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A School Is an Economy: Navasco and the Architecture of Sustainable Education Funding

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Abstract

This article asks a forward-looking question: how can education finance be structured so that spending consistently delivers reliable, high-quality learning conditions? Using Navrongo Senior High School (Navasco) as a case study, we examine how funding systems can better align with the practical requirements of teaching and learning. We show that classroom adequacy, infrastructure reliability, and pedagogical renewal must be financed as interconnected priorities. Frameworks shaped by the Millennium Development Goals and only partially adapted under the Sustainable Development Goals have emphasized capital expansion, but the next step is to embed maintenance, uptime, and systematic renewal into the core of financial design.

We propose Metanomics as a practical architecture for doing so. It is a resource-anchored, rules-based model that treats a school as an operating economy. Audited productive assets and contracted service flows are consolidated into a transparent Resource Basket that anchors a school-issued funding instrument governed by clear convertibility rules. Liquidity is directed to verified constraints—reliable power and connectivity, adequate classrooms, and updated learning materials—while maintenance is prepaid and disbursements tied to service-level performance. A fiduciary trust supported by a decentralised ledger ensures transparency and discipline.

The framework scales through clustering and district pooling, extends to universities through research receivables, and adapts to basic education via aggregated local assets—offering a replicable model that aligns finance directly with learning outcomes.

Keywords: *Navasco Metanomics; Resource-Backed Education Finance; Reliability-First Infrastructure; School Trust; Decentralised Governance; Ghana Secondary Education.*

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1. Introduction

Education is the fulcrum of national development, but its promise is realised only when four pillars stand together: sound infrastructure, motivated and well-supported people (students, teachers, leaders), a relevant curriculum, and disciplined finance that keeps the first three reliably funded. Navrongo Senior High School (Navasco) illustrates both the potential and the peril. Once celebrated as 'the light of the North' for the calibre of its graduates in medicine, economics, law, engineering, public service and enterprise, Navasco now contends with a system of constraints: overcrowded classrooms, aging laboratories, broken fittings, under-resourced libraries, overstretched accommodation, intermittent water, unstable electricity and patchy internet that depress teaching quality, reduce time-on-task, erode discipline and sap teacher morale.

The deeper problem is structural and historical. The prevailing funding architecture in Ghana and much of Africa is a continuation of colonial, one-sided and myopic systems of provisioning. Those systems were designed to extract administrative efficiency at minimal cost, not to build resilient, modern learning environments. After independence, there were brief, ambitious departures, most notably under Kwame Nkrumah, when infrastructure, science and national capability were centrally funded as state priorities. But the momentum waned. In subsequent decades, fiscal compression and external conditionalities channeled education finance into thin, projectised lines that built 'things' without underwriting the reliability and renewal that make those things productive. The era of the Millennium Development Goals(MDGs) entrenched this pattern by rewarding enrolment expansion and visible capital outlays; the Sustainable Development Goals(SDGs), with their emphasis on quality, equity and resilience, have not yet displaced it. As a result, laboratories sit idle when power fails, classrooms arrive without ventilation or maintenance budgets, libraries cannot keep texts current, and internet connectivity is an aspiration rather than a service level.

This paper responds with a dual move: diagnostic and constructive. First, we assemble descriptive evidence from Navasco stakeholders: teachers and staff, students, parents and guardians, alumni and administrators. Without over promising causal claims, the data tells a coherent story: seat scarcity, unreliable electricity and internet, episodic water access, broken fittings, and outdated science tools recur across the school, and respondents consistently judge the impact on performance to be material. The pattern is systemic rather than episodic; it cannot be solved by another one off grant or a single donor or government allocation.

Second, we theorise and build a financing system that matches the structure of the problem. Our approach—Metanomics—rebuilds the link between a school's real economy and the money it uses to fund learning. In the Navasco pilot, implemented through NABIYA Qapital, the school's tangible assets (gardens and farms, cattle and poultry, a mini-irrigation dam, rooftops for solar plus storage, kitchens and cold-chain) and its contracted flows (dining-hall purchases, alumni subscriptions and sponsorships) are audited into a transparent resource basket. That basket forms a reserve which credibly backs a school-issued token within clear, stress-sensitive redemption corridors. Liquidity is then programmed into the precise bottlenecks the data revealed: first reliability (solar-plus-battery and enterprise-grade internet service; borehole and pump efficiency; water storage and scheduling), then capacity (additional classrooms and refurbished fittings), and then renewal (current science equipment, calibrated instruments, up-to-date textbooks, smart-classroom kits). Maintenance is prepaid in escrow, and disbursements are released only when service levels are verified: power and bandwidth uptime, seats delivered, laboratory utilisation and textbook currency. The innovation is governance rather than gadgetry: a Fiduciary School Trust(FST) with a decentralised governance overlay brings the Board, school leadership, alumni and a regulated custodian under one rule-set; valuation methods and convertibility rules are published; and every tranche is conditional on outcomes the classroom can feel.

Navasco is an apt pilot because the productive base already exists and the alumni community is unusually capable and engaged. Yet the model is a protocol, and not a project: a standard way for any school to make its assets legible, bind its monetary instrument to that productive base, finance reliability alongside capacity and renewal. In rural settings, the basket leans into land, water and livestock; in urban schools it tilts toward rooftop energy, information-technology hubs and alumni subscriptions; in coastal or arid regions it adapts to fisheries and cold-chain or to boreholes, pumps and shade-house gardens. Universities can extend the basket to research and service income (executive education, laboratory services, royalties, clinical revenues) and fund campus-wide energy, bandwidth service levels, calibration cycles and faculty housing with the same discipline. Basic education can pool smaller assets at district level so modest schools benefit from professional procurement, and shared micro-grids.

This article empirically provides a stakeholder-grounded diagnosis of the constraints that suppress learning at Navasco, showing how a colonial funding logic, light on operations and maintenance, heavy on visible builds, persists into the present. Conceptually, it recasts education finance as a monetary-real loop in which reserves are school assets and contracted flows, issuance is rule-bound and stress-aware, and spending is tied to service levels rather than line items. Practically, the paper sets out an implementable blueprint—governance wrapper, valuation and disclosure templates that policymakers can adopt nationally and adapt continent-wide.

The rest of the article is organised as follows. Section 2 reviews the literature on infrastructure, learning quality and financing, situating Ghana's current predicament in historical and comparative perspective, while identifying why conventional models underperform. Section 3 sets out the methodology and data, explaining the stakeholder survey and the descriptive approach. Section 4 presents the diagnosis of infrastructure, resources and performance at Navasco, interpreting the figures and synthesizing what the statistics mean for learning. Section 5 develops the resource-based funding solution, our Metanomics blueprint implemented by NABIYA Qapital, and shows how it generalises to senior high schools nationally, to universities and to basic education. Section 6 and 7 present a unique Navasco analysis for adoption.

2. Light of the North: An Overview

Navrongo Senior High School, well known as Navasco, was born at a hinge in Ghana's history. In September 1960, at the dawn of republican self-governance, President Kwame Nkrumah founded 'President's College' in Navrongo as a lighthouse for the northern territories. This was what Dr Kwame Nkrumah wrote in the log book of the school on 26th October, 1960: 'This school has a future. I shall watch its progress with great interest'. The name soon settled into 'Navrongo School', and with it a motto that has proved prophetic: *Lux Borealis*— 'The Light of the North'. From the beginning, the school cultivated a double inheritance. One strand was modern and republican: selective public education as a route to national service. The other was older and indigenous: the soil-deep symbolism of the horn, chosen as the school's emblem, which in Northern Ghana summons courage and crowds, and serves as an instrument of authority, memory, and resolve.

Early leadership figures such as J. K. Fiegbor (also rendered Fiergbor) inaugurated Navasco's academic culture and its emphasis on purposeful infrastructure. Halls like MacDonald Hall, laboratories, and staff housing gave material form to the school's aspirations, and the institution quickly became a flagship in the Upper East Region. Milestones followed with ritual regularity—the golden jubilee in 2010, the diamond celebrations in 2021 (after a pandemic postponement)—each serving as both a look back and a recommitment to the founding conceit: that a school at Ghana's northern edge could illuminate the whole nation.

Yet Navasco's identity is captured as much in language as in buildings. Alumni call themselves Nabia, a short word for 'Citizens'. In Kasem usage, it invokes belonging and responsibility; in school lore it gathers further layers from the emblematic horn and the bull. Agriculture once ran on bovine traction where bulls and oxen turned soil into surplus, hauled produce to market, and converted muscle into margin. Finance borrows the same animal to signal optimism: the bull market as disciplined confidence. Navasco's emblem thus spans field and firm, ritual and risk: strength yoked to service.

That ethic came into sharp public focus in the 1990s when Navasco's science team twice stood within touching distance of national supremacy. In 1994 and 1995, under the then sector-based format of the National Science and Maths Quiz (NSMQ), Navasco fought through the northern ladder only to be edged by Ashanti powerhouses on the road to Accra's finale. Those seasons, won nationally by Prempeh College (1994) and PRESEC-Legon (1995), with Opoku Ware School perennial in the upper tiers, left a folk memory of 'almosts' that was less failure than proof of parity. It announced to the rest of Ghana that the Light of the North could scorch.

