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Assessment of Premium Quality Rice Market System Resilience in Bangladesh

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Abstract

This study looks at how the Premium Quality Rice (PQR) market in Bangladesh is organised, how it works, and how strong it is, using a method called the Market Systems Resilience Assessment (MSRA) created by USAID. The PQR market includes various actors—farmers, paddy traders, millers, wholesalers, retailers, and consumers—engaged in the production, processing, and distribution of fine-grain, high-value rice varieties. Despite declining per capita rice consumption in Bangladesh, demand for PQR is increasing due to rising incomes, urbanisation, and changing consumer preferences. Primary data were collected through two rounds of surveys: one involving 1,440 rice farmers and another involving over 2,000 market actors and consumers across key PQR-producing districts. Conducted during the COVID-19 pandemic, the surveys allowed examination of the market system's adaptive response to economic shocks. Resilience was assessed across eight domains categorised into structural (connectivity, diversity, power dynamics, and rule of law) and behavioural (cooperation, competition, decision-making, and business strategy) components. Findings show moderate resilience overall, with strong performance in competition and cooperation but weaknesses in connectivity, diversity, and strategic decision-making. While the PQR market benefits from competitive structures and profitable incentives for producers, challenges such as fragmented linkages and unequal power distribution hinder its full potential. This study underscores the importance of building adaptive, inclusive, and efficient value chains to enhance the resilience of agri-food systems. Periodic reevaluation of resilience metrics is recommended to track progress over time and guide market-orientated policy and development interventions.

Keywords: Resilience, Market Systems, PQR (Premium Quality Rice), farmers, Adaptive Capacity.

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1. INTRODUCTION

A market system constitutes a network where buyers, sellers, and various participants collaborate to trade specific products or services. Within this system, there are three distinct participant categories: (i) (i) (i) (i) (i) (i) direct market players like producers, buyers, and consumers, who actively fuel economic activities within the market; (ii) suppliers of supporting goods and services, including finance, equipment, and business consulting; and (iii) entities that influence the business environment, such as regulatory agencies, infrastructure providers, and business consultants (TechnoServe, 2023). The "market system" of rice in Bangladesh plays a vital role in the country's economy and food security. Rice, as the staple food of Bangladesh, relies on the market system to ensure its production, distribution, and availability to the population. The rice market system in Bangladesh encompasses various actors, including farmers, paddy traders, millers, rice wholesalers, rice retailers, and consumers. Farmers cultivate rice in different regions of the country, and their harvest is then collected by paddy traders and millers, who process it into various varieties of rice. Wholesalers subsequently acquire rice from millers and distribute it to retailers across the country. Finally, consumers access rice through retailers, who sell it in local markets and shops (Rahman et al., 2021). In this study we measured the resilience of the Premium Quality

Rice (PQR) market system by using the Market System Resilience Assessment (MSRA) tools developed by the United States Agency for International Development (USAID).

In the marketing year 2021-22 (May-April), Bangladesh produced 35.8 million metric tonnes of rice from 11.6 million hectares of land (USDA, 2022). Bangladesh is one of the world's top rice-consuming countries. The yearly per capita rice consumption stood at 144.8 kg in 2019 compared to 170.4 kg in 2012 (IFPRI, 2019). According to the Bangladesh Bureau of Statistics, the annual per capita rice consumption further declined to 120 kg in 2022 (HIES, 2022). Even though the amount of per capita rice intake has been decreasing over time in Bangladesh, the demand for fine-quality rice has been increasing sharply as consumer preferences and the purchasing power of the middle-class population continue to increase. Educated, affluent, and urban households in Bangladesh are increasingly consuming fine-grain (i.e., long-and-slender-grain) rice, replacing ordinary-grain (i.e., short-and-bold-grain) rice (Mottaleb and Mishra, 2016). Even individuals from lower-income backgrounds exhibit a preference against consuming coarse rice (Jamal, 2018).

Usually, there is no uniform definition of “rice qualitthe definition of quality is highly relative and varies by context (Custodio et al., 2019). For example, what rural consumers in India consider "low quality" may be viewed as "premium quality" by urban consumers in Senegal. in India consider "low quality" may be viewed as "premium quality" by urban consumers in Senegal. in India consider "low quality" may be viewed as "premium quality" by urban consumers in Senegal. in India consider "low quality" may be viewed as "premium quality" by urban consumers in Senegal.rs in India may be perceived as “premium quality” by urban consumers in Senegal (Demont et al., 2013). In this study the premium quality rice (PQR) varieties are characterised by long, slender, and fine grains; they may or may not have an aroma; and they command a higher price than other popular rice varieties (CSISA, 2018). Farmers in Bangladesh grow a good number of PQR varieties, including Chinisagar, Basmati, Badshabhog, BRRI dhan34, BR5, Kalizira, Tulsimala, BRRI dhan37, BRRI dhan38, BRRI dhan50, Bina dhan12, and Bina dhan15 (Aziz et al., 2017). PQR varieties have a 20–60% price advantage and 50% higher profit over other rice varieties, indicating that there could be significant interest in expanded production (CSISA, 2018). The total demand for PQR is growing at 5% per year because of rising per capita income, leading to increased consumption of PQR, urbanisation, growth of modern food supply chains (supermarkets), and growing investment of private companies in the rice value chains (CSISA, 2018).

1.1 Understanding the PQR Market System and its Resilience

The market system of PQR embodies a complex web of interactions involving producers, distributors, and consumers, all engaged in the trade of premium-grade rice varieties. This intricate system is centred around delivering rice products with elevated quality standards, encompassing factors such as superior taste, texture, and nutritional value (What is a Market System?, 2023). Within this market system, producers employ advanced cultivation techniques and innovative technologies to cultivate rice grains that meet these heightened standards. For example, farmers use modern rice varieties that exhibit premium characteristics in grain size and taste. The distribution facet of the PQR market system is also characterised by specialised supply chains designed to uphold the integrity of the rice variety from its source to the end consumer, reinforcing its premium status. This system garners attention from discerning consumers seeking top-tier culinary experiences and health-conscious options, driving an increasing demand for rice products that align with these preferences. Consequently, the PQR market system fosters a cycle of continuous enhancement and innovation across the rice production and supply chain, contributing not only to market resilience but also to the broader food security landscape.

Resilience is the ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth (USAID, 2022). Similarly, market system resilience is the ability of market systems to allocate resources, draw on system-level resources (such as social safety nets, social capital, the financial system, or government assistance), and innovate to solve problems in the face of shocks and stresses (Downing et al., 2018).

At the system level, resilience is defined as the capacity of the system to marshal and allocate available resources, be they public or private, community or national, to respond to a shock or stress regardless of its nature. To illustrate, over time, market systems tend to orient toward the accumulation of resources in smaller pockets in order to weather shocks and stresses, or they evolve various interconnected mechanisms to harness resources to solve, neutralise, and mitigate the risks associated with shocks and stresses.

Resilience within market systems is a relatively underexplored domain in the realm of development. While it draws from the foundations of market development, it delves into the market system's ability to withstand, adjust, or even transform when faced with shocks and challenges. Operating within the larger economic,

political, socio-cultural, and environmental frameworks, markets play a pivotal role in allocating resources to address systemic issues, particularly those arising from unforeseen shocks and strains. Experts specialising in market systems recognise the complex structure of relationships between various elements, such as actors, institutions, markets, and broader systems. The choices made by households and the behaviour of firms, whether cooperative or opportunistic, ripple through, influencing not only performance but also resilience at the market system level. Additionally, policies within the broader environment can exert an impact on performance across all tiers (Downing et al., 2018).

The United States Agency for International Development (USAID) developed and published a framework for measuring market system resilience in 2018 (Downing et al., 2018). Following that, they also prepared guidance for assessing resilience in a market system in 2019 (O'Planick et al., 2019). By adopting the USAID's Market System Resilience Assessment (MSRA) tool, this paper aimed to assess the market system resilience of PQR in Bangladesh using the empirical data.

