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Exploring Rice Supply Chain Challenges Through Serious Gaming:
Enhancing Market Fairness and Stability

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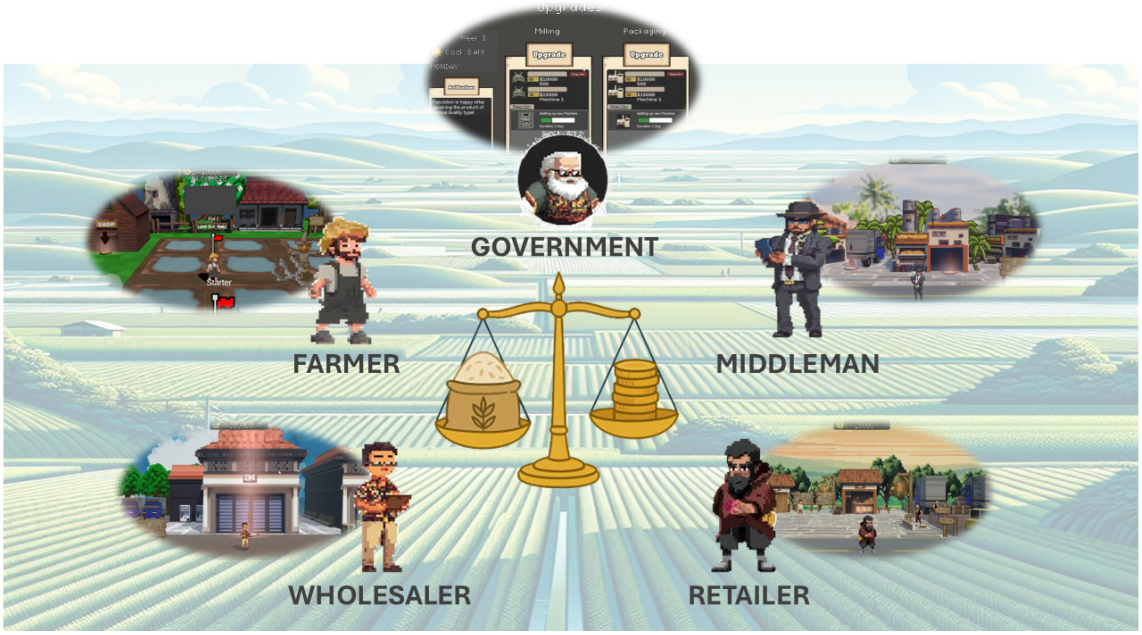

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Exploring Rice Supply Chain Challenges Through Serious Gaming:

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EXECUTIVE SUMMARY

This white paper explores the roles and challenges faced by stakeholders in the rice supply chain through the innovative use of serious gaming. It introduces **The Grain Trail**, an internally developed, online multiplayer platform that simulates the complex dynamics of the rice supply chain.

As global rice markets face increasing volatility due to climate change, political instability, and market disruptions, understanding the interdependent roles of stakeholders has become crucial. The game provides an engaging way for players to experience these roles firsthand, gaining insight into the challenges faced by each participant. Through real-time simulations and decision-making scenarios, players can explore how factors like price volatility, resource allocation, and market fluctuations affect the overall supply chain.

This paper highlights how **The Grain Trail** fosters collaboration among players, emphasizing the importance of joint efforts in achieving market fairness, price stability, and rice availability. The game serves as a safe, controlled environment where stakeholders can experiment with strategies to increase supply chain resilience in the face of market uncertainties.

Targeted at supply chain professionals, policymakers, and agricultural stakeholders, this white paper offers actionable insights into leveraging digital tools for supply chain management. Early testing of the game has already shown a marked improvement in participants' understanding of the rice supply chain and their ability to make more informed, strategic decisions. Looking forward, the game's principles may be adapted to other agricultural sectors, providing scalable solutions for global supply chain education and resilience.