Fast forward three decades and the pattern is recognisable. Navasco remains a regional bellwether, winning or placing strongly in Upper East qualifiers, sometimes by emphatic margins, yet tends to fall earlier than the eventual national champions. Titles and sustained finals runs have clustered among a small franchise set (PRESEC-Legon, Prempeh College, St Peter's, St Augustine's, Mfantsipim, among others), schools with deep benches, expansive laboratories, and long-standing alumni endowments. On the West African Senior School Certificate Examination (WASSCE), the nation publishes no official school-by-school league table; where independent compilations circulate, Navasco seldom appears in the very top national shortlists. Read together, these proxies place Navasco as regionally dominant and nationally competitive, but not yet a serial podium regular.

Why this 'near, but not quite' equilibrium? The bluntest answer is capital stock. Education is a production function, and, beyond talent and teaching, two inputs matter disproportionately for science-heavy performance: time and tools. Dormitories determine whether students arrive at class rested; water and sanitation decide whether they stay healthy; housing influences whether teachers remain long enough to create institutional memory; laboratories and equipment convert curiosity into experiment. Navasco's appeals over the past decade—for dormitory rehabilitation, laboratory upgrades, and staff accommodation—have been heeded only in increments: commendable alumni refurbishments, a new girls' dormitory, assorted repairs. But when the denominator of preparation hours and lab contact is structurally thinner than peers, national contests decided at the margin will, on average, lean toward the better-resourced schools.

None of this diminishes the central fact of Navasco's civic success: the Citizens have ranged widely and built bravely. Indeed, to assess Navasco only by contest finals is to mistake a compass for a clock. The school's deeper legacy is a habitus—a way of stitching knowledge to usefulness, and usefulness to community. Consider a cross-section.

In traditional leadership and cultural stewardship, figures such as Pe Dennis Aneakwoa Balinia Asagpaare II (Paramount Chief of Navrongo), Ambassador Yakubu Abdulai (Paramount Chief of Sagnarigu), and Nana Okogyedom Barimah Ntim-Barimah (Kwahu Tafo Akwantufohene) embody the synthesis of scholarship and custom that Ghana has long practised: modern deliberation underwritten by ancestral mandate. In entrepreneurship, Navascans power ventures that touch production, logistics, and knowledge systems: Gnostic Agritech Limitless, Mighty Enterprise, Heart of Oceans Industries and Akuafo Nketua in agrifood value chains; Porthologos Press and AREF Consult in research dissemination, consultancy and advisory; Metaengineering & Construction in infrastructure delivery; Indigenous Arts & Crafts Incorporated in heritage industries; and AREF Consult in policy-anchored advisory. The common thread is not fashion but function: these are firms built around solving real problems—soil fertility and yields, roads and water, youth skills and finance—across the Sustainable Development Goals.

In academia and public health, Professor Patience Afulani exemplifies the Navasco instinct to connect rigour with relevance, linking maternal health outcomes to systems design and equity. In higher-education leadership, Professor David Millar (Vice-Chancellor of the Millar Institute for Transdisciplinary and Development Studies and former Pro Vice-Chancellor of the University for Development Studies) represents the Northern project of taking the university to the doorstep of agriculture and enterprise, not the other way around. In engineering and applied problem-solving, figures such as Williams Chuliwor Chanayireh embody the Nabia tradition of turning technical skill into practical infrastructure—designing, building, and maintaining systems that make daily life workable where conditions are least forgiving. In agriculture and agribusiness leadership, Dr Charles Kwowe Nyaaba, and Jonas Abaching Assorrow stands for the fusion of scientific agronomy, enterprise development, and food-system stewardship that anchors livelihoods while expanding value chains.

In politics and public administration, Navascans such as Haruna Iddrisu, James Agalga, and Dr Francis Addai-Nimoh show that the Nabia imprint is visible not only in bench science or classrooms but also in the bargaining tables where laws are drafted, budgets negotiated, and policy frameworks cast. In spiritual leadership, Rev. Fr. Acheampong Emmanuel, among others, continues the older work of binding community—sometimes the most delicate engineering of all. In clinical innovation, Dr Rudolph Kantum Adageba's fertility practice points to another Nabia through-line: put high science at the service of ordinary family hopes.

Add to these the less visible but equally telling strata: teachers who return to remote districts armed with both chalk and compassion; engineers who design boreholes, bridges, and grid connections in the difficult spaces between towns; agric extension officers and cooperative builders who translate research into yields; artists and coders who freshen Ghana's aesthetic and digital vocabularies; civil servants who quietly hold the line for competence; and a global diaspora of Navascans such as Professor Ali Osman, Dr Emmanuel Yamusab Nyaaba , and Professor Sylvester Abanteriba, whose remittances, research collaborations, policy advice, and venture investments tether international networks to local needs. The diaspora's reflex is citizenship as practice: to be Nabia is not only to belong, but also to build.

Here, the emblem's horn earns another reading. In northern chieftaincy, the horn summons; in Navasco culture, it also concentrates. It asks: what is the one thing without which all else falters? For a school, that one thing is formative experience—the mixture of discipline and discovery that turns adolescents into adults. Navasco's insistence on being more than an exam machine has produced precisely the range one sees across its alumni: from priests to politicians, agronomists to editors, surgeons to artisans. The school's foundational bet—that the North could be a source, not merely a sink, of national talent—has been proven again and again by the lives of its Citizens.

The question, then, is not whether Navasco can reclaim the national podiums—of course it can—but how quickly and how permanently. The path is technocratic rather than mystical. First, finish the lab pipeline: equip, maintain, and schedule laboratories so that every science student accrues meaningful hours at the bench. Second, harden living space: modern dormitories and staff housing reduce churn, raise attendance, and free cognitive bandwidth for study. Third, institutionalise STEM coaching: not as emergency cram schools but as sustained mentorship, competitions, and maker-spaces. Fourth, codify alumni endowments: regularised giving, transparent governance, and targeted capital projects that compound over years. Surround these with the intangibles—music, sport, debating, creative writing—because schools serious about science are often the ones serious about the arts; curiosity rarely travels alone.

One can already see how this capital deepening translates into Navasco's wider thesis for Ghana's development. The school's entrepreneurs and professionals work at the seam where resource meets knowledge: turning cocoa, cashew, shea, clay, stone, water, sunlight, and human skill into higher-value artefacts. In a world where money and markets are being re-imagined through technology, this is precisely the edge Ghana needs: institutions that teach citizens to turn strength into structure, exuberance into enterprise, and heritage into hardware. Navasco's emblem was prophetic in this sense. The horn is not noise; it is signal. It calls people to assemble not for spectacle but for work. If the mid-1990s gave us 'almosts', they also gave us a map. Navasco could match the best when the inputs converged; when they diverged, margins tilted away. Today's regionals-strong, nationals-short pattern is the same map, simply seen from a higher altitude. The difference is that the solutions are now well understood and within reach. Complete the build-out, align governance, and sustain coaching; the rest will follow. For the Citizens themselves, the Nabia spread across Ghana and the world, the task is equally clear: keep doing what the name demands. Be citizens, not spectators. Contribute your time, treasure, knowledge, and networks. Every refurbished lab, scholarship, internship, and endowment pledge is a note in the old horn. And when the sound is full, the Light of the North will not merely shine; it will lead.

3. Literature Review

3.1. Education as a Foundational Pillar

The centrality of education in shaping national destinies has long been emphasized in both policy and scholarship. UNESCO (2015) underscores that education is a human right, and the foundation for sustainable development, productivity, and social cohesion. Adequate investment in secondary education, in particular, has multiplier effects: it expands human capital, reduces inequality, and fosters democratic citizenship (Psacharopoulos and Patrinos, 2018). For Ghana, senior high schools (SHSs) constitute a crucial bridge between universal basic education and higher learning or professional pathways, making their quality and sustainability pivotal. Every parent therefore wants their ward to attend an elite school such as Navasco. Jensen & Seltzer (2000) as reported in Yusif et al, (2011) observed that students performance is significantly determined by the type of school they attended.

Yet while policy documents highlight education as a priority, implementation often falls short. The World Bank (2020) notes that the 'learning crisis' in Sub-Saharan Africa is not primarily one of access, but of quality: students complete schooling without mastering foundational skills, largely due to the poor conditions under which teaching and learning take place. In this regard, Navrongo SHS—like many of its peers—embodies the paradox of high expectations and historical excellence undermined by systemic neglect.

3.2. Infrastructure and Educational Outcomes

Infrastructure has emerged as one of the most consistent determinants of educational outcomes. Satapathy (2015) highlights how adequate physical infrastructure is indispensable to effective education delivery, while Lawanson and Gede (2011) show that the state of classrooms directly influences student enthusiasm, concentration, and participation. Mustapha (2023) observed that poor classroom conditions have significant negative effect on students' concentration and attention during lessons. It also disrupts teaching and learning. The study revealed that conducive environmental conditions in the classroom improve students' performance through comfortable indoor environment, excellent work quality, learning habits of students and attention paid during classes. Barrett et al. (2019) synthesize evidence from across low- and middle-income countries to show that physical environments—from lighting to acoustics—have measurable impacts on learning outcomes.

In Ghana, the infrastructural challenge is acute. The World Bank (2008) reported stark disparities in the availability of textbooks, libraries, and laboratories, with rural schools particularly disadvantaged. Asiabaka (2008) attributes this to the absence of enforceable policy standards, leading to uneven provision and management of resources. More recent work by Agyekum (2020) and Asare (2018) documents how many SHSs operate in decades-old buildings with structural faults, leaky roofs, and unsafe electrical systems, all of which compromise effective learning.