2. REVIEW OF LITERATURE

According to Barrett & Constas, 2014, resilience theory recognises that there is an interrelated hierarchy of individuals, households, communities, and systems with bidirectional feedback across these levels of the organisation. Resilience at each level is connected to and can be dependent on resilience at other levels. Resilience isn't a fixed characteristic; rather, it arises as a property within complex systems. According to complexity theory, the only effective approach to gauging thresholds in such intricate systems is by traversing them (Carpenter et al., 2005). These thresholds are pivotal junctures where there's a substantial shift in the behaviour of a system or the values it holds (Downing et al., 2018).

Agricultural market systems can face a range of critical shocks that impact their stability and functionality. These shocks encompass various dimensions. Economically, price volatility can be a major obstacle to fluctuations that affect both producers and consumers. Social shocks, including political instability and governance issues, along with inadequacies in trade policies, can disrupt the smooth functioning of agricultural markets. Environmental shocks, such as natural resource degradation caused by floods, droughts, erratic rainfall, and soil fertility problems, can severely hamper agricultural productivity and distribution. Additionally, health shocks, exemplified by diseases and pandemics like COVID-19, introduce unexpected disruptions, impacting the labour force, transportation, and overall market operations. These key shocks collectively underline the vulnerability of agricultural market systems and emphasise the need for strategies to enhance their resilience and adaptability (World Bank, 2013).

Bahadur et al. (2015) utilises the three-pronged approach as a foundational concept for categorising the impacts of projects on resilience. While this approach's strength lies in its simplicity, the extent to which these three capacities—adaptive, anticipatory, and absorptive—are readily distinguishable as separate entities remains a subject of debate. This framework was specifically developed for the Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) program. However, notably absent from their categorisation is the transformative aspect, as Bahadur et al. (2015) assert that transformation is not a standalone capacity. Rather, they characterise it as an encompassing approach, aimed at holistically and fundamentally enhancing people's ability to adapt, anticipate, and absorb shocks and stresses. According to them, transformation isn't a self-contained capacity within resilience. Instead, it emerges from the fusion of adaptive, anticipatory, and absorptive capacities, coupled with various internal and external factors, ultimately leading to a redefined state. While the Three As framework offers a relatively uncomplicated method for classifying capacities, alternative frameworks offer more comprehensive guidelines and insights for assessing and comprehending resilience across various contexts, ranging from households and food systems to market systems. This viewpoint also contrasts starkly with the theoretical framework adopted by the Food and Agriculture Organisation (FAO) of the United Nations (UN), which classifies capacities as adaptive, absorptive, and transformative (FAO, 2020; Choptiany et al., 2015).

The FAO's Resilience Index Measurement Analysis II (RIMA II) serves as a pragmatic analytical tool, building upon the guidelines presented by the Food Security Information Network (FSIN) to gauge the resilience of food security. Similar challenges arise when applying absorptive, adaptive, and transformative capacities, much like those encountered in the Three As approach, to systematically define indicators for resilience measurement (FAO, 2020). RIMA II primarily relies on household-level data and revolves around six key modules: (i) (i) (i) (i) (i) access to essential services, (ii) social safety nets, (iii) food security, (iv) assets, (v) adaptive capacity, and (vi) shocks (FAO, 2020). Both FSIN and RIMA II advocate for the utilisation of panel data (FAO, 2020), ensuring that measurements are dynamic—incorporating temporal aspects or changes in the concerned outcome variable(s) (D'Errico, 2016). While RIMA II includes both indirect (inferential) and direct (descriptive) variables, it omits "exogenous variables," encompassing factors like the environment, socio-political dynamics, and institutional dimensions (FAO, 2016). Observable indicators of "resilience achievements" within RIMA II encompass changes in monthly per capita food expenditure and dietary diversity (FAO, 2016). Acknowledging the comprehensive nature of RIMA II, the FAO concedes that its implementation can be resource-intensive and time-consuming, often infeasible for

countries facing fragility and conflict; consequently, a condensed questionnaire format has been developed by the FAO (FAO, 2019).

While a few tools do exist, they are relatively limited in their emphasis on Market Systems Resilience (MSR) (O'Planick et al., 2019; ACDI/VOCA, 2023). Among them is the Market Systems Diagnostic tool developed by Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance (ACDI/VOCA, 2023). This tool has been implemented in Honduras to gauge the competitiveness, inclusivity, and resilience of the industry-level market system (ACDI/VOCA, 2023). The Market Systems Diagnostic tool primarily evaluates enterprises within several major industries, aiming to assess the overall health and resilience of the entire market system (ACDI/VOCA, 2023). Notably, this tool seems to exclude households and smaller market participants, which might be attributed to its development for high-value industries. Additionally, it doesn't consider external factors such as the natural environment, which can influence market system resilience.

While specialised tools for measuring household resilience (STRESS, GOAL, RIMA II) are established and operational, and tools for measuring market systems resilience (like the Market Systems Diagnostic) are under development, there's currently a lack of widely utilised tools that effectively combine theory-based resilience assessment for households and market systems. What's needed is a tool that's replicable, adaptable, and relatively straightforward for development practitioners to use. Ensuring practicality in terms of time and resource requirements for data collection, as well as flexibility to swiftly capture both post-shock responses and long-term development progress, are essential considerations in enhancing resilience measurement tools, thereby delivering actionable insights to practitioners (Jones et al., 2021).

The Market System Resilience Index (MSRI) takes a comprehensive approach to assessing market resilience across multiple tiers, considering external factors like the ecological environment—setting it apart from comparable tools. Originating in 2018 through the efforts of International Development Enterprises (iDE) as part of a Bangladesh-based market development initiative, the MSRI has evolved and integrated insights from the Resilience Evaluation Analysis and Learning (REAL) Award under the USAID Centre for Resilience (O'Planick et al., 2019). iDE's contributions to the Market System Resilience (MSR) framework by the USAID Bureau of Food Security (Downing et al., 2018) have also informed its development. The MSRI model from iDE amalgamates core resilience elements to gauge the effectiveness of market systems in anticipating, enduring, and adapting to internal and external shocks and pressures.

In contrast to guidance by the USAID, which segregates market resilience and market inclusion as distinct facets to be measured and pursued, the MSRI intertwines inclusivity within market resilience measurement. By embedding social dimensions and vulnerabilities into the assessment, the MSRI captures the human side of resilience alongside financial aspects, acknowledging the social nature of markets. Recognising that market systems hinge on households and vice versa, the MSRI stands out for incorporating households into its analysis, offering a systemic perspective that transcends mere household-level measurement (Choptiany et al., 2021).

The MSRI extends from the Self-evaluation and Holistic Assessment of Climate Resilience of Farmers and Pastoralists (SHARP) tool's agroecological indicators, creating a more holistic instrument aligned with the notion of planetary and social boundaries. This distinguishes the MSRI by bridging sectoral divides that often treat climate and the environment as separate issues. Understanding the interdependence of households, markets, and the ecological environment, the MSRI integrates ecological indicators to better gauge these complex relationships' impact on market system resilience.

The SHARP tool developed by FAO is designed as an instrument to assess the resilience of farmer and pastoralist households to climate change. It addresses the need to better understand and incorporate the specific situations, concerns, and interests of family farmers and pastoralists regarding climate resilience (Cabell & Oelofse, 2012). While inspired by agroecological indicators, the MSRI was meticulously designed to address operational challenges that could impede its application. It was crafted as a modular, adaptable tool, ensuring context-specificity without compromising comparability. Opting against creating new measurements for each project, the MSRI strikes a balance between qualitative and quantitative measurements, enhancing both comparability and nuanced insights. By maintaining a judicious range of determinants, the MSRI remains user-friendly, flexible, and poised to serve diverse projects. Building on the collective wisdom from prior tools and frameworks, the current iteration of the MSRI stands as a versatile and valuable instrument ready for a variety of applications (Choptiany et al., 2021).

