74 BRRI dhan100 zinc rice yield maturity grain zinc”; (c) “zinc biofortified rice milling cooking losses bioavailability phytate absorption”; (d) “Nigeria Food Consumption and Micronutrient Survey zinc deficiency prevalence children women”; (e) “zinc biofortified rice human efficacy trial zinc absorption women children Bangladesh”; and (f) “zinc rice adoption Bangladesh farmers seed biofortified rice scaling constraints”. Subscription databases such as Scopus or Web of Science were not searched.

Selection. Sources were included if they reported characteristics of FARO 71 or FARO 72, of their Bangladeshi parent varieties (BRRI dhan74 and BRRI dhan100), or evidence on zinc retention, bioavailability, efficacy, adoption or seed systems for zinc rice. Peer-reviewed articles, official documents and registry records were preferred. News reports were used only to document release facts and official statements, and are identified as such in the text. Studies of other rice varieties were used as indicative evidence on processes (milling, cooking, absorption) and are not presented as measurements of FARO 71 or FARO 72.

Synthesis. Findings were organised by theme (varietal characteristics, agronomic performance, nutrition, resilience, seed systems and adoption). Each reported trait was tagged by source type, and traits with no source were marked “not reported”. Where sources disagreed, we stated the discrepancy rather than resolving it.

Limitations. The search was not exhaustive, was restricted to openly accessible material, and relied largely on English-language sources. Unpublished NCRI variety-release data, which may contain information not captured here, were not available to the review.

RESULTS AND DISCUSSION

Overview of FARO 71 and FARO 72

FARO 71 and FARO 72 are zinc-biofortified pure-line varieties developed in collaboration with the Bangladesh Rice Research Institute (BRRI), HarvestPlus Solutions Ltd. and NCRI Badeggi, and were evaluated in multiple locations including Niger, Oyo and the Federal Capital Territory, and at the Centre for Dryland Agriculture, Bayero University, Kano (Leadership, 2025a). The national variety catalogue (National Centre for Genetic Resources and Biotechnology [NACGRAB], 2025) records their origin and ecological registration. Officials have described the varieties as engineered for Nigeria's lowland ecologies (Leadership, 2025a). Table 1 compiles the traits that could be traced to a source.

Agronomic performance and adaptation

The catalogue potential yields of 9.6 and 9.8 t/ha are substantially higher than yields reported for the parent varieties in Bangladesh. In national trials at 10 locations, BRRI dhan100 averaged 6.69 t/ha with a 146-day duration under boro (dry-season irrigated) conditions (TBS News, 2021). Comparisons across countries, seasons, and management systems should be made cautiously, but the gap suggests the Nigerian figures are best read as potential yields from release trials. Farm-level yields under typical Nigerian management are not yet documented, and the sources do not State the trial sites, seasons, fertilizer rates or water regimes behind the catalogue values.

A relevant agronomic interaction is the response to zinc. In Bangladeshi field trials, zinc sprays raised grain yield of BRRI dhan74 by about 6–18% and increased brown-rice zinc, while unsprayed BRRI dhan74 contained 22.02–23.78 mg/kg zinc in brown rice (Biswas *et al*., 2018). Because zinc deficiency in soils can constrain both yield and grain zinc, soil zinc status is a plausible determinant of how far the Nigerian figures are reproduced on farms. No Nigerian data on this interaction were found. The registration for savanna and rainforest ecologies and the description of the varieties as lowland types indicate the intended target environments. They do not substitute for multi-location, multi-season stability analysis, which the sources reviewed do not report. These gaps limit what can responsibly be said about adaptation beyond the evaluation sites.

Table 1. Characteristics of FARO 71 and FARO 72 traceable to the sources reviewed

Trait	FARO 71	FARO 72	Source and status
Original designation	BRRI dhan74	BRRI dhan100	NACGRAB (2025); catalogue entry
Variety type	Pure line	Pure line	Leadership (2025a); official statement reported by media
Grain zinc (mg/kg)	24.18	25.2 (up to 25.24 in release statements)	NACGRAB (2025); Leadership (2025a). Grain basis (brown or milled) not reported
Grain protein	Up to 11.98% (stated jointly for both varieties)	Up to 11.98% (stated jointly for both varieties)	Leadership (2025a); not given separately by variety
Potential yield (t/ha)	9.6	9.8	NACGRAB (2025). Trial sites, seasons and management not reported
Days to maturity	About 140–145 (intermediate)	Intermediate; days not reported in sources reviewed	FARO 71 figure is the authors' report and was not located in the published sources reviewed. BRRI dhan100: 146 days in Bangladeshi trials (TBS News, 2021)
Ecological registration	Savanna and rainforest	Savanna and rainforest	NACGRAB (2025)
Plant height	Not reported	Not reported	No source located
Tillering ability	Not reported	Not reported	No source located
Grain type	Medium-bold (Bangladesh)	Slender, non-sticky when cooked (Bangladesh)	HarvestPlus (2021) for parent varieties. Nigerian grain-quality data not reported
Pest and disease reaction	"Moderate resistance" stated; no data	"Moderate resistance" stated; no data	Leadership (2025a); no scores, pathogens or pests specified