The broader African experience echoes these findings. In Nigeria, Yusuf (2019) demonstrates how inadequate classrooms and laboratories suppress student performance and dampen teacher engagement. Afolabi and Ojo (2023) extend this argument by linking poor infrastructure to high teacher attrition, especially in public schools, thereby compounding the crisis. The literature thus consistently positions infrastructure as a linchpin in the educational production function: without safe, well-equipped spaces, neither teachers nor students can thrive.

3.3. Resource Gaps and Policy Failures

Despite broad consensus on the importance of infrastructure, funding gaps remain persistent. A study by Asamoah (2025) revealed financial constraints towards physical and technological infrastructure in schools due to the growing student's population. The study identified public private partnership (PPP), internally generated funds, and revenue diversification as remedy for school infrastructural challenges. Murillo and Roman (2011) argue that resource disparities account for much of the inequality in educational outcomes across Latin America—a dynamic mirrored in Ghana. Togbe (2023) observed that students' academic performance totally depends on factors such as quality of teachers, facilities available, and financial resources of a school. To close the huge gap between urban and rural education, government must invest in school infrastructure and give reasonable financial support to rural education. Green et al. (1996) had already called for integrating infrastructure into educational production models, yet public policy often treats infrastructure as an afterthought rather than a core input.

In Ghana, the introduction of the Free Senior High School policy in 2017 expanded access but exacerbated existing infrastructural constraints (Akyeampong, 2018). Increased enrolments without corresponding capital investment led to overcrowding, strain on utilities, and the deterioration of already inadequate facilities. This illustrates the inadequacy of access-driven funding models that do not internalise the full cost of quality delivery.

Donor aid, while significant, has also proven inconsistent. The African Development Bank (2019) highlights that external financing tends to be project-based, short-term, and donor-driven, often failing to align with long-term national infrastructure plans. Alumni contributions, though important, remain fragmented and insufficient. The cumulative effect is a vicious cycle: underfunding leads to deteriorating infrastructure, which undermines performance, which in turn erodes alumni loyalty and contributions.

3.4. Teacher Motivation, Student Performance, and Discipline

Beyond physical structures, infrastructure intersects deeply with human factors. Teacher motivation is strongly correlated with the quality of facilities. Hassana (2025) shows that inadequate housing, overcrowded classrooms, and lack of teaching materials drive attrition, particularly among experienced educators. Chiriswa (2002) finds that students in chronically underperforming schools often lose morale, creating a culture of low aspiration.

Discipline is also implicated. Kyriacou (1995) defines discipline as the scaffolding that sustains effective learning environments, yet indiscipline has escalated in many Ghanaian schools (Ofori, 2018). Enefu et al. (2019) liken it to a cankerworm undermining not just education but broader social fabric. Studies by Azogor (2016) and Prout and James (2003) situate indiscipline in broader socio-economic contexts, but poor infrastructure exacerbates the problem: overcrowded dormitories, inadequate recreational facilities, and lack of counselling spaces create conditions for misconduct to flourish.

The literature converges on the point that infrastructure is not a passive backdrop but an active determinant of the quality of human interaction in schools. Without adequate facilities, neither teachers nor students can maintain the focus, discipline, and morale required for excellence.

3.5. Comparative and Continental Perspectives

Globally, investment in school infrastructure has yielded transformative results. In South Korea and Singapore, deliberate strategies to modernise educational infrastructure in the post-war era were foundational to their subsequent economic miracles (Kim, 2002; Goh and Gopinathan, 2008). Latin America's targeted infrastructure investments—though uneven—show measurable improvements in learning outcomes where implemented (UNESCO, 2017).

In Africa, however, progress has been slower. The Global Education Monitoring Report (UNESCO, 2021) estimates that Sub-Saharan Africa faces an annual financing gap of US$39 billion to achieve SDG 4 on quality education. The African Union's Continental Education Strategy (CESA 2016–2025) recognises infrastructure as central but admits that member states lack sustainable financing mechanisms. Ghana's own Education Strategic Plan (2018–2030) identifies infrastructure as a key constraint but largely defers its financing to external aid and incremental public budgeting.

This comparative literature underscores that the gap is not in knowledge but in execution: the models of financing remain inadequate, fragmented, and donor-dependent, perpetuating a cycle of deficit.

3.6. Theoretical Gaps in Existing Literature

Most empirical studies adopt an 'educational production function' approach, linking inputs (teachers, materials, facilities) to outputs (performance, attainment). While useful, this framework has limitations. It treats infrastructure as a variable to be optimised within existing budget constraints rather than as a systemic investment requiring innovative financing.

Barrett et al. (2019) call for more integrated frameworks that connect physical infrastructure with pedagogy, health, and social equity. Yet the literature remains piecemeal. Policy analyses often identify resource gaps but stop short of proposing new paradigms of mobilisation. The underlying assumption is that governments, donors, or alumni will incrementally fill the gaps—a premise increasingly at odds with fiscal realities in high-debt, low-revenue African economies (Eichengreen et al., 2005).

Thus, the literature exposes a conceptual vacuum: while the need for infrastructure is well-documented, the mechanisms for sustainable financing remain under-theorised. This creates the space for a Metanomic approach.

3.7. Towards a New Paradigm

Given these gaps, a new paradigm is warranted. Metanomics as put forth in Alagidede (2025a, b), reconceptualises finance as resource-backed, decentralised, and community-anchored, and offers a radical departure from donor dependency and incrementalism. The literature on innovative financing—ranging from social impact bonds (Fraser et al., 2018) to blended finance (OECD, 2020)—shows that hybrid models can mobilise new resources. However, these models often remain tethered to external actors and global financial markets.

By contrast, resource-backed models such as NABIYA Qapital integrate local endowments, alumni networks, and digital finance to create endogenous funding streams. This aligns with the calls by Murillo and Roman (2011) and Barrett et al. (2019) for systemic innovation rather than piecemeal reform. While empirical evidence on such models in education is nascent, analogous successes in community health financing (Mills et al., 2012) and renewable energy cooperatives (Sovacool, 2013) demonstrate feasibility.

Therefore, the Navasco model is positioned not as a mere institutional case study but as a prototype for continental replication. It addresses the literature's identified gaps by proposing a financing paradigm that is:

- Endogenous, drawing on community and alumni capital.
- Resource-anchored, leveraging tangible assets.
- Digitally enabled, using blockchain-based instruments for transparency and scalability.
- Globally replicable, offering a model for other regions facing similar deficits.

The literature reviewed consistently affirms the centrality of infrastructure to educational outcomes, the inadequacy of current funding models, and the profound human consequences of neglect. Yet it also reveals a conceptual and practical void: while the need is well-established, sustainable solutions remain elusive. The Navasco model, grounded in Metanomics reframes education finance around endogenous, resource-backed systems, it offers a credible path to resolving the crisis of infrastructure in senior high schools and beyond.

4. Methodology and Descriptive Analysis

4.1. Research design and purpose

This study employs a cross-sectional, stakeholder-centred descriptive design to diagnose the infrastructural and resource conditions at Navasco and to assess their perceived implications for teaching, learning, discipline and performance. The design is suited to: (i) profiling deficits that policy commonly underestimates (Barrett et al., 2019), (ii) surfacing stakeholder knowledge that does not typically appear in administrative datasets, and (iii) motivating an alternative, resource-backed financing model (the Navasco–NABIYA Qapital prototype) when traditional approaches have proven insufficient..

No inferential models or regressions are estimated. The paper relies on descriptive statistics (means, medians, modes, standard deviations) to (a) establish the magnitude and pattern of constraints and (b) justify a paradigm shift in financing, consistent with the argument that infrastructure is a decisive input in the educational production process (Green et al., 1996; Satapathy, 2015).

4.2. Target and accessible populations

The target population comprises stakeholders with lived experience of Navasco's learning environment and outcomes: staff and administrators, alumni, heads of schools, students, and parents/guardians. The accessible population consisted of members of these groups active on official or vetted WhatsApp platforms and email during the fieldwork window: (i) Staff of Navasco; (ii) alumni year-group platforms; (iii) parent/guardian platforms. This frame privileged respondents with direct and recent exposure to the school's conditions—appropriate for a diagnostic study seeking decision-ready evidence.

4.2.1. Sampling strategy

A non-probability convenience sample was used, leveraging the above platforms. This choice is warranted where a full sampling frame is impractical and the immediate goal is programmatic prioritisation rather than population generalisation. In total, 155 individuals (old students/alumni, parents/guardians, staff/workers, benefactors) were invited; 115 complete responses were received ($\approx 74.2\%$). Inclusion criteria required age 16, a direct connection to Navasco, and informed consent.

Implication. While convenience sampling constrains statistical generalisability, the approach offers high content validity for identifying salient, correctable bottlenecks—a necessary prelude to financing design (UNESCO, 2015; World Bank, 2018).

4.3. Instrument and constructs

A structured questionnaire captured five construct areas aligned to the paper's theory of change—infrastructure and utilities teaching/learning conditions, and discipline performance:

i. Infrastructure and facilities (e.g., staff accommodation capacity, water reliability, structural integrity of sports/fence assets, staff commuting distance).

ii. Learning resources and technology (availability of ICT/labs; reliability of internet and power; currency of science equipment and textbooks).

iii. Classrooms, furniture and equipment (classroom adequacy, smart-classroom capability, condition of furniture/equipment, ventilation/lighting).

iv. Perceived impact on student performance (anchor item appearing in each table).

v. Role and exposure (teacher/staff, student, parent/guardian, alumnus/a, head/administrator; years of contact with Navasco).