3. METHODOLOGY

3.1 Study Area

The Cereal Systems Initiative for South Asia, Phase Three (CSISA-III) project, was designed with the primary goal of fostering the development of producer groups dedicated to cultivating PQR. With the funding support from the United States Agency for International Development (USAID), the International Rice Research Institute (IRRI) has implemented the project in several districts in Bangladesh.

To increase farmers' profitability in rice production, CSISA has worked to expand the cultivation of PQR since Phase III of the Activity was initiated in 2016, starting in southwest Bangladesh (the Khulna region) and in 2019 in the northern region (Rangpur and Dinajpur) (Figure-1).

It focuses on ensuring a consistent supply of high-quality PQR seeds to the producers through innovative private sector engagement. This involves facilitating partnerships between producer groups and seed companies through a business expansion model, thereby establishing a sustainable mechanism for seed supply. The project also endeavours to enhance the linkages between these seed companies and the Bangladesh Rice Research Institute (BRRI) to ensure a regular supply of breeder seeds.

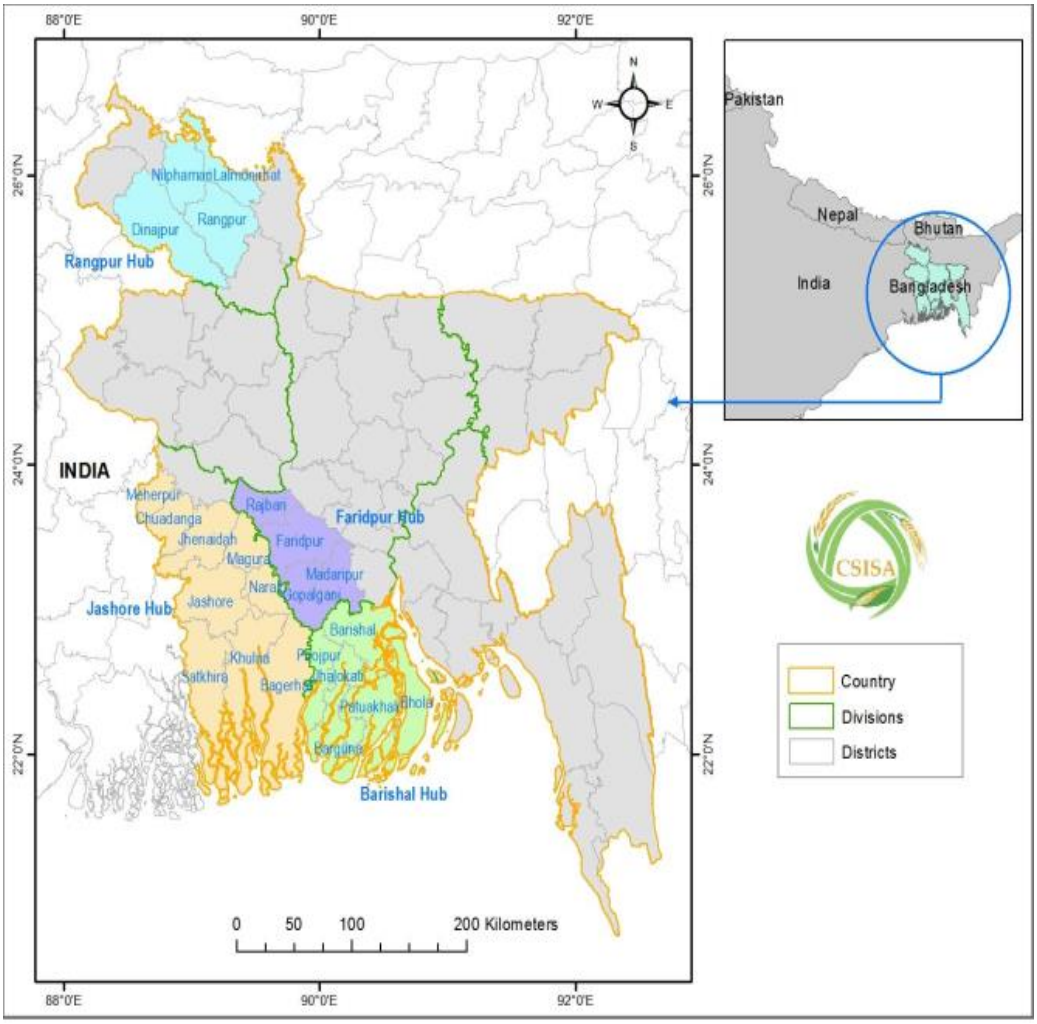

Figure 1: The CSISA project areas in Bangladesh

A survey was conducted in three districts of Bangladesh: Dinajpur, Sherpur, and Jhenaidah (Figure 2). These districts were chosen purposefully because farmers in them predominantly produce premium-quality rice compared to the other districts in the country. Among the selected districts, Dinajpur and Jhenaidah were taken from the CSISA project intervention areas, while the Sherpur district was taken out of the project working areas. Usually, farmers cultivate PQR during the aman season (August to November) (Kader et al., 2018), and this study collected PQR production and marketing-related data for the aman season

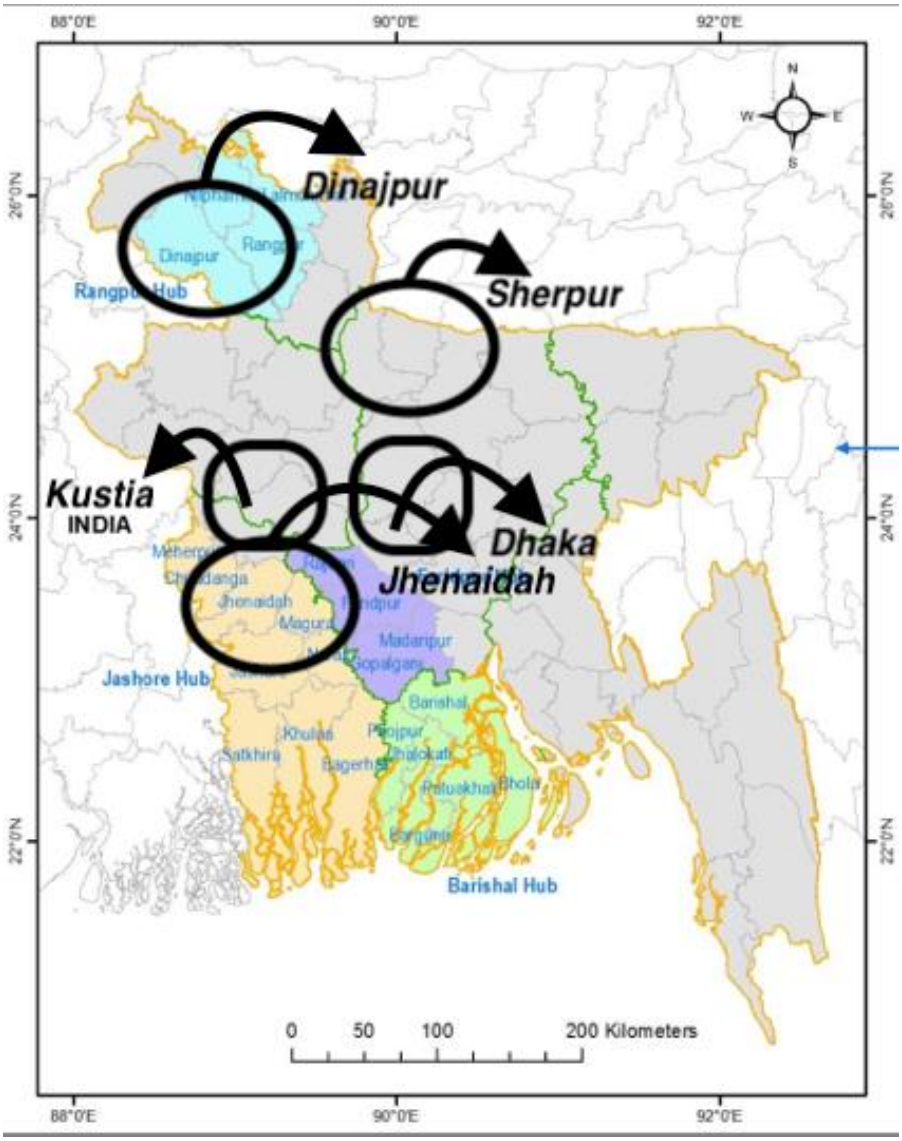

Figure 2: PQR production and market access survey areas in Bangladesh

3.2 Sampling and Data Collection

3.2.1 Farmer's Survey

The survey used a disproportionate sampling technique to identify the sample farmer. In the first stage of selecting the sample, researchers chose six sub-districts (upazilas) from Dinajpur, three sub-districts from Sherpur, and three sub-districts from Jhenaidah based on the area and volume of PQR production. A total of 144 villages from 12 sub-districts were chosen randomly. In the second stage, 10 farmers from each village were identified randomly (Figure 3). Hence, the study identified and surveyed 1,440 sample farmers, combining both PQR and non-PQR producers. The farmer's survey was conducted in 2020. Primary data were collected through face-to-face interviews with rice farmers by using a structured questionnaire employed in Surveybe, a computer-assisted personal interview (CAPI) software. A group of data enumerators was recruited and trained on