Zinc biofortification and nutritional quality

What the figures represent. The sources give grain zinc concentrations of 24.18 and 25.2 mg/kg but do not State whether these refer to paddy, brown (whole-grain) rice or milled rice. The distinction matters because zinc is concentrated in the outer layers removed by milling. For BRRI dhan74, the parent of FARO 71, polishing at 9–10% reduced grain zinc by about 2.6–5.84 mg/kg (Biswas et al., 2018). Since unsprayed brown rice of that variety contained 22.02–23.78 mg/kg in the same study, the catalogue value for FARO 71 is consistent with a brown-rice basis; in that case, milled rice available to most Nigerian consumers would contain less zinc. This inference comes from Bangladeshi data and needs confirmation in Nigerian samples.

Milling, cooking and absorption. Table 2 summarises evidence from other rice systems. Taken together, it shows that the grain concentration is only the starting point: milling and cooking reduce zinc, and phytate limits how much of the remaining zinc is absorbed. The polishing results for BRRI dhan74 are given above and are not repeated in the table.

Table 2. Evidence on zinc losses and bioavailability in rice (other rice systems)

Process or outcome	Finding	Source
Milling degree (variety PSB Rc14, rat bioassay)	Zinc of 27.2, 19.4 and 16.5 µg/g in brown, undermilled and milled rice; bioavailable zinc about 21, 17 and 15 µg/g. Higher percentage bioavailability after milling did not offset the lower zinc content	Hunt et al. (2021)
Polishing plus cooking (upland rice, Colombia)	Zinc fell from 24 to 19 mg/kg after 20 s polishing and cooking (79% retention); phytate was reduced to 13% of its raw level	Alliance Bioversity International and CIAT (n.d.); conference abstract
Cooking water (Bangladesh)	Zinc loss of 19% with adequate water versus 39% with excess water	“Loss of Zinc” (n.d.)
Phytate	Zinc in rice is bound in poorly absorbed phytate complexes; absorption depends on variety, milling and food processing	“Determinants of Zinc Bioavailability” (n.d.)

Efficacy evidence. The most direct evidence on health-relevant outcomes comes from Bangladesh, where the 9-month trial above found no change in plasma zinc despite the extra zinc intake ("The Effect of Zinc-Biofortified Rice," n.d.). A further randomized trial using BRRI dhan100 in young women has been registered (ISRCTN Registry, n.d.), but results are not yet available. The trial results do not show that zinc rice is ineffective, since plasma zinc is an imperfect biomarker and the intake increment was modest. Still, they do mean that claims of demonstrated health benefit are premature. Official statements that regular consumption could meet up to 40% of daily zinc requirements (Leadership, 2025b) should be read as a target or modelled expectation. The actual contribution depends on grain basis, milling, cooking method, quantity eaten and the phytate content of the whole diet, and no Nigerian calculation or feeding study was found.

Implications. For FARO 71 and FARO 72, the practical priorities are to (i) report zinc and phytate on brown, parboiled and milled rice from Nigerian samples; (ii) test retention under common Nigerian processing, including parboiling, which is widespread in local milling but was not covered by the studies located; and (iii) communicate that lighter milling and measured cooking water retain more zinc.

Production resilience and constraints

Release announcements make several resilience-related claims for the varieties. Table 3 sets these claims against the evidence found.

Table 3. Resilience claims for FARO 71 and FARO 72 and the evidence located

Claim	Where stated	Evidence located
Drought tolerance	Release announcements (Leadership, 2025b; Propcom+, 2025)	No comparative drought-screening or managed-stress data found
Pest and disease resistance	Release announcements; "moderate resistance" in NCRI statement (Leadership, 2025a)	No disease or pest scores, pathogens, or comparison with check varieties found
Flood or submergence tolerance	Not claimed in sources reviewed	None found; relevant to lowland ecologies
Adaptation to savanna and rainforest ecologies	Catalogue and release statements	Registration documented (NACGRAB, 2025); stability analysis not found
Yield stability across seasons	Not stated	None found

The claims are plausible targets for varieties that passed multi-location national testing, but the sources provide no data for readers to verify them or judge their magnitude. Resilience should therefore be presented as a stated attribute awaiting published evidence rather than an established advantage. This is why the title of this review no longer presents resilience as a finding. Lowland systems in Nigeria also face constraints that no variety can address alone, including irregular water supply, soil fertility, weed, pest and disease pressure, and variable access to inputs. Varietal deployment should be accompanied by agronomic recommendations, integrated pest and disease management and soil fertility management through extension.

Seed systems, adoption and value-chain development

Seed supply. In 2025, NCRI handed over early-generation seed of the two varieties to HarvestPlus under an agreement to produce breeder and foundation seed, targeting 15 metric tonnes (Daily Trust, 2025). Official statements indicate an intention to make seed commercially available to farmers (Leadership, 2025b). The sources reviewed have not assessed whether this volume, and the downstream certified-seed multiplication it must feed, is sufficient to meet farmer demand in major lowland rice states.