Items were measured on a 1–5 Likert scale. Importantly, some items are problem-phrased (higher value = *worse*, e.g., 'Unreliable Internet and Power'), whereas others are adequacy-phrased (higher value = *better*, e.g., 'ICT/Laboratories Facilities'). In this descriptive paper we preserve the raw direction of each item and interpret them accordingly; we do not re-scale to composite indices.

Content validity was enhanced through brief expert review (senior educators/administrator) to confirm coverage and clarity (Barrett et al., 2019).

4.4. Data collection and quality assurance

The survey link was posted to the stated WhatsApp platforms and email addresses with a plain-language consent statement. Participation was voluntary and anonymous. Responses were screened for completeness; the analysis includes 115 valid cases. Because the dataset available for this paper is aggregate (summary statistics per item), standard internal consistency diagnostics (e.g., Cronbach's) could not be computed; this is explicitly acknowledged as a limitation (see Section 3.9).

4.5. Analytical approach (descriptive only)

Given the study purpose and available data, the analysis is strictly descriptive:

- For each item we report Valid n, Mean, Median, Mode, Standard Deviation (Figures 1-3 below and Tables 1–3 in the appendix).
- We interpret items in their native direction (problem versus adequacy) and read the pattern across domains.
- We use the repeated 'Impact on Students' Performance' item (Mean = 3.30; Median = 4 across tables) as a perception anchor signalling stakeholders' consensus on material performance effects.
- For narrative economy we refer to a traffic-light rubric to classify concern levels for quick prioritisation:
  - Severe/acute: Means 2.30 on adequacy items (or 3.00 on problem-phrased items).

- Significant: 2.30–2.70 (adequacy) / 2.70–3.00 (problem).
- Moderate: 2.70–3.00 (adequacy) / 2.40–2.70 (problem). These thresholds are heuristic and purely descriptive; they are used to guide practical prioritisation, not inference.

No hypothesis tests, correlations, or regressions are reported. Instead, we answer the research questions qualitatively-from-quantities (Manski, 2013 style): we describe what is large, small, consistent, or heterogeneous and interpret it through the peer-reviewed literature.

4.6. Ethical considerations

The study obtained in-app informed consent, collected no direct identifiers, and stores de-identified data securely. Only aggregated results are reported.

4.7. Limitations

(i) Sampling: convenience sampling may over-represent digitally active stakeholders; rural or less-connected voices might be under-sampled.

(ii) Measurement: self-reports may contain optimism or salience bias; however, convergence across independent items and the performance anchor (Mean = 3.30) builds confidence that real constraints are being captured (World Bank, 2019).

(iii) Aggregation: absence of microdata prevents reliability tests, distributional diagnostics, and multivariate controls. These limitations motivate—not weaken—the case for a new financing approach that can be piloted, monitored, and iteratively evaluated with improved data.

5. Descriptive Diagnosis of Infrastructure, Resources and Performance

This section offers a diagnosis of the learning environment at Navasco using 115 valid stakeholder responses from teachers and staff, students, parents/guardians, alumni, and administrators. All items were measured on a 1–5 Likert scale, with some phrased as problems (higher values indicate worse conditions, as with 'Unreliable Internet and Power') and others as adequacy (higher values indicate better provision, as with 'ICT/Laboratories Facilities'). Across the three figures, the item 'Impact on Students' Performance' is strikingly stable at a mean of 3.30 (median 4), indicating a shared perception that the environmental conditions observed are not trivial inconveniences but have material consequences for learning. We intentionally present descriptive statistics only—no regressions—to establish the magnitude and configuration of constraints and to lay a transparent evidential basis for the financing paradigm proposed in the next section.

The descriptive diagnosis is complemented by visual evidence and enrolment data presented in the appendices. Appendix A provides selected photographs of Navasco's physical environment, including classrooms, laboratories, furniture, water and energy infrastructure, and agricultural assets. These images are not illustrative ornaments; they visually corroborate the survey-based findings by showing the coexistence of solid physical endowments with visible wear, congestion, and maintenance gaps—particularly in classrooms, fittings, and utility systems. Appendix C documents current student enrolment and programme distribution, indicating a total population of 1,745 students across science, arts, agriculture, business, and vocational tracks. When read together, the appendices contextualise the descriptive statistics by showing how a large and diverse student body is being served by infrastructure and services that have not scaled reliably with enrolment. The visual and numerical evidence therefore reinforces the core claim of this section: Navasco's constraints are not episodic or anecdotal, but structural, observable, and consistent with stakeholder perceptions captured in the survey data.

5.1. Infrastructure and Facilities

Figure 1 depicts an ecosystem under structural stress even before technology and classroom fittings are considered. Staff accommodation, rated 2.90 (SD 0.81), points to persistent overcapacity; commuting distance for staff, at 2.87 (SD 0.88), suggests daily frictions that erode instructional energy and availability for pastoral duties; and the structural integrity of the sports pit/fence wall, 2.88 (SD 0.96), signals maintenance backlogs in the wider physical plant. The reliability of basic services is also fragile: frequent water shortage registers 2.35 (SD 0.99), a level consistent with periods of scarcity that would disrupt sanitation, meal preparation, and science practicals. Dispersion in these indicators (SDs clustering between 0.8 and 1.0) implies heterogeneity by block or season, with pockets of acute deprivation. Read against established evidence that teacher housing, commuting burdens, and reliable utilities shape motivation, time-on-task, and co-curricular provision, the data are congruent with the conclusion that the school's foundational inputs are underperforming in ways that predict learning loss (Barrett et al., 2019; Murillo and Román, 2011; Yusuf, 2019). The repeat appearance of the performance anchor at 3.30 corroborates that stakeholders themselves connect these conditions to outcomes.

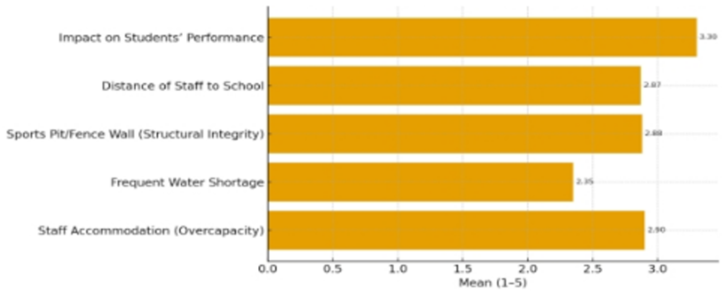

Figure 1. Infrastructure and Facilities (Mean Ratings)
(Source: NAVASCO stakeholder survey, n=115.)

5.2. Learning Resources and Technology

Figure 2 reveals the classic hardware–reliability paradox that haunts many resource-constrained schools. On the adequacy side, ICT/Laboratories Facilities average 3.02 (SD 1.01), suggesting that some hardware exists and is at least partially usable. Yet the backbone on which such facilities depend is weak: Unreliable Internet and Power scores 3.05 (SD 0.95)—the most severe technology constraint in the dataset when interpreted as a problem-phrased item. In parallel, pedagogical content and tools are aging: Outdated science equipment sits at 2.95 (SD 1.01), and Outdated textbooks at 2.92 (SD 0.95). The pattern is exactly what the literature would predict: where electricity and connectivity are unreliable, laboratories and ICT suites suffer low utilisation, teachers revert to chalk-and-talk modes, and the returns to prior capital expenditures are diluted (Barrett et al., 2019; World Bank, 2018). Once again, the performance anchor at 3.30 makes explicit that respondents read these conditions as having tangible effects on exam preparedness and day-to-day learning, especially in STEM.

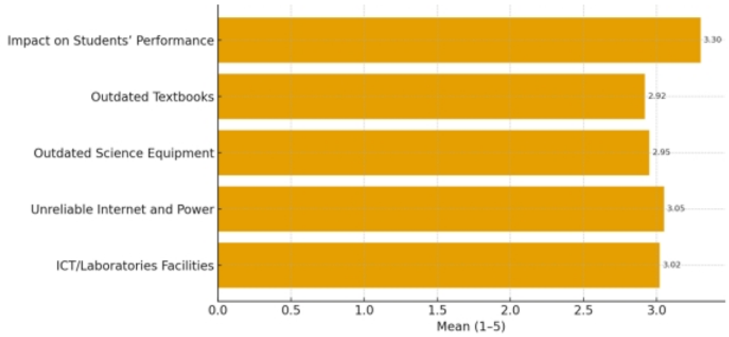

Figure 2. Learning Resources and Technology (Mean Ratings)
(Source: NAVASCO stakeholder survey, n=115.)

5.3. Classrooms, Furniture and Equipment

The most acute physical bottleneck emerges in Figure 3. Classrooms Available are rated 2.12 (SD 0.95), a level that decisively signals seat scarcity and overcrowding. The environment within those rooms is also compromised: Lack of smart classrooms (projectors) is 2.93 (SD 0.99), while Broken furniture and equipment stands at 2.82 (SD 1.11), indicating wear-and-tear beyond what routine operations can absorb. Poor ventilation and lighting is rated 2.07 (SD 0.71); although comparatively less severe than other constraints, it remains substandard for sustained concentration. The school effectiveness literature has repeatedly shown that overcrowding, equipment failure, and the absence of modern instructional aids depress instructional quality, complicate classroom management, and erode discipline climates (Barrett et al., 2019; Kyriacou, 2009; Wuni et al., 2017). Navasco's figures align with that body of evidence and help explain why stakeholders consistently assign a 3.30 to the perceived academic impact.