the questionnaires and CAPI tools. Each enumerator was provided with a laptop. They visited the sample households, interviewed the farmers, and obtained their consent prior to the interview. About 20 observations were excluded from the analysis due to missing information.

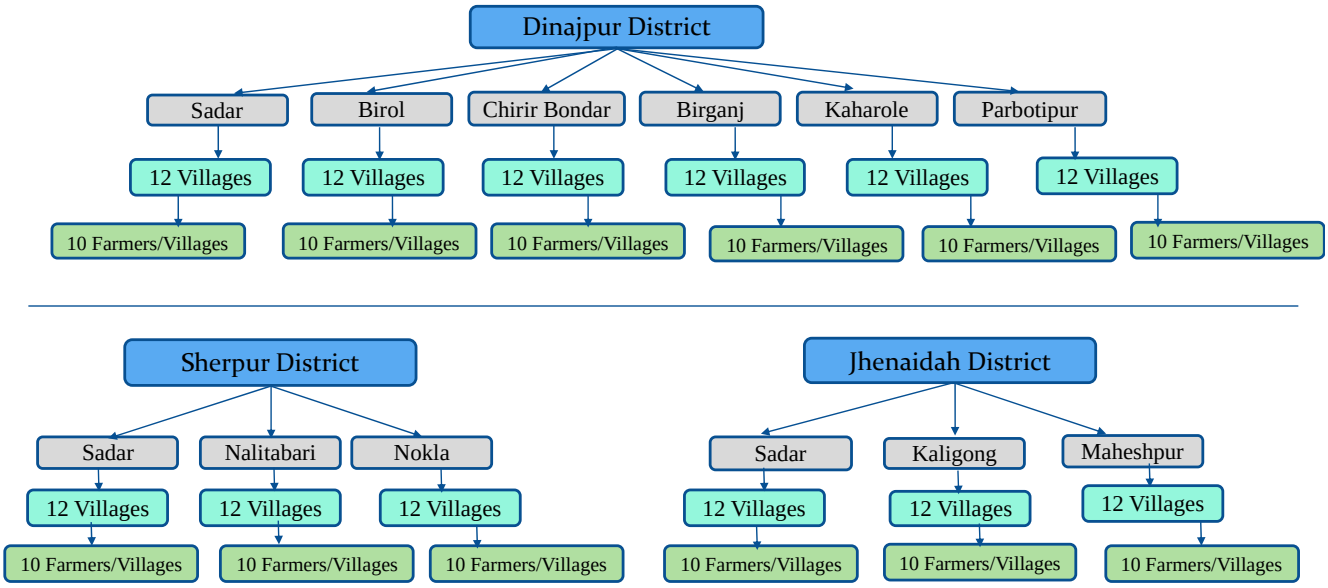

Figure 3: Disproportionate sampling framework of identifying sample farmers

3.2.2 Market Actor's Survey

Apart from the farmer survey, this study conducted a second round of surveys involving various market actors to analyse the PQR value chain and assess the resilience of the market system. This additional survey included 200 paddy traders, 200 rice millers, 125 wholesalers, 275 retailers, and 1,194 consumers from the Sherpur, Dinajpur, Jhenaidah, Kustia, and Dhaka districts. In this second round, Kustia district and Dhaka city, the capital of Bangladesh, were included for interviews with rice wholesalers, retailers, and consumers.

The second round of the survey was conducted over a significant period throughout 2021 due to its large volume and higher sample size. This strategic timeframe was selected to highlight the profound impact of COVID-19-related shocks on the complex market system. By conducting the survey during this period, the study aimed to explore not only the PQR value chain but also the ways in which the PQR market system responded, adapted, and demonstrated resilience in the face of the unprecedented disruptions caused by the global pandemic.

With the pandemic casting its shadow across diverse sectors, the market system's ability to navigate through the complexities and uncertainties was a central focus of this investigation. The research interest extended beyond a mere assessment of resilience; rather, it was rooted in understanding how the market actors, processes, and dynamics responded to the challenges imposed by COVID-19-related shocks. This strategic approach aimed to understand what happened in real-time during the survey period, helping to provide a complete analysis of both the strengths and weaknesses of the system as it changed.

Table 1: District-wise Sample Size of Paddy traders, Millers, Wholesalers, Retailers, and Consumers

Market Actors	Districts	Sample Size
Paddy Traders	Dinajpur	74
	Sherpur	64
	Jhenaidah	62
Millers	Dinajpur	75
	Sherpur	50
	Jhenaidah	75
Rice Wholesalers	Dinajpur	25
	Jhenaidah	25
	Kustia	25
	Dhaka	50
Rice Retailers	Dinajpur	50
	Jhenaidah	50
	Kustia	50
	Dhaka	125
Consumers*	Dinajpur	200
	Jhenaidah	200
	Kustia	200

3.3 Adopting the MSRA Framework

This study adopted USAID's Market Systems Resilience Assessment (MSRA) framework to assess the resilience of the PQR market system in Bangladesh across eight key domains. The USAID's MSRA framework was presented by Downing, J. (2019), where the author described the theory of measuring resilience of a market system using empirical data. The MSRA tools were developed based on eight broad domains, and these domains are categorised into two groups: four that pertain to structural aspects and four that delve into behavioural facets. The structural characteristics encompass connectivity, diversity, power dynamics, and the rule of law. On the other hand, the behavioural characteristics encompass cooperation, competition, decision-making, and business strategy (Downing et al., 2018).

These characteristics serve as pivotal measures for assessing the capacity of market systems to embody resilience. Moreover, they hold the potential to serve as catalysts for steering system transformation from a state that curtails resilience capacities to one that fosters and amplifies such capacities. Notably, characteristics impeding resilience capacities contribute to what is termed in this paper as "reactive" market systems. Conversely, characteristics that empower or reinforce resilience capacities contribute to the emergence of "proactive" market systems. Finally, these characteristics likely play out very differently in different contexts and thus need to be contextually defined or adapted (Downing et al., 2018).

3.3.1. Defining Proactive and Reactive Market System Orientations

Proactive market system orientation refers to the capacity and willingness of market actors to anticipate future shocks, adapt to emerging trends, and invest in long-term system improvements. This approach emphasises forward-looking behaviour, innovation, risk mitigation, and strategic collaboration aimed at building

systemic resilience before disruptions occur. (Downing et al., 2018; Barrett & Constas, 2014).

In contrast, reactive market system orientation reflects how actors respond to shocks after they occur. It involves short-term coping strategies, emergency adjustments, and recovery efforts that help the system regain functionality. While essential during crises, reactive responses often indicate limited preparedness and expose underlying vulnerabilities in the market system.

