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INFLUENCE OF COMMUNITY-BASED EARLY WARNING SYSTEMS ON RESILIENCE-ORIENTED PROJECT PLANNING AMONG NANO, SMALL AND MICRO-ENTERPRISES IN MARSABIT COUNTY, KENYA

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ABSTRACT

Nano, Small and Micro Enterprises (NSMEs), represent the final linkage within last-mile delivery of food, water, sanitation and hygiene (WASH) commodities, in Kenya's arid and semi-arid regions; however, these entities remain excluded from formal disaster risk management and project planning frameworks. The objective of this study was to determine the extent to which Community Based Early Warning Systems (CBEWS) influence Resilience-Oriented Project Planning amongst NSMEs in Marsabit County, specifically regarding access to early warning information, translation of that information into preparedness, and mechanisms that enable such transition. Utilizing programmatic evidence from the B-READY Anticipatory Action Program, a Pre-Crisis Market Mapping and Analysis (PCMMA) of fifty NSMEs, Activation Ready Protocol (ARP) co-design forums, and associated anticipatory action plans; along with a literature review of CBEWS, anticipatory actions, and enterprise resiliency, the study developed a conceptual model relating access to early warnings to outcomes in planning through three constructs: Trust, Translation, and Actionability. The findings of the study indicated that while drought and flood forecasts have Increased their reach to Marsabit's trading community; access does not consistently translate into planning: fewer than half of the enterprises participated in the study used climate information to prepare for shocks, and almost none had written continuity plans. In addition to lacking sufficient working capital to withstand even short duration disruptions. Successful translation occurred primarily when scientific forecasting was integrated with locally trusted Indigenous Technical Knowledge, disseminated via trader networks and radio broadcasts, and coupled with trigger-based financing protocols. As such, it is recommended that county governments, humanitarian organizations, financial institutions and NSMEs treat early warning as an intermediate input requiring deliberate co-designed project components rather than a terminal product.

Keywords: Community-based early warning systems; Anticipatory action; Nano, small and micro-enterprises; Resilience-oriented project planning; Indigenous Technical Knowledge

1 INTRODUCTION

Climate-related shocks are creating new challenges in the operational environments of small business in the arid and semi-arid lands (ASALS) in the Horn of Africa. What was previously a drought/flood cycle occurring every 5 to 10 years has changed to drought/flood events occurring approximately every 2 to 3 years in Kenya's ASAL counties. These changing frequencies reduce the recovery time for enterprises prior to the occurrence of another event [1]. Nano and Micro Enterprises (NSMEs) - the kiosks, mobile money agents, water vendors and small traders providing food, water and sanitation and hygiene (WASH) products to remote pastoralist populations - serve as central nodes in the exposure to climate variability. At the same time, they are among the most vulnerable entities to climate variability within their respective economies; and among the most important entities, given that many humanitarian organizations are increasingly reliant on the functionality of local markets to provide multi-purpose cash transfers and electronic voucher programs [1].

Generally, Early Warning Systems (EWS) are viewed as the first line of defense against such shocks. The United Nations' "Early Warnings for All" initiative [2] seeks to ensure that all persons receive hazard early warnings by 2027. The initiative is based on four pillars with the fourth pillar – preparedness and response capacity – being repeatedly identified as the source of failure in EWS for disadvantaged and resource-constrained populations [3]. The early warning - early action gap refers to technically valid weather forecasting models that either do not reach the intended population, are not perceived as credible by the population or cannot be used by the intended population.

Community-based early warning systems (CBEWS), which integrate scientific forecast data with locally collected and interpreted hazard information and are therefore anchored in local structures and knowledge, have been promoted as a possible way to bridge this gap [3]. In East African pastoralist areas this generally involves combining scientifically generated forecasts with indigenous technical knowledge - livestock behavior changes, vegetation changes, ritualistic cycles etc. - that communities may view as more credible due to familiarity and ease of implementation compared to more general scientific advisory recommendations from distant sources [4]. However, while reaching the nano/micro enterprise via early warning is a significant challenge, the key issue is whether this will lead to project planning oriented towards building resilience - written continuity plans, pre-positioning of supplies, pre-arranging capital/liquidity and establishing trigger protocols that allow a business to take initial actions before a shock escalates [1]. Thus, CBEWS becomes less about delivering an end product (the technical output of early warning) and more about an intermediate input that planners must intentionally convert into actual planning behaviors.