Table of Contents

1. Introduction

1.1. Overview

Rice is a staple food for approximately 50%-60% of the global population, making it one of the most widely consumed grains worldwide. It serves as a primary source of calories and nutrition, especially in Asia, where countries like China, India, and Indonesia have diets heavily reliant on rice. Beyond Asia, rice consumption is also significant in parts of Africa, Latin America, and the Middle East. Its affordability, versatility, and ability to grow in diverse climates contribute to its widespread consumption, playing a crucial role in global food security and economic stability. (Rice Consumption by Country 2025, n.d.) (Fadah, Lutfy, & Amruhu, 2024)

The rice supply chain encompasses all stages from production to consumption, ensuring a steady flow of rice from farms to markets. It begins with rice cultivation by farmers, followed by harvesting, milling, and processing to produce polished rice. The processed rice is then distributed through wholesalers and retailers before reaching consumers. Key players include farmers, middleman, wholesalers, retailers and a government agency. (Octania, 2021)

Factors such as weather conditions, market demand, disruptions and trade policies influence the efficiency of the supply chain. A poor harvest due to droughts or floods can result in a sudden drop in rice supply, causing prices to spike. Conversely, a bumper harvest (exceptionally large harvest of crops) can lead to a decline, affecting farmers' income.

For consumers, price volatility means that access to affordable staple foods like rice can become increasingly difficult. During COVID-19, many in Indonesia loses their income and the price of rice is above the ceiling price due to lack of availability, many households struggle to afford to buy rice (Octania, 2021). This exacerbates food insecurity and undermines the quality of life for millions of people in the region.

Ensuring sustainability and reducing post-harvest losses are crucial for maintaining a stable rice supply.

Serious games are digital games designed for purposes beyond entertainment, including education, training, healthcare, and social impact. These games utilize interactivity and engagement to enhance learning, skill acquisition, and behavior change (Michael & Chen, 2006).

Theoretical foundations of serious games include motivation, cognitive engagement, and sociocultural learning, making them effective tools for knowledge retention and problem-solving (Gee, 2007). Applications span medical training, rehabilitation, corporate learning, and military simulations (Johnson et al., 2015). Effective serious games incorporate meaningful challenges, adaptive learning, and immersive environments to optimize outcomes (Connolly et al., 2012).

As technology evolves, serious games continue to emerge as powerful tools for education, training, and social change (Deterding et al., 2011).

1.2. Objective

This whitepaper introduces The Grain Trail, an online rice supply chain multi-role game that was developed by TLIAP-NUS ("Serious Games," n.d.). This paper will share how the game provides players with a platform to experience the different roles in the rice supply chain and the different challenges faced by its stakeholders, in a relatively safe environment, with the objective of achieving market fairness and maintaining rice availability and price stability through cooperation, communication and good policies.

2. The Grain Trail

2.1. Overview

The Grain Trail is an online multiplayer role-based game that players can choose a role to play. Players take on one of five key roles in the staple food supply chain – Farmer, Middleman, Wholesaler, Retailer or Government. The game allows players to experience the rice supply chain dynamics to maintain market price fairness by ensuring rice availability and stability. Decisions impact both personal outcomes and other players, creating an interconnected system. Players face challenges such as seasonal demand, fluctuating rice prices, natural disasters and extreme weather.

Figure 1 : Source from TLIAP-NUS

The game also provides insights into supply chain impacts and prepares players for real-life situations.

The main objective of the game is to create awareness of the impact of the different roles' decisions on the supply chain's market availability, stability and fairness.

2.2. Player Roles

In this game, players join a group and chooses one of the available roles to play – farmer, middleman, wholesaler, retailer or government. Each of these roles has its own characteristics, objectives and challenges.

2.2.1. Farmer

The farmer is at the heart of the rice supply chain, responsible for planting, cultivating, and harvesting the rice. They use various farming techniques and technologies to ensure high-quality production. Their role involves managing resources like water, labour, and land while also dealing with seasonal variations and climate conditions. Farmers are directly impacted by market prices and often face challenges such as pests, disasters, and fluctuations in input costs.

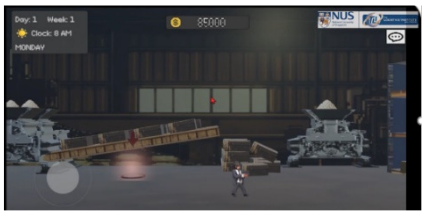
Mechanics:

- **Land Management**: Players start with a set amount of land and can buy more land as they progress. They must decide on the type of rice to grow based on climate conditions and market demand.
- **Water & Resources**: Water, fertilizer, pesticides, seeds availability is limited, so players need to purchase them wisely.
- **Labor Management**: Players hire farm workers to plant, maintain, and harvest rice, but must pay wages. Too many workers can reduce profitability, while too few can lead to crop failure.