3.3.2 Structural Characteristics of Market System Resilience

i). Connectivity: Connectivity in a market system refers to the extent and quality of relationships among actors, resources, and institutions across social, geographic, and economic domains. It encompasses both horizontal and vertical linkages, including relationships among producers, processors, traders, and input providers. A balanced degree of connectivity is critical for resilience. Overconnectivity can lead to inefficiencies, resource saturation, and reduced responsiveness to innovation, while underconnectivity can cause fragmentation and system fragility, where the failure of a single node disrupts the broader system (Holling, 2001). Strategic redundancy—such as maintaining multiple marketing channels or sourcing inputs from diverse suppliers—enhances resilience by providing alternative pathways when disruptions occur. This optimal range of connectivity, referred to as the "window of viability," represents the threshold where the system maintains adaptability without becoming rigid or disconnected (Downing et al., 2018).

ii) Diversity: Diversity within market systems refers to the variety and distribution of actors, products, marketing channels, and end markets (Downing et al., 2018). High levels of diversity contribute to system flexibility by enabling multiple pathways for adaptation and response to shocks (Folke et al., 2010). For example, a resilient system may include a mix of large and small firms, niche and commodity markets, or various customer segments. A lack of diversity—such as market dominance by a single firm or homogeneity in customer behavior—can lead to systemic vulnerabilities. In resilient systems, diversity is not only present but also balanced across different levels and nodes, contributing to the system's capacity for innovation, risk distribution, and dynamic adjustment (Leach et al., 2010).

iii) Power Dynamics: Power dynamics in market systems describe how influence and control over resources, decision-making, and access are distributed. When power is overly concentrated, it may lead to monopolistic behavior, exclusionary practices, and a suppression of innovation, which can significantly weaken resilience. Conversely, systems with overly diffuse power may struggle to coordinate responses or build consensus. Resilient market systems typically feature distributed and accountable power structures that allow for inclusive participation and mitigate exploitative behavior. Such systems are better positioned to adapt and recover from disturbances because they are supported by diverse actors with agency and access to decision-making processes (Pelling & Manuel-Navarrete, 2011).

iv) Rule of Law: The rule of law underpins a stable and predictable market environment by ensuring consistent enforcement of regulations, contracts, and property rights. It enhances trust among market actors and reduces transaction costs and uncertainty, which are essential for long-term investment and innovation (Downing et al., 2018). In resilient systems, the rule of law guarantees equitable access to justice and protection of rights, fostering fair competition and inclusive participation (Barrett & Constas, 2014). A strong legal framework contributes to the system's ability to absorb shocks, respond to market failures, and maintain functional integrity under stress.

3.3.3 Behavioral Characteristics of Market System Resilience

i) Cooperation: Cooperation refers to the extent to which market actors engage in collective actions to achieve shared objectives. While cooperation can enhance resilience by promoting knowledge exchange, coordination, and mutual support, its effect is context-dependent. When motivated by rent-seeking or exclusionary practices—such as collusion or price manipulation—cooperation can distort markets and reduce system adaptability (Downing et al., 2018). In contrast, inclusive and transparent forms of cooperation foster trust, shared learning, and joint problem-solving, all of which are critical to a system's adaptive capacity.

ii) Competition: Competition shapes the incentives that drive innovation, efficiency, and responsiveness within market systems. Healthy competition encourages firms to improve their value propositions, invest in technology, and adapt to changing market conditions, thereby reinforcing resilience (Holling, 2001). However, unregulated or predatory competition can undermine these benefits, leading to market concentration, exclusion of smaller firms, and short-termism. A resilient market system maintains a balance where competition drives performance but is tempered by regulatory oversight and mechanisms that safeguard fairness and inclusion.

iii) Decision-Making: Effective decision-making is central to resilience, as it determines how actors anticipate, prepare for, and respond to shocks. Resilient systems feature inclusive and evidence-based decision-making processes that consider diverse perspectives and are informed by real-time data and foresight (Leach et al., 2010). Transparent governance structures that facilitate

timely and adaptive decisions enable the system to adjust course when conditions change. Decision-making in such systems also reflects a balance between short-term operational needs and long-term strategic resilience objectives.

iv) Business Strategy: Business strategies within resilient market systems extend beyond immediate profitability to include long-term sustainability and adaptability. Firms that prioritize diversification, innovation, and strategic collaboration are better equipped to withstand and recover from disruptions (Chambers & Conway, 1992). For instance, diversifying product lines or sourcing arrangements reduces dependency on single points of failure, while partnerships enable resource pooling and shared learning. Business strategies aligned with resilience principles contribute to the robustness and agility of the wider market system, enhancing its capacity to navigate uncertainty and complexity.

3.4 Assessment of Market System Resilience

The MSRA Tool is designed to be flexible to fit different country contexts—recognizing there will always be limitations on data availability, time, and resources to conduct an assessment. The tool follows a simple three step process:

- Selecting indicators/variables
- Collecting data and score domain
- Assessing systematic resilience

3.4.1 Selecting Indicators/Variables:

Our approach involved utilizing the USAID's Market System Resilience Assessment (MSRA) Framework, which encompasses eight domains designed to delineate resilience capacities. Each domain comprises both "fast" and "slow" variables, characterizing the market system's orientation on a continuum from reactive to proactive in response to shocks and stresses. These variables are interrelated and can only be defined in relation to each other. Fast variables typically manifest changes within shorter timeframes. For instance, transactions are considered fast-moving variables, reflecting present occurrences. The MRSA recommends opting for 3-4 indicators for fast variables and 2-3 for slow variables (totaling 6-8) in each domain. These selections should adhere to two criteria: Relevance: are the indicators pertinent and meaningful within the context of the specific market system; and Feasibility: can the assessment team feasibly collect data within the available resources and timeframe.

3.4.2 Scoring Process: The data collected against those indicators were compiled to evaluate each domain's orientation on a 4-point scale, ranging from "very reactive" to "very proactive." This assessment was data-driven and rigorous, utilizing the indicators. However, considering the inherently social and somewhat intangible nature of these systems, the final assessment score (ranging from 1 to 4) inevitably involved a subjective judgment.

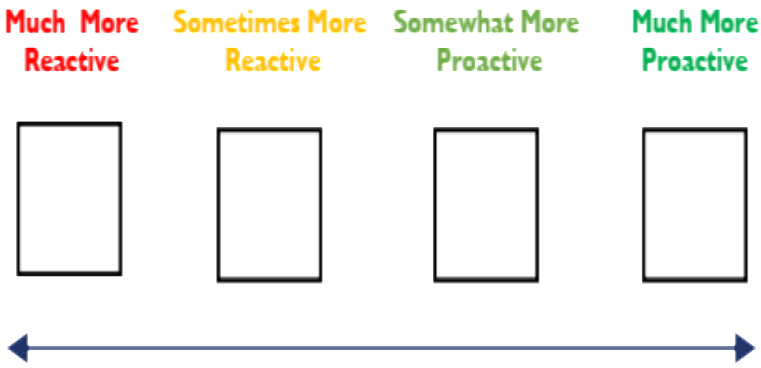

Figure 4: 4-point Scale (source: USAID's MSRA Tool)

3.5 The Indicators/Variables (04 Structural Domains + 04 Behavioral Domains):

This study adopted a total of 47 indicators under eight domains of PQR market system resilience. The indicators are as follows.

