Impacts of COVID-19 Pandemic Restrictions on Socio-economic Conditions of Smallholder Livestock Farmers in Kelantan

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DECLARATION

I hereby declare that the work embodied in this report is the result of my own research except for the excerpt as cited in the references.

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Impacts of COVID-19 Pandemic Restrictions on Socio-economic Conditions of Smallholder Livestock Farmers in Kelantan

ABSTRACT

During the COVID-19 pandemic, Malaysia has implemented the movement control order (MCO) on 18 March 2020, and then it was extended several times. As a result, all economic, social and agricultural activities were entirely halted. The livestock sector supports the livelihood of rural communities in Malaysia, because animal products represent an important protein source. Therefore, this study was conducted to understand the operating situation and demands of smallholder livestock farmers affected by the COVID-19 pandemic. The survey was carried out by two rounds in 10 districts of Kelantan. The first round of survey was conducted between September and November 2020, and the second round was conducted between November to December 2021. The data was collected using a pre-tested questionnaire that were addressed mainly about: farmers' basic information, farm management, marketing and action taken during COVID-19. Each interview was conducted face to face only after the given consent of the respondents to attend the interview and was strictly followed the standard operating procedure (SOP) of COVID-19. The descriptive statistics were used for data analysis. A total of 111 smallholder livestock farmers joined in this survey (89% of respondents were male; 31% of respondents were <30 years old; and 70% of respondents were education from secondary school). Results showed that about 72%, 11%, 10% and 4% of respondents were small landholdings (<2 ha), medium landholdings (>2 ha - 4 ha), large landholdings (≥5 ha) and landless (0 ha) farmers, respectively. There was no significant ($p>0.05$) difference on monthly income among the various landholding categories of farmers. Nearly all (94%) of the respondents were able to purchase feed, and 59% of respondents collected fodder from their surroundings during the MCO. Moreover, the majority (74%) of respondents did not acquire treatments for their animals., and 52% of respondents had lost animals on their farms. The majority (81%) of respondents claimed to be capable of rearing livestock on their own, implying that they do not need to employ the manpower during the MCO. The findings also revealed that farmers' business outputs have changed, including decreased products demand (56% of respondents) and experiencing a lower income (50% of respondents). However, about 48% of the respondents claimed that they were less affected by the marketing channel, and they were able to sell their animal products during the MCO. Despite all the challenges and difficulties, about half (48%) of the respondents claimed a steady market price trend, while more than 20% of the respondents were claimed a decreasing and increasing trend in market price during the COVID-19 pandemic. In conclusion, the COVID-19 pandemic had a less significant impact on the socio-economic conditions and livelihoods of smallholder livestock farmers in Kelantan due to the various coping strategies implemented by Malaysian government. Some recommendations have been made to ensure the livestock sector's continuity and sustainability, and they can be applied to other sectors and countries with similar economic issues.

Keyword: COVID-19, Movement Control Order (MCO), smallholder livestock farmers, socioeconomic condition.

Kesan Sekatan Pandemik COVID-19 Terhadap Keadaan Sosio-ekonomi Petani Ternakan Kecil di Kelantan

ABSTRAK

Semasa pandemik COVID-19, Malaysia telah melaksanakan Perintah Kawalan Pergerakan (PKP) pada 18 Mac 2020, dan kemudiannya dilanjutkan beberapa kali. Akibatnya, semua aktiviti ekonomi, sosial dan pertanian dihentikan sepenuhnya. Sektor ternakan menyokong kehidupan masyarakat luar bandar di Malaysia, kerana produk haiwan merupakan sumber protein yang penting. Oleh itu, kajian ini dijalankan untuk memahami situasi operasi dan permintaan penternak kecil yang terjejas akibat pandemik COVID-19. Tinjauan dilakukan sebanyak dua pusingan di 10 daerah di Kelantan. Tinjauan pusingan pertama telah dijalankan antara September dan November 2020, dan pusingan kedua dijalankan antara November hingga Disember 2021. Data dikumpul menggunakan soal selidik pra-ujian yang ditangani terutamanya tentang: maklumat asas petani, pengurusan ladang, pemasaran dan tindakan yang diambil semasa COVID-19. Setiap temu duga dijalankan secara bersemuka hanya selepas mendapat kebenaran responden untuk menghadiri temu duga dan mematuhi prosedur operasi standard (SOP) PKP dengan ketat. Statistik deskriptif digunakan untuk analisis data. Seramai 111 penternak kecil telah menyertai tinjauan ini (89% responden adalah lelaki; 31% responden berumur <30 tahun; dan 70% responden berpendidikan dengan sekolah menengah). Keputusan menunjukkan bahawa kira-kira 72%, 11%, 10% dan 4% responden adalah pegangan tanah kecil (<2 ha), pegangan tanah sederhana (>2 ha - 4 ha), pegangan tanah besar (≥5 ha) dan tanpa tanah (0 ha). petani, masing-masing. Tidak terdapat perbezaan yang signifikan ($p>0.05$) pada pendapatan bulanan di kalangan pelbagai kategori pegangan tanah petani. Hampir kesemua (94%) responden dapat membeli makanan, dan 59% responden mengumpul makanan ternakan dari persekitaran mereka semasa PKP. Selain itu, majoriti (74%) responden tidak mendapatkan rawatan untuk haiwan mereka, dan 52% daripada responden telah kehilangan haiwan di ladang mereka. Majoriti (81%) responden mendakwa mampu menternak ternakan sendiri, menunjukkan bahawa mereka tidak perlu mengambil tenaga kerja semasa PKP. Penemuan juga mendedahkan bahawa keluaran perniagaan petani telah berubah, termasuk penurunan permintaan produk (56% daripada responden) dan mengalami pendapatan yang lebih rendah (50% daripada responden). Walau bagaimanapun, kira-kira 48% daripada responden mendakwa bahawa mereka kurang terjejas oleh saluran pemasaran, dan mereka dapat menjual produk haiwan mereka semasa PKP. Di sebalik semua cabaran dan kesukaran, kira-kira separuh (48%) daripada responden mendakwa trend harga pasaran yang stabil, manakala lebih daripada 20% daripada responden mendakwa trend menurun dan meningkat dalam harga pasaran semasa pandemik COVID-19. Kesimpulannya, pandemik COVID-19 telah memberi kesan yang kurang ketara kepada keadaan sosioekonomi dan kehidupan penternak kecil di Kelantan kerana pelbagai strategi yang dilaksanakan oleh kerajaan Malaysia. Beberapa cadangan telah dibuat untuk memastikan kesinambungan dan kemampanan sektor ternakan, dan ia boleh digunakan untuk sektor dan negara lain yang mempunyai isu ekonomi yang sama.

Kata kunci: COVID-19, Perintah Kawalan Pergerakan (PKP), penternak kecil, keadaansocio-ekonomi

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CHAPTER 1

INTRODUCTION

1.1 Research Background

The COVID-19 pandemic, which was caused by the emergence of a new coronavirus strain (SARS-CoV-2) at the end of December 2019, has led to a global public health emergency and a socioeconomic crisis in 2020 and 2021. The first COVID-19 case was detected in Malaysia on January 25 among Chinese tourists arriving via Singapore. By February 16, the number of cases had risen to 22, indicating the first wave of cases. On February 27, the second wave of cases began, taking the total number of people infected with the coronavirus to over 1,000 (Pfordten & Ahmad, 2021). Malaysia had the highest total number of confirmed COVID-19 cases in Southeast Asia within weeks, with 4,817 cases, 77 deaths, and 2,276 cases of recovery announced by the Ministry of Health in Malaysia as of April 13, 2020 (Umair, Waqas & Faheem, 2021). During the COVID-19 pandemic, Malaysia has implemented a Movement Control Order (MCO) to prevent the pandemic from spreading. All economic, social, agricultural, and other activities were entirely halted as a general rule of the MCO. Malaysia's agriculture supply chain has been disrupted due to the implementation (Amir et al., 2020).

The COVID-19 pandemic has had a significant impact on many sectors, including livestock, globally, regional, and national levels. Many countries' actions, such as lockdown, travel restrictions, and border controls, had unwanted or unfavourable effects on the livestock industry, including difficulty transporting live

animals and animal products such as milk, meat, and eggs to markets. These difficulties have caused a decline in animal product processing capability, a drop in income, and a slowdown in business activity. Furthermore, as the disease spreads, movement restrictions become increasingly strict, resulting in labour shortages for the harvest or difficulties for farmers in transporting their products to market (Bekuma, 2020).

The aim of this study was to understand the operational situation and demands of smallholder livestock farmers impacted by the COVID-19 pandemic through a pre-tested questionnaire. The data obtained from these selected farmers have then identified the problem faced by livestock farmers, and suggestions towards reviving the farm have been made. Therefore, households would have better livestock farm or business, reduced poverty, and improved smallholders' livelihoods.

1.2 Problem Statement

The livestock sector has been severely impacted by the MCO and other restrictive actions taken to control the outbreak. Supply and market disruptions have brought livestock farmers under a lot of pressure since animals must be fed daily. Certain animals' production periods are short; – dairy cows must be fed every day, broilers every few weeks, and pigs every three months. Moreover, farmers must return to work immediately to plough their lands for fodder production. While manufacturing and service businesses may change their production schedules to avoid losses due to the outbreak, the livestock industry does not. In the normal process of ploughing, labour, crop, fertilizer, pesticide, and farm machinery are all provided within a fixed time frame. Smallholder farmers will suffer financially for the whole year if they do not receive necessary services during the critical farming season.

The MCO has a major impact on the livestock industry, which is still poorly understood. The livestock sector supports the livelihood of rural communities in Malaysia, because animal products represent an important protein source. A secure supply of livestock products is essential for a healthy and functioning economy and people's livelihoods. As a result, sustaining the livestock sector is a critical economic component in the ongoing battle against the outbreak; however, their hardships have received little exposure. Thus, it was critical to conduct this study in order to highlight concerns regarding the resilience of farming systems, markets, labour, food security, and other issues of smallholder farmers.

1.3 Objectives

1. To gain a better understanding of the operating situation and demands of smallholder livestock farms affected by the COVID-19 pandemic.
2. To identify the problems encounter by livestock farmers and to suggest possible solutions to revive the farm.

1.4 Hypothesis

H_0: COVID-19 pandemic has negative impacts on socio-economic conditions of smallholder livestock farmers in Kelantan.

H_1: COVID-19 pandemic has no negative impacts on socio-economic condition of smallholder livestock farmers in Kelantan.

1.5 Scope of Study

In this study, the impacts of COVID-19 on socio-economic conditions of smallholder livestock farmers in Kelantan were the main focus of the study. Data were obtained from the respondents through a standard questionnaire that were addressed mainly about: farmers' basic information, farm management, marketing and action taken during COVID-19 pandemic. The survey was carried out by two rounds. The first round of survey was conducted between September and November 2020, and the second round was collected between November to December 2021. The survey was conducted in 10 districts of Kelantan (Bachok, Gua Musang, Kota Bharu, Kuala Krai, Machang, Pasir Mas, Jeli, Tanah Merah, Pasir Puteh, and Tumpat) whose local smallholder livestock farmers raise livestock (cattle, sheep, goat, rabbit, chicken and quail). A total of 111 livestock farm households were covered to complete this survey. About 10-12 livestock farmers from each of the selected districts were surveyed based on the concentration of livestock population. The descriptive statistics were used for data analysis using SPSS software.

1.6 Significant of Study

This study has a lot of significance. One of them is to provide information regarding the problem faced by smallholder livestock farmers. It was able to give recommendations and measures that could help smallholder livestock farmers in bringing the farm back to life. This study also provided knowledge and noticed to the government about the situation and needs of smallholder farmers who had difficulty getting supplies in rural areas to ensure continuity and sustainability of their farm or business, especially during the COVID-19 pandemic. Moreover, this study can help the government identify areas or aspects that need to be emphasized to develop and advance the smallholder farmers with various modern technologies and livestock management skills in rural areas.

CHAPTER 2

LITERATURE REVIEW

2.1 Coronavirus disease (COVID-19) pandemic

In December 2019, pneumonia of unknown origin hit Wuhan, Hubei Province, China, quickly spreading across Asia and the world. By the end of January 2020, the World Health Organization (WHO) had declared it a public health emergency of international concern (Umair, Waqas & Faheem, 2021). Dr. Tedros Adhanom Ghebreyesus, Director-General of the WHO, reported that the COVID-19 outbreak had affected 213 countries, with 1,524,162 confirmed positive cases and 92,941 deaths, in his opening remarks during a media briefing on COVID-19 on April 10, 2020. The WHO named the new coronavirus COVID-19 after it was identified as the cause of this severe acute respiratory syndrome coronavirus two or SARS-CoV-2. The novel coronavirus SARS-CoV-2, which originated in Wuhan, has now been added to the list of viruses that pose a threat to humans (Shah et al., 2020).

SARS-CoV-2 was still spreading over the world at the time of writing. As of September 03, 2021, Table 1 lists the top 10 countries with the highest number of COVID-19 cases reported (Worldometer, 2021). Many websites provide the most recent information about COVID-19 cases around the world. At the time the data for Table 1 were retrieved, the total number of cases reported worldwide was 219,956,335 with 4,557,084 deaths and 196,595,478 recovered.

Table 2.1 Top 10 countries with the highest numbers of COVID-19 cases as at September 03, 2021 (Worldometer, 2021).

No.	Country	Total cases	Total deaths	Total recovered
1	USA	40,513,018	662,853	31,199,835
2	India	32,902,345	439,916	32,056,085
3	Brazil	20,830,712	582,004	19,801,725
4	Russia	6,956,318	184,812	6,218,048
5	UK	6,862,904	132,920	5,533,227
6	France	6,799,240	114,680	6,310,756
7	Turkey	6,435,773	57,283	5,872,385
8	Argentina	5,195,601	112,195	4,884,418
9	Iran	5,055,512	108,988	4,269,508
10	Colombia	4,913,031	125,097	4,742,640
23	Malaysia	1,786,004	17,191	1,506,273

COVID-19 affects people differently. More than 90% of persons infected with the virus experience mild to moderate respiratory symptoms, which recover independently. Many others, on the other hand, will get sick to the point of needing medical attention. Severe sickness is more likely to strike the elderly and those with underlying medical disorders such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer. The most common symptoms are fever, coughing, exhaustion, and loss of taste or smell. Sore throat, headache, aches and pains, diarrheas, a rash on the skin, discolouration of the ringer or toes, and red or inflamed eyes are the less common symptoms. Severe symptoms began when the infected person had difficulty breathing or shortness of breath, loss of speech or mobility or confusion, and chest pain. When infected with the virus, symptoms occur in 5-6 days on average, but it can take 14 days. COVID-19 can make anyone sick and cause them to get very ill or die at any age (WHO, 2020).

Currently, researchers believe that COVID-19 spreads by droplets and virus particles released into the air by infected individuals during breathing, talking, laughing, or singing, as well as coughing or sneezing. In a few seconds, larger droplets may fall to the ground, but small infectious particles can linger in the air and accumulate indoors, especially in crowded areas with poor ventilation. This is why mask use, hand hygiene, and physical distancing are critical in preventing COVID-19 (Sauer, 2021).

2.2 COVID-19 outbreak in Malaysia

On January 25, the first COVID-19 case in Malaysia was detected among Chinese travelers arriving from Singapore. Until the first wave of cases in late February, the number of confirmed cases in Malaysia remained relatively low. However, localized clusters began to emerge in Malaysia in late February and early March (Umair, Waqas & Faheem, 2021). The first death from the SARS-CoV-2 outbreak started on March 17, 2020. There had been 8 cases of COVID-19 in Malaysia at the end of the week since the first case was reported. The number of cases had increased to 16 the next week, on February 8, 2020 (Abdullah, 2020). The number of cases had risen to 22 by the following week (Abdullah, 2020). For 11 days, no new cases were reported until February 27, 2020.

