WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal Homepage: www.ijrpr.com ISSN 2582-7421

Prioritising Municipal Food Market Upgrades Through Public Health Risk Assessment and Engineering Project Portfolio Management

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DOI : https://doi.org/10.55248/gengpi.07.1026.35009

ABSTRACT

Municipal food markets support livelihoods, food access and local economic activity, yet deteriorating infrastructure can create public health risks. Inadequate water supplies, drainage, waste management, refrigeration and hygienic trading spaces can undermine food safety, particularly where maintenance resources and investment budgets are limited. This article examines how public health risk assessment can inform engineering project portfolio management to prioritise market upgrades. It proposes an integrated framework that combines hazard identification, exposure assessment, infrastructure condition surveys and stakeholder consultation with project selection and resource allocation. Upgrade options are assessed against risk reduction potential, technical feasibility, lifecycle costs, implementation readiness, equity and operational disruption. Portfolio decisions consider dependencies between projects, budget constraints and the need to maintain essential market services during construction. Particular attention is given to transparent scoring, uncertainty, vendor participation and safeguards against prioritising visible improvements over critical sanitation needs. The framework also outlines monitoring through infrastructure performance, hygiene compliance and implementation indicators, while distinguishing these measures from demonstrated reductions in disease. It offers a structured basis for accountable investment planning, subject to local validation and evaluation of health outcomes.

Keywords: Municipal food markets; public health risk assessment; engineering project portfolio management; infrastructure prioritisation; food safety; investment planning.

1. INTRODUCTION

1.1 Municipal Food Markets and Public Health

Municipal food markets support food access, employment, local commerce and community livelihoods. Their role extends beyond selling produce to connecting traders, suppliers and consumers within urban and rural economies [2]. Healthy market guidance identifies safe, nutritious food provision as a community function while recognising substantial differences between markets [1].

Infrastructure deficiencies can undermine this function. Unreliable water, obstructed drainage, inadequate waste disposal, poor refrigeration and unsuitable trading spaces can create opportunities for contamination and exposure. Hygiene principles emphasise facilities and equipment that support cleaning, safe handling and contamination control [3]. Urban food policy also connects safe food access with local government action and socioeconomic conditions [4].

Risks are not uniform across markets. They depend on food characteristics, handling practices, trading intensity, infrastructure performance and the populations exposed. Risk analysis therefore requires consideration of hazards and exposure rather than assuming that visible deterioration alone establishes the magnitude of health risk [7].

1.2 Investment Constraints and Competing Upgrade Priorities

Municipalities must choose among upgrades while funding both construction and maintenance. Financing constraints and weaknesses in public investment management can limit infrastructure provision and asset upkeep [5]. Ageing facilities, incomplete records and competing stakeholder demands further complicate decisions. Pressure for visible improvements may favour prominent buildings or paving over less conspicuous water, drainage and waste systems.

Selecting projects individually can overlook shared infrastructure and dependencies. Refrigeration requires reliable electricity, while additional water provision may increase drainage demands. A project that appears attractive independently may therefore deliver limited benefits without complementary investment.

Portfolio management offers a structured basis for considering combinations of projects, strategic objectives and available resources [6]. Applied here, it will connect market needs with feasible investment packages and implementation capacity. Priorities should reflect underlying health concerns, operational requirements and equitable access rather than expenditure or visibility alone. Risk-informed decision-making supports examining the significance of hazards before selecting management responses [7]. This establishes the rationale for an integrated framework.

1.3 Article Aim, Scope and Proposed Contribution

This article proposes integrating public health risk assessment with engineering project portfolio management to prioritise municipal food market upgrades. It presents a conceptual framework rather than reporting completed projects or measured health improvements. Risk analysis provides a foundation for examining food safety concerns and management options [7], while portfolio guidance supports coordinated investment decisions adapted to organisational circumstances [6].

Intended users include municipal planners, public health officials, market managers, engineers and vendor representatives. The framework links baseline assessment, project development, prioritisation, portfolio selection, delivery and evaluation. It will address dependencies, lifecycle responsibilities, uncertainty and stakeholder participation.

Expected risk reduction will remain distinct from demonstrated population health improvement. Evaluation principles require attention to context and the interaction of intervention components [8]. The next section establishes the public health and portfolio-management principles needed to support transparent, feasible and defensible municipal investment decisions.