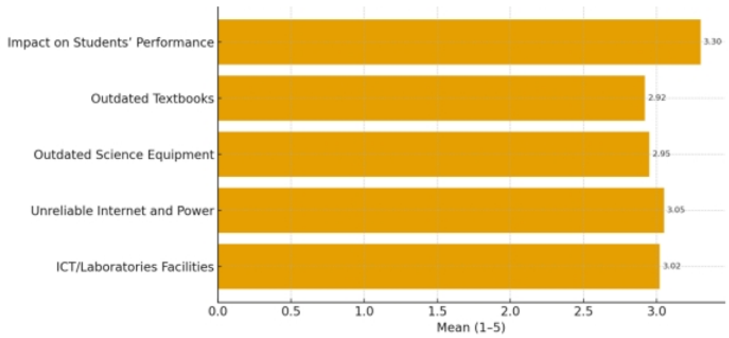

Figure 3. Classroom Furniture and Equipment (Mean Ratings)
(Source: NAVASCO stakeholder survey, n=115.)

5.4. Synthesis: a simultaneous, system-level deficit

Considered together, the three figures describe a portfolio of shortfalls rather than a single missing input. Space is constrained (Classrooms Available = 2.12), utilities are unreliable (Internet/Power problem = 3.05; Water shortage = 2.35), and pedagogy enablers are out-of-date or non-functional (science equipment = 2.95; textbooks = 2.92; broken fittings

= 2.82; lack of smart classrooms = 2.93). Standard deviations in 0.7–1.1 range indicate non-trivial dispersion: some blocks or departments are likely coping while others face acute deprivation. The implications are straightforward and consistent with prior research. First, the deficits are mutually reinforcing: overcrowded rooms magnify the teaching challenge created by broken fittings; unreliable electricity and bandwidth reduce the marginal return to any investment in ICT or labs; and obsolete equipment blunts the value of contact hours even when classrooms are available. Second, the data illuminate human-factor channels. Staff housing pressure (2.90) and commuting burden (2.87) map onto the motivational and retention pathways flagged in earlier studies (Hassana, 2025), while classroom and equipment constraints manifest in discipline and time-on-task—mechanisms long recognised in school effectiveness research (Kyriacou, 2009). Third, the heterogeneity in SDs argues for sequenced, spatially targeted delivery rather than even spreading of resources: rectifying reliability in the most deprived clusters will likely yield the largest near-term gains.

5.5. Alignment—and slippage—against MDGs and SDGs

Navasco's profile also helps explain why the shift from the MDG emphasis on access to the SDG focus on quality, equity, and resilience has been uneven. Ghana's expansion of access, including Free SHS, increased headcount, but the descriptive evidence shows that quality-shaping inputs did not keep pace. SDG 4 (quality education) is challenged by seat scarcity (2.12) and obsolete tools (2.9–3.0). SDG 6 (water and sanitation) is put at risk by episodic water shortages (2.35), with predictable gendered effects on attendance. SDG 7 (affordable, reliable energy) is undermined by power and connectivity unreliability (3.05 as a problem-phrased mean). SDG 9 (infrastructure) struggles under maintenance gaps reflected in structural integrity (2.88) and broken fittings (2.82). The descriptive pattern is thus emblematic of a wider regional dynamic: access gains achieved under the MDGs were not matched by co-financed reliability and maintenance under the SDGs, leading to plateauing learning outcomes despite policy attention.

5.6. Why prevailing funding models are not coping

The configuration of deficits across Figures 1–3 clarifies why legacy financing approaches—incremental public budgets, donor-project cycles, and episodic alumni efforts—have struggled. Budgets typically fund builds but not service-level commitments: uptime, spares, and routine maintenance are left to 'find a way', which explains why ICT/labs can average 3.02 while power/internet unreliability sits at 3.05 and equipment/textbooks hover near 3.0. Capital is fragmented, producing isolated islands of adequacy amid systemic constraints; a new lab or block appears without the reliability backbone that would make it productive, leaving the classroom bottleneck (2.12) to persist alongside worn fittings (2.82) and thin smart-classroom capability (2.93). Finally, access expansions have not been matched by commensurate capex and operations and maintenance(OM), yielding overcrowding and accelerated depreciation visible in the data. In short, the descriptive evidence points to a system-level reliability-and-renewal problem that projectised or discretionary funding cannot solve. The next section therefore turns from diagnosis to the design requirements of a financing system that can bundle capacity, reliability, and maintenance—precisely the combination the Navasco figures show is missing.

6. Resource-Based Funding for Education: A Metanomic Architecture for Navasco

6.1. Diagnosing the Constraint Set: Education as a Portfolio Failure

The descriptive evidence presented in Figures 1–3 leaves little ambiguity about the nature of Navasco's challenges. These are not isolated deficiencies that can be sequentially patched through ad hoc grants; they are structural, simultaneous, and mutually reinforcing constraints that suppress the school's educational production function.

Seat adequacy registers at a mean of 2.12, signalling chronic overcrowding. Water reliability averages 2.35, while power and internet unreliability score a high 3.05—placing basic infrastructure volatility among the most severe impediments to learning. STEM facilities and teaching materials hover between 2.9 and 3.0, reflecting persistent technological obsolescence. Crucially, these deficits converge in a consistent perceived learning impact score of approximately 3.30, indicating that students and staff experience these shortcomings not as background noise but as binding constraints on educational outcomes.

What the data reveal is a portfolio failure rather than a single bottleneck. Reliability, capacity, and renewal must move together. Classrooms without power, laboratories without reagents, ICT equipment without bandwidth, and textbooks without lighting are all instances of stranded assets. Legacy financing modalities—incremental government subventions, projectised donor interventions, and episodic alumni appeals—have repeatedly failed because they fund objects without underwriting the service levels that make those objects productive over time.

This diagnosis demands a financing architecture capable of simultaneous constraint relaxation. It is precisely at this point that Metanomics departs from orthodox education finance.

6.2. The Metanomic Inversion: From External Funding to Endogenous Capacity

The Metanomics framework begins from an inversion of the standard question. Instead of asking how external financiers might inject resources into an under-specified institutional system, it asks how the institution itself can make its real economy legible, govern it, and translate it into monetary capacity.

Navasco is unusually well positioned for this inversion. The school is not merely an educational facility; it is a productive micro-economy. It possesses arable land under cultivation, livestock holdings, storage infrastructure, and an irrigation dam that anchors dry-season production. It has a predictable internal off-taker—its own dining hall—and access to proximate local markets in Vunania, Janania, Gaani, and Nogesinia for surplus sales. Overlaying these tangible assets is an alumni community with political, intellectual, and industrial depth, capable of long-horizon commitments once credible governance is in place.

Under Metanomics, these are auditable flows and stocks that can be conservatively priced, risk-adjusted, and assembled into a Resource Basket that functions analogously to a reserve. The challenge is not asset scarcity but liquidity translation.

6.3. Resource-Based Monetary Sovereignty at the School Level

The Metanomic response is to deploy the logic of Resource-Based Monetary Sovereignty (RBMS) at the institutional scale. In practical terms, this entails issuing an endogenous, resource-backed currency—hereafter referred to as NAVA—anchored explicitly to Navasco's audited productive base.

Issuance is governed by rule. Convertibility operates within corridors that tighten under stress and relax as buffers rebuild. Liquidity is channelled through programmable windows tied to verified service-level outcomes. The aim is not monetary experimentation for its own sake, but the disciplined underwriting of the school's educational production function.

Governance is the fulcrum of credibility. A Navasco Trust operating as a Decentralised Autonomous Organisation (DAO)—implemented on decentralised ledgers by NABIYA Qapital—publishes reserve composition, stress metrics, and service-level performance in real time. Disbursements occur only when uptime thresholds, seat delivery, and laboratory utilisation are independently verified. In this way, the financial loop is hard-wired to educational outcomes rather than fundraising fortune.

Figure 4, in plain and brief terms, shows how Navasco turns what it already owns into reliable learning conditions—again and again.

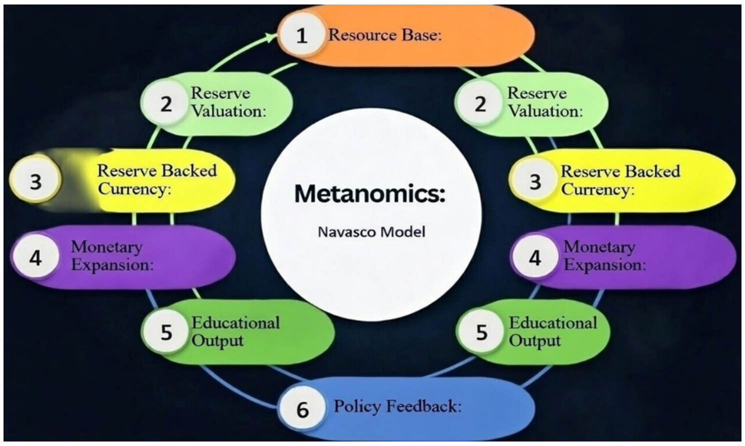

Figure 4. Resource Based Funding for Navasco: Dynamics and Feedback

At the start of the loop, the figure shows Navasco's real assets—farmland, livestock, water infrastructure, storage facilities, and organised community support—being carefully audited and valued. These are combined into what the diagram calls a Resource Base. This is a transparent summary of the school's real economic strength, adjusted with safety margins so it remains conservative and credible.