Lessons from Bangladesh. Bangladesh released its first zinc rice in 2013 and offers the longest record of experience. Despite sustained investment, a 2026 survey of rice farmers in 39 villages in Faridpur District found that more than 77% were unaware that zinc-biofortified rice was available for cultivation, and non-adopters cited seed unavailability or dissatisfaction with grain quality and yield ("Zinc Biofortified Rice in Bangladesh," 2026). In a panel study, adoption of high-zinc rice in the Aman season among women farmers who received nutrition training fell from 59% in 2018 to 8% in 2020. Adoption among control farmers fell from 13% to 2%, leading the authors to call for continuous training, public messaging and improved seed systems (Valera et al., 2024). A policy brief identified lack of readily available seed, weak demand among aggregators and millers, and lack of differentiated marketing as the main barriers, noting that zinc rice is often mixed with other rice, which prevents consumers from choosing it (Global Alliance for Improved Nutrition, n.d.).

Grain quality and consumer acceptance. Consumer research in Latin America found that grain quality characteristics were important to the acceptance of zinc-biofortified rice (Woods *et al*., 2020). The Bangladeshi parents differ in grain type, with BRRI dhan74 described as medium-bold and BRRI dhan100 as slender and non-sticky when cooked (HarvestPlus, 2021). Nigerian data on milling quality, cooking behaviour and consumer or trader preference for FARO 71 and FARO 72 were not found. Market intelligence studies of rice stakeholder preferences (Custodio et al., 2023) suggest this evidence should be generated early, since acceptance by processors and traders determines whether farmers find a market for the grain.

Implications. Taken together, the Bangladeshi experience suggests that release and seed handover are early steps and that adoption and nutritional impact depend on awareness, seed access, grain quality, and a market that rewards the trait. Without a mechanism to keep zinc rice identifiable from field to consumer, the nutritional benefit is diluted in mixed lots. Extension services have a central role in awareness and agronomy, as the farmers surveyed in Bangladesh had limited exposure to extension ("Zinc Biofortified Rice in Bangladesh," 2026).

Research gaps and policy implications

Table 4 lists priority knowledge gaps that follow from the evidence reviewed.

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Table 4. Priority research gaps for FARO 71 and FARO 72

Gap	Why it matters	Suggested approach
Grain basis and processing retention of zinc	Determines how much zinc reaches the consumer	Measure zinc and phytate in paddy, brown, parboiled and milled rice from Nigerian samples, and after local cooking
Farm-level yield and stability	Potential yield is not farm yield	Multi-location, multi-season on-farm trials with farmer management and published site and season details
Stress and disease reaction	Resilience claims are unverified	Managed drought screening, disease and pest scoring against check varieties
Soil zinc and fertilizer response	May affect both yield and grain zinc	Trials combining soil zinc status with zinc fertilizer or foliar treatments
Consumer, processor and trader preference	Acceptance determines market demand	Sensory and grain-quality studies and market preference surveys in major rice markets
Nutritional efficacy	Health benefit is not demonstrated	Absorption modelling with Nigerian diets and, where feasible, biomarker studies
Seed availability and adoption	Bangladesh shows low awareness and seed constraints	Track certified-seed output, farmer awareness and adoption over time

For policy, the evidence supports several actions: invest in certified seed multiplication beyond breeder and foundation stages; fund extension campaigns that explain both the nutritional and agronomic aspects of the varieties; support identity-preserved marketing and processing that avoids mixing; encourage lighter milling and good cooking practices in nutrition messaging; and require published, verifiable data when resilience or health claims are made in public communication.

CONCLUSION

FARO 71 and FARO 72 are an important step because they bring a nutritional trait into a crop already central to Nigeria's food system. Official sources report grain zinc of 24.18 and about 25.2 mg/kg and potential yields of 9.6 and 9.8 t/ha for savanna and rainforest ecologies. The evidence reviewed supports the following distinctions. **Documented:** release, parentage, catalogue values for zinc and potential yield, and the start of breeder and foundation seed production. **Plausible but unverified for these varieties:** retention of useful zinc after local milling and cooking, stress tolerance, and farm-level yields close to potential. **Not demonstrated:** improvements in human zinc status, and acceptance by Nigerian consumers and traders.

The authors recommend that (i) the grain basis and measurement conditions of reported zinc values be published; (ii) farm-level performance and stability data, including plant height, tillering and disease reaction, be released; (iii) retention and bioavailability be assessed under Nigerian processing and diets; (iv) seed multiplication and extension plans be matched to demand; and (v) public communication avoid presenting expected benefits as demonstrated outcomes. Long-term contribution should be judged by farmer-level performance, adoption, seed-system development, grain quality, market acceptance and dietary use.

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APPENDIX A: AUTHOR CONTRIBUTION STATEMENT

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