Thus, this article investigates the conversion process. Utilizing both primary evidence from the B-READY program in Marsabit county along with secondary evidence from a literature review focused on the topic, it poses the following research questions:

To what extent, and through what mechanisms, do community-based early warning systems influence resilience-oriented project planning and preparedness among nano and micro-enterprises in Marsabit County?

The article's contribution is directed at project planning and management practice: how should projects be designed so that early warning information is planned for, rather than merely received?

2 BACKGROUND AND CONTEXT

Marsabit County, in Kenya's extreme north, is the country's second largest county by land area and one of its most climate-exposed. Rainfall is bimodal, low and erratic; roughly 81 percent of the population depends on pastoralism and 16 percent on agro-pastoralism [5]. Around 80 percent of pastoral and 69 percent of agro-pastoral households live below the poverty line, and acute malnutrition persistently exceeds the global emergency threshold [5]. NSMEs are frequently the last functioning supply-chain node connecting remote settlements to essential goods, and are increasingly pre-positioned as vendors for market-based humanitarian responses [1].

The 2026 Pre-Crisis Market Mapping and Analysis (PCMMA) of fifty NSMEs across Moyale, Sololo and North Horr found ninety-two percent had suffered supply-chain disruption in the preceding year, linked to flooding (60%), drought (46%) and rising transport costs, with seventy-six percent of disruptions directly climate-attributable [1]. Financial buffers are thin — sixty-two percent held under KES 20,000 in working capital and most could not sustain operations beyond seven days without sales — and ninety-four percent had no insurance. Formal continuity planning is almost absent: seventy percent relied on informal, mental plans and only two percent had anything in writing [1].

However, Marsabit has recently become a focal point for coordinated anticipatory actions. For example, the World Food Programme (WFP) launched a five-year Anticipatory Action Plan for Wajir and Marsabit (2024 – 2027) that identifies specific SPI-3 drought trigger levels that when exceeded will activate funds allocated for anticipatory actions [5]. In

addition, Welthungerhilfe worked closely with the Marsabit County Technical Working Group to develop a flood early action plan for the county with triggers tied to rainfall intensity and river water flow [6]. Additionally, Oxfam/SND B-READY project was funded by Visa Foundation and conducted a PCMMA study and organized cluster meetings for fifty NSMEs that developed Activation Ready Protocols (ARPs) converting these triggers into actionable operational components for individual businesses/enterprises [7]. Therefore, Marsabit is uniquely situated as an extremely well-documented case study to assess whether community-based early warnings do or do not lead to enterprise planning.

2.1 Problem Statement

The global approach to policy views early warnings and anticipation as mutually exclusive; thus, The Sendai Framework, a new framework on disaster risk reduction identifies "understanding risk" as central to the development of effective disaster risk management [8]. In addition, "Early Warning For All", an initiative launched in 2022, defines preparedness and response capabilities as the weakest link in the capacity to respond to natural disasters. However, Marsabit has provided data showing that there is no direct relationship between these two approaches. Only 18% of Nano, small and micro-enterprises (NSMEs) in Marsabit received and made effective use of climate-related information; while 32% received it but was unable to use it; 24% assessed it as unreliable or late; and 26% did not receive any [1]. Therefore, more than seven out of ten enterprises that receive early warnings encounter obstacles that prevent them from using the warning for planning purposes.

The above findings are consistent with the broader body of research related to Community-Based Early Warning Systems (CBEWS) that indicates that technical accuracy is typically required, but is not sufficient to translate warning into action [3]; rather trust, ownership and actionable translation determine if the warning will become action. The underlying theory linking community-based warning systems to resilience-oriented planning at the individual enterprise level remains unexplored within both the disaster-risk and PPM literatures. Current Marsabit based frameworks (e.g., World Food Programme's Accelerated Action Plan (AAP); World Humanitarian Health's Emergency Assistance Program (EAP)); have been designed primarily for household-based humanitarian caseloads; however, only the relatively new B-READY ARP framework provides a trigger-based planning process for business continuity. This article addresses the previously unexamined theoretical gap related to how community-anchored warnings are converted (or fail to be converted) into resilience-based plans for individual enterprises and examines the implications for project design and management.