2. CONCEPTUAL FOUNDATIONS AND DECISION PRINCIPLES

2.1 Public Health Risk Assessment in Market Environments

A hazard is an agent or condition capable of causing harm; exposure concerns contact with that hazard, while vulnerability describes factors influencing susceptibility or capacity to avoid harm. Risk combines the likelihood and severity of adverse effects under specified exposure conditions [7]. These distinctions prevent infrastructure defects from being treated as equivalent to measured illness.

Microbial hazards may spread through contaminated food, water, surfaces, waste and human contact. Drainage failures, inadequate refrigeration and poor separation can interact with handling practices to sustain exposure pathways [9]. Chemical risks require consideration of substances, concentrations and consumption patterns [10]. Physical hazards, including fragments from damaged structures, require assessment of credible entry routes.

Susceptible populations may experience different consequences from similar exposures. Repeated contact or consumption also changes the assessment question and relevant observation period [9].

Preliminary qualitative screening will identify priority concerns using structured descriptions and available evidence. Detailed quantitative assessment will require suitable, reliable exposure, occurrence and dose-response information. Limited surveillance, small samples and uncertain consumption data must be acknowledged. Risk estimates will therefore report appropriately documented assumptions, evidence gaps and variability, rather than imply precision unsupported by the information available locally.

2.2 Engineering Project Portfolio Management

Individual project management coordinates delivery of a defined investment, whereas portfolio management selects, authorises and reviews collections of investments against strategic objectives [6]. For municipal markets, the portfolio question concerns which combination of upgrades should proceed, when and with what resources.

Project comparison will consider health relevance, service improvement, feasibility and lifecycle affordability. Infrastructure prioritisation guidance demonstrates how social, environmental, financial and economic criteria can inform selection under budget constraints [11]. Investment sequencing will address dependencies, such as electricity improvements enabling refrigeration or drainage capacity supporting additional water provision.

Some alternatives will be mutually exclusive, including replacement versus rehabilitation of the same facility. Others will share enabling infrastructure or compete for contractors, shutdown access and management attention. Capital availability must therefore be considered alongside implementation capacity and future operating obligations. Asset management principles reinforce balancing performance, risk and expenditure across the lifecycle [14].

The highest-ranked standalone projects may not form the best feasible portfolio if their combined costs exceed budgets or essential dependencies remain unfunded. Selection will consequently examine packages and constraints rather than simply accumulate scores. Decisions will document strategic alignment, resource assumptions and reasons for deferring attractive projects.

2.3 Equity, Transparency and Lifecycle Responsibility

Equitable access to safe trading conditions will guide both project appraisal and delivery. Assessment will consider small vendors, informal traders, women, people with disabilities and underserved neighbourhoods. Accessibility principles encompass physical environments, information and public services, supporting attention to barriers affecting market users [12].

Stakeholder participation will identify needs that administrative records may overlook. Criteria, weights and selection reasons will be documented before commitments, consistent with transparent infrastructure prioritisation [11]. Consultation must allow influence rather than merely endorse predetermined investments.

Upgrades may increase fees, disrupt trade or displace vendors unable to meet new costs. Livelihood protection and representation are relevant considerations when measures affect informal economic activity [13]. Affordability and temporary trading arrangements will therefore enter appraisal.

Capital funding will include maintenance ownership, staffing, operating resources and renewal needs. Lifecycle responsibility supports sustained services rather than construction alone [14]. Non-negotiable safety obligations will remain distinct from discretionary improvements. These principles establish the information required to assess markets, identify needs and develop options without excluding less visible risks or marginalised groups.

3. BASELINE ASSESSMENT AND UPGRADE OPPORTUNITY IDENTIFICATION

3.1 Market Profiling and Stakeholder Mapping

Assessment will first define whether the boundary covers one market, several facilities or a municipal network. The boundary will identify trading areas, shared services and surrounding infrastructure relevant to market operation. Context assessment supports specifying stakeholders, settings and available evaluation capacity [20].

Market profiles will record size, food categories, trading hours, estimated footfall, stall occupancy and formal or informal vendor arrangements. Stakeholder mapping will identify municipal departments, utility providers, inspection bodies, market managers, traders and consumers. Representation of informal workers is consistent with guidance recognising their livelihoods and participation [13].

Vendor interviews and observation will explore interruptions, cleaning difficulties, storage practices and informal workarounds that official records may miss. Consultation will use accessible formats and appropriate languages. Participation information will explain purpose, confidentiality and use of findings, with consent arrangements established where required. These activities will build an understanding without assuming that the most vocal stakeholders represent every market user.

