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RESEARCH ARTICLE

POST-HARVEST LOSSES ASSESSMENT IN THE WATERMELON CHANNEL DISTRIBUTION DURING COVID-19 RECOVERY PHASE IN MALAYSIA

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ABSTRACT

The pandemic has profoundly disrupted the stability of the agri-food supply chain, primarily due to the inconsistent supply reaching the market caused by movement restrictions. This economic downturn is influenced by losses along the business supply chain and has prompted a closer examination in this study. The focus is on the specifics of post-harvest losses of watermelons, particularly in the aftermath of the COVID-19 recovery phase. The watermelon is selected for scrutiny due to its status as the second-largest high-value crop in SSL after papaya (increasing by 142.3% in 2022). This choice indicates that the local production sufficiently satisfies domestic demand and is also available for export. The study reveals that losses contribute to almost 69.4%, resulting in a reduction of 2.0 metric tonnes from the pre-pandemic situation, where losses were around 1.0 to 1.2 metric tonnes. These losses are attributed to delays in distribution, especially at the farm level, due to distribution restrictions and a shortage of labour for harvesting. Overall, these findings aim to provide insights for industry players on how to handle future crises by developing backup plans to reduce losses.

KEYWORDS

Watermelon losses, COVID-19, Supply Chain, Fruits, Recovery Strategies

1. INTRODUCTION

The global lockdown imposed due to the COVID-19 pandemic has halted essential activities worldwide. In these challenging circumstances, Malaysia has been significantly affected by the COVID-19 pandemic, disrupting both the supply chain and consumer demand including the trade of fruits and vegetables. The first confirmed positive reported case in Malaysia was on January 25, 2020, and the country implemented the Movement Control Order (MCO) or lockdown on March 18, 2020. Throughout the pandemic, the transition from peak to recovery (2020-2021), with three main phases across Malaysia are:

	COVID-19 MCO	Timing
1.	Movement Control Order (MCO)	18th March – 12th May 2020
2.	Conditional Movement Control Order (CMCO)	13th May – 9th June 2020
3.	Recovery Movement Control Order (RMCO)	10th June – 28th June 2021

The Malaysian government has consistently backed the economy with the RM 295 billion stimulus package, known as "Pelan Jana Semula Ekonomi Negara" or “PENJANA”. Of this, RM 350 million is earmarked for the agriculture and food sector industry (Deloitte, 2020). The agri-food production supply chain plays a vital role in sustaining livelihoods, promoting a healthy population, and supporting the nation. However, the pandemic significantly disrupted the stability of the agri-food supply chain, primarily due to an inconsistent supply reaching the market that was caused by the movement restrictions. Consequently, reports indicate a negative growth ranging from 0.03% to 22.8% in Malaysia's Gross Domestic Product (GDP), amounting to RM 36.9 billion (Ministry of Finance Malaysia, n.d.). The COVID-19 pandemic, as reported by by a group of researchers has resulted in a decreased demand, causing a notable impact on post-harvest losses (Tan et al., 2023). These losses encompass various activities, including harvesting, handling, storage, transportation, and processing. This disruption has led to an increase in such losses, posing significant concerns for food security, economic sustainability, and the overall efficiency of the agricultural supply chain.

During the Movement Control Order (MCO), numerous farmers faced unforeseen challenges as they were unable to sell their produce. This situation compelled them to dispose of their goods due to the inability to store perishable items for extended periods. The lockdown had a direct impact on the rise in fresh food prices, attributed to the difficulties that were experienced by the agri-food producers in selling their products. This was the result of disrupted marketing channels and logistical issues (Suhaimee et al., 2021).

At the same time, news reports issues among the farmers during the pandemic crisis in Lojing, where approximately 200 vegetable growers in the region have faced daily losses ranging from RM 300,000 to RM 400,000, equivalent to about 200 metric tonnes per day. Cucumber growers in Gua Musang are also grappling with daily losses amounting to RM 1,000 per day (Ibrahim, 2020). The impact extends to Lembah Klang,

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where the Movement Control Order (MCO) has led to the disposal of 10,000 metric tonnes of fruit, representing a 30-50% increase in losses compared to the pre-pandemic period (Xiang Yi, 2020).

Though the figures provided are approximations, this case study delves into the specifics of post-harvest losses in watermelons, following the COVID-19 recovery phase. The choice of watermelon from its recognition as a key fruit for ensuring food security, is outlined in the National Agro-Food Policy 1.0 and 2.0. The watermelon holds significant importance as it has achieved a Self-Sufficient Level (SSL) of 131.9% in 2022. Despite being the second-largest high-value crop in SSL after the papaya (142.3% in 2022), it is indicated that its local production adequately meets domestic demand and is also available for export. The watermelon stands out as the most exported among Malaysian tropical fruits, totalling 40,721 metric tonnes and is valued at US$13 million in 2022. The country exhibits a low dependency on watermelon imports, approximately 7.7% in 2022, with potential imports mainly focusing on unique varieties such as the Japanese Kumamoto Watermelon.