The second wave of coronavirus infection began on this date. A week later, the number of COVID-19 cases had increased exponentially. In Malaysia, 55 cases have already been reported. The following week, with 158 cases on March 12, 2020, the trend continued (Abdullah, 2020). For every three days, the number of cases doubled until March 18, 2020, when there were 790 reported cases. Due to a pandemic,

movement control order (MCO) in Malaysia was implemented for the first time on March 18, 2020 (Tang, 2020). Despite the implementation of MCO, a week later, the number of cases had doubled. There were already 1,796 cases on March 25, 2020 (Abdullah, 2020).

Malaysia's Prime Minister declared on the same day that MCO would be extended for another two weeks, till April 14, 2020. By March 31, 2020, there had been a total of 2,766 cases with 43 deaths (Abdullah, 2020). COVID-19 cases in Malaysia included imported cases from other countries, close contacts of locally confirmed cases, and community-acquired cases with a known (for example, the Tabligh gathering) or unknown source of infection. The larger clusters were then discovered during a massive gathering in Sri Petaling, Selangor, from February 27 to March 3, 2020, which drew an estimated 15,000 or more people.

When the Brunei Health Authority discovered the first COVID-19 patient in Brunei, who had attended the gathering, they notified the local authorities. Following the notification, a number of government agencies went to great lengths to track down all Malaysians who had attended the gathering for health screening (Rampal & Seng, 2020). Within weeks, Malaysia had the highest cumulative number of confirmed Covid-19 cases in Southeast Asia, with 4817 confirmed infections and 77 deaths by April 13, 2020 (Umair, Waqas & Faheem, 2021).

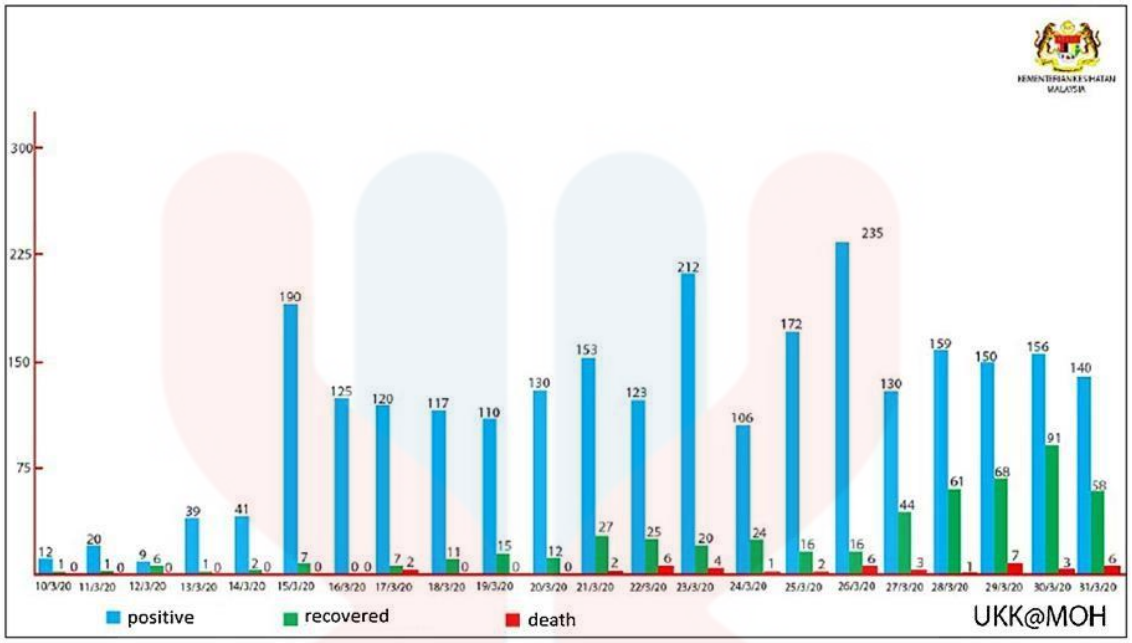

Figure 2.1 Total new cases, recovered cases, and deaths reported daily from March 10 to March 31, 2020 (Abdullah, 2020).

The number of reported cases rapidly reduced to less than 100 per day by mid-April. However, between May and early June, newly reported cases showed a sharp increase, with more than 100 cases of local infections, most of which were non-Malaysians. Quarantine detainees at immigration detention camps and immigrant hot spot locations were attributed for these cases. The number of reported cases did not surpass 50 per day from that time until early September. However, on September 7, 2020, a sudden surge of new positive cases signaled the beginning of the second wave of local infection, with an R_t value of 1.7 and increasing cases in Kedah and Sabah. These two states' high R_t values had a significant impact on the national R_t value (Abdullah, 2020).

The pandemic's third wave began on September 20, 2020, with an R_t value of 2.2. Within four weeks, however, the R_t value had dropped to 1.5, indicating that daily cases of COVID-19 were growing, albeit slowly. The cumulative number of infected cases was 113,010 as of December 31, 2020. The highest number of positive cases in a

single day was 2,525; most cases were transmitted locally (Abdullah 2020), with Selangor contributing the most cases, followed by Sabah, Johor, and Malacca (Muhamad Khair, Lee, & Mokhtar, 2021).

2.2.1 Government policy measures and actions for COVID-19

Malaysia is one of the countries that responded quickly to COVID-19 by generating a variety of quick responses. The main goal was to reduce the economic and social impacts, prevent the spread of the disease, and provide care for its residents (Shah et al., 2020). The government has been forced to take more restrictive measures to control the outbreak and keep the healthcare system from collapse. On March 16, 2020, Malaysia's Prime Minister announced a restricted lockdown known as the MCO. The first MCO (MCO1) began on March 18 and will end on March 31, 2020. It was then extended for another two weeks (MCO2) until April 14, 2020 (Salim et al., 2020).

As the first step in controlling the virus's spread during MCO phases 1 and 2, the government imposed severe mitigating measures. All educational institutions, places of worship, and non-essential sectors were forced to close due to this policy. Only the agriculture, industry, and service sectors, tied to the production of food supplies and necessities, were allowed to operate at total capacity by the government. The Malaysian National Security Council proposed the restrictions enacted under the Prevention and Control of Infectious Diseases Act 1988 (Act 342) and the Police Act 1967 (Muhamad Khair, Lee, & Mokhtar, 2021).

Interstate and inter-district travel were prohibited unless needed to prevent the virus from spreading. In addition, the family's head of the household was only allowed to shop for groceries within a 10-kilometer radius. The police and military departments

worked together to establish roadblocks at all state and district boundaries to track people's movements to ensure MCO's efficacy. The MCO played a crucial role in containing the outbreak. According to López and Rodó (2020), a 60-day lockdown could prevent the pandemic from spreading, as well as a potential second wave of COVID-19 cases. However, after four weeks of MCO during phases 1 and 2, business owners began to have difficulty continuing their operations if they were shut down further.

2.2.2 The Malaysian economy has been affected by the MCO

COVID-19 had a devastating impact on the global economy as a whole. The COVID-19 pandemic, according to the Organization for Economic Cooperation and Development (OECD), has caused widespread social distress and enormous economic disruption (Shah et al., 2020). Unsurprisingly, the pandemic has caused the deaths of many people worldwide, compelling everyone to embrace a new norm of masks, SOPs, and lockdowns. Malaysia is no stranger to lockdowns, having enacted many MCOs to battle the epidemic since the beginning of 2020. Since then, every MCO has been linked to a devastating effect on people's mental health, reduced household income, and poverty, among other things (Arfa, 2021).

Malaysian economy was affected the hardest during the implementation of the first MCO, with the economy falling to -17.2% in 2Q2020. Malaysia's full-year GDP growth is expected to be -5.6% in 2020, dropping from 4.4% in 2019 (Jalil, 2021). The country's GDP declined by 0.5% in the first quarter of 2021, much lower than in 2020 when the second MCO was implemented. Small-to-medium enterprises (SMEs) account for 35% of Malaysia's GDP (Gross Domestic Product) and 70% of the country's jobs

(Bernama, 2020). The MCO had a significant impact on SMEs, leaving many to confront financial difficulties. In addition, during the two-month lockdown, manufacturers that contributed to Malaysia's export income were ordered to stop operating, leading the economy to fall by 8.3%, compared to a negative 1.7% growth in 2019. After 169 months of trade surpluses, Malaysia reported an RM3.5 billion trade deficit in April 2020 (Moneycompass, 2020).

The MCO 2.0 allowed most firms, SMEs, and export producers to stay open to help the economy recover. As a result, it had a lessening effect on business owners, allowing them to earn money even during the lockdown. Regardless of this decision, firms and SMEs struggled to stay afloat since they were still recovering from the previous one. Furthermore, many consumers and investors are still worried about the economy and prefer to save rather than spend, resulting in significant sales and profit reductions (Arfa, 2021).

Malaysia has taken several steps to recover its economy to reduce the economic impact of the pandemic. Prime Minister Tan Sri Muhyiddin Yassin announced the PRIHATIN Rakyat Economic Stimulus Package (PRIHATIN Package) on March 27, 2020, as part of ongoing efforts to reduce the impact of COVID-19. These RM 250 billion packages are intended to protect people's welfare, support businesses, including SMEs, and strengthen the economy. The Malaysian government has allocated a large budget to different sectors to minimize the impact of the MCO, initiate people-based economic development, and encourage national strategy. The government has announced a range of necessary measures, including the PRIHATIN Package (Shah et al., 2020).

Table 2.2 The PRIHATIN Rakyat Economic Stimulus Package (PRIHATIN Package).

PRIHATIN Package	Beneficiary
RM 1 billion fund allocation to the Ministry of Health for medical equipment purchases and to pay for services, in addition to RM 500 million announced earlier.	Ministry of Health
RM 600 allowance for healthcare personnel and RM 200 allowance to frontliners such as police, immigration, and customs personnel.	Healthcare personnel and frontliners such as police, immigration, and customs personnel
RM 10 billion allocation to fund B40 and M40 families under the National Caring Aid (Bantuan Prihatin Nasional), including: • RM 1600 one-off payment to 4 million households earning below RM 4000; • RM 1000 one-off payment to 1.1 million households earning between RM 4001 and RM 8000; • RM 800 one-off payment for unmarried persons aged ≥21 years earning less than RM 2000; • RM 500 one-off payment for 4000 singles aged ≥21 years earning between RM 2000 and RM 4000.	Malaysian citizens
15–50% electricity bill discount beginning on April 1, 2020 for 6 months.	
Free internet from all telcos from April 1, 2020 until the end of the MCO.	
People Housing Projects (PPR) and public housing residents are exempted from paying rent for 6 months.	
The government allows pre-retirement withdrawal from the Private Retirement Scheme (PRS) of up to RM 1500 without tax penalties.	
Wage subsidy program for workers who earn RM 4000 or less for 3 months.	
RM 500 one-off payment for civil servants including contract staff (grade 56 and lower).	Civil servants
RM 200 one-off payment for all students at higher learning institutions.	Students at higher learning institutions
RM 500 one-off payment for e-hailing drivers.	E-hailing drivers
RM 250 one-off payment for government pensioners.	Government pensioners
Buildings belonging to the government, such as convenience stores, day-care centres, and school canteens will be exempted from rental payment.	Business owners
RM 25 million allocation in collaboration with NGOs to provide food and shelter for senior citizens, Orang Asli, and the disabled.	Senior citizens, Orang Asli, and individuals with

PRIHATIN Package	Beneficiary
	disabilities
National Health Protection Scheme (MySalam) and COVID-19 quarantine patients are entitled to receive RM 50 per day for 14 days.	COVID-19 patients
An allocation of RM 400 million to upgrade the broadband network.	Telco companies
Cleaning and catering contract workers at schools, public universities and training institutions, and government agencies will be paid a salary and their terms of service will be extended for another month by taking into account the MCO period.	Contract workers (cleaning and food services)
Insurance and takaful sectors will provide a special RM 8 million fund to bolster COVID-19 testing. Each policyholder can go for a screening test worth up to RM 300 in private hospitals and laboratories.	Insurance policy holders
TEKUN National, an agency under the Ministry of Entrepreneurial and Cooperative Development and People's Trust Council (MARA), an agency under the Rural Development Ministry, along with other government agencies, will offer a moratorium to small and medium-sized enterprises beginning April 1, 2020.	Small and medium-sized enterprises (SMEs)
Similar to PTPTN loan repayment deferment, the repayment of the Skills Development Fund Corporation (PTPK) loan is also extended from April 1, 2020 to September 30, 2020.	PTPK loan holders
RM 1 billion allocation for the Food Security Fund.	Food security fund

RM, Malaysian ringgit; MCO, Movement Control Order; NGO, non-governmental organization; PTPTN, National Higher Education Fund.

2.3 COVID-19 and Livestock

The reason for the devastating economic impact of the COVID-19 pandemic has less to do with the disease's transmission and more to do with the lockdown methods used by most governments. To control the rate of infection, a variety of measures were implemented around the world, including home confinement, travel restrictions, and business closures. Food availability and distribution were affected as a result of these restrictions. If COVID-19 (World Trade Organization. Frequently Asked Questions:

The WTO and COVID-19) is thought to decrease global merchandise trade by 13 to 22%, the impact on the livestock agricultural sector will be considerably greater (Ani et al., 2021). Travel restrictions in many regions have hindered the delivery of breeding stock and slaughter animals. Because fresh meat and milk have a short shelf life, unsold production due to global constraints degraded their quality, increased production costs, and eventually disrupted production. Every day, dairy farmers in the United States waste approximately fifteen million liters of milk (Forstadt, 2020).

During the COVID-19 pandemic, meat and livestock prices and processing volumes were highly unpredictable (Hashem et al., 2020). The surge in grocery demand and the drop in order at food service companies caused the downside risk in mid-March 2020. The slowing and closure of beef and pork processing plants later caused far more significant supply-side disruptions in April and May (Lusk et al., 2021). The livestock sector, particularly the dairy and meat industries, and related processes, have been badly impacted by the COVID-19 pandemic's lockdown and other restrictive measure (Galanakis, 2020).

Moving live animals and animal products (milk, meat, and eggs) to markets was difficult, and there were restrictions on seasonal border crossings (transhumance) with ruminants. There were also decreased in the purchasing power of production logistics, as well as labour and professional services shortage (Hashem et al., 2020). These constraints have caused significant disruptions in the livestock supply chain, reducing the livestock industry's economic and productive efficiency (FAO, 2020b).

Cattle, hog, and chicken slaughter were all up roughly 5% in February and March 2020 compared to the same time period in 2019. This was due to large livestock supply into 2020, as well as industry initiatives to push slaughter ahead into the first

quarter. COVID-19's effects on beef and pork packing plants, however, began to show themselves in April 2020. Because of the rest of the economy's shutdowns, many packing plant workers began staying at home, causing processing volumes to drop. Following that, tests found that workers in a number of packing plants had been infected with COVID-19, resulting in a series of temporary plant closures and further reductions in the working capacity of those businesses that remained open (Lusk et al., 2021).

The impact of COVID-19 on the livestock industry has yet to be thoroughly measured and felt. While formal analyses are not yet achievable, current observations show that livestock value chains are disrupted. Lessons learned from previous epidemics suggest that these disruptions and their devastating socioeconomic effects will only worsen (FAO, 2020a). Fortunately, the COVID-19 outbreak may have paved the way for new study areas that are highly important to the sustainability of the livestock industry (Ani et al., 2021).

2.3.1 Disruption of supply chain

The supply chain is a business and information process that transfers products or services from suppliers to customers through the manufacturing and distribution processes (Surni et al., 2020). The COVID-19 outbreak severely affected the livestock industry's long-term sustainability in a variety of areas, from production to marketing and consumption of animal products (Figure 1). Access to farming inputs, such as animal feed resources, livestock movements for pasture and water, and animal equipment, such as milking machines, vaccines, and other important production inputs, was the primary production operational interrupter. Indeed, demands to stay at home and social distance have had an impact on farm services that rely on humanitarian

assistance, disrupting routine work and animal husbandry (low number of laborers, veterinarian visits and services, and workers in product processing) (Hashem et al., 2020).