3.2 Infrastructure Condition and Service Assessment

Infrastructure assessment will examine whether services exist, function reliably and meet intended needs. Water checks will cover availability, continuity, storage and quality, interpreted against appropriate standards and local requirements. Drinking-water guidance supports risk-based assessment from supply to consumption rather than reliance on test results [15].

Survey teams will inspect drainage, toilets, handwashing facilities, waste storage and collection. They will assess cold storage, electrical reliability, ventilation, surface condition and separation of incompatible activities. Facility design guidance links cleanable premises, suitable materials and waste arrangements with hygienic operation [16].

Each asset record will describe location, accessibility, condition, capacity, responsible operator and service interruptions. Photographs and measurements will follow agreed recording procedures. Absence of infrastructure will be distinguished from inadequate operation, deferred maintenance or insufficient capacity. Asset management principles support evaluating performance alongside lifecycle responsibilities [14].

The assessment will identify shared utilities whose improvement could benefit several zones, including distribution pipes, drainage connections and electricity supplies. These relationships will inform subsequent project dependencies. Findings will describe service deficiencies and consequences rather than assume that replacing every ageing asset is the most effective intervention.

3.3 Hazard, Exposure and Vulnerability Characterisation

Hazard characterisation will connect infrastructure deficiencies with plausible contamination pathways and identify circumstances under which exposure could occur. Assessment will distinguish raw products from ready-to-eat foods, considering storage duration, temperature control, preparation practices and opportunities for cross-contamination. Risk assessment should examine exposure conditions rather than infer risk solely from hazard presence [18].

Inspection findings, incident records and sampling results will be reviewed alongside direct observations. Samples will be selected for a defined purpose using appropriate methods and documented locations. Sampling guidance supports matching procedures to the intended decision and acknowledging limitations [17]. A negative result will not establish that every location or trading period is safe.

Characterisation will identify potentially exposed vendors, customers, cleaners and nearby residents, including susceptible groups. It will consider contact frequency, consumption patterns, water use and movement between activities.

Each finding will distinguish observed evidence, reasonable inference and unresolved assumptions. Risk management guidance supports documenting uncertainty and the information informing assessment [19]. Hazard detection alone will not constitute a complete estimate of health risk; occurrence, exposure and consequences will require interpretation within the defined market setting.

3.4 Baseline Quality, Uncertainty and Problem Definition

Baseline review will identify missing records, inconsistent inspection practices, seasonal variation and measurement limitations. Definitions, units, sampling periods and service boundaries will be documented so subsequent comparisons address comparable conditions. Evaluation guidance emphasises credible evidence and transparent explanation of limitations [20].

Confirmed deficiencies will be separated from suspected problems requiring investigation. Uncertainty will be recorded rather than converted into falsely precise scores [19]. Where evidence is weak, additional assessment may precede investment decisions.

Problem statements will specify the affected service, plausible exposure pathway, population concerned and operational consequence. They will avoid prescribing equipment or construction before alternatives are considered. An initial opportunity register will group needs by location, urgency and shared infrastructure. This creates a defensible assessment baseline while retaining uncertainty. The next section converts identified needs into comparable project options with explicit benefits, costs and delivery requirements for appraisal.



Figure 1. Public health risk and infrastructure assessment architecture for municipal food markets.

4. PROJECT DEVELOPMENT AND PRIORITISATION MODEL

4.1 Defining Upgrade Options and Investment Packages

Upgrade development will consider repairing, replacing, expanding or reorganising services before committing to construction. Options may include water-system rehabilitation, drainage improvements, waste facilities, reliable refrigeration and hygienic trading areas. Facility guidance links appropriate premises and equipment with cleanability, waste management and contamination control [16].

Each option will specify scope, beneficiaries, service boundaries, enabling works and expected operational changes. Appraisal guidance supports comparing alternative ways of achieving objectives, including continuation of existing arrangements where appropriate [22]. A drainage repair should therefore be compared with wider rehabilitation only after capacity, condition and future demand are understood.

Standalone projects will be assessed alongside integrated packages. Shared water, electricity or waste infrastructure may serve several zones, but packages can also increase delivery complexity. Operational measures, including collection schedules, cleaning responsibilities and maintenance arrangements, will accompany physical works where needed. Evidence gathered during baseline evaluation will inform these choices [20]. Options will remain provisional until technical feasibility, service ownership and anticipated benefits have been examined.