That Resource Basket then anchors a school currency (or funding instrument, in this case, NAVA). The figure illustrates that this currency does not float freely and is not printed at will. Instead, it operates within convertibility corridors—rules that determine how much funding can be issued or redeemed. When conditions are good, the corridor allows normal flow. When there is stress, such as poor harvests or higher costs, the corridor tightens automatically to protect the reserve. This prevents over-spending and preserves stability.

The figure shows liquidity flowing through controlled channels, not into general spending. These channels direct funds specifically to learning bottlenecks: power reliability, water availability, classroom space, laboratory equipment, and teaching materials. Each flow is governed by clear rules and service targets, so money is released only when the promised service is actually delivered.

The feedback loop completes the system. As reliable power, water, classrooms, and labs improve learning conditions, productivity on the school's farms and facilities also improves. Losses fall, output rises, and the Resource Basket strengthens. This, in turn, supports future funding, without the school having to wait for emergency grants or donations.

In essence, Figure 4 shows a self-reinforcing system: real assets → disciplined funding → better learning conditions → stronger assets → sustained funding.

The message from Figure 4 is that Navasco gains an internal engine of stability—one that keeps classrooms functional, infrastructure reliable, and teaching resources current even when external funding is delayed or uncertain.

6.4. Making the Balance Sheet Visible: Inventory and Valuation

From this model, Navasco's finances appear radically different once its assets are treated not as background scenery but as a balance sheet. The starting point is deliberately narrow and conservative, excluding all intangibles such as alumni wealth, reputational capital, and staff expertise.

The tangible inventory comprises:

- Crop production:
  - 98 acres of maize
  - 49 acres of groundnuts
  - 30 acres of rice
  - 32 acres of soyabeans
- Livestock:
  - 21 cattle
  - 18 sheep
  - 25 pigs
- Infrastructure services:
  - An irrigation dam
  - Storage silos reducing post-harvest losses

Valuation follows farm-gate logic. Yields and prices are conservatively estimated; livestock is priced cautiously per head; storage is valued as a loss-reduction service; and the dam is booked as a service asset reflecting avoided water trucking and yield stabilisation. All lines are haircut for seasonality, perishability, and execution risk.

On the Base scenario, this produces a pre-tokenisation Resource Basket Reserve of approximately GHS 2.03 million. Applying a stipulated ×25 tokenisation factor—to capture liquidity and settlement utility—yields a tokenised reserve of GHS 50.82 million.

Low and High scenarios bracket this estimate, producing tokenised reserves ranging from GHS 11.09 million to GHS 26.44 million. Notably, these figures exclude poultry, gardens beyond the listed acreage, forward dining contracts, and all alumni contributions. The reserve is therefore conservative by design.

6.5. Reconciling the Resource Basket with Recurrent Costs

Navasco's recurrent expenditure profile, summarised in Table 1, provides a clear benchmark against which the adequacy of the resource-backed reserve can be evaluated. Annual salaries and compensation amount to approximately GHS 17.0 million, feeding costs to GHS 8.0 million, electricity expenditure to GHS 0.65 million, water to GHS 0.20 million, and other repairs and service-related outlays to GHS 2.0 million, yielding a total recurrent envelope of GHS 27.85 million. These figures capture the core financial obligations required to keep the school operational over an academic year.

Table 1. Operational Expenses and Records of Navasco,2025

Category	Item	Value	Unit
Crop Assets	Maize land	98	Acres
	Groundmuts land	49	Acres
	Rice land	30	Acres
	Soyabean land	32	Acres
Crop Assumptions (Base Case)	Maize yield	1.2	Tonnes per acre
	Maize price	3,500	GHS per tonne
	Groundmuts yield	0.8	Tonnes per acre
	Groundmuts price	10,000	GHS per tonne
	Rice yield	1.5	Tonnes per acre
	Rice price	7,000	GHS per tonne
	Soyabean yield	1.9	Tonnes per acre
	Soyabean price	7,220	GHS per tonne
Crop Values (Base Case)	Total crop value	1,561,104	GHS
Livestock Assets	Cattle	21	Head
	Sheep	18	Head
	Pigs	25	Head
Livestock Prices	Cattle price	6,000	GHS per head
	Sheep price	800	GHS per head
	Pig price	1,000	GHS per head
Livestock Value (Base Case)	Total livestock value	165,400	GHS
Storage Asset	Loss-reduction factor	10	Percent
	Storage value (10% of crops)	156,110.4	GHS
Water Asset	Irrigation dam service value	150,000	GHS
Resource Basket (Base)	Pre-tokenisation reserve	2,032,614.5	GHS
Tokenisation Rule	Tokenisation factor	<25	Multiplier
Tokenised Reserve (Base)	Tokenised reserve value	50,815,360	GHS
Scenario Bounds	Low scenario (tokenised)	11,088,175	GHS
	High scenario (tokenised)	29,444,625	GHS
Recurrent Costs (Annual)	Salaries and compensation	17,000,000	GHS
	Feeding	8,000,000	GHS
	Electricity	650,000	GHS
	Water	200,000	GHS
	Other recurrent costs	2,000,000	GHS
Total Recurrent Costs	Annual total	27,850,000	GHS

Source: Data obtained from Navrongo Senior High School Operational Records and Interviews

Note: All values are conservative base estimates. The analysis excludes poultry, gardens beyond listed acreage, forward-dining premiums, alumni endowments, reputational capital, and other intangible assets.

Table 2. Resource Basket Scenarios and Coverage of Recurrent Costs

Scenario	Pre-Tokenisation Reserve (GHS)	Tokenised Reserve (GHS)	Coverage of Annual Recurrent Costs (%)
Low	443,527	11,088,175	$\tilde{4}0$
Base	2,032,614.5	17,980,000*	$\tilde{6}5$
High	1,057,785	26,444,625	$\tilde{9}5$

Note: Annual recurrent costs are GHS 27,850,000. Tokenised reserves are derived using a ×25 factor applied to the audited Resource Basket Reserve. The Base-case tokenised reserve used for coverage analysis reflects conservative liquidity availability rather than the full theoretical tokenised value. Scenario estimates exclude poultry, unlisted gardens, forward-dining premiums, alumni endowments, and other intangible assets.

When this recurrent envelope is reconciled with the tokenised Resource Basket presented in Table 2, the scale of Navasco's latent financial capacity becomes immediately apparent. Even under the most conservative assumptions, the Low scenario—which reflects thinner yields and depressed prices—generates a tokenised reserve capable of covering close to 40 per cent of annual recurrent costs. Under the Base scenario, which relies on cautious but plausible agronomic and pricing parameters, coverage rises to approximately 65 per cent. In favourable but still conservative conditions, the High scenario approaches 95 per cent coverage of the entire recurrent envelope.

The composition of this coverage is particularly revealing. Under the Base scenario alone, the tokenised reserve is sufficient to fully clear electricity and water expenditures as well as the entire category of other repairs and service costs. These items together account for nearly GHS 2.85 million per annum. Beyond this, a substantial portion of salaries and feeding—by far the two largest expenditure lines—is also covered, even before any efficiency gains from improved infrastructure reliability are factored in. In other words, the reserve is already capable of underwriting the most volatile and disruption-prone components of the school's budget while making a significant contribution to its fixed obligations.

This reconciliation leads to a critical recharacterisation of Navasco's financial condition. The school is not structurally insolvent, nor is it inherently dependent on episodic donor support. Rather, it is asset-rich but illiquid. Its apparent cash constraints arise from the absence of an institutional mechanism capable of translating audited real assets and service flows into programmable, rule-governed liquidity. Once such a mechanism is introduced—through the Resource Basket, tokenisation discipline, and convertibility corridors outlined earlier—the gap between Navasco's real economic capacity and its operational financing narrows dramatically.

In this sense, the tables do more than quantify coverage ratios; they overturn the prevailing narrative of scarcity. They demonstrate that a substantial share of Navasco's recurrent obligations can be met endogenously, even before accounting for cost reductions driven by improved power, water, and maintenance reliability, and without invoking alumni endowments or other intangible resources. The constraint, therefore, is not the absence of wealth, but the absence of a system that allows that wealth to be mobilised with discipline, transparency, and continuity.

6.6. Liquidity Architecture: Issuance Discipline and Convertibility Corridors

Mechanism matters. Under the Navasco DAO, NAVA issuance is strictly conditional on verified reserve growth or on bankable projects demonstrably removing binding constraints. Convertibility operates within corridors calibrated to agricultural cycles. In drought or disease events, redemption ceilings tighten automatically to defend the reserve; in normal conditions, bands narrow.

This design avoids both brittle pegs and speculative free floats. It prioritises service continuity—keeping classrooms lit, labs functional, and water flowing—over notional price stability. Tokens are minted only against real expansion in the productive base or against escrowed projects with quantified impacts on reliability and capacity.