1.1 Overview of The Watermelon Industry Before and During The COVID-19 Pandemic

Watermelon, scientifically known as Citrullus Lanatus and belonging to the Cucurbitaceae family originates from West Africa and comes in various sizes and shapes, with round and oblong being the common form. Abundant in vitamins A, B6, and C, watermelon is a significant source of lycopene. It was initially cultivated in Malaysia in the early 1950s. According to the production data from 2022, watermelon covered nearly 4.7% of the overall fruit production areas in Peninsular Malaysia, amounting to 7,308 hectares and 122,821 metric tonnes. The primary cultivation regions include Kelantan (30.0%), Pahang (29.1%), Johor (10.8%), and other states (30.1%), as indicated in Table 1.

Table 1: Watermelon production area by states, 2021

	State	Planted Area (hectares)	Production	% Percentage of harvested area
1.	Kelantan	2,187	39,465	30.0%
2.	Pahang	2,129	31,091	29.1%
3.	Johor	792	13,491	10.8%
4.	Terengganu	724	9,541	9.9%
5.	Others Peninsular State	1,476	29, 233	20.2%
	Total	7,308	122,821	100%

Source: Department of Agriculture Malaysia, 2022

Watermelon is a delicate fruit that necessitates careful handling during harvest and distribution in the market due to its substantial weight and size. It demands proper care during transportation and handling (Yakubu et al., 2018). The post-harvest loss that is incurred in the production and consumption of watermelon has serious implications for farmers and food security in general (Wullingdool, 2020).

A reflective examination of the supply chain before and after the onset of COVID-19 reveals noticeable transformations. Previously marked by consistent production, well-established market operations, and efficient supply chains, the industry experienced disruptions due to lockdowns, restrictions, and shifts in consumer behaviour (Verhoef and Noordhoff, 2022). During the COVID-19 pandemic, the watermelon industry faced fluctuating business operations due to an imbalance between supply and demand, leading to an oversupply. This surplus resulted in financial losses for business stakeholders, especially the growers.

Globally, these losses occurred within watermelon-producing countries during the COVID-19 period, and similar impacts were also observed in various other nations. For instance, in Bangladesh, there was a significant decrease in selling prices ranging from 20-38% (Ali, 2020), while India experienced a complete lack of demand from watermelon traders (Shagun, 2021). Moreover, exporting watermelons from the Myanmar border to China had faced delays, stretching from 2-3 days to 15-20 days, with only 20-30 trucks of watermelons passing checkouts out of the usual 500 in a normal delivery (Global New Light of Myanmar, 2023). Additionally, China implemented new import tariffs and border trade restrictions due to the COVID-19 rationalisation plan (Frontier, 2022), which was imposed to stabilise the economic plan amidst the pandemic. Meanwhile, in Malaysia, watermelon prices at the farm level sharply declined from RM 1.40 per kilogram to RM 0.70 (Sulaini, 2020). This resulted in the need to dispose of fruits, incurring losses ranging from RM 20,000 to RM 40,000 for 30 metric tonnes, either by selling at reduced prices or giving them away to friends and relatives (Yusof, 2021).

2. Materials and Methods

This research employed a case study methodology that involved comprehensive interviews with various industry stakeholders, including farmers, wholesalers, and retailers. The data collection took place from August 1st to October 25th, 2020 (after the RMCO phase), primarily through in-depth interviews. The study focused on around 45 watermelon growers who were chosen from the 2020 myGAP certification list issued by the Department of Agriculture. These growers were specifically located on the East Coast of Malaysia, particularly in the prominent watermelon-producing regions of Terengganu and Pahang. In order to map the entire supply chain, a snowball sampling technique was used to gather information from other key participants such as wholesalers and retailers. This approach has yielded insights from approximately 30 respondents who are associated with the farming community.