4.2 Selection Criteria and Measurement Definitions

Selection criteria will cover potential health-risk reduction, service reliability, equity, technical feasibility and implementation readiness. Public health assessment will consider credible exposure pathways and affected populations rather than infrastructure appearance alone [18]. Each criterion will have a definition, indicator, evidence requirement and scoring direction.

Financial assessment will include capital expenditure, operating costs, maintenance capability and disruption to trading. Appraisal will distinguish affordability within municipal budgets from broader social value and distributional consequences [22]. Estimated benefits will be labelled as projections, with assumptions separated from demonstrated outcomes.

Indicators may include service interruption frequency, accessible handwashing coverage, drainage capacity and the proportion of underserved users benefiting. Related measures will be reviewed to avoid counting the same deficiency twice. Composite-indicator guidance highlights correlation, aggregation and compensability issues that can distort rankings [23].

Mandatory requirements will operate as screening conditions rather than ordinary weighted benefits. An option that cannot satisfy essential safety or legal conditions will require redesign or exclusion. Risk management principles support transparent criteria and documented treatment decisions [19]. Missing evidence will not automatically receive a favourable score; uncertainty will be recorded and may trigger further investigation before assessment or selection proceeds.

4.3 Weighting, Scoring and Stakeholder Deliberation

Criteria weights will be developed through structured deliberation involving municipal planners, engineers, public health officials, market managers and representative vendors. Participants will consider the importance of improvements across defined scoring ranges, rather than assign weights to vague labels. Multi-criteria guidance explains the relationship between scales, preferences and weighting [21].

Technical specialists will score evidence within their competence, while an interdisciplinary panel will review consistency and resolve disagreements. Dissent, assumptions and conflicts of interest will be documented. Infrastructure governance guidance supports transparent decision processes and stakeholder engagement [24].

Indicators using different units will be transformed onto comparable scales through a justified normalisation method. The method and reference bounds will be fixed before final scoring. Composite-indicator guidance cautions that normalisation and weighting choices influence results [23]. Sampling-derived indicators will retain information about coverage and uncertainty [17].

Numerical rankings will inform deliberation without removing accountability. The panel will explain departures from scores and identify unresolved issues. Final records will distinguish evidence-based judgements from stakeholder preferences and show how each influenced the proposed selection.

Table 1. Proposed criteria for prioritising municipal food market upgrade projects

Criterion	Indicator	Evidence source	Scoring direction	Weight-setting approach	Main limitation
Potential health-risk reduction	Expected reduction in specified exposure pathways	Risk assessment; inspection and sampling records	Higher credible reduction preferred	Public health judgement and stakeholder deliberation	Estimated benefits may lack direct health-outcome evidence
Service reliability	Expected reduction in interruptions or inadequate service	Utility logs; asset surveys; operator records	Greater reliable improvement preferred	Compare improvements across defined service ranges	Historical records may be incomplete
Equity and accessibility	Benefits reaching underserved users; barriers removed	Vendor mapping; accessibility assessment; consultation	Greater equitable access preferred	Include affected groups in deliberation	Beneficiary counts alone may conceal unequal benefits
Technical feasibility	Ability to deliver the required service within site constraints	Engineering surveys; preliminary designs	Greater demonstrated feasibility preferred	Technical assessment against defined descriptors	Early designs may overlook site conditions

Criterion	Indicator	Evidence source	Scoring direction	Weight-setting approach	Main limitation
Implementation readiness	Status of permissions, land access, designs and delivery arrangements	Readiness checklist; municipal records	Greater readiness preferred, subject to strategic need	Agree descriptors before scoring	Overweighting readiness may disadvantage neglected markets
Lifecycle affordability	Capital, operating, maintenance and renewal costs	Cost estimates; operating plans; asset records	Lower comparable costs preferred	Assess alongside service benefits and budget limits	Forecast costs and asset lives are uncertain
Maintenance capability	Availability of responsible staff, skills, funding and spares	Maintenance plans; staffing and budget records	Stronger sustainable capability preferred	Joint engineering and operational review	Planned resources may not remain available
Trading disruption	Duration and severity of interrupted access or trading	Construction plans; vendor consultation	Lower disruption preferred	Consider livelihood effects and mitigation	Shorter construction does not always mean less harm

4.4 Budget Constraints, Dependencies and Portfolio Selection

Portfolio selection will identify a feasible combination of upgrades within capital budgets, operating commitments and delivery capacity. Infrastructure governance guidance emphasises affordability and coordinated investment decisions [24]. Dependencies will be represented explicitly: refrigeration may require electricity improvements, while increased water use may depend on drainage capacity.