Domain 1: Connectivity: The Logical Dependence between Components within a System

Indicators:

i. Number of suppliers/distributors/customers (Horizontal and Vertical, within/outside group, with family/friend)

ii. Volume of Transection
iii. Commercial relationship Churn
iv. Availability of finance
v. Delays in financial flows
vi. Labor patterns

Domain 2: Diversity: The Different Ways that the Component Parts of the System can be Assembled
Indicators:

i. Redundancy Rate
ii. Diversity of types of products, services, etc. in a sector
iii. Business failure rate
iv. Business start-up rate
v. Diversity of channels
vi. Variations in financial services
vii. Growth of specialized services targeting business within an industry

Domain 3: Power Dynamics: The Concentration and Exercise of Power in a System
Indicators:

i. Market Structure (monopoly/perfect competition/oligopoly etc.)
ii. Level of pricing control
iii. Income Inequality
iv. Government Investment in road, utilities, health, and education
v. Existence of special interest group
vi. Perceived level of corruption

Domain 4: Rule of Law: Equality Before the Lawvii.
Indicators:

i. Existence of uniform grades and standards
ii. Awareness of laws and regulation
iii. Adherence to agreements
iv. Press Freedom Index
v. System Legitimacy

Domain 5: Cooperation: How Agents Work Together for Mutual Benefit Indicators:

i. Number of joint initiatives/partnerships
ii. Emergence of industry associations
iii. Cooperation to add value (e.g., joint marketing or branding, advocacy to improve policies and regulations, agreement on standards to increase industry)
iv. Cooperation to gain fair advantage (level the playing field)
v. Cooperation to gain unfair advantage
vi. Emergence of Specialized business to business services

Domain 6: Competition: How Agents Establish Superiority over Others Who are Trying to Do the Same
Indicators:

i. Number of new market entrants
ii. Co-investment along value chains
iii. Number of repeat customers
iv. Perceived subsidy capture
v. Perceptions of being cheated

Domain 7: Evidence-Based Decision-Making: How Agents Make Operational Decisions
Indicators:

i. Level of spend on market research
ii. Number of alliances between academia and businesses
iii. Influence of science on social and market systems
iv. Patterns of information flows
v. Presence of industry journals, networks and meetings

Domain 8: Business Strategy: How Agents Achieve their Goals
Indicators:

i. YTD R&D expenditure
ii. YTD capital expenditure
iii. Investment in data gathering an analysis
iv. Level of sophistication in branding
v. Investment in customer service
vi. Customer Loyalty trends
vii. Access to Finance

4. RESULTS AND DISCUSSIONS

To comprehensively evaluate the resilience of the PQR market system, the study undertook a systematic approach involving a questionnaire survey. This survey served as our primary means of data collection, enabling us to capture a well-rounded perspective encompassing both qualitative insights and quantitative data. Across all eight domains that comprise the market system resilience framework, the study meticulously gathered information from diverse market actors, stakeholders, and experts.

However, it's important to acknowledge that, despite our comprehensive efforts, certain indicators within these domains posed challenges in terms of data availability or feasibility through the survey alone. In response to this, we augmented our dataset by incorporating secondary information from reliable sources, ensuring that the analysis remained robust and representative.

To further enhance the accuracy and depth of our assessment, we engaged experts with deep-rooted knowledge in the intricacies of the PQR market system. Their invaluable expertise played a critical role in evaluating specific indicators, enriching the scoring process with insights that spanned beyond the confines of the survey data.

4.1 Scoring the Indicators

The culmination of our data collection and analysis resulted in quantitative values for most indicators, forming the foundation for calculating resilience scores across individual domains. We employed a participatory approach by organising a stakeholder workshop to validate and refine these scores, following the methodology outlined in USAID's Market Systems Resilience Assessment (MSRA) tools. During the workshop, we presented initial scores—ranging from 1 to 4—for each indicator, derived from both data analysis and expert input. Participants reviewed and discussed the proposed values, providing critical feedback based on their sectoral knowledge and field experience. This workshop played a pivotal role in ensuring the credibility, accuracy, and contextual relevance of the scoring process. Following in-depth discussions, consensus was reached on the final scores for each domain. This systematic and participatory method enabled a standardised yet context-sensitive assessment, revealing both the strengths and areas requiring improvement within the PQR market system's resilience.

Table 2: Scoring of Connectivity Domain

SL #	Indicators	State	Market Actors						Average Score
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	Number of suppliers/distributors/customers (Horizontal and Vertical, within/outside group, with family/friend)	F	68% PQR producer, 32% non-PQR producers	small traders, aratdar with commission, arotdar without commission arotdar with and without commission, numerous farmers, and buyers	200 millers	83% from millers, 15% from other wholesalers	12 suppliers, numerous consumers	Numerous suppliers including online shops	**3**
2	Volume of Transection	F	80% of the produces	3814 kg	5120 kg	Average 2000 kg/transection	average 180 kg per day	3 kg per month	**3**
3	Commercial relationship Churn (maintaining of long-term business relationship)	F	50% new	50% new supplier, 50 % new buyer	120 buyer,	15% new supplier, 50% new buyers	25% new suppliers, 10% new consumers	25% new supplier	**2**
4	Availability of finance	F	58% yes, 42% no	55% have access to credit	85% have access to finance	29% have access to credit	14% have access to credit	Not Applicable	**2**
5	Delays in financial flows	S	No delays, cash on delivery	5-15 Days	delayed payment, 30-45 days	while buying 15 days, while selling 15-30 days	Cash on delivery	Cash on delivery	**2**
6	Labor patterns (labor movement e.g. within/between area/region/country)	S	family labor, hired labor	56% does not have permanent labor	Labor from mostly the local area and the technical persons from different area	36% have no permanent employee, 31% have one permanent employee	74% have no permanent employee	not Applicable	**1**
	Overall Score								**2**

Table 3: Scoring of Diversity Domain

SL #	Indicators	State	Market Actors						Average Score
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	Redundancy Rate	F	low	medium	low	low	low	low	**1**
2	Diversity of types of products, services, etc. in a sector	F	21 PQR varieties	22 PQR varieties	17 PQR varieties	8 PQR varieties	8 PQR varieties	15 PQR verities	**3**
3	Business failure rate	S	very few	medium	very few	very few	very few	-	**1**
4	Business start-up rate	F	medium	very low	very low	low	low	–	**2**
5	Diversity of channels	S		less diversified	somehow diversified	diversified	diversified	diversified	**3**
6	Variations in financial services	S	Low	medium	many	medium	lower	very lower	**2**
7	Growth of specialized services targeting business within an industry	F	medium	Low	medium	Low	Low	medium	**1**
	Overall Score								**2**

Table 4: Scoring of Power Dynamics Domain

SL #	Indicators	State	Market Actors						Average Score
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	Market Structure (monopoly/perfect competition/oligopoly etc.)	S	Perfect Competition	Oligopoly	Oligopoly	Perfect Competition	Perfect Competition	-	**3**
2	Level of pricing control	S	No control	little	mostly	little	little	no control	**3**
3	Income Inequality	S	little	little	high	little	high	high	**2**
4	Government Investment in road, utilities, health, and education	F	moderate	moderate	moderate	moderate	moderate	moderate	**2**
5	Existence of special interest group	F	yes	yes	yes	yes	yes	yes	**4**
6	Perceived level of corruption	F	no corruption	moderate	high	medium	low	no corruption	**2**
	Overall Score								**3**

Table 5: Scoring of Rule of Law Domain

SL #	Indicators	State	Market Actors						Average Score
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	Access to legal services	F	low	low	high	high	moderate	Low level	**3**
2	Awareness of laws and regulation	**F**	Low level	35%-medium	very aware	41%-Medium	26%-medium	low level	**2**
3	Adherence to agreements (commitment of agreement/word)	**F**	very high	high	high	high	high	high	**4**
4	Press Freedom Index (particularly for PQR rice related news)	**S**	high	high	medium	medium	medium	high	**3**
5	System Legitimacy (obeying the law)	**S**	medium	low	low	low	low	medium	**2**
6	Orientation to equity (an index around consumer protection, number, management orientation, funding etx.)	**S**	not at all	very low	high	high	low	high	**2**
	Overall Score								**3**

Table 6: Scoring of Cooperation Domain

SL #	Indicators	State	Market Actor						Average Scroe
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	Number of joint initiatives/partnerships	F	High	High	72%-joint partnership	High	Medium	low	3
2	Emergence of industry associations	F	medium	low	high	high	medium	low	3
3	Cooperation to add value (e.g., joint marketing or branding, advocacy to improve policies and regulations, agreement on standards to increase industry)	F	High	High	High	High	High	High	4
4	Cooperation to gain fair advantage (level the playing field)	F	High	low	low	low	low	high	2
5	Cooperation to gain unfair advantage	S	low	medium	high	high	medium	low	2
6	Emergence of Specialized business to business services	S	medium	medium	high	high	high	not applicable	3
	Overall Score								**3**