- **Weather Events**: Randomized weather events (droughts, floods, storms) affect the harvest, requiring players to plan for contingencies or insure their crops.
- **Market Prices**: Players must sell rice when market prices are high and avoid selling at low prices to maximize profits. Players may need to negotiate with the middleman to reach an agreeable price.

2.2.2. Middleman

The middleman acts as the intermediary between the farmer and the other actors in the supply chain. They purchase rice from farmers and then transport it to the wholesalers. Their role involves ensuring a steady flow of rice from farms to other parts of the supply chain. They add value by husking, milling, sorting, packaging, and processing rice before selling it on to wholesalers.



Mechanics:

- **Rice Collection**: Players buy rice from farmers at fluctuating prices (based on negotiation).
- **Rice Processing**: Players husked, milled, processed and package the rice before selling them to wholesaler
- **Truck Management**: Players manage their own trucks to transport the rice from farmer and to send the processed rice to wholesaler. They can choose to invest in increasing their fleets to improve efficiency.
- **Storage**: Rice needs to be stored before sale. Players manage warehouses to keep the rice safe and reduce spoilage, which costs money.

- **Price Negotiation**: Players negotiate prices with farmers to get better deals while still being fair, keeping relationships strong. Offering better prices to farmers can improve supply in the long run.

2.2.3. Wholesaler

The wholesaler purchases large quantities of rice from the middleman and sells it to retailers. They play a crucial role in stabilizing prices by acting as a buffer against supply fluctuations. Wholesalers typically store rice in warehouses and package it in smaller quantities for retailers. Their role is vital in ensuring that rice reaches retail outlets or food processors at an efficient cost.

Mechanics:

- **Bulk Purchases**: Players buy rice in bulk from the middleman. The goal is to buy low and sell high, managing price fluctuations in the market.
- **Storage & Spoilage**: Rice can spoil or degrade over time, so players need to invest in good storage facilities and decide when to sell to avoid losing stock.
- **Market Demand**: The wholesaler must track demand for rice during different times. Players decide when to sell based on projected demand, market trends, and seasonality.
- **Distribution Channels**: Players build and maintain relationships with retailers or large buyers to ensure their rice is in demand by ensuring the stock availability.

2.2.4. Retailer

Retailers are the direct point of sale for consumers. They purchase rice from wholesalers and sell it in smaller quantities to the general public. They set the final price that consumers pay, often adding their own mark-up. Retailers play a key role in making rice accessible to consumers, managing stock levels, and responding to local demand and preferences.

Mechanics:

- **Inventory Managemen**t: Players manage how much rice they order from wholesalers based on market trends and available space.
- **Pricing Strategy**: Players must set the final price for consumers, balancing between the government's set maximum selling price and maximizing profit.
- **Customer Demand**: Randomized customer demands may affect which types of rice are popular.
- **Customer Relationships**: Players manage customer loyalty by providing good service and stocking the right types of rice. Happy customers may return, increasing profits.