Mutually exclusive alternatives will not be selected together. Shared enabling works will be costed consistently, and benefits will not be counted repeatedly across dependent projects. Contractor availability, municipal staffing and continuity of essential services will constrain sequencing.

Urgent protective measures will be considered separately from longer-term investment packages, with immediate responsibilities documented. The selected portfolio may depart from simple score order when dependencies, affordability or implementation limits alter feasibility. Appraisal will therefore compare packages and consequences, not merely individual rankings [22]. Decision records will explain funded projects, deferred options and conditions for subsequent reconsideration.

4.5 Sensitivity Analysis and Decision Robustness

Sensitivity analysis will test alternative weights, costs, benefit estimates and normalisation choices. Established multi-criteria methods support examining whether preference changes alter rankings [21]. Projects remaining priorities across plausible scenarios will be distinguished from those dependent on optimistic assumptions.

Weak evidence may justify targeted investigation before irreversible commitment. Evaluation principles require transparent limitations and credible interpretation [20]. The final selection record will explain robustness, unresolved uncertainty and reasons for proceeding. A defensible portfolio must then become coordinated delivery that protects market users, preserves essential services and supports operation throughout implementation phases.

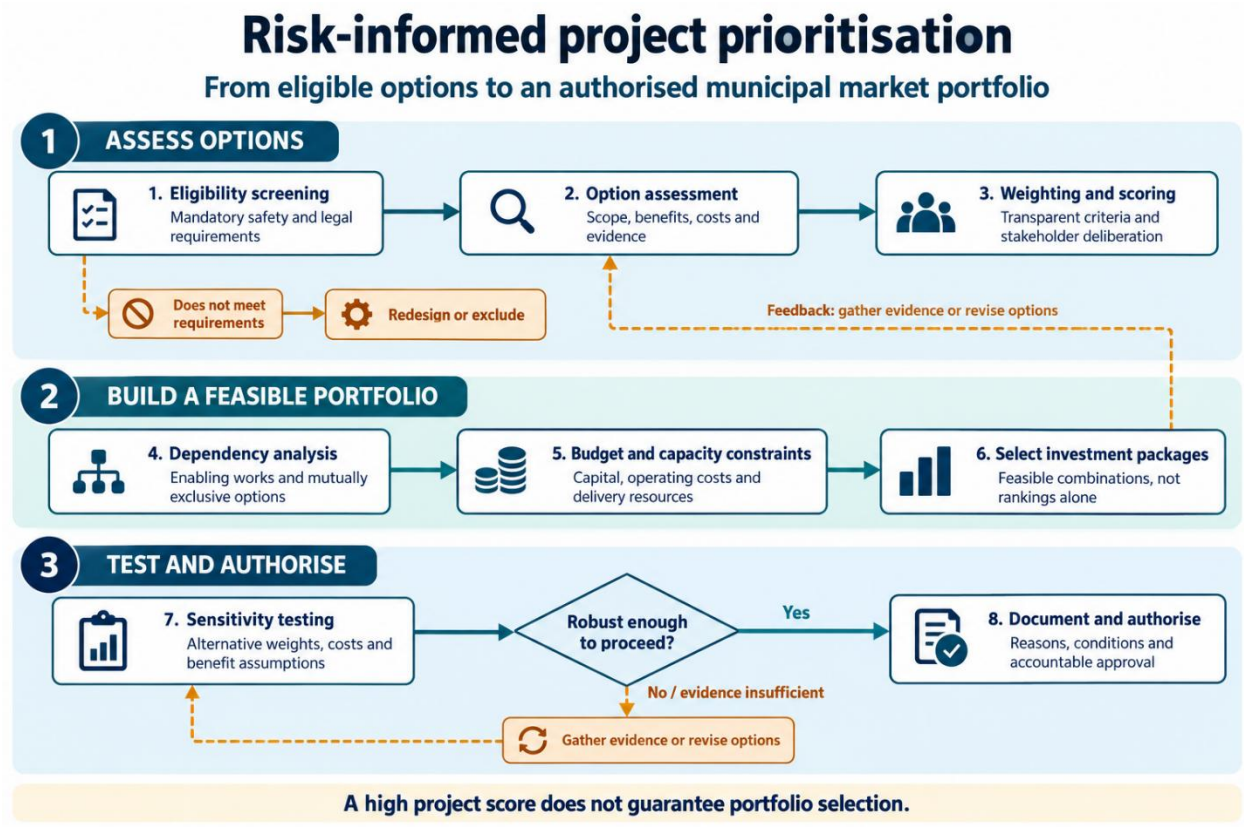


Figure 2. Risk-informed project prioritisation and portfolio selection pathway.