Table 7: Scoring of Competition Domain

SL #	Indicators	State	Market Actors						Average Score
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	Number of new market entrants	F	high	medium	low	medium	medium	high	3
2	Co-investment along value chains	F	medium	low	high	medium	medium	high	3
3	Number of repeat customers	F	high	high	high	high	high	high	4
4	Level of protectionism (to protect own business/company)	S	medium	medium	high	high	high	not applicable	3
5	Perceptions of being cheated/perception of trust by consumers	S	low	low	very low	low	medium	medium	3
6	Extent of labor violation	S	low	low	low	low	low	-	4
	Overall Score								4

Table 8: Scoring of Evidence-Based Decision-Making Domain

SL #	Indicators	State	Market Actors						Average Score
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	Level of spend on market research	F	little	little	medium	high	high	little	**2**
2	Number of alliances between academia and businesses	F	medium	not at all	medium	not at all	little	little	**1**
5	Presence of industry journals, networks and meetings	F	medium	little	medium	high	low	not at all	**2**
3	Influence of science on social and market systems	S	medium	not at all	high	little	little	not at all	**2**
4	Patterns of information flows	S	TV, Cell phone (94%), Smartphone (14%)	TV, Cell phone (100%), Smartphone (45%)	TV, Cell phone (100%), Smartphone (40%)	TV, Cell phone (100%), Smartphone (54%)	TV, Cell phone (100%), Smartphone (32%)	TV, Cell phone (89%), Smartphone (22%)	**3**
6	Level of academic connectivity to private sector	S	medium	low	high	low	low	not at all	**2**
	Overall Score								**2**

Table 9: Scoring of Business Strategy Domain

SL #	Indicators	State	Market Actors						Average Score
			Farmers	Traders	Millers	Wholesalers	Retailers	Consumers	
1	YTD R&D expenditure (Yearly Research Expenditure)	F	1	1	1	0	1	1	**1**
2	YTD capital expenditure (Yearly Capital Expenditure)	F	0	medium	high	low	low	no	**2**
3	Investment in data gathering an analysis	F	0		low	low			**1**
4	Level of sophistication in branding	F	0		medium	medium			**2**
5	Investment in customer service	F	0		medium	medium	medium		**3**
6	Customer Loyalty trends	S	not applicable	medium	good	good	good	medium	**3**
7	Job Satisfiction Level (market players)	S	medium	medium	high	medium	medium	medium	**3**
8	Access to Finance	S	58% yes, 42% no	medium	high	high	medium	low	**3**
	Overall Score								**2**

For a visual representation of these domain scores and a comprehensive overview of the PQR market system's resilience landscape, we present the findings in the subsequent table, showcasing the resilience scores assigned to each domain. This quantitative evaluation, coupled with qualitative insights, forms a comprehensive foundation upon which recommendations and strategies can be built to enhance the overall resilience of the PQR market system.

Table 10: Market System Resilience Domains and their Score

Domains	Sore
Connectivity	2
Diversity	2
Power Dynamics	3
Rule of Law	3
Cooperation	3
Competition	4
Decision Making	2
Business Strategy	2

***Source**: Author's calculation based on primary and secondary data*

4.2 Assess the Systemic Resilience

We plotted the score for each domain on the radar diagram (Figure 1). The market system's inclusivity and resilience level increase as the line moves farther from the center. Resilience isn't an all-or-nothing concept, which is why the eight dimensions introduce nuance—different aspects of the market system might demonstrate varying degrees of inclusivity, with some elements displaying more inclusive behaviors while others might lag behind.

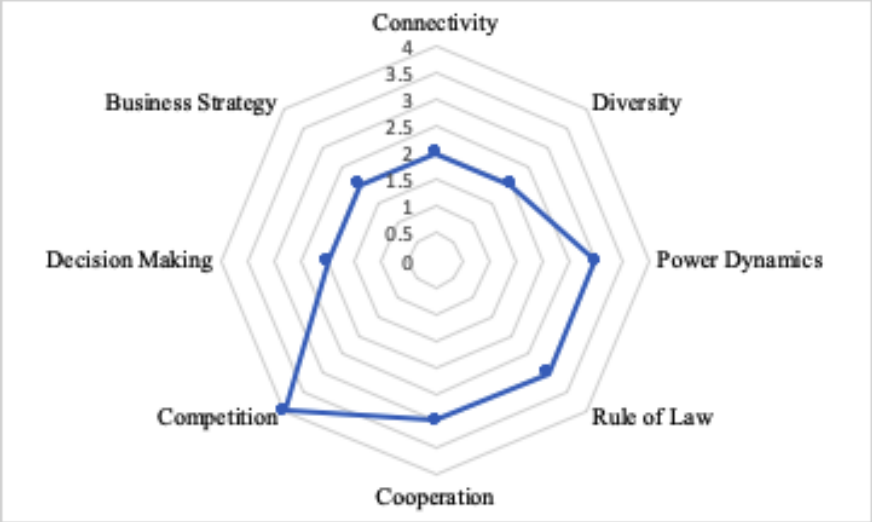

Figure 1: PQR Market System Resilience

The obtained results offer valuable insights into the resilience dynamics within the PQR market system. The data highlights a distinct trend where the competition domain emerges as notably more proactive compared to the power dynamics, rules of law, and cooperation domains, which exhibit a moderately proactive disposition. This pattern suggests that the market actors within the PQR context benefit from a conducive competitive environment. The presence of well-established conditions for perfect competition becomes evident across all actors involved in the PQR market. This alignment with the principles of perfect competition signifies an equitable landscape, where market participants engage on equal footing, fostering a level playing field that bolsters the system's resilience. However, further exploration could delve into the nuances within the power dynamics, rules of law, and cooperation domains, shedding light on potential factors influencing their somewhat proactive stance and contributing to the overall market system's ability to absorb and navigate disruptions.

Conversely, when we examine the connectivity, diversity, decision-making, and business strategy domains, an intriguing pattern emerges: these domains exhibit a somewhat reactive orientation. This observation points to a distinct facet of the market system's resilience landscape. It suggests that within these specific dimensions, the market system demonstrates a comparatively lower level of inherent resilience when confronted with shocks and vulnerabilities. The marked reactivity in these domains implies that there might be underlying factors contributing to a diminished ability to promptly absorb, adapt, or respond to disruptions. Delving deeper, we could explore the intricate interplay between connectivity and information flow, the spectrum of diversity within market participants, the efficiency of decision-making processes, and the alignment of business strategies with resilience objectives. This multifaceted investigation could uncover insights into potential areas for improvement, strategies for enhancing these domains' resilience, and the broader implications for bolstering the overall market system's capacity to navigate uncertainties effectively.

5. CONCLUSION

In summation, the present assessment provides an initial exploration into the resilience dynamics of the PQR market system within the context of Bangladesh. However, this endeavor is not meant to be a singular endeavor. On the contrary, it serves as a foundation for an ongoing journey towards understanding and enhancing resilience. Recognizing the ever-evolving nature of market systems and the dynamic socio-economic landscape, our approach supports the notion that resilience is not static; it evolves over time. Therefore, we emphasize the importance of periodic reevaluation to track the progression of systemic resilience.

In this vein, we advocate for a cyclical approach, where subsequent assessments offer insights into how the PQR market system's resilience evolves and adapts. By benchmarking against its own previous scores, the system's journey becomes a self-reflective process that incorporates lessons learned and adjustments made over time. However, we caution against the temptation to compare this system with others or to adhere rigidly to predefined notions of optimal proactive-reactive orientations. Such comparisons may oversimplify the complex interplay of factors unique to each context.