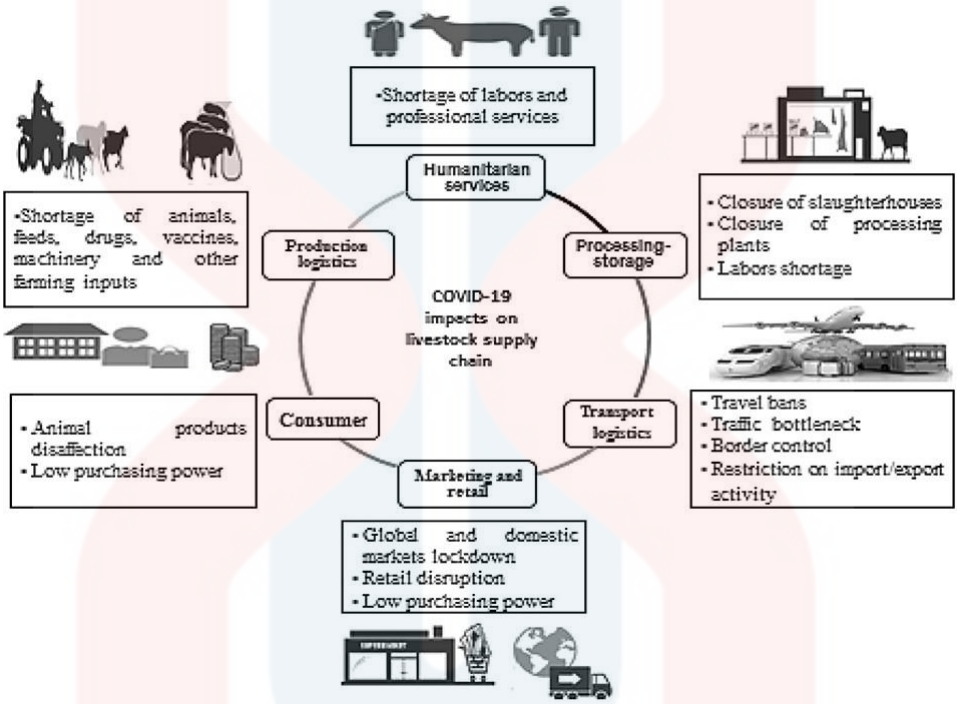

Figure 2.2 Impacts of the COVID-19 pandemic on the livestock supply chain.

COVID-19 had the huge impact on the animal product supply chain, begins with disease outbreaks among processing plant workers, which led to plant closures and resulting impact across the food chain (Marchant-Forde & Boyle, 2020). The lockdown measures have had a short-term impact on people's mobility, making it difficult for many of them to get to their places of work. When employees are away from work due to illness or restrictions on local and migrant employees' movement, the lockdown significantly impacts the supply chain. It reduces the company's production capacity and harms the food safety of employees (Barman et al., 2021). Labour shortages and limited availability of raw materials and other ingredients resulted from movement restrictions and illness. Industrial feed companies are losing productivity due to

physical distance and the need for additional standard precautions. Feed delivery has been further delayed due to disruptions in supply routes. Transhumance can often be hindered by movement restrictions, making it difficult for farmers to feed their livestock. Cattle feeding, for example, takes several months for livestock to reach a sufficient degree of performance. The projected losses in the feedlot sector reflect the lower value of animals put in feedlots before Covid-19 took effect (Bekuma, 2020).

Furthermore, the processing of animal products such as milk and meat (delivery failure and reduced processing and slaughtering capacities) creates yet another challenge to the completion of the production cycle, pushing farmers to cut output capacity and waste products (Gortázar & de la Fuente, 2020). Farmers have reportedly been forced to destroy their products by burning or allowing them to rot as a result of the restrictions. According to the American Co-operative of Dairy Farmers, 14 million liters of milk are dumped every day due to a disrupted supply chain. In England, the head of dairy farmers stated that 5 million liters of milk are in harm in a single week (Aday & Aday, 2020). Dairy farmers in Bangladesh are also unable to sell their milk and are suffering from terrible economic situations as a result of the lockdowns. Bangladesh loses over 67 million dollars per day owing to the squandering of 15 million gallons of milk. Farmers were also obliged to sell their milk for a low price of around 0.14 US dollar per litter, which was over 0.6 US dollar less than the normal price (Begum et al., 2020).

The pandemic's impact on the livestock supply chain continues to have an impact on local and global marketing processes (reduced marketing opportunities, a halt to import/export activity, and lower purchasing power) as well as consumer demand (misconceptions about the safety of animal products and lower consumer income) (Hashem et al., 2020). Due to the lockdown also, buyers cannot dine out and

must prepare the majority of their meals at home. Furthermore, customers would prefer not to visit supermarkets or marketplaces since they would be exposed to the COVID-19. Due to social distance and restaurant closures, the buyer chooses takeout and home delivery. Consumers have concentrated on products with a longer shelf life, such as dried or canned food, pasta, milk or milk replacements, hardened food due to accommodations, and daily cooking at home (Barman et al., 2021). These disruptions in the livestock supply chain brought producers (farmers) in danger of losing their income. This problem has put the long-term survivability of livestock production systems in doubt (Schmidhuber et al., 2020).

2.3.2 Hindering access to the market

Due to lack of market access and operational challenges, some smallholder farmers and distributors had trouble selling their products during the MCO's first period. Intermediaries, who gather animals or products and aggregate them for fattening, packaging, or retailing, are hindered by movement restrictions. Farmers will also lose their link to larger buyers when intermediaries are disrupted, especially if there are no communications connecting value chain parties (FA0, 2020c). Although the availability of livestock products is sufficient, the COVID-19 pandemic has had a negative impact on some sub-sectors. For example, approximately 49 smallholder dairy farmers were unable to sell their milk products (about 1,100 L of cow/goat milk) on a daily basis, resulting in a daily loss of RM7,000 (Vaghefi, 2020). The closure of international borders, as well as the restriction of nighttime travel, has also caused slowdowns and delays in the distribution of products such as animal health inputs, raw ingredients for

animal feed (maize, soya, imported supplements), and live animals, leading to higher operating costs for traders and higher prices for retailers and processors (Lynch, 2020).

Distribution and retail are essential parts of the livestock supply chain; successful delivery and retail ensure that farmers and consumers are connected, completing the production-demand link. Local vehicle movement and road traffic controls, as well as the lockdown of broad areas, have all been substantial obstacles to distribution and retail operations (Hashem et al., 2020). Many livestock producers and traders have lost access to global and local markets, as well as their incomes. Global movement restrictions have had an impact on trade around the world because the world is currently one unit. Movement restrictions in Asia have halted livestock trade from Lao People's Democratic Republic, Thailand, Myanmar, and Vietnam to China. Meat export reductions in Latin America, particularly in Argentina and Uruguay, have impacted farmer revenues (Jackson et al., 2020).

In China, transportation constraints on main roads have impacted local meat supplies, and family farms are unable to market hogs because trucks are unable to enter towns due to the lockdown (Schmidhuber et al., 2020). Until travel restrictions were lifted in the Philippines, delays in vehicles transporting raw materials for processing meat threatened to cause a shortage. Similarly, tight road traffic controls interrupted milk distribution, resulting in milk dumping (FAO, 2020b). Moreover, due to limited access to markets and slaughterhouses or processing plants in Northern America, pig prices in the United States fell by around 27% in just over a week. In 2018, the European Union (EU) transported alive 4.3 million cattle, 3.5 million sheep and goat heads, 33.4 million pigs, and 1,000 million poultry between EU countries. Belgium, Ireland, Spain, Greece, France, and Italy trade around 1.8 million head of cattle each year.

The reintroduction of border controls has hindered the transit of live animals, not only interrupted business but also extending transportation times, which is adverse to animal welfare (FAO, 2020b). In some EU nations, such as Poland, where domestic consumption contributes to only 15% of total production, this situation has resulted in a specific fall in farm gate prices (Rossi, 2020). In developing countries, the situation has gotten significantly worse, especially for household breeders who are struggling with poverty and low individual wages. In East Africa, for example, many livestock producers, mainly nomad tribes, rely on seasonal exports of live animals and frozen meat to Middle Eastern countries during certain marketing seasons such as Ramadan, pilgrim season, and Eid. As a result, their annual income and livelihood have been affected negatively by movement restrictions (FAO, 2020a).

The impact of COVID-19 related travel restrictions has driven the challenge faced by some minority producers, such as rural women, who are unable to access markets due to the lockdown restrictions and rely on informal trading of small livestock, dairy products, and poultry in local markets to support their families (Schmidhuber et al., 2020). In general, the COVID-19 outbreak has disrupted many marketing potentials by reducing demand from a wide range of regular consumers, including schools, restaurants, local markets, hotels, the institutional sector, and the tourism industry (Hashem et al., 2020).

2.3.3 Reduced access to inputs and services

Farmers have been unable to get livestock production inputs due to restrictions on import/export activities and local movements, as well as limited marketing opportunities. Due to the restrictions on movement and the disruption of national and

international trade routes, vital livestock farming materials and facilities, such as feed, replacement stock (e.g., day-old chicks, piglets, gilts, heifers, and semen straws), drugs and vaccines, feed additives, and other livestock farming inputs, are in short supply (Hashem et al., 2020). The new national transport policy, which required passenger loads to be reduced significantly to ensure appropriate social distancing successfully, led to a doubling of transportation costs during the lockdown. The increased cost of transportation and restrictions on mobility resulted in a decline in the supply of farm inputs (Meseret et al., 2021).

Inadequate availability of necessary inputs such as feed and fodder, at least during the first phase of the restrictions, severely impacted the rearing animals' growth and productivity, resulting in significant economic loss. Animal feed was challenging to get by in most regions due to the shutdown of feed mills. Due to a lack of adequate feed supplies, dairy farmers were forced to feed their cattle and buffaloes primarily with available dry crop residues and brans in the early stages. For example, Argentina, the world's largest supplier of soybean meal, has cut back on exports to feed mills by roughly half, thus imperilling the availability of one of the most important feed ingredients in farm animal diets (Seleiman et al., 2020).

Artificial insemination (AI) service delivery and animal health service delivery, such as vaccines and other treatments, also decreased during the time, with more than 40% of dairy farmers reporting such decreases (Meseret et al., 2021). Limited access to veterinary facilities and even veterinarians, as well as difficulty transporting animals to the polyclinic when they were needed, resulted in a high incidence of morbidity and, in some cases, animal death. In the long run, this restricted health care would significantly influence the animals' reproductive efficiency and production (Biswal et al., 2020). There is no doubt that these declines in production inputs and their trade can have a

negative impact on animal productivity, livestock producers' profitability (particularly smallholder meat and dairy producers), and the profitability and commercial stability of these sectors (Hashem et al., 2020).

2.4 Socio-economic impacts of COVID-19 on smallholder farmers

Smallholders are small-scale farmers, cattle herders, forest keepers, and fishers who operate farms ranging in size from less than one hectare to 10 hectares, depend primarily on family labour, and rely on agricultural operations for their primary source of income (FAO, 2020c). COVID-19's total impact on smallholders is currently unclear. Still, there is growing evidence and possible implications in supply, demand, labour, falling or rising prices, decreasing food production, famine, and death.

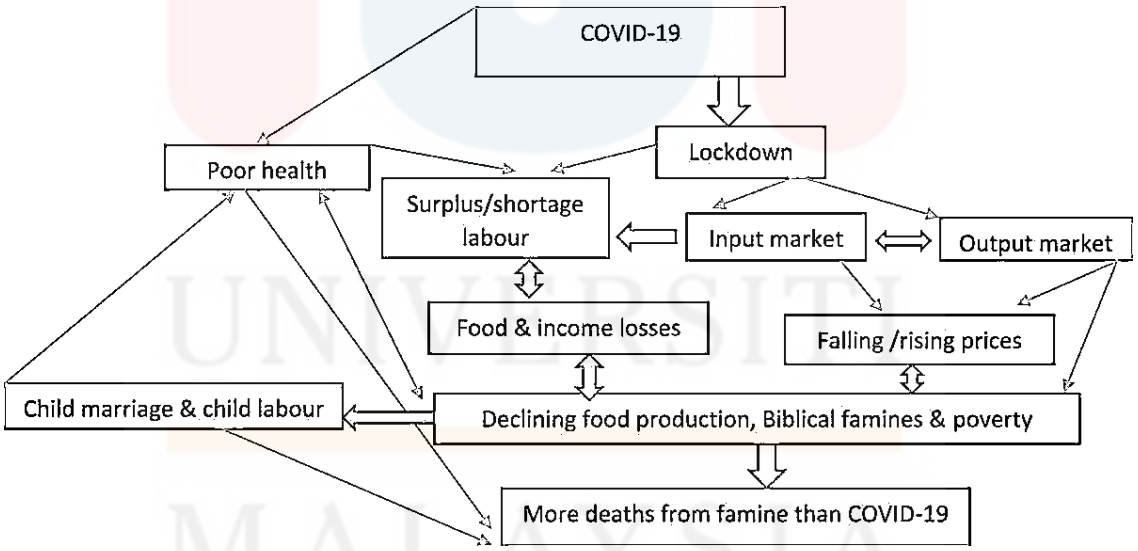

Figure 2.3: Potential impacts of COVID-19 on smallholders
(Source: Ingutia, 2021)

According to Figure 2.3, temporal consequences such as lockdowns render it more difficult for farmers to obtain needed inputs such as seeds, fertilizers, and field labour, leading farmers to skip planting and harvesting seasons (Ingutia, 2021). Smallholders are major food producers; if many of them are infected with COVID-19, this could significantly reduce food production. As a result, as seen in Figure 2.3, this can lead to food shortages, food stocks falling behind demand, rising food prices, and food crises, all of which have direct consequences for poverty, hunger, social instability, and stability (Devereux et al., 2020). Since they lack social safety nets, low productivity, and low savings and investment rates, poor smallholders are more vulnerable to economic shocks, including COVID-19 lockdown. Smallholders may resort to selling their equipment, land, and assets if they do not receive support, such as access to seeds, markets, finance, and social security schemes, leading to a temporary or permanent halt to their farming activities. As a result, employment losses have occurred, and an increase in population, which has led to a rise in child labour, child marriage, and lower school enrolment rates (Guido et al., 2020).

CHAPTER 3

METHODOLOGY

3.1 Instrumentation

A semi-structured survey questionnaire was developed and pre-tested. With a few slight adjustments, the final questionnaire was divided into several parts, each with several questions focusing on basic farmer information, farm management, marketing and action taken during COVID-19 pandemic. The questionnaire was prepared using livestock farm management and socio-economic information as shown in Appendix A.

3.2 Study site and sample size

This survey was conducted in 10 districts of Kelantan, which were Bachok, Gua Musang, Kota Bharu, Kuala Krai, Machang, Pasir Mas, Jeli, Tanah Merah, Pasir Puteh, and Tumpat. The smallholder livestock farmers were divided into four groups based on their landholdings: large (> 5 ha), medium (>2 ha and ≤5 ha), small (≤2 ha), and landless (0 ha) farmers. The age groups of smallholder livestock farmers were: (I) 6 to 17 years (young), 18 to 57 years (adult), and more than 57 years (old). Initially, some well-known livestock farmers in the surveyed areas were contacted about the survey. Their farm operations were investigated. A total of 111 smallholder livestock farmers were listed for this study, and the questionnaires were distributed to 111 smallholder livestock farmers in 10 districts of Kelantan. Smallholder livestock farmers were chosen from each of the selected districts, based on the concentration of livestock population.

These 111 livestock-raising households were chosen with the aim of forming a "livestock Farmers' Group" in each district (as livestock entrepreneurship).