5. PORTFOLIO GOVERNANCE, DELIVERY AND OPERATIONAL SUSTAINABILITY

5.1 Governance, Approval and Accountability

Municipal leadership will approve the portfolio, authorise funding and remain accountable for strategic outcomes. Public health teams will define health protection requirements; engineers will oversee technical adequacy; market managers will coordinate daily operations; and utility providers will confirm service interfaces and operating commitments. Infrastructure governance guidance emphasises clear institutional responsibilities and coordinated decisions [24].

A responsibility matrix will identify decision owners, delegated limits, reporting requirements and escalation routes. Independent reviewers will examine major investment assumptions and readiness evidence before approval. Procurement integrity principles will inform declarations of interest, separation of evaluation duties and documented management of conflicts [25].

Selection records will state reasons for approval, funding conditions, unresolved risks and reporting dates. Changes to scope, sequencing or expenditure will require proportionate authorisation. Vendor representatives will contribute operational knowledge and challenge distributional effects without assuming statutory or technical duties. Governance arrangements will also identify who can formally suspend work when essential protections fail, consistent with explicit accountability throughout project delivery [30].

5.2 Procurement and Phased Delivery

Approved requirements will become procurement specifications defining service capacity, materials, accessibility, performance tests, documentation and acceptance criteria. Tender evaluation will examine contractor competence, financial capacity, delivery risks and maintenance support rather than purchase price alone. Public procurement guidance supports integrating risk management and evaluation throughout contracting [25].

Construction will follow dependencies between utilities, drainage, refrigeration and trading facilities. Programmes will accommodate trading patterns, seasonal demand and shutdown windows. Temporary water supplies, waste collection, toilets, handwashing and accessible routes will be established before existing services are interrupted.

Work areas will be separated from food handling through suitable barriers, controlled access and arrangements for dust, debris, runoff and pests. Water supply changes will include appropriate monitoring and corrective procedures, informed by water safety planning principles [28].

Contracts will assign responsibility for temporary services, inspections, defects and reinstatement. Contingency resources will address credible disruptions without concealing uncontrolled expenditure. Proposed scope changes will be assessed against cost, schedule, safety and service consequences before approval. Delivery reviews will check whether enabling works and protective arrangements remain adequate as site conditions evolve throughout each construction phase.

5.3 Vendor Participation and Livelihood Protection

Vendor communication will begin before construction and continue through relocation, commissioning and early operation. Accessible notices and discussions will explain schedules, service interruptions, alternative trading spaces and responsibilities. Stakeholder engagement guidance supports continuing dialogue and accessible grievance arrangements [27].

Livelihood assessments will examine temporary income losses, customer access, transport costs and affordability. Relocation planning will consider lower-income traders, seasonal vendors and people whose trading arrangements are poorly documented. Displacement guidance highlights attention to vulnerable groups and livelihood restoration where applicable [26].

A recorded feedback process will assign response deadlines and escalation routes. Proposed fees and allocation rules will be reviewed for exclusion risks. Practical demonstrations will explain new facilities, cleaning duties and fault reporting. Participation will be evaluated through documented changes to decisions, resolved concerns and representation of affected groups, rather than consultation attendance alone or expressions of general satisfaction.

5.4 Commissioning, Handover and Maintenance Funding

Commissioning will test infrastructure against approved capacity, service and safety requirements before unrestricted use. Evidence will include inspection records, functional tests, resolved defects and confirmation of utility interfaces. Project delivery guidance distinguishes transition into operation from construction completion [30].

Handover will provide asset registers, drawings, operating procedures, warranties and maintenance schedules. Staff will demonstrate relevant operating and fault-response skills; asset management guidance emphasises competence and clear involvement in operational responsibilities [29].

Named owners will accept cleaning, servicing, repair and reporting duties. Budgets will cover routine maintenance, consumables, inspections and credible replacement needs, with spare-part arrangements confirmed. Water systems will retain monitoring and corrective procedures after handover [28]. Physical completion will therefore mark a delivery milestone, while sustained performance will require continuing resources, competent operation and review of actual service conditions.