3 LITERATURE REVIEW

3.1 Community-Based Early Warning Systems

CBEWS anchor the collection, analysis and dissemination of risk information in local systems rather than solely with national and/or international agencies [3]. A systematic review identified CBEWS have common characteristics that consist of four key elements — risk knowledge, monitoring, warning communication and response capability — which are similar to those in the UN Early Warnings for All framework and Marsabit's anticipatory action plans. The same review and other studies about community engagement in early warning consistently identify response capability as the least effective of the four elements — community engagement has been viewed by many authors as a dissemination issue (getting messages to a wider audience quicker), rather than an issue related to decision making (having communities able to take action when they receive a message). The difference between these two issues is critical here: Marsabit's NSMEs generally receive warnings — the failure lies in translating the warnings into planned actions for what appear to be primarily financial, organizational and informational reasons as opposed to technical.

3.2 From Early Warning to Anticipatory Action

The anticipatory action (AA) movement seeks to formalize the process of translating warnings into pre-planned and pre-funded actions [9]; such that when implemented, AA results in an increased rate of household access to both information regarding an impending hazard, as well as the resources required to take immediate action based upon the information received. However, practitioner feedback also notes that despite this trend towards an earlier response, there continues to be a significant disparity in the time frame between receipt of warning and actual response for vulnerable populations. Additionally, practitioner feedback indicates that while technology may provide much of the infrastructure necessary for early warning systems, such systems will be ineffective if they do not have sufficient levels of social trust. This is where community-based early warning systems, which integrate local knowledge and indigenous understanding with decision-making processes, can fill the gap.

3.3 Indigenous Technical Knowledge and the Legitimacy of Warning

A growing literature documents Indigenous Technical Knowledge's (ITK) role in how East African pastoralists interpret climate risk. The comparative study of this approach to interpreting climate risk in Ethiopia, Uganda, and Tanzania shows that pastoralists will use a combination of meteorological, biological, and astrological indicators to understand

climate risk. Furthermore, studies also suggest that trust in science-based forecasting increases significantly when it is combined with ITK as opposed to replacing ITK altogether [4]. As most directly related to our current research question, a recent study on the development of hybrid early warnings systems in the Karamoja Cluster (Kenya-Uganda) argue that for early warnings to be successful they need to involve real co-productive processes involving elder pastoralist leaders/traditional forecasters and meteorological agencies/institutions, as well as acknowledge the role of ITK, but do not simply provide tokenistic acknowledgement of tradition while continuing to utilize the same technical systems [10]. In addition, there was significant overlap between the Marsabit ARPs and BDIT Colleges' approaches to developing hybrid warning systems using Kenya Meteorological Department forecasting with ITK (livestock behavior; goat intestine reading; certain tree-shedding; ant movements; and moon/star observation); however, both organizations treated these two types of forecasting as complementary/legitimizing each other rather than competing.

3.4 Nano and Micro-Enterprise Vulnerability and Resilience

Small-enterprise disaster-resilience literature has largely focused on more formally defined small-to-medium sized enterprises (SMEs) with little focus on nano/micro-end of African Small Accessible Local Trading Economies. The same study of 202 MSMEs operating in flood prone Kigogo Dar Es Salaam indicated that years of operation, capital, education — as well as a basic continuity plan — were all significant predictors of how quickly they recovered after a flood [11]. An evidence map of SME disaster risk management frameworks in low-and-middle-income countries identified formal continuity planning as an exception. Further, it identified informality itself as being the greatest driver of vulnerability for informal businesses because they are most unlikely to have documented plans and least likely to be able to obtain the financial resources required to implement them [12]. This also mirrors Marsabit; ninety-six percent of NSMEs in Marsabit save informally via chamas, mobile money, and cash and there is very little insurance coverage [1] — a pattern consistent with broader evidence on informal savings constraints among Kenyan microenterprises [13].