3.3 Sampling procedure

This study was used non-probability sampling as the sampling procedure. Non-probability sampling is defined as a sampling technique where the researcher selects samples based on the researcher's subjective judgment rather than random selection. Non-probability sampling was used because when compared with probability sampling, the procedures used to determine units to be included in a sample were much more manageable, quicker, and cheaper. The sampling technique that was chosen under non-probability sampling was purposive sampling, where specific landholding categories of farmers were chosen and completed the survey. Parameters investigated in this survey are shown in Appendix A. Briefly, the monthly income, type of animals, feed cost, breeding cost, labor cost, amount of selling meat, and own consumption, as well as vaccine and parasite treatment cost, were investigated.

Each interview of this survey was conducted face to face only after the given consent of the respondents to attend the interview and was strictly followed the standard operating procedure (SOP) of the MCO. Only the respondents who was solely responsible for the farm has completed the survey. The survey was carried out by two rounds in 10 districts of Kelantan. The first round of the survey was conducted from September to November 2020, and the second round was from November to December 2021. Data were collected based on the responses of the respondents and after the interviewer has completed a thorough evaluation of the farm when it was necessary. Few questionnaires for this survey were conducted through online or phone when there

were ongoing concerns about the extent of the MCO that was imposed. Owners of local livestock farms, namely (i) Koperasi Usahawan Ternak Kelantan Berhad (D-5-0780) and (ii) Yusof Eco Farm, Felda Kemahang, Tanah Merah, had helped in the beginning and completion of this study.

3.4 Data analysis

After the data collection, the values of mean and percentage for each parameter were quantified, as well as standard deviation (SD) was determined using SPSS to analyze the data and answer the study's objectives. In order to meet the study's aims, a descriptive statistical analysis was performed. The descriptive statistical analysis was performed to create a significant difference among the landholding categories of respondents. However, the statistical analysis was not performed on some data obtained due to the lack of appropriate respondents' number.

CHAPTER 4

RESULTS & DISCUSSION

4.1 Demographics and socioeconomic characteristics

4.1.1 Origin of respondents

One hundred and eleven (111) respondents from 10 selected districts in Kelantan participated in the survey, of which 72% of respondents were farmers from small farm size (≤2ha), 11% of respondents from medium farm size (>2 ha), 10% of respondents from large farm size (≤5 ha), and only four percent (4%) of respondents from landless farm size (0 ha). The four districts with the greatest proportion of small farm size respondents were from: Bachok (15%), Kota Bharu (14%), Jeli (13%), and Tumpat (11%) as shown in Table 4.1. Meanwhile, medium and large farm size respondents were mostly from Gua Musang (36%) followed by Pasir Puteh (33%), and all respondents from landless farmers were from Kota Bharu, Pasir Mas, Tumpat, and Gua Musang, which was 25% for each district.

4.1.2 Gender and age

Results show 86% of the respondents being male farmers and 11% were female farmers. The respondents were classified into five categories based on their age: up to 30 years, 30-39 years, 40-49 years, 50-59 years, and >60 years. The observed age range of respondents was 16-71 years, with an average of 39.0 years. The statistical distribution of age is shown in Table 4.1. There were no significant (P>0.05) differences

in age of the farmers among all farm sizes. According to findings from the Centers for Disease Control and Prevention (CDC), the risk of severe illness and death from the COVID-19 virus increases with age. COVID-19 is more prone to cause severe illness in older people. People over the age of 65 accounts for more than 81% of COVID-19 deaths. The number of deaths among those aged 65 and over is 80 times higher than those aged 18 to 29 (CDC, 2021). As shown in the results of this survey, the majority (31%) of respondents in livestock business were not in the high-risk category, which are under 30 years of age.

4.1.3 Family members

Household size ranged from 1 to ≥6 family members per household, with the vast majority (22%) of respondents falling in the range of 1 to 2 family members and 20% of respondents having ≥6 family members. Followed by 14%, 13%, and 15% of respondents having 3, 4 and 5 households, respectively. The majority (67%) of respondents from landless farmers had ≥6 households, and 33% had only 1-2 households. Small farmers mostly (28%) had only 1-2 households, while 21%, 19%, 18%, and 15% of respondents from small farmers had 3, 4, 5, and ≥6 households, respectively. About 33%, 27%, 18%, 18% and 9% of medium farmers had 5, 4, 1-2, ≥6 and 3 household sizes, respectively. Meanwhile, about 50%, 25%, 13% and 13% of large farmers had ≥6, 1-2, 4 and 5 households, respectively. This indicates that respondents among all farm sizes had small (1-2 people) and large (6 or more people) household sizes.

4.1.4 Education

The educational level of respondents ranged from no formal schooling to graduate. The distribution of respondents according to their educational levels is shown in Table 4.1. Among the respondents of all farm sizes, two-thirds have completed secondary school (70%), with all of respondents (100%) from landless farmers and over half (55%) of respondents from small farmers having an education level at the secondary school. Followed by 58% of respondents from medium farmers and 70% of respondents from large farmers stated that they had an education level at the secondary school.

Meanwhile, 9% of respondents had completed primary school which the majority was medium farm size farmers (25%) followed by only 10% and 5% of respondents from large and small farmers had a primary school education level, respectively. About 20% of respondents had graduated, with the highest being from small farm size farmers (24%) and only 10% of respondents from large farmers. Another 2% of the respondents did not have any formal schooling, of which only 1% of respondents were from small farmers and 10% of respondents were from large farmers. This shows that the respondents among all farm sizes generally have received formal education from primary school until graduation.

4.1.5 Experience in raising livestock

The observed range of experience to raise livestock was 1–30 years, with the average being 7.3 years. As shown in Table 4.1, medium farmers had the longest (12.9 years) of experience in raising livestock followed by small and large farmers which had an average of 7 and 6 years of experience in raising livestock, respectively. Meanwhile, the landless farmers had an average of 4 years of experience in raising livestock. However, the results showed that there were no significant ($P>0.05$) differences in experience to raise livestock of the farmers among the farm sizes.

4.1.6 Monthly income

In terms of the monthly income, results showed the highest monthly income was the small farm size farmers which was RM6863 followed by large farm size farmers (RM4818), medium farmers (RM1710), and landless farm size farmers (RM1625). This implies that small farm size farmers generate more monthly income than other farm sizes. However, there was no significant ($P>0.05$) difference in monthly income among the farm sizes of the respondents because of a big difference in standard deviation among all farm sizes (Table 4.1).

Table 4.1: Demographic and socioeconomic characteristics of participants from livestock households across 10 districts in Kelantan during the MCO, according to farm size

Characteristics	Total	Farm size*				*p*-value
		Landless (%)	Small (%)	Medium (%)	Large (%)	
District						
Kota Bharu	12 (13)	25 (1)	14 (11)	0	9 (1)	
Bachok	11 (12)	0 (0)	15 (12)	0	0	
Pasir Puteh	10 (11)	0 (0)	10 (7)	33 (4)	0	
Pasir Mas	10 (11)	25 (1)	10 (8)	8 (1)	9 (1)	
Tumpat	11 (12)	25 (1)	11 (10)	8 (1)	9 (1)	
Machang	9 (10)	0 (0)	10 (8)	0	9 (1)	
Tanah Merah	10 (11)	0 (0)	8 (6)	17 (2)	9 (1)	
Jeli	9 (10)	0 (0)	13 (9)	0	9 (1)	
Kuala Krai	9 (10)	0 (0)	10 (7)	8 (1)	9 (1)	
Gua Musang	9 (10)	25 (1)	3 (2)	25 (3)	36 (4)	
Gender						
Male	86 (95)	100 (4)	88 (70)	83 (10)	100 (11)	
Female	11 (12)	0 (0)	13 (10)	17 (2)	0 (0)	
Age						
<30	31 (34)	33 (1)	38 (30)	18 (2)	13 (1)	
30-39	25 (28)	33 (1)	25 (20)	27 (3)	50 (4)	
40-49	14 (15)	0 (0)	14 (10)	18 (2)	38 (3)	
50-59	15 (17)	33 (1)	19 (15)	17 (2)	0 (0)	
60+	8 (8)	0 (0)	7 (5)	27 (3)	0 (0)	
Household size						
1-2 people	22 (24)	33 (1)	24 (19)	18 (2)	25 (2)	
3 people	14 (15)	0 (0)	18 (14)	9 (1)	0 (0)	
4 people	13 (14)	0 (0)	14 (10)	27 (3)	13 (1)	
5 people	15 (17)	0 (0)	15 (12)	27 (3)	13 (1)	
6 or more people	20 (21)	67 (2)	17 (13)	18 (2)	50 (4)	
Education						
No formal schooling	2 (2)	0 (0)	1 (1)	0 (0)	10 (1)	
Primary school	9 (8)	0 (0)	5 (4)	25 (3)	10 (1)	
Secondary school	70 (73)	100 (4)	69 (55)	58 (7)	70 (7)	
Graduate	20 (21)	0 (0)	25 (20)	0 (0)	10 (1)	
Experience to raise livestock (year)	7.3 ± 6.8 (91)	4.0 ± 2.6 (4)	7.0 ± 7.1 (69)	12.9 ± 6.6 (8)	6.0 ± 3.6 (10)	0.079
Monthly income, RM	5922 ± 34729 (101)	1625 ± 946 (4)	6863 ± 39993 (76)	1710 ± 534 (10)	4818 ± 5640 (11)	0.966

Figures in parenthesis indicate number of respondents. Mean ± standard deviation.

4.2 Types of animals

4.2.1 Cow

As shown in Table 4.2, the most common ruminant livestock raised among the respondents was cow (56) followed by goat (38) and sheep (24). The average number of young cows raised by respondents was the highest from medium farm size which was 10 animals followed by large, landless, and small farm sizes which the average number of young cows were 9.9, 7.5 and 5.2 animals respectively. While, the highest average number of adult cows was from a large farm size (21.7 animals) followed by medium and small farm sizes which were 17.0, and 9.5 animals of adult cows, respectively. Meanwhile, only one respondent from a landless farm size had 17 adult cows. The total average number of cows among all farm sizes was 19.4 cows. Though, there were no significant ($P>0.05$) differences in total cows among farm sizes of the respondents.

4.2.2 Goat

Similarly, the average number of young goats raised by respondents was the highest from medium farm size which was 13 animals followed by large and small farm sizes which the average number of young goats were 12.3 and 7.3 animals, respectively. While, the highest average number of adult goats was from a large farm size (25.7 animals) followed by small and medium farm sizes which average of adult goats were 15.1 and 8.8 animals, respectively. Landless farm size was excluded from the analysis as there was only one respondent, with total number of 40 goats including young (20 goats) and adult goats (20 goats). However, there were no significant ($P>0.05$) differences in total goats among all farm sizes of the respondents.

4.2.3 Sheep

The highest average total number of sheep was from medium farm size (37 animals) with the average number of young and adult sheep being 20 and 17 animals, respectively. The average numbers of young and adult sheep from small farm size were 8.3 and 13.4, respectively, whereas the average numbers of young and adult sheep from large farm size were 5.5 and 6.5, respectively. Meanwhile, there was no respondent from landless farm size. Due to the number of respondents in sheep being less than 3 respondents hence a statistical analysis was not performed (Table 4.2).

Table 4.2: Ruminant livestock population from livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Species	Total	Farm size*				*p*-value
		Landless (%)	Small (%)	Medium (%)	Large (%)	
Cow						
Young	7.4 ± 7.4 (44)	7.5 ± 3.5 (2)	5.2 ± 3.8 (23)	10.0 ± 9.0 (10)	9.9 ±11.7 (11)	0.133
Adult	13.9 ± 13.4 (51)	17*	9.5 ± 8.6 (28)	17.0 ± 15.0 (11)	21.7 ± 18.3 (11)	0.023
Total	19.4 ± 18.9 (56)	24.0 ± 15.1 (3)	12.9 ± 11.3 (31)	26.1 ± 21.1 (11)	29.8 ±27.9 (11)	0.030
Goat						
Young	9.3 ± 6.6 (32)	20*	7.3 ± 3.8 (21)	13.0 ± 10.3 (4)	12.3 ± 9.2 (6)	0.091
Adult	16.4 ± 16.2 (33)	20*	15.1 ± 13.7 (22)	8.8 ± 5.3 (4)	25.7 ± 26.6 (6)	0.239
Total	24.2 ± 18.0 (38)	40*	21.5 ± 14.1 (26)	18.4 ± 14.8 (5)	38.0 ± 29.8 (6)	0.099
Sheep$^{\beta}$						
Young	9.2 ± 9.6 (19)	-	8.3 ± 8.5 (15)	20.0 ± 18.4 (2)	5.5 ± 6.4 (2)	-
Adult	12.1 ± 12.5 (21)	-	12.2 ± 12.8 (17)	17.0 ± 18.4 (2)	6.5 ± 4.9 (2)	-
Total	20.8 ± 19.8 (24)	-	20.1 ± 19.0 (20)	37.0 ± 36.8 (2)	12.0 ± 11.3 (2)	-

*Only one respondent; $^{\beta}$Statistical analysis was not performed due to lack of respondent number. Figures in parenthesis indicate the number of respondents.

4.2.4 Non-ruminant animals

Among all farm sizes, small farm size had most of respondents who raised the non-ruminant livestock. As shown in Table 4.3, small farm size had the average total number of 7806 broiler chicken, 570 village chicken, 135 duck, 3000 quail and 106 rabbit. Medium farmers which had two respondents with an average number of 461 village chicken and 7850 quail. While, only one respondent had 500 chicken (broilers and layers), 5000 ducks and 200 rabbits. Large farmers also had only one respondent who had 10 village chicken and 2 rabbits, followed by only one respondent who had 400 chicken layer and 8 village chickens. Due to the lack of respondent data on non-ruminant livestock among all farm sizes, hence, statistical analysis was not performed.

Table 4.3: Non-ruminant livestock population from livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Species	Farm size*				*p*-value
	Landless (%)	Small (%)	Medium (%)	Large (%)	
Chicken					
Broiler	-	7805.8 ± 12613.0 (5)	500 (1)	-	-
Layer	400 (1)	-	500 (1)		
Village	8 (1)	569.7 ± 1912.3 (22)	461 ± 620.8 (2)	10 (1)	-
Duck	-	135.0 ± 230.0 (4)	5000 (1)	-	-
Quail	-	3000 ± 2828.4 (2)	7850.0 ± 10111.6 (2)	-	-
Rabbit	-	106.2 ± 138.6 (25)	200 (1)	2 (1)	-

Figures in parenthesis indicate the number of respondents.

4.3 Reasons for farming

Based on Table 4.4, the result showed that 85% of the respondents chose their reason for farming was to generate revenue, with all respondents (100%) from landless and medium farmers, said yes. About 88% and 82% of respondents from small and large farmers, said yes, that their farming was to generate revenue. Followed by the main reason for farming was the sale of live animals (58%), which 64% and 63% of respondents were from large and small farmers. Half of the respondents (50%) from medium farmers said yes, and only 25% of respondents from landless farmers said yes that their main reason for farming was to sale of live animals. Results also showed that 18% of the respondents' reason for farming was food for the family, with 36% of respondents from large farmers said yes and 25% of respondents from medium and small farmers said yes. Another 18% of respondents were from small farmers who said yes that their farming was food for the family.

Besides, respondents also stated their reasons for farming includes the sale of livestock products (15%), which 42% and 36% of respondents from medium and large farmers, said yes. Only 13% of respondents from small farmers said yes that one of their reasons for farming was the sale of livestock products, and there were no respondents from landless farmers. This may be because landless farmers do not have many animals to produce livestock products. Hence, they only focus on selling live animals and for meat, dairy, or eggs. About 16% of respondents among all farm size said yes that traditional activity was their reason for farming, with 20% of respondents from small farmers and only 17% of respondents from medium farmers said yes. Meanwhile, there were no respondents from both large and landless farmers.