5.5 Portfolio Review and Adaptive Reprioritisation

Scheduled portfolio reviews will examine progress, expenditure, emerging risks and service outcomes. Unexpected failures, escalating costs or changing market needs will trigger reassessment of sequencing and affordability. Infrastructure governance principles support oversight across the investment lifecycle [24].

Revisions will retain links to original objectives, updated evidence and approval records. Changes will explicitly assess equity and essential risk controls. Where composite scores are recalculated, assumptions will remain visible [23]. Evaluation will then assess whether investments deliver intended services, remain affordable and plausibly reduce exposure under observed market conditions over sustained operation.

6. EVALUATION, LIMITATIONS AND MANAGEMENT IMPLICATIONS

6.1 Integrated Evaluation Indicators

Evaluation will distinguish infrastructure outputs, exposure-related indicators and health outcomes. Delivery measures will include cost variation, schedule adherence, unresolved defects and trading disruption. Public appraisal guidance supports assessing achieved results alongside expenditure and distributional consequences [22].

Infrastructure indicators will measure water availability, drainage performance, refrigeration reliability and service interruptions. Water monitoring will follow defined operational limits and corrective procedures appropriate to the supply system [28]. Hygiene observations will assess handwashing, food separation, cleaning and facility use through consistent protocols.

Maintenance responsiveness, accessible service coverage and differences between vendor groups will complement technical measures. Livelihood assessment will examine trading days lost, relocation costs, affordability and recovery of income where records exist. Displacement guidance provides relevant principles for considering affected livelihoods [26].

User satisfaction will be reported separately from measured service performance. Composite summaries will retain their underlying indicators because aggregation can conceal unequal outcomes [23]. Improved inspection scores will indicate observed compliance, not independently establish reduced

disease. Health outcomes will require suitable surveillance, denominators and interpretation of other influences. Indicator definitions, collection responsibilities and reporting intervals will be agreed before implementation.

6.2 Evaluation Design and Attribution

Evaluation will establish baseline and post-upgrade observation periods covering comparable trading conditions. Repeated measurements will capture variation before construction, during disruption and after services stabilise. Project evaluation will be planned alongside delivery rather than added after completion [30].

Sampling schedules will account for rainfall, temperature, market attendance, food mix and seasonal demand. Concurrent changes in inspection, vendor training, waste collection or enforcement will be documented. Water-system assessments will distinguish infrastructure changes from operational monitoring and corrective action [28].

Where feasible, comparison markets or phased implementation will strengthen interpretation. Selection differences and contamination between comparison groups will still require examination. Measurements will use consistent definitions, instruments, observation procedures and denominators. Missing observations, altered sampling locations and interrupted services will be recorded.

Analysis will report effect estimates with uncertainty and examine whether results differ across market zones or vendor groups. Appraisal principles support proportionate evaluation and transparent consideration of alternative explanations [22]. Simple before-and-after differences will remain exploratory when credible counterfactual evidence is unavailable. Attribution to infrastructure alone will require stronger designs addressing concurrent interventions, contextual changes and underlying trends over time.

Table 2. Municipal market upgrade portfolio evaluation matrix.

Evaluation domain	Indicator	Baseline	Post-upgrade assessment	Responsible body	Interpretation limitation
Project delivery	Cost and schedule variation; defects; trading days disrupted	Approved budget, programme and existing disruption records	Actual expenditure, completion dates, defects and disruption	Municipal project office	Scope changes and external delays affect comparisons
Water services	Supply availability; interruptions; compliance with defined quality requirements	Repeated service records and appropriate water tests	Comparable monitoring after commissioning and during routine operation	Utility provider and public health team	Seasonal supply changes and sampling coverage influence findings
Drainage and waste	Flooding frequency; drainage failures; missed waste collections	Observations across relevant weather and trading conditions	Repeated inspections and service records	Municipal engineering and waste services	Rainfall and waste volumes may differ between periods
Refrigeration	Temperature compliance; downtime; repair frequency	Temperature logs and equipment records	Comparable logs, alarms and maintenance records	Market management and maintenance provider	Loading patterns, ambient conditions and operating practices affect performance
Hygiene and exposure	Handwashing provision and use; cross-contamination observations; appropriate sampling results	Standardised observations and risk-informed sampling	Repeated assessment using consistent protocols	Public health and inspection teams	Observations and samples provide partial evidence of exposure
Equity and access	Service coverage and affordability by vendor group; accessibility barriers	Disaggregated access and fee information	Changes in coverage, charges and reported barriers	Municipal planning and vendor liaison teams	Undocumented or displaced traders may be missed
Vendor livelihoods	Trading days lost; relocation costs; income recovery	Available trading and livelihood records	Assessment during construction and after reopening	Municipal social development team	Income reporting and wider economic changes complicate attribution