3.5 Resilience as a Project Planning Construct

The "3A" model in the "BRACED" program is used to break down the concept of resilience into three components as follows: Absorptive Capacity (withstanding a shock with an organization's existing resources), Adaptive Capacity (reacting to or proactively adjusting to changes resulting from the shock) and Anticipatory Capacity (the ability to take proactive action based upon expected future shocks/changes). This is important for this analysis because it allows us to separate anticipatory capacity (what CBEWS is creating) from absorptive and adaptive capacity. In other words, while an enterprise can be provided with better advance warnings through systems like CBEWS, it will only be able to absorb and adapt to the impacts of those shocks if they have sufficient working capital, adequate levels of insurance, and sufficient diversity in their suppliers. Therefore, providing enterprises with better advance warnings than they previously had without also providing them with mechanisms to increase their absorptive and adaptive capacities results in informed enterprises that are equally vulnerable to adverse effects of a disaster - the exact phenomenon being observed by the Marsabit data.

3.6 Theoretical and Conceptual Perspective

Two theoretical perspectives are combined. Resilience theory, via the 3As framework, supplies the outcome-side vocabulary distinguishing an enterprise that merely receives a warning (anticipatory capacity) from one able to withstand and adjust to a shock (absorptive and adaptive capacity) [14]. Stakeholder theory provides the vocabulary for defining how this co-design process will be structured so that those parties involved in the ARP forums can negotiate the triggers and actions needed to translate the warning received into plans. Stakeholders can include all parties who can either impact or are impacted by a project's goals and objectives. Success is contingent upon coordinating values across the entire stakeholder set through engaged participation throughout the design phase of the project as opposed to simply providing stakeholders with output of the project. [15]

Together these generate a five-stage conceptual chain:

Community-Based Early Warning Systems → Early Warning Information/Access → Risk Perception and Decision-Making → Resilience-Oriented Project/Business Planning → Enterprise Preparedness and Resilience

The Marsabit evidence demonstrates that each of these stages can be impacted positively as they are linked together. CBEWS-to-access is influenced by channel credibility - NSMEs rely upon radio and trader networks more than upon either digital or pure institutional channels because there is no separation between the trust one has for a message concerning a warning and the trust one has for the person who conveyed it. Access-to-perception is also dependent on translation - forecasts made by technical people have utility only if they are translated to simple language and as advisory-type messages about an organization's operations that are evaluated relative to ITK [1,7,10]. Perception-to-plan is where attrition occurs most frequently since simply having a proper understanding of a perceived risk does not necessarily translate to an operational plan or sufficient liquidity to access resources during a disaster event — this is the exact area at which stakeholder-negotiated and trigger-link financing is being employed (pre-disbursement of

funds) to support organizations with plans that are available for use [7]. Planning-to-actualized-resilience will depend on whether the plan has been exercised and updated — adaptive capacity within the 3As framework [14]. Community-based early warnings are therefore the starting point for a series of steps, each requiring different project components to impact the ultimate goal of achieving enterprise-level resilience.

4 MATERIAL AND METHODS

This article is a conceptual, analytical, and evidence-based as opposed to being an original report based on new primary research. Three different types of evidence with varying levels of evidence will be utilized. Firstly; Empirical Project Evidence: the 50 nano, and small-medium enterprises' (NSMEs) [1] results from the 2026 PCMMMA; The ARP Co-Design Forums [7]; and the World Food Programme (WFP) (2025) and WHH/County (2026) Anticipatory Action Plans. All these three are considered programmatic evidence developed via identified methodology and validated by stakeholders however they have not been independently reviewed by peers. They will also be referenced only where necessary, limiting all references to that which is described. Secondly; Secondary Literature on CBEWS; anticipatory action; indigenous technical knowledge; and enterprise resilience — prioritizing post-2015 sources while retaining foundational theory [16] for conceptual grounding. Lastly; Policy Documentation (the Sendai Framework [8] and Kenya's Micro and Small Enterprise Act [17]) establishing the regulatory environment for the discussions.