Some respondents (10%) among all farm sizes said yes that their reason for farming was the use for festivals such as Eid al-Adha and Ramadan, which most of the respondents (33%) from medium farmers said yes, and only 9% of respondents from small farmers said yes. Likewise, there were no respondents from both large and landless farmers. Only 8% of respondents among all fam sizes said yes that their reason for farming was to cope with lowered agricultural revenue with only 10% and 9% of respondents from small and large farmers said yes. Meanwhile, there were no respondents from medium and landless farmers.

Only 1% of respondents among all farm sizes chose their reason for farming was the social status, which was 9% of respondents from large farmers, said yes. Meanwhile, there were no respondents from landless, small and medium farmers. There were also 15% of respondents among all farm sizes who stated the other reasons for farming, for example, to help their community and rearing livestock as a hobby, which 18% of respondents were from small farmers. About 25%, 9% and 8% of respondents from large, medium, and landless farmers mentioned that they had the other reasons for farming, and it was a hobby and helping the community. This shows that the main purpose of smallholder livestock farmers in Kelantan rearing animals during the MCO was to generate revenue and sale of live animals.

Table 4.4: Reasons for farming from livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Species	Total (%)	Farm size*			*p*-value
		Landless (%)	Small (%)	Medium (%)	Large (%)
Generate revenue	85 (94/107)	100 (4/4)	87 (69/80)	100 (12/12)	82 (9/11)
Food for family	18 (22/107)	25 (1/4)	18 (14/80)	25 (3/12)	36 (4/11)
Sale of live animal	58 (64/107)	25 (1/4)	63 (50/80)	50 (6/12)	64 (7/11)
Sale of livestock product	15 (17/103)	0 (0)	13 (10/80)	42 (5/12)	36 (4/11)
Use for festival	10 (11/92)	0 (0)	9 (7/80)	33 (4/12)	0 (0)
Cope with lowered agricultural revenue	8 (9/91)	0 (0)	10 (8/80)	0 (0)	9 (1/11)
Traditional activity	16 (18/92)	0 (0)	20 (16/80)	18 (2/12)	0 (0)
Social status	1 (1/11)	0 (0)	0 (0)	0 (0)	9 (1/11)
Others	18 (17/107)	25 (1/4)	18 (14/80)	8 (1/12)	9 (1/11)

Figures in parenthesis indicate the number of respondents.

4.4 Farm management

4.4.1 Feeds and feeding

The descriptive result for farm management is shown in Table 4.5. The highest proportion of feeding systems (38%) among all farm sizes was ‘only feeding’, which 45% were mainly practiced by small farmers. About 24% of respondents practiced ‘mainly feeding, some grazing/scavenging’ feeding system, which majority (31%) were practiced by large farmers. Some respondents practiced ‘mainly grazing, some feeding’ feeding system (23%), which was widely practiced by medium farmers (24%). Only

15% of respondents practiced the 'grazing/scavenging' feeding system, which 50% mainly practiced by landless farmers. This suggests most farmers practice only feeding and less grazing/scavenging during the MCO.

In terms of the type of feeding, most (61%) of the respondents practiced limited feeding which the majority were practiced by landless farmers (75%) and small farmers (66%) followed by medium farmers (36%) and large farmers (40%). In contrast, 39% of respondents practiced unlimited feeding, whereas 64%, 60%, 34% and 25% of respondents for medium, large, small and landless farmers were mainly practiced unlimited feeding. This suggests that farmers prefer limited feeding to animals. Perhaps it was an austerity measure due to the difficulty of getting feed supply throughout the MCO.

The majority (94%) of respondents said yes that they purchased feed for livestock, which 100% of respondents who said yes were large and landless farmers followed by 98% and 67% of respondents from small farmers and medium farmers. In contrast, only 6% of respondents said they do not purchase feed, which mainly 33% of respondents from medium farmers and only 3% of respondents from small farmers. This indicates the majority of farmers managed to obtain feed supply during the MCO.

The average cost of monthly purchased feed among all farm sizes was RM1373, with large farmers having the highest average cost, RM2800 per month. The second-highest average cost of monthly purchased feed was RM1702 from the medium farmers, followed by small farmers, having an average cost of RM1195 per month. Lastly, landless farmers had the average cost of monthly purchased feed amount RM133. This may be because large and medium farmers had many more animals to be fed than other farm sizes farmers; therefore, they had the highest average cost of purchased feed per

month than other farm sizes farmers. However, there was no significant (P>0.05) difference in the average cost of monthly purchased feed among the farm sizes of the respondents.

Table 4.5: Feeding system from livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Species	Total (%)	Farm size*				*p*-value
		Landless (%)	Small (%)	Medium (%)	Large (%)	
Feeding system						
Grazing/scavenging	15 (17/107)	50 (2/4)	10 (8/80)	27 (4/12)	23 (3/11)	
Mainly grazing, some feeding	23 (26/103)	0 (0)	24 (19/80)	27 (4/12)	23 (3/11)	
Mainly feeding, some grazing/scavenging	24 (27/107)	25 (1/4)	24 (19/80)	20 (3/12)	31 (4/11)	
Only feeding	38 (42/107)	25 (1/4)	45 (35/80)	27 (4/12)	23 (3/11)	
Type of feeding						
Limited feeding	61 (63/107)	75 (3/4)	66 (52/80)	36 (4/12)	40 (4/11)	
Unlimited feeding	39 (40/107)	25 (1/4)	34 (27/80)	64 (7/12)	60 (6/11)	
Purchase feed						
Yes	94 (101/107)	100 (4/4)	98 (78/80)	67 (8/12)	100 (11/11)	
No	6 (6/92)	0 (0)	3 (2/80)	33 (4/12)	0 (0)	
Purchase feed (RM/month)	1373 ± 3227 (95)	133 ± 83 (4)	1195 ± 2992 (73)	1702 ± 3666 (7)	2800 ± 4714 (11)	0.391

Figures in parenthesis indicate the number of respondents.

4.4.2 Breeding

Based on Table 4.6, over half (56%) of respondents from all farm sizes practiced both natural mating and artificial insemination (AI) for their breeding method, with landless farmers 100% highly practicing both breeding methods. The only AI breeding method was mostly practiced by small farmers (20%) followed by large farmers (18%) and medium farmers (17%). The only natural mating breeding method had 17% of respondents among all farm sizes who practice it, which was widely practiced by medium farmers (33%) followed by large farmers (27%) and small farmers (14%). Another 9% of respondents among all farm sizes practiced the selection of animal as their breeding method, which mostly practiced by medium landholding farmers (17%) followed by large farm size (9%) and small farm size (8%) who practiced the selection of animal as their breeding method. This shows that most farmers had successfully acquired knowledge and practiced both breeding methods, natural mating and AI, which can help develop their livestock farm or business during the MCO.

When asked respondents among all farm sizes if they had incurred any cost for breeding, 60% and 50% of respondents from large farmers and landless farmers said yes, respectively. About 40% and 33% of respondents from small farmers and medium farmers stated that they had incurred the cost for breeding. However, respondents who said no, when asked if they had incurred any cost for breeding were mainly medium farm size (67%) followed by small farm size (60%), large farm size (40%) and landless farmers (50%), who had not incurred the cost for breeding. This shows that during the MCO, most landless and large farmers had incurred costs for breeding on their farms, while small and medium farmers incurred less cost for breeding.

As shown in Table 4.6, the average incur cost for breeding per month among all farm sizes was RM1318, with medium farm sizes having the highest average cost (RM5467) per month. For small, landless and large farm sizes, the average incur cost for breeding were RM1072, RM550 and RM466 per month, respectively. Though, there were no significant (P>0.05) differences in incur cost for breeding per month among respondents of all farm sizes.

Table 4.6: Breeding method from livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Species	Total (%)	Farm size*				*p*-value
		Landless (%)	Small (%)	Medium (%)	Large (%)	
Practice breeding method						
Selection of animal	9 (9/103)	0 (0)	8 (6/80)	17 (2/12)	9 (1/11)	
Only natural mating	17 (18/103)	0 (0)	14 (11/80)	33 (4/12)	27 (3/11)	
Only AI	18 (19/103)	0 (0)	20 (15/80)	17 (2/12)	18 (2/11)	
Natural mating & AI	56 (58/107)	100 (4/4)	58 (44/80)	42 (5/12)	45 (5/11)	
Incur any cost for breeding						
Yes	38 (44/107)	50 (2/4)	40 (32/80)	33 (4/12)	60 (6/11)	
No	63 (62/107)	50 (2/4)	60 (48/80)	67 (8/12)	40 (4/11)	
Incur cost for breeding (RM)	1318 ± 3038 (37)	550 ± 636 (2)	1072 ± 2287 (27)	5467 ± 8271 (3)	466 ± 491 (5)	0.049

Figures in parenthesis indicate the number of respondents.

4.4.3 Labour service

The findings revealed that the highest percentage (81%) of respondents raised livestock on their own, with 100% and 83% of respondents from landless and small farm sizes followed by, 67% and 737% of respondents from medium and large farm sizes, said they raised livestock on their own. Meanwhile, 18% and 17% of respondents from large and medium farm sizes had a higher percentage who responded to raising

livestock by a non-family member. About 14% of respondents among all farm sizes stated the livestock were raised by both own and non-family, with medium farmers having a higher percentage (17%) of respondents. Followed by 15% and 9% of respondents from small and large farmers stated the livestock were raised by both own and non-family. This may be due to the huge farm size by large and medium farmers who may need manpower to help manage the farm as they have a larger number of animals than other farm sizes.

The average cost for hired labour per month among all farm sizes was RM2631, with small farm sizes having the highest average cost RM2143 per month. Followed by medium and large farmers, the average costs for hired labour were RM1167 and RM933 per month, respectively. Meanwhile, only one respondent from landless farmers had cost RM1200 per month for hired labour. Though, there were no significant ($P>0.05$) differences in cost for hired labour per month among farm sizes of the respondents.

As shown in Table 4.7, 100% of respondents from landless farm size hired labour for a continuous duration. Small farm size had the most (32%) of respondents stated they hired labour for only 1 month duration followed by 28%, 22%, 17% and 6% of respondents hired labour for 3 months, continuous, 6 months and 12 months, respectively. Meanwhile, medium farm size mostly (66%) hired labour for 3 months, and another 33% of respondents hired labour for 12 months and continuous duration. The majority (50%) of respondents from large farmers hired labour for a continuous duration and the other 25% of respondents hired labour for 1 to 3 months. This indicates that most of the respondents among all farm sizes preferred to have the continuous duration for labour services to manage the farm, not only for the short time.

Table 4.7: Labor service from livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Species	Total (%)	Farm size*				*p*-value
		Landless (%)	Small (%)	Medium (%)	Large (%)	
Raise livestock by						
Own	81 (84/107)	100 (4/4)	83 (64/80)	67 (8/12)	73 (8/11)	
Non-family member	7 (7/103)	0 (0)	4 (3/80)	17 (2/12)	18 (2/11)	
Both	14 (15/103)	0 (0)	15 (12/80)	17 (2/12)	9 (1/11)	
Cost for hired labour (RM/month)	2631 ± 3875 (24)	12000*	2143 ± 3243 (15)	1167 ± 351 (3)	933 ± 230 (3)	0.732
Duration for hired labour (month)						
1 month	26 (8/103)	0 (0)	32 (7/80)	0 (0)	25 (1/11)	
3 months	29 (9/103)	0 (0)	28 (6/80)	66 (2/12)	25 (1/11)	
6 months	10 (3/80)	0 (0)	17 (3/80)	0 (0)	0 (0)	
12 months	8 (2/92)	0 (0)	6 (1/80)	33 (1/12)	0 (0)	
Continuous	29 (9/107)	100 (1/4)	22 (5/80)	33 (1/12)	50 (2/11)	

*Only one respondent.

4.5 Production of livestock products

4.5.1 Meat

As shown in Table 4.8, the findings revealed that most large farmers (40%) sell their meat at the local market and trader, and the other 20% of respondents sell the meat through neighbours. About 36% of respondents from medium farmers said they sell meat to traders, 24% of respondents sell the meat at the butcher and through neighbours, and another 17% sell the meat at the local market. Followed by small farmers which most of respondents (30%) sell the meat to the trader, 19%, 15%, and 12% of

respondents sell meat at local market, butcher, and neighbours, respectively. Another 27% sell the meat at different places, for example, through online platform, social media or bookings. Meanwhile, landless farmers had majority (29%) of respondents said they sell the meat mainly at the local market and butcher, while the other 14% of respondents sell the meat to trader, neighbour and other places. Overall, most (32%) of respondents among all farm sizes sell the meat to the butcher, 20% of respondents sell at the local market, followed by 16% and 14% of respondents sell the meat to butcher and though neighbours and the others 19% of respondents sell the meat at other places such as social media and online bookings during the MCO.

The total average income of selling meat per month among all farm sizes was RM9929, with large farms having the highest average income which is RM25533 per month. Medium farm size also had a high average income of selling meat per month which was RM 15278 followed by small farm size RM7294 and landless farm size RM2667. However, there was no significant ($P>0.05$) difference in monthly meat-selling income among the farm size of the respondents.

The findings also revealed the total average amount of meat for own consumption per month among all farm sizes was 106.6 kg, which landless farmers having the highest average amount of meat for their own consumption of 100.5 kg per month. Followed by small, medium, and large farmers which had the average own consumption of meat 59 kg, 10.7 kg and 3.3 kg per month, respectively. This indicates landless farmers use most of the meat for their own consumption and large farmers use the meat mainly for selling and less use for their own consumption during the MCO.

4.5.2 Milk

About 44% of respondents among all farm sizes stated their primary use of milk was for self-consumption and sale, while another 12% of respondents among all farm sizes said they use it for processing. All of respondents from landless farmers (100%) mainly use milk for self-consumption followed by small farmers who mostly use milk for sale (57%) and self-consumption (43%). The majority of respondents (50%) from medium farm size said they used milk for sale and the others 25% said they used milk for self-consumption and processing. Meanwhile, majority (50%) of respondents from large farm size said that they used milk for self-consumption. Another 33% and 17% of respondents from larger farm size used milk for sale and processing. This reveals that most respondents among all farm sizes mainly use milk for self-consumption and sale, which were similar to a previous study of cross-sectional survey in Pakistan, reported that most respondents who raised livestock—47.1% raised livestock for milk only for self-consumption and 33.4% sold the milk (ADB, 2020).

When respondents among all farm sizes were asked about selling the milk, 100% of respondents from medium farm size said yes, while small farm size, 43% of respondents said they sold the milk, and the other 57% of respondents said they were not. Followed by large farmers who had 67% of respondents stated they sold the milk, and 33% of respondents were not. Meanwhile, 100% of respondents from landless farm size did not sell the milk. This indicates that most of the respondents among all farm sizes had sold the milk production from the animals during the MCO except the landless farmers.

Among all farm sizes, the total average milk yield was 278.3 L per day, with small farmers having the highest average milk yield, 205.4 L per day. Followed by medium and large farmers with an average of 9 L and 6.5 L milk yield per day, respectively. Meanwhile, there was only one respondent from landless farmers who yield 200 L per day. Due to lack of data and low number of respondents, hence statistical analysis was not performed (Table 4.8).

The average milk sales among all farm sizes were 8.8 L per day, which small farm size had the highest average of milk sales, 11 L per day. Meanwhile, medium farm size had an average of 8.5 L milk sales per day, and large landholding farmers had an average of 5.8 L milk sales per day. Similarly, landless farmers had no data obtained, and due to lack of data and low number of respondents, the statistical analysis was not performed.

4.5.3 Egg

Based on Table 4.8, 80% of respondents among all farm sizes produced eggs at the farm, which landless farmers had the highest percentage (67%) of respondents producing eggs, and the other 33% of respondents were not. Meanwhile, small landholding farmers had 79% of respondents who were involved to produce eggs, and 25% of respondents were not. All medium and large landholding farmers (100% of respondents) were involved to produce eggs from their poultry. This shows that the majority of respondents among all farm sizes were involved to produce eggs from the poultry in the farm during the MCO.