Central to our methodology is the tool's ability to capture the trajectory of change and the proportional shifts over time. As we venture from baseline evaluations to subsequent mid-line assessments, we gain a dynamic perspective of how the market system's resilience evolves and adapts in response to changing circumstances. The essence of this approach lies in its comparativeness, eschewing the pursuit of absolute measurements. This is rooted in the recognition that the notion of absolute reactive or proactive risk management is inherently intricate, considering the inherent fluidity of systems and the ever-evolving nature of practical boundaries.

In conclusion, this initial assessment lays the groundwork for an ongoing exploration into the resilience fabric of the PQR market system. By embracing a cyclical and context-specific approach, we set the stage for fostering a resilient ecosystem that can not only endure shocks and uncertainties but also thrive in the face of evolving challenges. As we continue to unravel the intricacies of resilience, this journey becomes an instrumental part of fortifying the PQR market system's capacity to navigate the complexities of an ever-changing landscape.

REFERENCE

ACDI/VOCA., 2023. Market Systems Diagnostic: Understanding System Health. **https://www.acdivoca.org/what-we-do/tools/market-systems-diagnostic/**

Aziz, M. and Kashem M., 2017. Productivity Improvement of Premium Quality Rice Through Fertilizer Management in The Haor Areas. *Bangladesh Agronomy Journal*, vol. 19, no. 2, Oct. 2017, pp. 139–143., doi:10.3329/baj.v19i2.31863.

Bahadur, A., Peters, K., Wilkinson, E., Pichon, F., Gray, K., Tanner, T., 2015. *The 3As: Tracking Resilience across BRACED*; ODI: London, UK, 2015; www.***odi.org/publications/9840-3as-tracking-resilience-across-braced***

Barrett, C. B., & Constas, M. A., 2014. Toward a theory of resilience for International Development Applications. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2628707

Cabell, J. F., & Oelofse, M., 2012. An indicator framework for assessing agroecosystem resilience. *Ecology and Society*, *17*(1). https://doi.org/10.5751/es-04666-170118

Carpenter, S. R., Westley, F., & Turner, M. G., 2005. Surrogates for resilience of Social–Ecological Systems. *Ecosystems*, *8*(8), 941–944. https://doi.org/10.1007/s10021-005-0170-y

Chambers, R., & Conway, G. R.,1992. *Sustainable rural livelihoods: Practical concepts for the 21st century*. IDS Discussion Paper 296.

Choptiany, J., Graub, B., Phillips, S. Colozza, D., & Dixon, J., 2015. *Self-Evaluation and Holistic Assessment of Climate Resilience of Farmers and Pastoralists*; FAO: Rome, Italy, 2015; **http://www.fao.org/3/i4495e/i4495e.pdf**

Choptiany, J. M., Nicoletti, C. K., Van Beck, L., Seekman, V., Henao, L., Buchholz, N., Parker, T., Kothari, R., Ullah, Md. H., & O'Hara, C., 2021. The Market Systems Resilience Index: A multi-dimensional tool for development practitioners to assess resilience at multiple levels. *Sustainability*, *13*(20), 11210. https://doi.org/10.3390/su132011210

CSISA., 2018. https://csisa.org/expanding-high-value-and-premium-quality-rice-in-bangladesh/

Custodio, M., Cuevas, R. P., Ynion, J., Laborte, A., Velasco, M., & Demont, M., 2019. Rice quality: How is it defined by consumers, industry, food scientists and geneticists?. Trends in Food Science & Technology. 92. 10.1016/j.tifs.2019.07.039.

Demont, M., Rutsaert, P., Ndour, M., & Verbeke, W., 2013. Reversing urban bias in African rice markets: Evidence from Senegal. *World Development*, *45*, 63–74. https://doi.org/10.1016/j.worlddev.2012.11.011

D'Errico, M., Garbero, A., & Constas, M., 2016. *Quantitative Analyses for Resilience Measurement. Guidance for Constructing Variables and Exploring Relationships among Variables*; Technical Series No. 7; Resilience Measurement Technical Working Group FSIN: Rome, Italy, 2016;

Downing, J., Field, M., Ripley, M., & Sebstad, J., 2018. *Market Systems Resilience - A Framework for Measurement*. Marketlinks.org. https://www.marketlinks.org/sites/default/files/media/file/2020-09/Market-Systems-Resilience-Measurement-Framework-Report-Final_public-August-2019.pdf

FAO., 2020. *Core Indicators for Resilience Analysis: Toward an Integrated Framework to Support Harmonized Metrics*; FAO: Rome, Italy, 2020; **https://www.fsinplatform.org/sites/default/files/paragr.raphs/documents/Core_Indicators_Resilience_Analysis_Publication.pdf**

FAO., 2020a. *Resilience Index Measurement and Analysis: Short Questionnaire*; FAO: Rome, Italy, 2020; **http://www.fao.org/3/cb2348en/CB2348EN.pdf**

FAO., 2016. *RIMA-II: Resilience Index Measurement and Analysis—II*; FAO: Rome, Italy, 2016; Available online: **www.fao.org/resilience/resources/resources-detail/en/c/416587/**

Folke, C., Carpenter, S. R., Walker, B., et al., 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, 15(4), 20.

FSIN., 2014. *Resilience Measurement Principles: Toward an Agenda for Measurement Design*. Food Security Information Network. **https://www.fsinplatform.org/index.php/resilience-measurement**

HIES., 2022. Household Income and Expenditure Survey-2022. Bangladesh Bureau of Statistics. Ministry of Planning. https://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/b343a8b4_956b_45ca_872f_4cf9b2f1a6e0/2023-12-23-11-15-1b221684b3d6eabaa1969237888fe5e2.pdf

Holling, C. S., 2001. Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, 4, 390–405.

IFPRI., 2019. Per capita rice consumption in Bangladesh: Available estimates and IFPRI's validation survey results. https://doi.org/10.2499/p15738coll2.133124

Jones, L., A. Constas, M., Matthews, N., & Verkaart, S., 2021. Advancing resilience measurement. *Nature Sustainability*, *4*(4), 288-289.

Leach, M., Scoones, I., & Stirling, A., 2010. *Dynamic sustainabilities: Technology, environment, social justice*. Routledge.

Mottaleb, K., & Mishra, A., 2016. Rice Consumption and Grain-type Preference by Household: A Bangladesh Case. Journal of Agricultural and Applied Economics, 48(3), 298-319. doi:10.1017/aae.2016.18

O'Planick, K., Pulido, T., Cissé, J., Merwe, R. V. D., Meissner, L., Lamm, J., & Griffin, T., 2019). *USAID's Guidance for assessing resilience in market systems*. Marketlinks.org https://www.marketlinks.org/sites/default/files/resources/guidance_for_assessing_resilience_in_market_systems_final_sept_2019.pdf

Pelling, M., & Manuel-Navarrete, D., 2011. From resilience to transformation: The adaptive cycle in two Mexican urban centers. *Ecology and Society*, 16(2), 11.

Rahman, M.C., Pede, V., Balie, J., Pabuayon, I.M., Yorobe, J.M. & Mohanty, S., 2021. "Assessing the market power of millers and wholesalers in the Bangladesh rice sector", Journal of Agribusiness in Developing and Emerging Economies, Vol. 11 No. 3, pp. 280-295. https://doi.org/10.1108/JADEE-04-2018-0053

TechnoServe., 2023. *What is a market system?*. https://www.technoserve.org/our-work/what-is-a-market-system/. Accessed on July 24, 2023.

USAID., 2022. United States Agency for International Development. https://www.usaid.gov/sites/default/files/documents/1870/USAIDResiliencePolicyGuidanceDocument.pdf. Accessed on February 21, 2022

USDA., 2022. *Grain and Feed Annual*. Retrieved April 23, 2022, from https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Dhaka_Bangladesh_BG2022-0005.

What is a market system?., 2023. *BEAM Exchange*. Retrieved March 3, 2023, from https://beamexchange.org/market-systems/what-market-system/#:~:text=Starting%20with%20manufacturers%2C%20for%20example,households%20that%20buy%20the%20products.

World Bank., 2013. *Agricultural Sector Risk Assessment in Niger: Moving from Crisis Response to Long-Term Risk Management*. Washington, DC