There was no additional survey, interview, or focus group data collected for this study. There are no additional statistics or quotes outside of those contained in the project reports cited. When there is sufficient evidence to support a definitive assertion — such as the unknown long term sustainability of ARP-generated funding, which has not experienced a full activation cycle — this will be noted instead of inferred.

5 RESULTS AND DISCUSSION

5.1 Accessibility and the Information Gap

Approximately one fourth of the NSMEs receive little to no climate information. Radio accounts for approximately 68 percent of how these businesses currently receive climate information, while SMS represents 28 percent of how they access it, and digital platforms account for less than 2 percent. The use of digital platforms reflects both connectivity issues and low levels of business-related literacy among this group [1]. Therefore, projects that assume the majority of the target population will be able to disseminate climate information through their smartphones are likely to exclude the vast majority of the intended recipients. Consequently, radio and trader network relay — which are being recommended as priority investments by the county's ARPS — better reflect current behavior by these businesses [7].

5.2 Trust and the Integration of Indigenous Technical Knowledge

Technical rainfall or SPI-3 values carry little practical meaning for a trader deciding whether to bulk-purchase stock. The credibility of predictions can be confirmed when they have been cross-checked using ITK Indicators that support the broader body of research regarding forecasting in East Africa [4,10]. The relationship is bidirectional: each knowledge source lends legitimacy to the other, producing a combined signal traders are more willing to act on than either alone. Protocols built solely around meteorological indicators, without a channel for community-held indicators, are likely to under-perform.

5.3 The Translation Problem

The gap between the 18% that receives as well as utilizes climate data and the 56% that receives but cannot utilize it [1] signifies empirically the warning-action gap; failure to act resides in the translation, not the dissemination. The ARP's advisory format for businesses was directly designed [7] consistent to the AA literature and its emphasis on the need for specific warnings, not general.

5.4 Business Continuity Planning and the Limits of Awareness

Approximately ninety-eight percent of the NSME owners indicate they are in need of business continuity training, however, only approximately two percent have a written continuity plan in place; seventy percent use memory-based plans generated by repeatedly experiencing past events [1]. There isn't an awareness issue here — it is simply a lack of a documented process or methodology for utilizing the owner's existing experience as a basis for developing documentation — consistent with evidence that a basic written plan strongly predicts recovery speed [11], and confirming that risk perception alone does not produce planning without facilitation.

5.5 Stock, Supply-Chain and Financial Preparedness

Eighty percent of NSMEs cite cash shortages as the primary limitation in maintaining a sufficient level of inventory, far greater than any other limitation [1]. Most have less than KES 20,000 for working capital; therefore, having the ability to anticipate risks (absorptive capacity), will be unable to convert that anticipation into action without having an adequate amount of absorptive capacity to do so [14]. The ARP's provision of advance funding based on triggers which is to be disbursed upon those triggers being met, addresses the missing link of absorptive capacity [7].

5.6 Early Warning versus Early Action

The ARPs formalize a five stage "continuum" of preparedness — Monitor, Prepare, Activate, Respond, Recover — by dividing a framework of "preparedness" into different stages, each with specific triggers and resources required [7]. While the previously developed frameworks (the WFP's AAP and the WHH's EAP) focused on households as caseloads; the B-READY ARP applies this same trigger-based logic to enterprise continuity, demonstrating that an architectural approach for humanitarian AA architecture can be adapted for enterprise-level project planning.

5.7 Institutional Coordination and Remaining Barriers

The institutional matrix of the ARP provides a clear indication of how tasks are distributed among key stakeholders including; NDMA/KMD (Monitoring), County Trade Departments (Coordination), Financial Institutions (Liquidity) and Business Associations (Dissemination) [7]. This distribution of responsibilities by stakeholders as noted in this study aligns with the expectations of Stakeholder Theory that all relevant stakeholders should be aligned [15] and supports evidence which has shown that SME resilience gaps in LMICs arise due to lack of coordination rather than absence of any one capacity [12]. Despite these allocations being identified there still exist numerous gaps: Insurance is almost completely absent (94% of respondents reported they were uninsured); Formalization is limited for those seeking SACCO/Bank finance; And, although women-owned enterprises represent the majority of surveyed NSMEs (76%), young people show markedly lower participation in ARP processes than older enterprise owners. These indicate where the chain — information, translation, financing, coordination — remains weakest, not that it fails to function.