The average income from egg selling among all farm sizes was RM1196.3 per month, with small farmers having an average income of RM733.6 per month. There was only one respondent from landless farm size who had an income of RM4050 of egg selling per month. Meanwhile, there were no data obtained from medium and large landholding farmers. Hence, a statistical analysis was not performed due to a lack of data and the number of respondents.

Results also showed the total average number of eggs for their own consumption per month among all farm sizes was 63.6 eggs, with small farmers having an average of 52.7 eggs per month for their own consumption. There was only one respondent from medium and large landholding farmers who had used 200 and 25 eggs for their own consumption per month, respectively. Similarly, no data was obtained from landless farmers and due to a lack of data and the number of respondents, a statistical analysis was not performed.

Table 4.8: Selling information in participants from livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Parameter		Total (%)	Farm size*			*p*-value
			Landless (%)	Small (%)	Medium (%)	Large (%)	
Meat	Where sells the meat?						
	Local market	20 (22)	29 (2)	19 (13)	17 (3)	40 (4)	
	Butcher	16 (17)	29 (2)	15 (11)	24 (4)	0	
	Trader	32 (33)	14 (1)	30 (22)	36 (6)	40 (4)	
	Neighbour	14 (16)	14 (1)	12 (9)	24 (4)	20 (2)	
	Others	19 (21)	14 (1)	25 (20)	0	0	
	Amount of selling meat (RM/month)	9929 ± 20315 (62)	2667 ± 2082 (3)	7294 ± 14404 (44)	15278 ± 18468 (9)	25533 ± 47513 (6)	0.158
	Own consumption of meat (kg/month)	106.6 ± 370.6 (30)	100.5 ± 1413.5 (2)	59.0 ± 119.3 (19)	10.7 ± 10.7 (6)	3.3 ± 2.5 (3)	0.472
Milk	Main use of milk						
	Self-consumption	44 (8)	100 (1)	43 (3)	25 (1)	50 (3)	
	Sale	44 (8)	0	57 (4)	50 (2)	33 (2)	
	Processing	12 (2)	0	0	25 (1)	17 (1)	
	Selling of milk						
	Yes	54 (8)	0	43 (4)	100 (2)	67 (2)	
	No	47 (7)	100 (1)	57 (5)	0	33 (1)	
	Milk yield (L/d)	278.3 ± 644.1 (7)	200 (1)	205.4 ± 4442.2 (5)	9.0 ± 8.5 (2)	6.5 ± 4.9 (2)	
	Milk sale (L/d)	8.8 ± 7.1 (7)	0	11 ± 8.5 (3)	8.5 ± 9.2 (2)	5.8 ± 6.0 (2)	
Egg	Produce egg at the farm						
	Yes	80 (16)	67 (2)	79 (11)	100 (2)	100 (1)	
	No	20 (4)	33 (1)	25 (3)	0	0	
	Income from egg selling (RM/month)	1196.3 ± 1547.0 (8)	4050 (1)	788.6 ± 1113.9 (7)	0	0	
	Own consumption of egg (no./month)	63.6 ± 72.1 (11)	0	52.7 ± 62.1 (9)	200 (1)	25 (1)	

*Statistical analysis was not performed due to only one respondent.

4.6 Livestock management

4.6.1 Diseases

As shown in Table 4.9, when respondents were asked if the animals had suffered any disease, over half (53%) of respondents among all farm sizes said yes and another 49% of respondents said no. The highest percentage of respondents who said yes that the animals had suffered any disease were landless farmers (75%) and small landholding farmers (56%). Meanwhile, the highest percentage of respondents who said no, that means the animals had not suffered any disease and they were medium (67%) and large landholding farmers (55%). This suggests that animals from landless and small landholding farmers are easily prone to disease possibly due to the unsatisfactory farm environment.

Some of the diseases that were affected the animals as said by the respondents during COVID-19 pandemic was Haemorrhagic septicaemia, Newcastle Disease, Contagious Ecthyma, FMD, cold, lice, diarrhea, bloat, worm, cough, eye infection, nail diseases, pop eyes, fever, loss of appetite, and paralyzed.

4.6.2 Vaccination

The majority (60%) of the respondents among all farm sizes performed the vaccination to the animals on the farm, with large landholding farmers having the highest percentage (82%) of respondents. Medium landholding farmers also have a high percentage (81%) of respondents who performed the vaccination on the farm followed by small landholding farmers (51%) and landless farmers (50%). Another 42% of respondents said they did not perform any vaccination, with landless farmers having the highest percentage (50%) of respondents. Small farmers also have a high percentage

(49%) of respondents who did not perform the vaccination on the farm followed by medium (20%) and large landholding farmers (18%). This indicates that large and medium landholding farmers mainly were aware of the importance of animal health management thus performed the vaccination program on their farm and successfully obtained the vaccine during the MCO. Moreover, according to Uddin et al. (2011), dairy farmers who implemented vaccines and medications earned 14.3% more than those who did not use vaccines and medications. As a result, an effective vaccination program should be constructed for all farmers to follow.

Few vaccines and medicines were used on-farm by respondents among all farm sizes, which were mainly the vaccine for Newcastle disease, FMD, vitamin, deworming, antibiotics, HS, smallpox, Brucellosis, the vaccine for broiler, Idectin/Doramectin, black quarter, and anthrax.

4.6.3 Parasite treatment

The majority (60%) of respondents among all farm sizes said they had not used parasite treatment on the farm, which most (60%) of respondents from small landholding farmers said they had not used. Most of the respondents from large and medium landholding farmers also said they had not used parasite treatment on the farm, which 55% and 45% of respondents, respectively. Landless farmers had the least percentage (33%) of respondents who said they had not used parasite treatment, which means most (67%) of respondents from landless farmers said they had used parasite treatment on their farm. Other respondents from medium, large and small landholding farmers also had 55, 45 and 41% of respondents, respectively, said they used parasite treatment on their farm. This indicates that farmers with large, medium and small farm sizes use less parasite treatment on their farms than landless farmers.

The total average spending for vaccine and parasites per year of all respondents among all farm sizes was RM380, with large and landless farmers having the highest average spend per year, RM747 and RM740, respectively. While medium farmers had an average spend of RM385 per year followed by small landholding farmers with an average spend of RM282 per year for vaccines and parasites. This shows that large landholding and landless farmers had spent more on vaccines and parasites treatment on their farms compared to medium and small farmers. This may be due to a greater number of animals needing to be taken care of on the farm for vaccine and parasite treatment.

4.6.4 Lost animal

As shown in Table 4.9, most (52%) of the respondents said they had lost animals per year on the farm, possibly due to disease, sickness, escaping, natural calamity, predators, injury, theft, and other reasons. About 55% and 53% of respondents from medium and small landholding farmers said they had lost animals over a year followed by 50% and 45% of respondents from landless and large landholding farmers, respectively. Meanwhile, 48% of respondents among all farm sizes said they had not lost any animals over the year, with most (55%) of the respondents were from large farm sizes and another 50% of respondents from landless farmers followed by 45% and 47% of respondents from small and medium landholding farmers, respectively. This shows that regardless of the size of the farm small to large, farmers will still experience the loss of animals during the MCO due to the reasons mentioned earlier.

4.7 Waste management

4.7.1 Use of manure

The result shows that 72% of respondents among all farm sizes said yes that they use manure for certain purposes. All (100%) of the respondents from landless farmers and 91% of respondents from large farmers said yes, that they use manure for certain purposes on the farm followed by 69% and 66% of respondents from small and medium landholding farmers who use manure for certain purposes. Meanwhile, 29% of respondents among all farm sizes did not use manure on the farm, with 33% and 32% of respondents from medium and small landholding farmers and only 9% of respondents from large landholding farmers said they had not use manure. This suggests that most farmers had practiced the use of manure on the farm for a certain purpose.

4.7.2 Purpose of using manure

The majority (90%) of respondents among all farm sizes said that the purpose of using manure on the farm was for fertilizer, which all (100%) of the respondents from landless and large landholding farmers said they use manure for fertilizer purposes. Followed by 88% of respondents from small and medium landholding farmers stated that they used manure for fertilizer purposes. Meanwhile, only 10% respondents for all farm sizes said that they used the manure for sale, of which the minority (12%) of respondents was from small and medium landholding farmers. This shows that most of the respondents among all farm sizes used manure on farms mainly for fertilizer, and few other respondents used manure for sale.

Table 4.9: Livestock management in livestock households across 10 districts in Kelantan during the MCO, according to farm size.

Parameter	Total	Farm size*				*p*-value
	(%)	Landless (%)	Small (%)	Medium (%)	Large (%)	
Diseases						
Yes	53 (57)	75 (3)	56 (45)	36 (4)	45 (5)	
No	49 (50)	25 (1)	48 (35)	67 (8)	55 (6)	
If yes, diseases name	Haemorrhagic septicaemia, Newcastle Disease, Contagious Ecthyma, FMD, cold, lice, diarrhea, bloat, worm, cough, eye infection, nail diseases, pop eyes, fever, loss of appetite, paralyzed					
Vaccination						
Yes	60 (61)	50 (2)	51 (41)	82 (9)	82 (9)	
No	42 (41)	50 (2)	49 (35)	20 (2)	18 (2)	
If yes, vaccine & medicine names	Newcastle disease, FMD, vitamin, deworming, antibiotic, HS, smallpox, Brucellosis, vaccine for broiler, Idectin/Doramectin, black quarter, anthrax,					
Parasite treatment						
Yes	44 (46)	67 (2)	41 (33)	55 (6)	45 (5)	
No	60 (59)	33 (1)	60 (47)	45 (5)	55 (6)	
Spend for vaccine & parasite (RM/year)	380 ± 696 (50)	740 ± 368* (2)	282 ± 532 (32)	385 ± 320 (7)	747 ± 1451 (7)	0.308
Treatment						
Yes	27 (24)	50 (2)	22 (15)	22 (2)	63 (5)	
No	74 (66)	50 (2)	78 (54)	77 (7)	37 (3)	
Treatment cost (RM/year)	268±291 (15)	1000 (1)	179±173 (11)	750 (1)	150±71 (2)	
Lost animal						
Yes	52 (55)	50 (2)	53 (42)	55 (6)	45 (5)	
No	48 (50)	50 (2)	47 (37)	45 (5)	55 (6)	
Use of manure						
Yes	72 (77)	100 (4)	69 (55)	66 (8)	91 (10)	
No	29 (30)	0	32 (25)	33 (4)	9 (1)	
Purpose of using manure						
Fertilizer	91 (77)	100 (4)	88 (55)	88 (8)	100 (10)	
Sale	10 (8)	0	12 (7)	12 (1)	0	

*Statistical analysis was not performed due to only two respondents.

4.8 COVID-19 impacts to smallholder farmers

4.8.1 COVID-19 exposure and preventive measures

Based on Table 5.1, the findings revealed that 15% of respondents said that their community had been affected by COVID-19, and 13% of respondents said that there were positive COVID-19 cases identified in their community. This suggests that most respondents were less affected by the COVID-19 outbreak, possibly due to the less densely populated area than the downtown area. This will make the individuals in the community have good social distancing while interacting with each other, and the standard operating procedure (SOP) can be maintained. Thus, fewer COVID-19 cases were identified and the community of the respondents among all farm sizes were less affected by the COVID-19 outbreak.

On another bright sight, a large number (92%) of respondents among all farm sizes were aware of the COVID-19 outbreak that was happening around the world. Only 7% of respondents among all farm sizes did not receive awareness about COVID-19. This indicates that responders of all farm sizes appear to have a high degree of awareness about the COVID-19 outbreak in the community. It could signify that the government's public awareness campaign and programs have reached the community. This is in line with a previous study of the effects of COVID-19 policies on livelihoods and food security of smallholder farm households in Nigeria, which found that over 75% of respondents believe the virus is widespread, while only 9% do not believe the pandemic is real (Balana et al., 2020).

When respondents were asked if the community had imposed any preventive measures against COVID-19 such as washing hands, wearing a mask and physical distancing, over half (56%) of respondents among all farm sizes had successfully taken

preventive measures against COVID-19 and another 41% of respondents did not. Similarly, according to the previous study, found that over 85% of respondents expressed concern about the possibility of contracting the disease towards themselves or family members, so they appear to be taking preventive measures (Balana et al., 2020).

4.8.2 Changes in farm or business

Based on Figure 4.1, over half (56%) of respondents stated that they were facing decreased demand for products, and 50% of respondents were having a reduced income. Followed by 30% of respondents having financial losses, 15% having decreased price of products, and 10% of respondents having other related changes in the farm or business. Only a few respondents stated they were having no effects (6%) and shortage of workers (1%). This shows similarity with previous study of the impact of the COVID-19 pandemic on smallholder and medium-scale dairy cattle farmers in Ethiopia, which found the majority of dairy producers reported decreased demand for cow milk as a reason for the lower volume of milk sold, expressing concern that COVID-19 could be spread via contaminated milk at the farm level or during transaction. About 75% of respondents said that movement restrictions had caused the drop in raw milk available for sale. Furthermore, milk sale prices to consumers/processors had declined dramatically, with 46% of farmers and respondents reporting the decline. This was caused by the reduced demand of milk in Ethiopia (Meseret et al., 2021), and another previous study, also found that due to a decrease in meat supply, meat prices jumped by 21.7% by the end of May 2020; pork and chicken prices increased by 17.7 and 10.5%, respectively (Ijaz et al., 2021).

Among all farm sizes, 58% of respondents were having changes in access to inputs, for example, shortages of raw materials and delivery problems during the COVID-19 pandemic. Another 35% of respondents had not having changes in access to input during COVID-19 pandemic. This is consistent with previous study, which found that 81% of the 137 respondents who raise cattle for milk said they had trouble selling their milk on a daily basis in the last few months, and another 11.7% said they couldn't market their milk at all. Furthermore, 89.1% of respondents who were able to market their milk lowered their milk prices due to the COVID-19 outbreak (ADB, 2020). Another previous study, found that the travel ban has affected delivery breeding stock and hatching eggs in many countries. During the first 15 days of the lockdown, Bangladesh's poultry industry lost roughly 115 billion BDT (1.35 billion USD). It also caused a shortage of livestock feed and other logistical supplies, as well as insufficient veterinary services (Khan et al., 2021).

About 50% of respondents among all farm sizes said that they had collected fodder from their surroundings during COVID-19 restrictions, and another 33% of respondents said they had not. A previous study conducted by China's Enterprise Survey for Innovation and Entrepreneurship on some agricultural enterprises found that 38.5% of livestock farmers identify feed shortages caused by "logistics disruption" as the most significant challenge in their production following the COVID-19 outbreak (Pan et al., 2020). Hence, farmers need to collect fodder or tree leaves from their surrounding area to meet the daily dietary requirements of the animals, or the animals may starve to death during the COVID-19 pandemic.

When respondents were asked if the trucks come into the village, 45% said that they entered to deliver feed and collect products from the farm. Meanwhile, another 54 and 51% of respondents said the trucks did not enter the farm to deliver feeds and

collect products, respectively. The transportation sector supports the food and agriculture industries with commodities and food delivery. Trucking is responsible for nearly 75% of all agricultural commodities and food products supplied as a very flexible mode of transportation (Walters et al., 2020). This may cause the farmers to face limited input supply and difficulties selling their livestock products. This finding was similar to a previous study, which found that 85.9% of respondents among farmers saying concerned that COVID-19 would limit their access to livestock inputs, 78.8% said that it will limit their capacity to feed livestock, and 67.9% said that it would limit their ability to sell livestock (Middendorf et al., 2021).