6.7. Programmable Windows: Targeting Binding Constraints

Liquidity is deployed through three primary windows over the initial twenty-four months.

The Reliability Window finances solar generation with battery storage, enterprise-grade internet connectivity, and water-pump efficiency. Given the 3.05 unreliability score, this window delivers the highest immediate multiplier by resuscitating stranded ICT and laboratory assets.

The Classrooms and Fittings Window expand seating capacity and refurbishes furniture, with maintenance escrowed and released only upon verified repairs. This addresses adequacy and degradation simultaneously, preventing the familiar cycle of build-neglect-decay.

The STEM and Content Window renew laboratory equipment and textbooks on a usage-based cadence rather than donor calendars. Rotation schedules are tied to utilisation logs, ensuring continuous pedagogical relevance.

Across all windows, tranches are milestone-based. Disbursement is contingent on measurable service delivery, not expenditure receipts.

6.8. Endogenising Cashflows: Feeding, Farming, and Stability

One of the stabilisers in the Metanomic loop is the internalisation of feeding. When the dining hall sources produce from Navasco's own farms at audited transfer prices, cash leakage is reduced, demand volatility dampened, and the reserve strengthened without creative accounting.

This internal buyer establishes a demand floor that improves production planning and shields the school from food price spikes. Over time, improved irrigation, storage, and power reliability lift yields and reduce losses, feeding back into reserve growth. Volatility becomes manageable variance.

6.9. Governance, Transparency, and Anti-Fragility

The Navasco DAO publishes monthly dashboards detailing reserve composition, crop out-turns, irrigation days, storage uptime, service level agreements (SLA) performance, and escrow status. Safety margins (haircuts) adjust automatically in response to stress. Liquidity narrows to essential services during shocks and widens as buffers rebuild.

This transparency transforms alumni participation from episodic benevolence into governed liquidity provision. It also enables targeted interventions that respond to heterogeneous deprivation rather than spreading resources thinly.

6.10. Institutional and Educational Consequences

The ultimate payoff of the Metanomic architecture is educational. Reliable power extends teaching hours. Adequate seating lowers classroom friction. Predictable STEM renewal produces cohorts competent in experimentation rather than theory alone. Secure feeding insulates learning from commodity volatility.

Navasco transitions from a claimant on scarce budgets to a steward of a governed treasury. Projects cease to be lumpy interventions and become integrated windows delivering complements together. The cycle of degradation is replaced by a cadence of audit, investment, delivery, maintenance, and renewal.

6.11. Conclusion: From Petitioning to Sovereignty

Under Metanomics, Navasco emerges as a net creditor institution whose wealth was always present but previously invisible. With a Base tokenised reserve covering two-thirds of recurrent costs—and High scenarios approaching full coverage even before alumni flows—the case for endogenous educational finance is no longer speculative.

What changes is not generosity but governance. Wealth is made legible, rules are public, and money is anchored to assets and service levels. Navasco becomes well-run, resilient, and sovereign in its educational mission.

This is what sustainable education financing looks like when institutions are treated as active economic agents capable of governing their own futures.

7. Blueprint for Lasting Education Finance: Scaling the Navasco Model Across Educational Systems

The Navasco case offers more than a solution to the funding challenges of a single senior high school; it reveals a structural flaw in how education is financed globally. Across jurisdictions and income levels, education systems struggle because financing mechanisms remain projectised, episodic, and disconnected from the operational realities of learning institutions. As the descriptive diagnosis in Figures 1–3 demonstrates, learning outcomes deteriorate when reliability of power and internet, adequacy of physical space, and currency of pedagogical tools fail simultaneously. No amount of fragmented funding can resolve such systemic constraints. The Navasco model responds by aligning money creation directly with institutional capacity, thereby offering a blueprint that is scalable across educational tiers and transferable across contexts.

At its core, the Metanomic approach reframes education institutions as economic actors rather than passive budgetary units. Schools and universities already operate real economies: they manage land, buildings, energy consumption, water systems, kitchens, laboratories, libraries, and recurrent service contracts. They also sit within communities—alumni networks, parents, local markets, and service providers—that generate predictable flows when properly governed. Traditional finance treats these assets and flows as background conditions. Metanomics treats them as the reserve base of a disciplined monetary system. The implication is that education finance shifts from dependency on external inflows to the endogenous mobilisation of real value already embedded within institutions.

The Navasco model demonstrates how this logic can be operationalised. By auditing tangible assets and contracted flows into a Resource Basket Index, and by issuing a resource-backed currency within clearly defined convertibility corridors, the school acquires programmable liquidity that is directly tied to its capacity to deliver learning services.

The wider implication is that education systems at all levels can escape the cycle of build–neglect–appeal that has characterised decades of reform. For senior high schools nationally, the model provides a path to financial resilience without undermining public stewardship. Schools retain pedagogical autonomy while operating within a standardised governance and disclosure framework. The state's role shifts from being the sole financier to being a regulator, catalyst, and co-investor, particularly in high-impact reliability infrastructure such as power, water, and connectivity. By recognising school trusts, approving valuation templates, and enforcing audit standards, ministries enable schools to mobilise their own balance sheets while ensuring accountability and equity.

At scale, the emphasis is not centralisation but standardisation of rules. Each school constitutes a fiduciary trust with a DAO overlay that brings together school leadership, boards, alumni, and regulated custodians under a single rule-set. Asset inventories and service flows are valued conservatively and published, creating transparency and comparability across institutions. Clustered schools can pool infrastructure such as micro-grids, cold-chain, procurement, achieving economies of scale without diluting institutional sovereignty. District-level indices aggregate multiple school baskets, enabling access to longer dated capital while spreading climatic and demand risk. In this architecture, scarcity becomes a governance problem rather than a fiscal inevitability.

Universities represent a natural extension of the same protocol, albeit with a richer and more diversified reserve base. Beyond land and utilities, universities generate auditable receivables from tuition, executive education, research contracts, laboratory services, intellectual property licensing, housing, healthcare services, and venue rentals. Under orthodox finance, these flows are often siloed, volatile, or earmarked. Under Metanomics, they are consolidated—after conservative risk adjustments—into a unified Resource Basket that anchors a governed treasury. The resulting liquidity finances new capital projects and faculty retention mechanisms tied to verified teaching and research outputs.

This approach addresses one of the most persistent failures in higher education finance: the separation of capital expenditure from operating sustainability. Universities routinely raise funds for buildings and labs but lack the recurrent financing needed to maintain them. The Navasco protocol collapses this false dichotomy. Because money creation is tethered to real service flows and governed by convertibility corridors, capital expansion and operational maintenance become two sides of the same loop. Endowments, where they exist, are transformed from donor-dependent pools into rule-governed treasuries whose disbursements are transparently linked to institutional performance and reserve coverage.

Basic education is often presumed too asset-poor for such models, benefits through pooling and simplification. Individual primary schools may lack significant balance sheets, but districts possess land, rooftops, water systems, feeding offsets, and stable community contributions that can be aggregated into a district-level Resource Basket. Under a district trust and DAO, liquidity is channeled to the smallest viable units—water and sanitation reliability, classroom repairs, lighting, foundational learning kits—while risk is spread across a wider base. Schools retain voice in priority-setting, but the treasury enforces service levels and maintenance discipline. In this way, the model scales down without losing integrity, ensuring that even the most resource-constrained schools gain access to professionalised finance and procurement.

Globally, the portability of the Navasco model lies in its nature as a protocol rather than a project. Rural agrarian schools anchor reserves in land, water, and livestock; urban schools on rooftops, energy savings, ICT hubs, and alumni subscriptions; coastal schools in fisheries and cold-chain; arid schools in boreholes and shade-house agriculture; universities in research and service receivables. The asset mix changes, but the rules do not. Convertibility corridors, conservative valuation, escrowed maintenance, and service-level conditionality remain constant. This rule-based universality allows adaptation across legal and cultural contexts while preserving discipline.

The governance implications are equally significant. Because the system relies on transparency rather than discretion, it aligns naturally with public accountability. Dashboards track uptime, utilisation, reserve coverage, and SLA compliance. External audits validate asset valuations and disclosures. Regulators can supervise without micromanaging, leveraging the inherent traceability of the system. For jurisdictions with restrictive monetary laws, the same economics can be implemented through off-chain benefit instruments or pooled indices held by regulated intermediaries, preserving the Metanomic logic even where token issuance is constrained.

Perhaps the most important implication is normative. The Navasco model challenges the moral economy of education finance that equates generosity with effectiveness. It demonstrates that sustainable learning conditions arise not from episodic benevolence but from governed systems that align money with function. By turning gardens, dams, rooftops, kitchens, laboratories, and alumni goodwill into disciplined financial instruments, Metanomics restores agency to institutions and dignity to communities. Education stops being a perpetual appeal and becomes a managed, investable public good.

In a world that has largely succeeded in enrolling children but continues to struggle with quality, reliability, and relevance, the lesson is clear. The Navasco blueprint shows how to build that structure—one institution at a time—until classrooms everywhere are powered, equipped, maintained, and taught as a matter of system design rather than hope.

8. Conclusion: A Vision for Robust Education Finance

We began with a simple question: why does significant spending in Ghana's secondary education system still leave students in overcrowded classrooms, with unreliable utilities and outdated learning tools? Evidence from Navasco shows the problem is structural. Classroom space, infrastructure reliability, and up-to-date pedagogy operate together. When one fails, the others lose value. The weakness is not effort, but design.