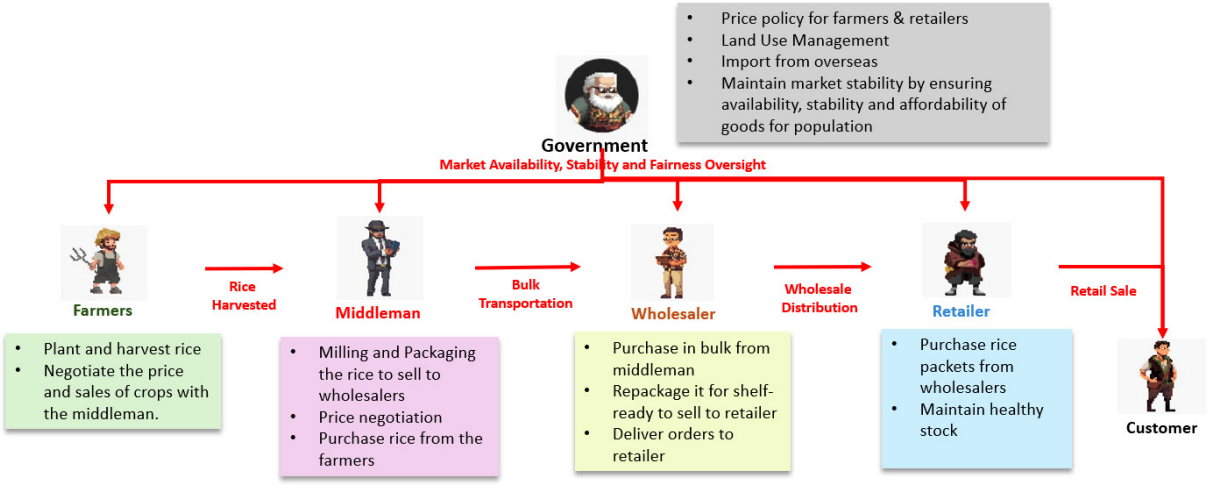
2.2.5. Government

The government plays a regulatory and supportive role in the rice supply chain. It establishes policies related to agriculture, trade, and food security, and may provide subsidies or support to farmers to ensure stable rice production. Governments also intervene in pricing by setting the minimum selling rice for the farmers and maximum selling price for retailers, and food distribution to ensure rice remains affordable and accessible for the population during disasters or extreme climate to maintain the supply chain's stability.

Mechanics:

- **Policy & Subsidies**: The government sets policies that affect rice prices and subsidies for farmers. Players can introduce policies to stabilize prices or support farmers, but each decision impacts other parts of the chain.
- **Disaster Relief**: The government may provide aid after weather-related disasters, ensuring rice availability in affected regions.

- **Market Monitoring**: The government tracks prices and demand. They can influence market trends, either by introducing price controls, or offering incentives to players.



2.3. Game Play

In this game, players navigate through the complex world of the rice supply chain, taking on different roles such as a Farmer, Middleman, Wholesaler, Retailer, or Government. The objective is to strategically manage resources, balance supply and demand, and make key decisions that impact the overall success of their business while ensuring the stability of the rice market. Players must adapt to changing market conditions, unexpected events, and competing interests while trying to maximize profits and support food security.

2.3.1. Storyline

The game is set on a small island with a small population of 100 families. Their main staple food is rice. The rice consumption is 100%. The island is prone to extreme weather and natural disasters that may affect the availability of the rice.

The game plays in rounds of 7 days:

- At the start of Day 1, players will be able to set their selling prices. Farmers will start their planting on Day 1.
- All players will be notified on the game noticeboard of the current prices set by the Government
- Government's popularity meter level is set to 100% at the start of the game
- It takes 7 days for the crops to be ready for harvest.
- Middleman will negotiate with Farmer for its best price and pays a pre-agreed deposit to the Farmer
- Middleman will collect the rice from Farmer using his own vehicles on the 1st day of the week.
- Middleman will deliver the rice to Wholesaler using his own vehicle
- Wholesaler will send the rice to Retailer using his own vehicle
- Deliveries for all roles takes 2 days to complete
- Processing, husking, milling and packaging takes 2 days to complete
- Government may release new plot of lands for plantation, provide subsidies to help farmers, or release its own rice stockpile to help stabilize the price.
- Each time the Government decides to "converts" a land into a plantation plot, some of the population may not be happy
- The population happiness or satisfaction is what determines the Government's popularity meter level

2.3.2. Start by Choosing a Role in a Group

- Players would first select the supply chain group (or "country") that they would like to join.
- Players can then choose to start as a Farmer, Middleman, Wholesaler, Retailer, or Government, each with its own unique set of objectives and responsibilities.
- The Player that creates the group will be automatically assigned to play the Government's role.

2.3.3. Resource Management

- As a Farmer, you will plant, grow, and harvest rice crops while managing water, fertilizer, pesticide, labour, and weather conditions.
- As a Middleman, you buy rice from farmers, processed it and transport it to wholesalers ensuring efficient logistics and handling prices.
- As a Wholesaler, you purchase rice in bulk, repackage it, store it, and sell it to retailers, carefully timing your sales to market demand and price trends.
- As a Retailer, you stock rice in your store, set pricing strategies, and respond to consumer demand, aiming to maximize profits.
- As the Government, you create policies, manage subsidies, and regulate prices to ensure food security while influencing the overall stability of the rice market.

2.3.3. In-game Communication

The game incorporates two distinct communication channels to facilitate interaction, cooperation, and information sharing among players, each serving a unique purpose in simulating real-world supply chain dynamics.