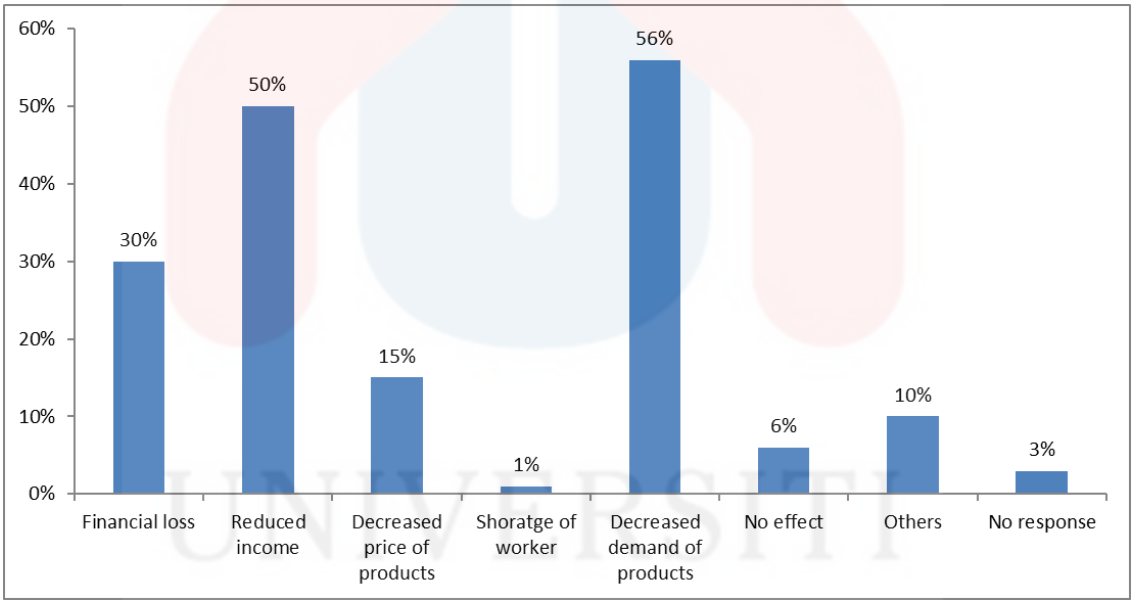

Figure 4.1: Changes in farm or business due to MCO.

4.8.3 Policies to encounter the COVID-19 restriction.

As shown in Figure 4.2, 70% of respondents among all farm sizes strongly stated the main policy that needed to address the problems faced during the adverse conditions was financial support for livestock farmers who are affected by COVID-19. About 40% of respondents stated the removal of travel restrictions policy for transportation of livestock products, and 34% of respondents stated the price control policy to not allow prices to drop below productions costs. Followed by 14% of respondents stated on the exemptions policy to allow the movement of animals to new pasture and the farmer's right to live there, and another 12% of respondents stated other policies that were needed to help farmers during the COVID-19 restrictions. This shows that farmers face a significant financial impact to support themselves and their families as well as movement to receive the input supplies from outside. To stimulate the productive spirit of farmers and livestock operations again, initiatives to counter the difficulty faced and unconducive income during these adverse conditions (COVID-19) are crucial. Therefore, the following policies are needed to be considered by the government.

However, despite many challenges and risks faced by respondents among all farm sizes, 76% of respondents still do not think to shift to other businesses. Meanwhile, only 13% of respondents among all farm sizes have the thought to change to different business. This is likely because farmers face a great risk of losing huge incomes and lack of household food supply during the COVID-19 pandemic. As a result, they considered changing to a more revenue business.

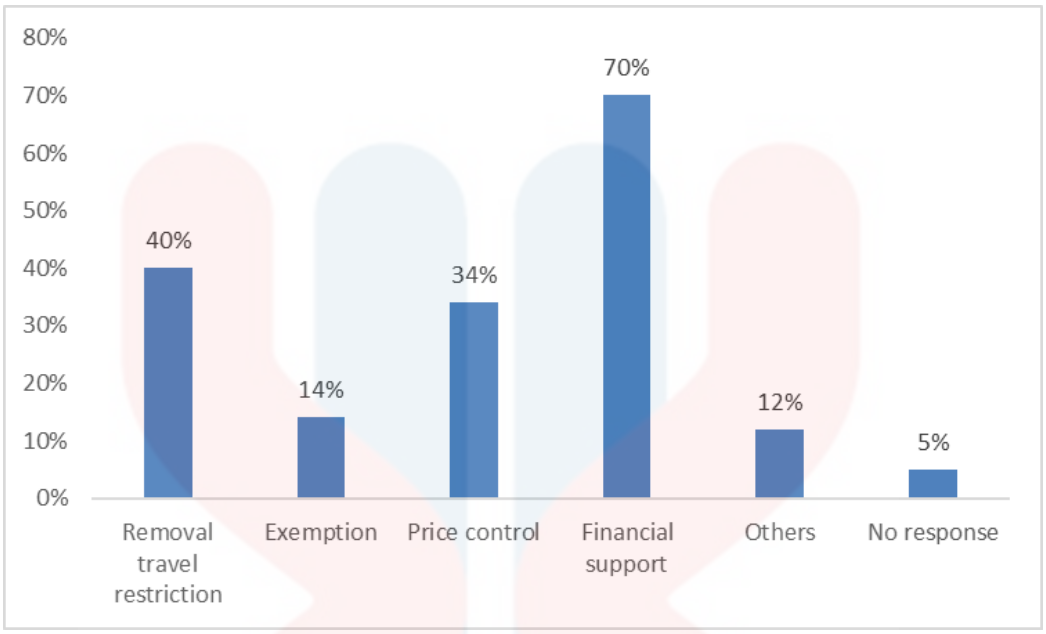

Figure 4.2: Policies are needed to address the problems faced during adverse condition (COVID-19).

4.8.4 Sources of information

The result showed that about 98% of respondents among all farm sizes had a smartphone as a tool for their source of information. Another 16%, 5%, and 2% of respondents said that they also have computers, tablets, and other communication tools, respectively, used for their source of information (Figure 4.3). According to a previous study, two-thirds of smallholder farmers recognize a cell phone to be a very vital tool for the home or farm, and just over half (56%) have used one, and less than half (46%) of smallholders own a phone (Riquet et al., 2016). This shows that farmers were generally aware, competent, interested, and utilized a vital technology which is mobile phones, for the source of information as shown by these findings.

The majority (91%) of respondents among all farm sizes have access to the internet, while only 9% of respondents did not have access to the internet (Table 4.8). Getting the correct information from accessing the internet would enable smallholder

farmers, who account for 4/5 of global agricultural production from developing regions, to increase production gains. The Internet of Things (IoT), or internet-enabled connectivity between everyday devices, can benefit agriculture in this regard. The advantages of IoT usage in agriculture for farmers are threefold. First, by maximizing the utilization of inputs, these systems assist farmers in lowering production costs and waste. Furthermore, IoT can improve productivity by providing more and more precise data to decision-makers. In less developed places, however, limitations to IoT in agriculture exist. To begin with, rural places usually find it difficult to access communication network infrastructure. Farmers must also be offered the appropriate incentives to invest in IoT devices, which have high upfront installation costs. The good news is that certain organizations and initiatives have already started to address these issues. Mimosa Technology, for example, is assisting smallholder farmers in Vietnam in adopting IoT-enabled precision agriculture by leasing hardware equipment to farmers' cooperatives, reducing smallholder farmers' costs (Lee Won & Choudhary, 2017).

As shown in Figure 4.4, the majority (79%) of respondents said that the internet helped in terms of marketing in social media. About 32% of respondents stated that the internet helped in networking and getting advice from other farmers, and the other 16% of respondents stated that the internet helped them join classes online. This shows that farmers have begun to change their plans to improve rearing operations and use the internet to access markets and information due to the COVID-19 pandemic. They relied on internet access to run and operate successful businesses. Farmers access the internet to keep up with commodity markets, interact with customers, learn to expand into new markets, and manage risk and reduce vulnerabilities to the business.

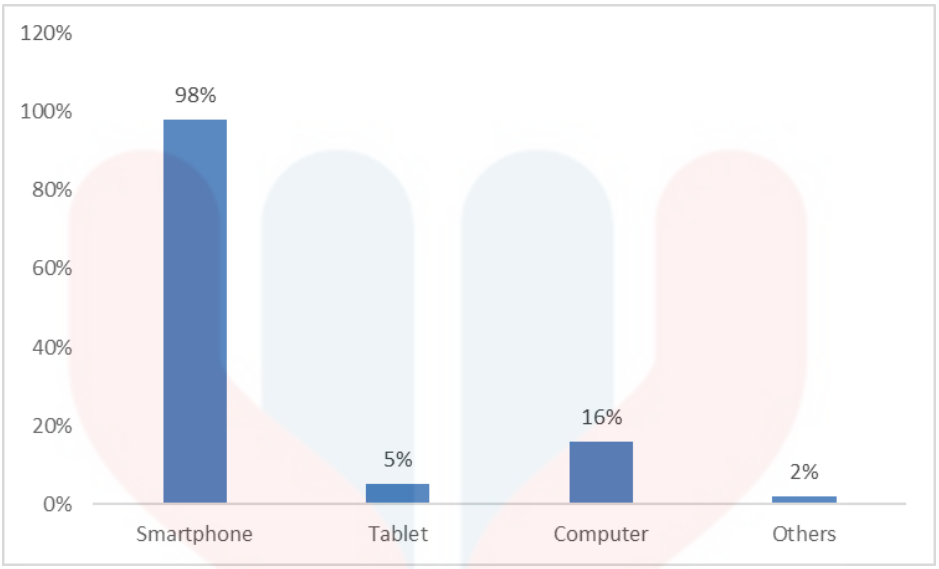

Figure 4.3: Sources of information.

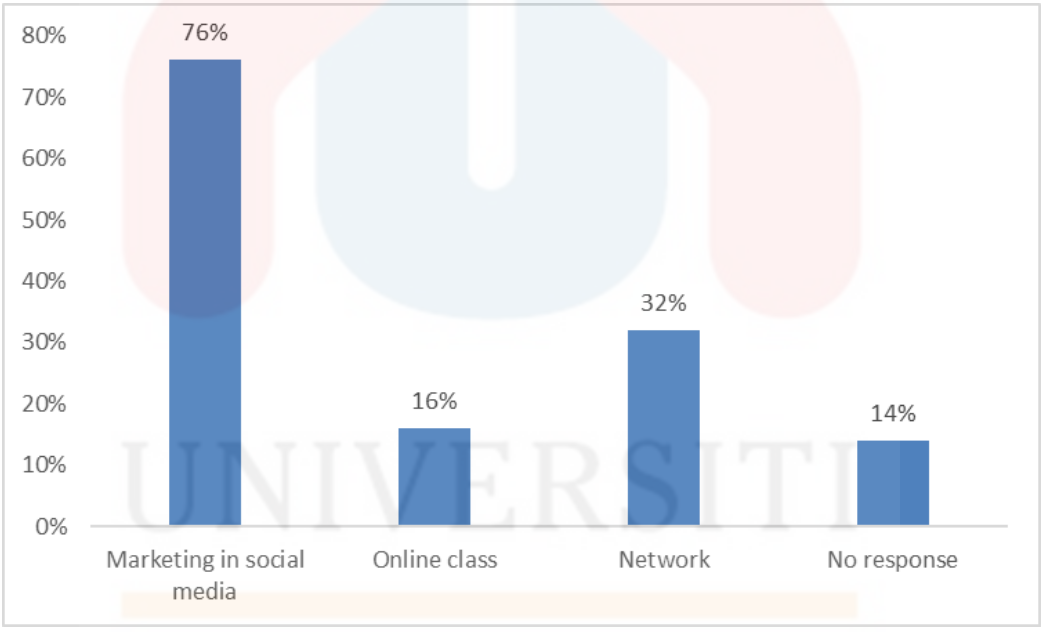

Figure 4.4: How does the internet help during the MCO?

4.8.5 Market price trend during COVID-19 pandemic

Figure 4.5 shows the percentage of respondents towards the market price trend during pandemic COVID-19. Most of the respondents (48%) among all farm sizes noticed only normal market price trends. Meanwhile, 25% of respondents stated the decreasing market price trend, and another 24% of respondents stated the increasing market price trend. This indicates that the businesses of respondents among all farm sizes were not severely affected during the COVID-19 pandemic where they stated the stable market price trends. This is similar with the findings of previous study (Lynch, 2020) who stated that the closing of livestock markets to minimize the spread of COVID-19 is often considered to be affecting the livestock industry. Except in South Sudan and Uganda, which found that the end-market prices for meat and milk have remained generally steady despite market closures and movement restrictions. However, meat and milk prices were varied based on product and market orientation, rather than following general trends. In certain Nairobi communities, for example, the price of beef per kilo has been reduced by as much as 20%, while the price of goat and sheep meat has stayed unchanged or increased slightly. Despite lower animal supply, higher transportation costs, and lower market activity, meat prices have remained relatively stable, indicating that supply meets consumer demand. Increased production and sending animals tomarket without equivalent demand development or market expansion will result in an oversupply of animals and a drop in live animal prices.

Another previous study by Mead et al. (2020) who found that demand for slaughter animals declined by 8% in March 2020 due to a slowdown at processing plants and COVID-19 shutdowns, forcing farmers to accept lower prices or keep their livestock from the sale. The pandemic had a significant impact on dairy products as

well. Between February and June 2020, the Producer Price Index (PPI) for dairy products decreased 2.7%, while raw milk fell over 40%.

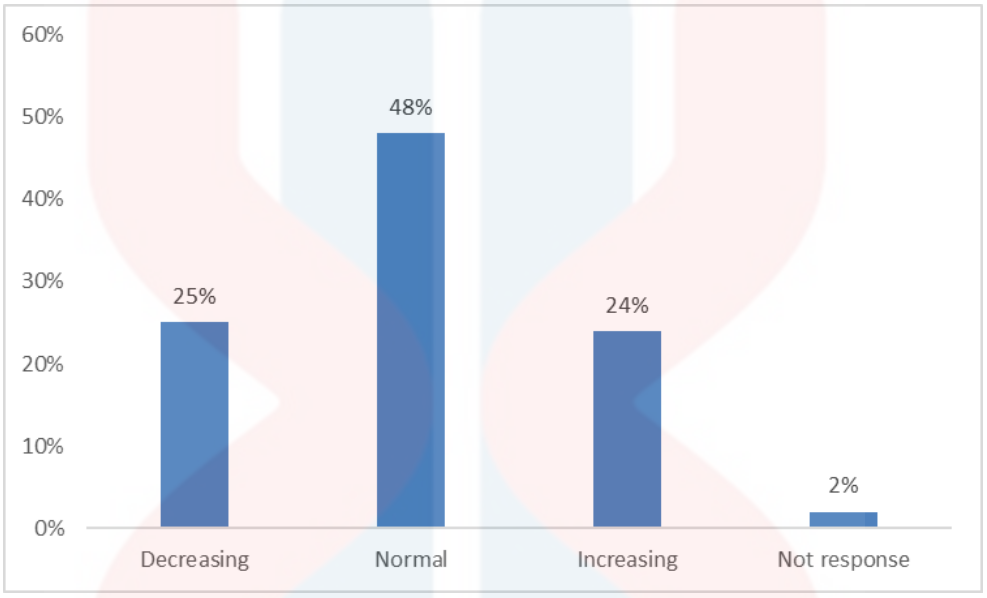

Figure 4.5: Market price trend during pandemic COVID-19.

4.9 Government support

The findings revealed that 65% of respondents among all farm sizes did not receive any benefits or services from government agency during COVID-19, while only 35% stated that they received the services like AI, treatment and others (Table 5.1). Moreover, over half (60%) of the respondents were aware of whether DVS still provides services throughout the MCO. Only 30% of respondents were not aware. Many of the challenges found in this study can be predicted in advance to prevent similar problems during future lockdowns and pandemics. To control and mitigate the developing challenges during this crisis period, it is critical to support farmers in continuing the production cycle, growing market demand, and using alternative supply chains. To ensure an uninterrupted supply chain, the livestock feed, and medicine, as

well as livestock-derived products including milk, meat, and eggs, should be classified as emergency commodities. In this context, the government should quickly include milk, meat, and eggs in the countrywide aid package to stabilize market demand for these products. The government should offer farmers subsidies that are properly allocated, as well as agricultural loans that are easy to repay in a short period of time (Rahman & Chandra Das, 2021). The government also should take all possible measures to combat the distressful situations through effective governance, necessary financial support, and creating a compatible environment for reviving the sector and ensuring the livelihood of the associated stakeholders. In this aspire, the role of the private sector, NGOs, and even the common citizens should also play a significant role (OECD, 2020).