Evaluation domain	Indicator	Baseline	Post-upgrade assessment	Responsible body	Interpretation limitation
Maintenance and satisfaction	Repair response time; preventive maintenance completion; user satisfaction	Existing fault records and user feedback	Routine maintenance records and repeated feedback	Asset owner and market management	Satisfaction does not independently establish technical performance
Health outcomes	Relevant illness reports or surveillance rates, where suitable	Defined surveillance period and population denominator	Comparable surveillance with contextual analysis	Public health surveillance authority	Underreporting and multiple exposure sources limit causal inference

6.3 Practical and Methodological Limitations

The framework will face incomplete disease surveillance, uncertain exposure estimates and inconsistent asset records. Markets with stronger documentation may appear more deserving simply because their problems are better measured. Composite-indicator guidance warns that data quality and methodological choices can influence comparative results [23].

Subjective scoring and political preferences may affect weights, project definitions and final selection. Procurement delays, limited engineering capacity and contractor shortages may restrict delivery even when priorities are established. Procurement governance therefore requires attention to integrity, capacity and implementation risks [25].

Cost estimates may change after surveys reveal concealed defects or utility constraints. Maintenance shortfalls can undermine completed infrastructure, while relocation and revised fees may disadvantage vulnerable vendors. Livelihood safeguards will require attention throughout implementation rather than reliance on consultation [26].

Weights and rankings will not transfer automatically between municipalities with different hazards, budgets and service responsibilities. Sensitivity testing will reveal some uncertainty without resolving weak evidence. Sustained benefits will depend on operating resources, competent personnel and appropriate practices; asset management guidance highlights the importance of involvement and competence [29]. These dependencies will constrain generalisation of findings.

6.4 Management Implications and Future Research

Municipal investment planning will require coordination between finance, engineering, public health and market management. The framework will provide a proposed basis for comparing investment packages while retaining explicit accountability for trade-offs. Infrastructure governance principles support coordinated planning and oversight across investment lifecycles [24].

Future studies will examine lifecycle costs, equity effects, decision transparency and sustained service performance. Multisite evaluations with longer follow-up will test applicability across market sizes, administrative capacities and trading systems. Research will compare integrated portfolio selection with isolated project decisions using defined outcomes and comparable resource constraints.

Methodological work will investigate uncertainty propagation, alternative normalisation methods and participatory weighting. Composite-indicator guidance provides a basis for testing how analytical choices influence results [23]. Researchers will also assess whether vendor contributions alter decisions and whether grievances receive effective responses [27].

The framework will require feasibility testing before effectiveness claims. Responsible adoption will depend on documented decisions, sustained operation and evidence connecting investment choices with intended services and exposure reduction.

7. CONCLUSION

7.1 Framework Summary and Practical Contribution

Municipalities must allocate limited investment funds across competing infrastructure needs while protecting public health and market livelihoods. The proposed framework connects risk assessment, project development and portfolio selection with coordinated delivery and sustained operation. It will support comparison of investment packages through explicit criteria, documented assumptions and consideration of dependencies, affordability and equity. Shared responsibility among municipal leaders, engineers, public health teams, utilities and vendors will strengthen accountability without obscuring technical duties. Transparent decisions will explain both selected projects and deferred needs. Success will require reliable water, drainage, sanitation and other essential services that remain accessible and maintainable, rather than construction completion alone or expenditure against an approved capital budget.

7.2 Conditions for Responsible Adoption

Responsible adoption will require locally appropriate evidence, competent oversight and sufficient maintenance capacity. Sensitivity testing will examine uncertain costs, benefits and stakeholder preferences before commitments become irreversible. Meaningful vendor involvement and continuing evaluation will help identify exclusion, disruption and emerging service failures. Implementation should proceed in stages, with decisions revised when evidence changes. Improved infrastructure or inspection results must not be presented as proof of reduced disease without suitable supporting data. Disciplined prioritisation can nevertheless support safer markets, protected livelihoods and more accountable public investment when essential services remain operational.

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