6 MARSABIT COUNTY AS THE CASE CONTEXT

Marsabit is analytically significant, but more importantly it is a useful case study, for four reasons. Firstly, due to its semi-arid climate with two dry seasons per year, and high levels of rainfall variability, Marsabit is at greater risk from compound hazards such as droughts and floods that are unusual in many other areas of Kenya and thus require proactive action based on anticipated risks rather than reactive responses based on singular hazards [5,6]. Secondly, Marsabit has a pastoral economy which means the success of the NSME programme will depend on factors including the health of livestock in the area and terms of trade between the region's pastoralists and markets in southern Ethiopia. In addition to physical damage resulting from disasters, therefore, disruptions will also operate through market transmission channels. For example, where there have been improvements made to agricultural infrastructure such as roads and irrigation systems, they may be ineffective if pastoralists do not have access to markets where their products can be sold. Therefore, while the ARP uses physical hazard indicators, the plan also includes market linkage adjustments. The reason for this inclusion is to account for the fact that road damage, for example, which prevents pastoralists reaching markets, could result in similar losses to those incurred by businesses damaged physically [7]. Thirdly, the remote location of many rural settlements in Marsabit County means that customer mobility is an additional dimension of vulnerability. In addition to physical damage to buildings or stock, customers being unable to reach markets because of road damage etc. could be equally damaging [7], therefore resilience planning requires consideration of both physical assets and customer mobility. Finally, Marsabit County is unique among counties in Kenya in respect of its strong and well established indigenous knowledge architecture - which provides a basis for building trust among different actors and increasing coordination during periods of disaster [7]. This is particularly relevant to the research question examined within this paper and it provides a degree of strength to the evidence presented here that is unavailable when studying lower hazard or less knowledge-rich counties.

7 PRACTICAL IMPLICATIONS FOR PROJECT PLANNING AND MANAGEMENT

The evidence and framework above carry implications extending beyond disaster risk management into core PPM practice.

7.1 Risk-informed design

Use Access to Early Warning Systems as Necessary but Insufficient. A project will overestimate its contributions to the overall resilience if measured solely by the percentage of people who receive a warning from the system. However, even if they do receive warnings, it is unlikely that they would act on them. The use of Marsabit's monitoring metrics as a

guide for replicating a similar approach provides a possible model for determining whether or not a community understands the warning received, trusts the information provided and takes action as required.

7.2 Translation as a funded activity

Log Frames Should Provide Funding for Converting Technical Forecasts into Business Relevant Advisories. As such, translation cannot be viewed as simply a product of dissemination and should be included as a funded activity with staff assigned to perform the conversion from technical language to business relevant language using the ARP's structured advisory format as a reference point.

7.3 Adaptive management

Triggers, Thresholds, Channels should be Viewed as Provisional/Revisable. Following the ARP's post activation review process for establishing new triggers, thresholds and/or channels is recommended.

7.4 Financing absorptive capacity

Anticipatory action budgets should include pre-arranged emergency funds which are triggered by specific events and conditions of need; this is an example of how the ARP included cash disbursement mechanisms for funding. Financing should not be treated as separate from other microfinance activities.

7.5 Structured participation

The ARP co-design process — plenary orientation, experience-sharing, cluster design methodology, scenario testing, validation [7] — operationalizes stakeholder theory's claim that value is created through (and not merely communicated to) stakeholders [15]. This process could be replicated in other comparable contexts.

7.6 Formalised trigger-to-action rules

The formalization of decisions on whether to take an action (i.e., the "action" part of the actionable alert) is that it will proceed through agreed upon (decision tree format) sequences of actions (monitoring; verification; activation; notification/communication; action; review) vs. Discretionary action by field staff. Therefore, this provides for consistency in both timing and quality of activation.

7.7 Business-specific communication and market-integrated humanitarian design

Enterprise advisories are different than those provided to households. As such, advisory communications for enterprises are also different than household communications. Additionally, pre-qualifying entities that meet ARP-compliant requirements as cash/voucher vendors creates synergies between humanitarian operations & private sector investments in continuity plans.