Case study methodologies are commonly employed in qualitative research to quantify and analyse the presence, meanings, and relationships of specific words, themes, or concepts. The data on the losses along the supply chain were then analysed using Content Analysis and were descriptive. The study utilised Content Analysis with ATLAS.ti 7 software; in quantifying losses, the improved formula has been employed for accurate measurement, it is as follows:

$$\% \text{ weight loss} = \frac{Wi - Wf}{Wi} X\ 100$$

Where: W_f = final weight of the sample/commodity at each handling point

W_i = initial weight of the sample/commodity at each handling point

3. Results and Discussion

3.1 Channel Distribution of Watermelon in Malaysia

The progression of an agricultural product through various phases of production and distribution before reaching the end consumers is encompassed in the fundamental description of the agrifood supply chain (Lezoche et al., 2020; Safari, 2021). In the Malaysian agricultural fresh supply chain, the research reveals that approximately half of the produced fresh fruits and vegetables are channelled through wholesalers who undertake multiple roles as collectors and distributors (Man et al., 2009). In particular, in distant or remote areas and among small-scale farmers a more efficient role is played by transporters or collectors. Correspondingly, the supply chain concepts are interconnected in business through channel distribution, although the supply chain delineates the broader concept involving the entire process, while channel distribution refers to the path or route that is taken by the product as it moves from the producer to the end consumer. When evaluating watermelon losses, the channel distribution approach can be utilised to achieve the objective. Accordingly, DK (n.d.) has elaborated on the channels of distribution in the supply chain, categorising them into three broad groups:

- ***Zero-Level Channel: Producer/Farmer to consumer***

Explanation: The product is delivered directly from the producer/ farmers to the consumer.

- ***One-Level Channel: Produce/Farmer to retailer to consumer***

Explanation: The product is sold by the producer to the retailer, who, in turn, sells it to the consumer, in a method known as retail distribution.

- ***Two-Level Channel: Producer/Farmer to wholesaler/collection centre to retailer to consumer***

Explanation: The product is sold by the manufacturer to the retailer and then it is sold to the consumer. This process involves two middlemen, often referred to as wholesalers and retailers, between the producer and the consumer.

Hence, within the Malaysian watermelon distribution system, two primary methods, as depicted in Figures 1 and 2, are observed: the utilisation of one and two-level channel distribution. Normally, watermelons are not directly supplied from the farm to the consumer (referred to as a zero-level channel) due to the frequent long distances of farms in remote or diverse state locations. Instead, the transportation of watermelons from farms to markets is handled by intermediaries. Nevertheless, amidst the COVID-19 crisis, there has been an attempt to sell directly from the farm to the consumer, albeit this approach is not highly efficient due to imposed restrictions, resulting in farmers having to decrease prices.

Figure 1: Watermelon one-level channel distribution

*involves an intermediary (retailer) between the farmer and consumers

Figure 2: Watermelon two-level channel distribution

*from farmers to wholesalers, then to another chain (i.e. retailers and distributor agents), and to the consumers

3.2 Pre and During COVID-19 Case.

Table 2 depicts the watermelon distribution process and the time that is required for transporting the product from the farm to the end consumer, both before and during the COVID-19 pandemic, using either the longest chain or a two-level channel. Under normal circumstances, the product would typically reach the final consumer within 4 to 5 days. However, amid the pandemic, this timeframe had extended to approximately 6 to 10 days. The prolonged delivery times can be attributed to the disruptions in the marketing channels and logistical challenges. Under USDA guidelines, the shelf-life of a watermelon can normally be extended to 3 weeks or 21 days after its harvest, in low temperatures (10°C – 15°C). Nevertheless, during the pandemic, disruptions occurred across the board, including suitable storage at the wholesaler warehouse, leading to an increase in post-harvest losses. In summary, there was a 2-day delay in the overall distribution process before and during the time of the COVID-19 crisis.

Table 2: Watermelon distribution time along the supply chain before and within MCO phase of COVID-19

	Before COVID-19	**MCO phase**
Farmer to Wholesaler / Collector	1-2 days	2-3 days
Wholesaler / Collector to retailer	2-3 days	4-5 days
Retailer (Fruits stall for selling)	4-8 days	6-10 days

Source: (Field study, 2020)

3.3 Watermelon Losses in Channel Distribution During COVID-19

As shown in Table 3, the case study findings reveal that watermelon losses in farms have decreased by 33.3 % (from 3.0 metric tonnes to 2.0 metric tonnes). While in wholesalers or collection centres, the losses were at 25.0% (from 2.0 metric tonnes to 1.5 metric tonnes), and the last level involved 11.1% distributors and retailers (from 1.5 metric tonnes to 1.0 metric tonnes). At the retail level, the stock amount will be smaller, and it has spread to a few places from the wholesaler. Retailers may be divided into small hawkers, such as fruit stalls or grocery stores, while medium and large stalls are supermarkets and hypermarkets. Thus, for the direct supply chain- from farm to wholesaler and small wholesaler during the pandemic, it is estimated that losses were about 69.4% or around 2.0 Mt.