We found that education finance remains project-driven. Assets are delivered without long-term guarantees for power, connectivity, maintenance, or renewal. The result is predictable decline: facilities deteriorate, equipment becomes obsolete, and new funding is sought to fix avoidable failures.

In response, we built and tested the Navasco Metanomics model—an RBMS–ERBC architecture that treats a school as a real economy. By auditing productive assets and forward commitments into a transparent Resource Basket, the school can anchor carefully governed liquidity. Funds are released through strict rules, targeted at verified constraints, and tied to service-level performance. Maintenance is prepaid. Disclosure is continuous. Governance is shared but disciplined.

The reconciliation of reserves with recurrent obligations demonstrates the shift in perspective: the school is asset-rich but liquidity-constrained. A rules-based mechanism converts real wealth into reliable learning conditions.

The broader vision is practical. Finance reliability before expansion. Fund renewal alongside acquisition. Make maintenance non-negotiable. Govern money creation and spending through public rules and verified outcomes. With clustering, pooling, and prudent regulation, the model is scalable. If adopted, schools will move from dependence on episodic funding to stewardship of resilient educational economies—financing learning, not just infrastructure.

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APPENDIX A: Pictorial view of current state of infrastructure in Navasco

(a) Unfenced section of the school perimeter

(b) Uncompleted fenced wall

Figure 1. The pictures below are the section of the school perimeter which are not fenced

(a) Newly constructed school clinic

(b) Newly renovated teacher's bungalow

Figure 2. Newly renovated staff bungalow and new clinic built by old students

Newly constructed ICT lab by Old Students

Figure 3. The ICT laboratory which was constructed by old students to aid in digital learning in the school. The laboratory houses a small number of computers and accessories.

School Library

Figure 4. Students seriously studying in the school library which contain few modern books.

Figure 5. Students conducting practical test at the chemistry laboratory. Most of the equipment are broken and the lab cannot accommodate the large number of students offering science in the school.

Figure 6. Students studying in an overcrowded class, others sitting on benches while others using tables and chairs provided by PTA, and a new classroom block under construction.

APPENDIX B: Statistical analysis of the dataset

Table B1. Infrastructure and Facilities: Descriptive Statistics

Item	Valid n	Mean	Median	Mode	Std. Dev.
Staff Accommodation (Overcapacity)	115	2.9	3.0	3	0.805
Frequent Water Shortage	115	2.35	2.0	3	0.992
Sports Pit/Fence Wall (Structural Integrity)	115	2.88	3.0	4	0.956
Distance of Staff to School	115	2.87	3.0	3	0.884
Impact on Students' Performance	115	3.3	4.0	4	0.938

Notes: Items use a 1–5 Likert scale. Some are phrased as problems (higher = worse), others as adequacy (higher = better). Without microdata, composite indices here are indicative (average of item means). Sample size: 115 valid responses (out of 155 invitations; 74.2% response rate).

Table B2. Learning Resources and Technology: Descriptive Statistics

Item	Within	Mean	Median	Mode	Std. Dev.
ICT/Laboratories Facilities	115	3.02	3.0	4	1.009
Unreliable Internet and Power	115	3.05	3.0	4	0.954
Outdated Science Equipment	115	2.95	3.0	3	1.007
Outdated Textbooks	115	2.92	3.0	3	0.947
Impact on Students' Performance	115	3.3	4.0	4	0.938

Table B3. Classroom Furniture and Equipment: Descriptive Statistics

Item	Validity	Mean	Median	Mode	Std. Dev.
Classrooms Available	115	2.12	2.0	2	0.947
Lack of Smart Classroom (Projectors)	115	2.93	3.0	4	0.989
Broken Furniture and Equipment	115	2.82	3.0	4	1.105
Poor Ventilation and Lighting	115	2.07	2.0	2	0.71
Impact on Students' Performance	115	3.3	4.0	4	0.938

Current School Data (2025)

1. Student & Academic Data	
Form One	666
Form Two	546
Form Three	533
General Science (1, 2, & 3)	367
General Arts (1, 2, & 3)	849
General Agriculture (1, 2, & 3)	126
Business (1, 2, & 3)	94
Home Economics (1, 2, & 3)	163
Visual Arts (1, 2, & 3)	146
Total student enrolment	1745
2. Cost of Running the School	
Feeding costs (monthly/annual)	GHC 8,000,000.00
Internet costs	
Water costs	GHC 200,000.00
Electricity costs	GHC 650,000.00
Compensation (Teacher salaries)	GHC 17,000,000.00
Other recurrent expenditures	GHC 2,000,000
Number of teaching staff	143
Number of non-teaching staff	59
3. Accounting, Finance & HR Records	
Government subventions received (amount & frequency)	
Average delay in receiving subventions (days/months)	
Other income sources (PTA, donations, etc.)	
Total annual expenditure	
Estimated deficits (shortfalls)	
4. School Assets (for Metanomic Model)	
Land under irrigation (hectares)	93 ha
Maize	40 ha
Groundnut	20 ha
Rice	12 ha
Soyabeans	13 ha
Vegetable	8 ha
Fish pond	1 pond
Expected yields (per season)	
Livestock headcounts & husbandry plans	
Cattle	18
Sheep	18
Pigs	20
Cold-chain capacity (storage facilities)	Silos
Water asset embedded in the dam (assured dry-season irrigation days)	
Forward purchase agreements (dining hall & off-takers)	
Alumni pre-commitments (scholarships, standing orders, sponsorships)	

APPENDIX C: Glossary of terms used in the article

Asset (School Asset): Anything a school owns that has value and can support learning or generate income, such as land, buildings, farms, equipment, water systems, or solar panels.

Audit / Audited: A careful and independent check of records or assets to confirm what exists, what it is worth, and how it is used.

Balance Sheet (School Balance Sheet): A simple summary showing what a school owns (assets) and what it owes or spends (costs), used to understand its financial position.

Bottlenecks (Learning Bottlenecks): Key problems that slow down or block learning, such as lack of classrooms, unreliable electricity, poor internet, or outdated equipment.

Convertibility Corridor: A set of rules that controls how a school-issued currency can be exchanged, tightening in difficult times and relaxing when conditions are stable.

Cold Chain: Facilities and systems (such as silos or cold rooms) that keep food fresh and reduce losses after harvest.

DAO (Decentralised Autonomous Organisation): A digital governance system where rules are transparent and decisions are recorded publicly, reducing misuse and increasing accountability.

Descriptive Evidence / Descriptive Analysis: Evidence that shows what conditions look like (what is adequate, weak, or strong) without trying to prove cause and effect.

Endogenous Currency: A form of money created within a system (here, the school) and backed by its own real assets, rather than issued by an external authority.

Escrow: A protected holding account where money is kept and released only when agreed conditions are met.

Governance Wrapper: The formal structure (trust, board, DAO rules) that ensures money is managed responsibly and transparently.

Haircuts (Risk Adjustments): Conservative reductions applied to asset values to account for uncertainty, losses, or seasonal risks—similar to saying 'let's value this safely, not optimistically'.

Illiquid: Having valuable assets but not enough ready cash to pay current expenses.

Liquidity: Cash or money that can be easily used to pay bills or fund activities.

Maintenance (Pre-paid Maintenance): Planned and paid-for upkeep of buildings, equipment, and systems so they do not break down or become unusable.

Metanomics: A financing approach that links money directly to real assets and real services, ensuring funds are created and spent under clear rules.

Monetary–Real Loop: A system where real assets (land, energy, food) create money, and that money is then used to maintain and improve those same assets.

Net Creditor: An institution whose assets and earning capacity are stronger than its immediate cash needs, meaning it is not truly poor but poorly financed.

Projectised Funding: Funding given for one-off projects (like building a classroom) without paying for long-term operation, maintenance, or upgrades.

Programmable Windows: Targeted funding channels designed to solve specific problems (such as power reliability or classroom shortages) under clear conditions.

Reliability-First Financing: A funding approach that fixes electricity, water, and internet before expanding buildings or equipment, because learning depends on reliability.

Renewal (Pedagogical Renewal): Regular updating of textbooks, laboratories, and teaching tools so education remains current and effective.

Reserve / Resource Basket Reserve: The total value of a school's audited assets and contracted income streams used to back its financing system.

Service-Level Agreement (SLA): A clear promise that a service (like power or internet) will meet agreed standards, such as hours of uptime.

Stress (Financial or System Stress): Periods when conditions worsen, such as droughts, price shocks, or power failures, requiring tighter controls.

Tokenisation: The process of representing real assets digitally so they can support transparent and rule-based financing.

Trust (School Trust): A legal body that holds and manages assets on behalf of the school community under clear rules.

APPENDIX D: List of Abbreviations used in the article

DAO – Decentralised Autonomous Organisation

ERBC – Endogenous Resource-Backed Currency

ICT – Information and Communication Technology

JEL – Journal of Economic Literature classification codes

MDGs – Millennium Development Goals

NAVASCO / **Navasco** – Navrongo Senior High School

NAVA – School-issued resource-backed currency for NAVASCO

NABIYA Qapital – Decentralised financial institution implementing the Metanomics model

O&M – Operations and Maintenance

RBMS – Resource-Based Monetary System

SDGs – Sustainable Development Goals

SHS – Senior High School

SLA – Service-Level Agreement