The first is the Chat tool, a versatile platform that enables players—representing stakeholders such as farmers, middleman, wholesalers, retailers and the government agency—to engage in real-time, freeform communication. Through the Chat tool, players can negotiate prices, propose trade agreements, or discuss strategies to address challenges like supply shortages or market imbalances. For instance, a retailer might message a wholesaler to haggle over the price of a rice batch, while a farmer could use the chat to request for new plantation plot to increase production. This tool fosters dynamic collaboration, mirrors stakeholder negotiations, and encourages transparency, allowing players to learn the art of balancing individual goals with collective stability and fairness.

The second channel is the Notification Panel, a structured, system-driven interface designed to deliver timely updates and alerts to all players. Unlike the Chat tool's conversational flexibility, the Notification Panel broadcasts critical game-state information, such as weather events affecting rice yields (e.g., "Heavy rains flood Region A—production down 15%"), market shifts (e.g., "Demand spikes in urban markets due to festive season"), or government price-setting policy (e.g., "The minimum selling price for paddy is $XXX"). This ensures everyone stays informed about external factors and key decisions that influence the supply chain, promoting proactive responses and equitable access to information. Together, these channels create a layered communication system: the Chat tool drives player-initiated cooperation, while the Notification Panel provides a shared context, enhancing decision-making and reinforcing the game's focus on maintaining rice supply stability, market fairness, and availability.

2.3.4. Market Dynamics

Demand and Supply Fluctuations: The game's economy will fluctuate, with rice prices changing based on market availability, weather events, and consumer demand.

Random Events: Weather events (droughts, floods) or natural disaster (price earthquake, typhoon) will force players to adapt quickly and find new strategies to cope with challenges.

Price Negotiation: Throughout the game, players negotiate prices with other supply chain participants. As a farmer, you'll negotiate with middlemen. As a wholesaler, you'll negotiate with retailers. The goal is to secure the best deal for your character's role.

2.3.5. Decision-Making

Strategic Planning: Every decision you make, from crop selection as a farmer to policy implementation as the government, impacts the market. For example, a government decision to increase subsidies might help farmers but lead to increased costs for retailers.

Investing in Technology: Players can invest in new technology, such as more efficient machinery, to improve their operations and stay competitive.

Balancing Short-term and Long-term Goals: Players must balance immediate profits with long-term sustainability.

2.3.6. In-game Challenges

Occasionally, players will face in-game challenges like rice shortages, surpluses, festival seasons or natural disasters. For instance, a drought might lower rice production for farmers, affecting the entire supply chain. The government might need to step in with disaster relief, while retailers may need to manage shortages in stores.

2.3.7. Multiplayer Elements

Players can collaborate or compete with others in multiplayer mode, where they manage different parts of the supply chain, working together to ensure a smooth rice flow or competing for market dominance. The success of the game relies heavily on collaboration, trade negotiations, and adapting to each other's decisions in real-time.

2.4. Winning/Losing the Game

The game ends when the Government's popularity drops below 40% or the game reaches the round 14 of play. If the game ends due to its Government popularity, it will be deemed as the whole group has failed to optimize the rice supply chain dynamics, regardless of how much profit was made by the other roles.

The group that wins is the one that its government has the highest population popularity meter with the highest combined profits in the group.

3. Challenges and Limitations

One of the main challenges is the multiplayer and collaboration. Players may be motivated to try to dominate the market at the expense of others or fail to cooperate effectively in supply chain management.

To mitigate this, the game emphasizes the need to satisfy the population. If the price is too high, the population will be unhappy. If there's shortage of rice, population will be unhappy. And these will be reflected on the Government's popularity meter and when the level drops to 40%, the game will end with every player considered to have lose the game. Hence players are 'forced' to collaborate with each other to optimize the supply chain.

Another challenge is the balancing of the different supply chain roles in the game to ensure that they are engaging and fun. For example, the Government does not have much to do especially if everything is going 'smoothly'.

Hence, we design each role with unique, equally compelling mechanics and ensure that players' decisions in one role directly impact other roles, fostering a sense of interconnectedness and collaborative gameplay.

4. Conclusion

While the concept of a rice supply chain simulation game offers exciting potential, it faces challenges related to complexity, balance, AI behavior, and player engagement. The key will be to create an experience that is both accessible and deep, engaging both casual players and those interested in the intricacies of global supply chains. By designing a dynamic, evolving world with interconnected systems and offering a variety of ways to play, this game could succeed in delivering both educational value and entertainment.

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