Table 3: Watermelon Post-harvest Losses Rate During Pandemic Covid-19: Farm – Large Wholesaler – Small Wholesaler- Retailer

	Channel Distribution	**Amount of Usable**	**Amount of Losses**	**Percentage of Losses**
1.	Farm • Production: 3.0 Mt/ acre	2.0 Mt	1.0 Mt	33.3 %
2.	Large Wholesaler • Stock: 2.0 Mt	1.5 Mt	0.5 Mt	25.0 %
3.	Small Wholesaler • Stock: 1.5 Mt	1.0 Mt	0.5 Mt	11.1 %
	Total		2.0 Mt	69.4 %
4.	*Retailer • Stock: min 100 Kg	80 Kg	20 Kg (or 4 fruits; 5kg / fruit)	20.0 %

*Retailer sample size is at the small-medium case, with an average of 100 Kg per session.

Based on an interview session with farmers, around 62.3%, or 28 respondents, acknowledged that watermelon losses were attributed to disruptions in logistics. This was particularly evident among those who were involved in contract farming with FAMA and large supermarkets during the initial stages of MCO phases 1-4, spanning approximately 11 months from March to December 2020 (Safari et al., 2021). This arrangement facilitated distribution effectively. However, small and medium-scale farmers encountered difficulties in navigating police roadblocks, as they relied on middlemen or agents for their watermelon transportation. Despite distribution being permitted, delays during the COVID-19 pandemic were experienced due to a shortage of manual harvesting manpower. Consequently, cumulative losses of 1 metric tonne occurred at the farm level. Additionally, during these phases, constraints were imposed on acquiring input resources such as fertilisers and pesticides, leading to incurred losses at the farm level.

Meanwhile, at the wholesale level, the primary challenges were restrictions on business operations. The government limited operations to the hours between 8 am and 12 noon, with other markets such as the night markets remaining closed. This significantly affected the accumulation of large quantities of stock, resulting in losses ranging from 11.1% to 25.0%. Proper chilling facilities were necessary to maintain shelf life, but only 34% (10 respondents) of the wholesalers had equipped facilities; the rest experienced issues such as rotting, damage, and wastage. Although the situation began to improve during phases 5-6 or RMCO (January to March 2021), consumer demand showed slow growth. The issues in business operations also extended to retailers, affecting almost 80% of demand and resulting in losses of about 20%. This was particularly significant considering the usual demand during Ramadhan bazaars, leading to a surplus and a drop in retail prices from RM 1.30/kg to RM 0.80/kg. Farmers acknowledge that prior to the onset of COVID-19, losses were lower, at around 40 per cent. This means that out of a total of 2.0 metric tonnes, the losses amounted to approximately 1.0 to 1.2 metric tonnes. Despite efforts, losses persist throughout the supply chain, which is attributed to challenges in farm and processing handling, storage, and labour shortages. Furthermore, the unforeseen crisis has exacerbated these losses by introducing disruptions in the supply chain, primarily due to the imposed restrictions.

During the pandemic, online business transactions have become widespread across the country. Previously, non-food items were commonly purchased through online platforms, however, during the

crisis, this trend extended to include the fresh food industry. Several industry players and government initiatives utilised digital platforms such as Lazada, Agrobazaar, PELADANG Online, Jaya Grocer online, Tesco online, AEON online, and personal shoppers for fresh groceries via WhatsApp groups. These platforms served as effective marketing channels connecting retailers with buyers. The adoption of digital purchasing experienced a significant surge in popularity among consumers, especially during the critical phase. However, as restrictions eased, consumers tended to revert to traditional shopping patterns.

4. Conclusion

The global health crisis caused by COVID-19 has had a significant impact on businesses and communities around the world, leading to the need for them to adjust and innovate according to new standards. This pandemic emphasises the importance of having a strong and adaptable agri-food supply chain in place to maintain food security. This research focuses on examining the watermelon post-harvest losses in Malaysia during this period, revealing that these losses are almost half of what they were before the pandemic. The main reasons behind these losses include disruptions in distribution and transportation, shortage of workers, as well as restrictions on business hours. These challenges have greatly contributed to decreased demand due to consumers shifting from physical stores where they used to create demand. Therefore, it is crucial for strategic plans such as risk management analysis and digitalising businesses with clear policies to be put into action to reduce uncertainty and improve sustainability within the agri-food supply chain. It is essential for industries and individuals alike to collaborate through various means in order to strengthen stability within this supply chain. One recommendation would be for business operations, to transition towards digitisation while ensuring continuity measures are implemented promptly.

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