7.8 Chain-based MEAL and institutional sustainability

Monitoring should measure all aspects of the access-understanding-decisions planning preparedness chain (not simply an awareness metric). Further, the ARP mechanism should be integrated into county government structures (Department of Trade & Cooperatives & County DRM Framework), for purposes of sustainability.

8 CONCLUSION

This article has shown whether, and how, community-based early warning systems affect (i.e., how they can lead to) resilient project planning among NSMEs in Marsabit. There is no evidence of an automatic and/or straightforward connection. In Marsabit, the NSMEs have low levels of financial resources, limited formal continuity plans and little to no insurance coverage, although there is high levels of knowledge about their exposure risks and a great desire for assistance with preparedness. Many NSMEs receive early warnings, however relatively few make use of them. The difference is more likely due to lack of trust, translation, and financial ability rather than the quality of the forecast. Only when early warning systems incorporate both trusted Indigenous Technical Knowledge and provide business-specific translations of that knowledge, pre-arranged financing linked to specific triggers, and a structured process for co-designing projects — as was done with the B-READY ARP — do we see a clear path from receiving early warnings to developing plans. When one piece of this puzzle is absent, the entire sequence will break down. The article's main contribution is to transition the conceptualization of community-based early warning from being the last step in the production and delivery of disaster-related products — i.e., from a terminal product to an intermediate input in a longer causal chain — including access to information, translating that information into usable form, making decisions based on that translated information, planning responses, preparing those responses, etc., where each point requires different types of planned and deliberately-designed project components.

Recommendations

- **Project planners and managers:** provide funding for translation, financing and coordination elements specifically. Include MEAL indicators which independently assess each stage of preparedness – access, understanding, decision making, planning and ultimately realized preparedness.
- **County Government of Marsabit:** establish a formally embedded ARP mechanism at the Department of Trade & Cooperatives and include it into the county's Disaster Risk Management Framework, with a designated budget line. Provide extended simple registration services for the informal NSMEs to enable them to access emergency funds.
- **Humanitarian and development organizations:** replicate the ARP co-design process across all of the remaining ASAL counties. Budget post-activation reviews instead of designing a one-time protocol.
- **Early warning institutions (KMD, NDMA, WRA):** institutionalize a routine way for early warning institutions to engage indigenous knowledge holders on their forecasts and how they are interpreted. The current practice is to occasionally involve indigenous knowledge holders when interpreting forecasts.
- **Financial service providers:** design emergency liquidity products tied to triggers for NSMEs. Link formally with existing Chama and Savings Group structures instead of having the credit applicant go through a formal sector credit check before accessing emergency liquidity products.
- **Market actors and business associations:** formalize the ARP cluster representative role as a permanent communications hub between activations.
- **NSMEs themselves:** use the NSME Action-Ready Scorecard for self-assessment and to close specific gaps — written plans, alternative suppliers, safe storage, emergency savings.

Further research should follow the performance of the Marsabit ARPs during the first full activation against an actual drought or flood event to test whether pre-arranged financing and trigger-based communications function as intended under extreme shock conditions. Additionally, examine if the youth participation gap will decrease over time as the ARP mechanism becomes mature.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

This article did not involve the collection of new primary data from human participants by the authors; it draws on secondary programmatic data collected under the B-READY Anticipatory Action Program [1,7]. Ethical clearance for the primary data collection underlying the PCMA and ARP co-design process was obtained from the National Commission for Science, Technology and Innovation (NACOSTI) and from the County Government of Marsabit.

Statement of informed consent

All participating enterprise owners and key stakeholders interviewed as respondents provided informed consent prior to their participation.

Author Contributions

Abdi Rach Huka: conceptualization, literature review, formal analysis, development of the conceptual model, writing – original draft, writing – review and editing. Dr. Jennifer Wangari Wairiuko: conceptualization, methodology, supervision, validation, writing – review and editing. Dr. Samuel Macharia: supervision, validation, writing – review and editing.

Data Availability

The PCMMA and ARP records underlying this article can be made available in a public repository or upon reasonable request to the corresponding author.

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