Veterinary services provide a unique role in safeguarding global health security on a worldwide scale. As a result, veterinary services should be classified as an emergency service. The proper application of digital technology for stakeholder networking and speedy information sharing, as well as the application of other agricultural technologies for hygiene and sanitation and cost-effective farm management, could aid in mitigating the effects of future disasters like COVID-19 (Rahman & Chandra Das, 2021).

Table 4.10: Government support and livelihoods in participants from livestock households across 10 districts in Kelantan during the COVID-19 irrespective of farm size.

Parameter	Response		
	Yes	No	No response
Affected community by COVID-19	15 (17)	84 (93)	1 (1)
Farmer's awareness of COVID-19	92 (102)	7 (8)	1 (1)
Taken preventive measures against COVID-19	56 (62)	41 (46)	3 (3)
Positive Covid-19 cases identified in the community	13 (14)	85 (94)	3 (3)
Changes in access to inputs	58 (64)	35 (39)	7 (8)
Fodder collection from surroundings during COVID-19	59 (66)	33 (37)	7 (8)
Enter trucks in villages to			
deliver feeds to farm	45 (50)	54 (60)	1 (1)
collect products from farm	45 (50)	51 (57)	4 (4)
Thinking to shift to other business	14 (16)	84 (93)	0
Access to the internet	91 (102)	9 (9)	0
If yes, internet helps to the business	92 (96)	13 (14)	1 (1)
Received any benefits/services from government agency	35 (39)	65 (72)	1 (1)
Awareness whether DVS still provides services throughout MCO	60 (67)	37 (41)	3 (3)

Figures in parenthesis indicate number of respondents.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In light of this study, it is revealed that COVID-19 pandemic had less significant impact on the socio-economic conditions and livelihoods of smallholder livestock farmers in Kelantan. The challenges and issues most often faced by farmers were the difficulty to access farm inputs such as shortages of raw materials and delivery problems (58% of respondents). Due to movement restrictions and the difficulty for veterinarians to visit their farms, the majority of farmers said that they did not acquire treatments (74% of respondents) for their animals on the farm. However, a large majority (94%) of farmers did not have any difficulty to purchase feed and claim to be capable of rearing livestock on their own (81% of respondents), implying that they do not need to employ labour, workers, or manpower during the MCO. The findings also revealed that farmers' farm or business outputs have changed, including decreased products demand (56% of respondents), and experiencing a lower income (50% of respondents). However, farmers mentioned that they were less affected by the marketing channel, with an average of 48% of farmers were able to sell meat, milk, and eggs during the MCO. Despite all the challenges and difficulty, about half (48%) of the respondents claimed a steady market price trend, while more than 20% of the respondents were claimed a decreasing and increasing trend in market price during the COVID-19 pandemic.

5.1 Recommendation

The COVID-19 pandemic's impact on the livestock industry is undeniable. These challenges can be tackled, but only if each segment of the livestock supply chain receives the necessary reform, strategy, approach, and intervention actions to mitigate the impact of COVID-19 on smallholder farmers. It is recommended that the government and livestock experts should create and discover many robust strategies on livestock supply chains, including inputs distribution channels and marketing channels to assure a continuous supply of animal protein to the citizens during the MCO. This is because well-balanced nutrition is critical in the fight against viral threats, and it may help strengthen resilience to COVID 19. Due to the interstate movement restrictions, livestock products would always run out of stock. Hence, the government should build a milk or beef pocket area around in every state of the country so that livestock products do not have to be transported interstate. This would ensure that all states in Malaysia can meet customer demand, particularly during a pandemic, when everyone is scrambling to get food supplies for the whole family.

Furthermore, responsible parties should also establish a farm input collecting centre in rural areas, such as feeds and essential medicines, in order to make it easier for smallholder farmers to get what they need without having to contact the manufacturer directly; instead, they can go to the centre and get what they need. It would not only make things easier for farmers to obtain supplies, but it also ensures the farm or business's survival throughout the MCO. Moreover, although the government provides economic stimulus packages during the MCO, the incentives may not be enough to boost livestock's economic growth in nowadays unpredictable market conditions. New capital in the form of loans, subsidies, grants, credit facilities, and support funds would be a direct approach that could temporarily reduce some financial burdens.

Moreover, in order for smallholder farmers to make advancements in genetics, nutrition and herd management, the proper implementation and investment in modern digital technologies and productive assets should be prioritized. Livestock technicians should make an effort to provide technical guidance in the field for smallholder farmers and develop new livestock technology training models, such as using online teaching platforms, social media, short messaging services, and other methods to provide online livestock technology guidance. The Malaysian Veterinary Institute (IVM), for example, can give training and certificate courses to validate labour abilities. Smallholder farmers' knowledge and skills will be enhanced through the application of modern technology combined with practical training programs, leading to better local livestock production, safety, and quality of livestock products in future disasters like COVID-19.

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APPENDIX A

Questionnaire

Impacts of Covid-19 pandemic restrictions on food security, poverty and development of smallholder livestock farmers

1. Household identification
a) Name of the household owner:……..
b) Respondent ID:……..
c) Age of the owner:……...
d) Educational level of the owner: ……
e) Total number of household members: ……..
f) Monthly income of owner: RM……
g) Size of landholdings: Please tick (√)
• Large (> 5 ha)
• Medium (>2 ha and ≤5 ha)
• Small (≤2 ha)
• Landless (0 ha)
h) Address: …… …… ……

2. How many ruminant animals does your household currently keep?

Species	Total	Young (≤ 1 year)	Adult (> 1 year)
a) Cow:			
b) Goat			
c) Sheep			

3. How many non-ruminant animals does your household currently keep?

Species	Total	Young (≤ 6 months	Adult (> 6 months)
a) Broiler chicken			
b) Layer chicken (hybrid)			

c) Village chicken			
d) Quail			
e) Rabbit			

4. For how many years have you raised livestock?

.....year(s)

5. What are the household's two principal reasons for raising/keeping the livestock? Please tick (√)

- Savings/generate revenue
- Food for the family (milk/meat consumption)
- Sale of live animals
- Sale of livestock products
- To use for festivals and ceremonies (Tabaski, Ramadan, etc.)
- Cope with lowered agricultural revenues
- Traditional activity in the household or family
- Social status/prestige
- Other (specify):

  .....
  .....

6. Farm management

a) What system of feeding did you use for the animal that produced the milk/meat? Please tick (√)

- Only grazing/scavenging
- Mainly grazing/scavenging, some feeding
- Mainly feeding, some grazing/scavenging
- Only feeding (zero grazing/scavenging)
- Other (specify):.....

b) What type of feeding of the animals do you practice? Please tick (√).

- Limited feeding
- Unlimited feeding

c) Has this household purchased any fodder/crop residues/industrial by-products/roots & tubers/commerical pellet (balanced concentrates)/feed supplements for animals in the past 12 months? Please tick (√).

- Yes

- No

If yes, how much spend for every month?

RM..... /month)

d) Has this household practiced any controlled mating or other breeding strategy for animals in the past 12 months? Please tick (√).

- Selection of reproductive animal
- Artificial insemination
- Natural mating

e) Has this household incured any cost related to breeding animals? Please tick (√)

- Yes
- No

If yes, how much spend for last 12 months?

RM.....)

f) Who raise the livestock? Please tick (√)

i) Own

ii) Non-family labour

iii) Both own & non-family labour

g) If you hire any labour, what was the total cost of the labour you hired for keeping livestock over the past 12 months?

RM. ...../month

h) If use non-family member, how many months have you had to recruit non-family labour? Please tick (√)

- 1 month
- 3 months
- 6 months
- 12 months
- Continous

i) If use non-family member, how much was each of these workers paid by day of work?

RM..... /day

Beef (meat purpose)

(a) Where did you principally sell the meat? Please tick (√)

- Local market
- Other market
- Butcher

- Trader, directly from the farm
- Neighboring household
- Other (specify): .....

(b) During these months, what was the amount of these sales on average each month?

RM. ...../month

(c) During these months, what quantity of meat (in kg) did you sell on average each month?

.....kg/month

(d) During these months, what quantity of meat (in kg) produced by yourself did you consume in the household on average each month?

.....kg/month

Milk

a) What was the main use of the milk of animals? Please tick (√)

- Self consumption
- Sale
- Processing
- Other (specify): .....

b) During these months, what was the average quantity of milk (in liters) produced by animal and by day?

.....litre/day

c) Have you sold any of this milk production from animals? Please tick (√)

- Yes
- No

If yes, during these months, what was the average quantity (in liters) of this milk that was sold each day?

.....litre/day

How much is the average sale of this milk each day?

RM. ...../day

Where do you principally sell the milk produced? Please tick (√)

- At home, at the farm
- At the market
- By contract (dairy company, hotel, etc.)
- Other (specify):.....

d) During these months in which animals were milked, how much of the animal milk collected did this household consume per week?

.....litres/week

e) Did you produce milk products (butter, cheese) during the last 6 months? Please tick (√)

- Yes
- No

f) If yes, how much income did you receive from the production of milk products during the last 6 months?

RM ...../month

Egg

a) Did you produce eggs from the chicken during the last 6 months? Please tick (√)

- Yes
- No

b) How many eggs from the chicken did you produce each month during the last 6 months?

...../month

c) How many eggs from the chicken did you sell on average each month during these months?

...../month

d) How much has this household earned by selling eggs in the past 3 months?

RM..... /month

e) Where did you principally sell the eggs from the chicken? Please tick (√)

- At the household, at the farm
- At the market
- By contract (enterprise, hotel, etc.)
- Other (specify):.....

f) During these months, how many eggs did you consume in the household on average every month?

...../month

7) Animal health management

a) Did animals suffer any disease in the past 12 months? Please tick (√)

- Yes
- No

If yes, what kind of disease did affect animals in the past 12 months?

……
……
……
……

b) Did you perform any vaccination in your farm in the past 12 months? Please tick (√)

- Yes
- No

If yes, against which disease are the animals vaccinated? Please tick (√)

- Brucellosis
- FMD
- Anthrax
- Black quarter
- New castle disease
- Small pox
- Gumboro

c) During the last 12 months has this household treated animals against external parasite? Please tick (√)

- Yes
- No

d) If yes, during the last 12 months how much did this household spend on vaccines and treatments against internal and/external parasites for animals?

RM…..... /year

e) During the last 12 months have the animals in this household received any curative treatment? Please tick (√)

- Yes (RM_____/year)
- No

f) Has this household lost any animals in the past 12 months (e.g., due to disease, sickness, escaping, natural calamity, predators, injury, theft, etc.)? Please tick (√)

- Yes (how many?_____/year)
- No

If yes, how many animals lost in the past 12 months?

...../year

8) Waste management

a) Has this household made any use of the dung produced by animals in the past 12 months? Please tick (√)

- Yes
- No

If yes, used for what purpose?

- Fertilizer
- Sale
- Produce gas
- Other (Please specify): ……..

b) Did the household sell the dung produced by animals in the last 12 months? Please tick (√)

- Yes
- No

If yes, how much has this household earned from the sales of dung produced by animals in the past 12 months?

RM… ...../year

9) Covid-19 awareness and knowledge

a) Has your community been affected by Covid-19? Please tick (√)

- Yes
- No

b) Did your community receive any public health awareness about Covid-19? Please tick (√)

- Yes
- No

c) Did your community impose any preventive measures associated with Covid-19? Please tick (√)

- Yes
- No

d) Has there been any positive Covid-19 cases identified in your community? Please tick (√)

- Yes
- No

e) How has COVID-19 affected your farm or business? Please tick (√)

- Financial loss
- Reduced income
- Decreased price
- Shortage of worker
- Decreased demand

- Others specify):

  .....
  .....

f) Did you face shortages of raw materials and delivery problems during covid-19? Please tick (√)
   - Yes
   - No

g) How have you collected the fodder or tree leaves from surroundings during covid-19? Please tick (√)
   - Yes
   - No

h) How have you cultivated your land for fodder production during covid-19?
   .....
   .....
   .....

i) How have you sold your products (milk/meat/egg)?
   .....
   .....
   .....

   If not sold, what have you done your products?

.....
.....
.....

j) Has animal died because of stravation? Please tick (√)
   - Yes
   - No

k) Was the feed delivered to farms? Please tick (√)
   - Yes
   - No

l) Did the trucks enter villages to collect their products? Please tick (√)
   - Yes
   - No

m) What policies are needed to address the problems faced during adverse condition (COVID-19)? Please tick (√)
   - Removal of the travel restrictions for transportation of livestock products.
   - Exemptions to allow the movement of cattle to new pasture and the farmer's right to live there.
   - Price controls to not allow prices to drop below production costs.
   - Financial support for livestock farmers who are affected by COVID-19.
   - Others (specifiy):

     .....
     .....

.....
.....

n) Are you thinking to shift to other business? Please tick (√)

- Yes
- No

o) Do you own a Smart phone, Tablet, Computer? Please tick (√)

- Smartphone
- Tablet
- Computer
- Other (please specify):

……
……...

p) Do you have access to the internet? Please tick (√)

- Yes
- No

if yes, does internet help you with the business? Please tick (√)

- Yes
- No

if yes, how the internet helps?

- Marketing in social media
- Joining classes online
- Networking and getting advices from other farmers
- Other (please specify):

.....
.....

10) Market price change

a) What has been the market price trend during pandemic Covid-19? Please tick (√)

- Decreasing
- Normal
- Increasing
- Not applicable

11) Government support

a) Has the community been provided or benefited from any support, or programmes? Please tick (√)

- Yes
- No

b) Do you know Department of Veterinary Services (DVS) still advice farmers and

provide services throughout MCO? Please tick (√)

- Yes
- No

c) Have you received any services from DVS during MCO? Please tick (√)

- Yes
- No

If yes, what type of services you have received? Please tick (√)

- Artificial Insemination (AI)
- Letter of approval from DVS
- Vaccination
- Treatment of animals
- Others (Please specify):

……
……
……

APPENDIX B

Descriptive analysis

Descriptives

MonthlyIncome

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Landless	4	1625.0000	946.48472	473.24236	118.9316	3131.0684	1000.00	3000.00
Small	76	6863.1579	39993.32558	4587.54907	-2275.7085	16002.0243	100.00	350000.00
Medium	10	1710.0000	534.27001	168.95101	1327.8063	2092.1937	1000.00	2500.00
Large	11	4818.1818	5640.35782	1700.63187	1028.9379	8607.4258	500.00	20000.00
Total	101	5922.7723	34729.71892	3455.73619	-933.3099	12778.8545	100.00	350000.00

ANOVA

MonthlyIncome

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	331987918.0	3	110662639.3	.089	.966
Within Groups	1.203E+11	97	1240034533		
Total	1.206E+11	100			

MonthlyIncome

Duncan[a,b]

treatment	N	Subset for alpha = 0.05
		1
Landless	4	1625.0000
Medium	10	1710.0000
Large	11	4818.1818
Small	76	6863.1579
Sig.		.780

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 8.809.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

HiredLabour

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	15	2143.3333	3242.51152	837.21287	347.6903	3938.9764	300.00	12000.00
Medium	3	1166.6667	351.18846	202.75875	294.2662	2039.0672	800.00	1500.00
Large	3	933.3333	230.94011	133.33333	359.6463	1507.0204	800.00	1200.00
Total	21	1830.9524	2763.62426	603.07226	572.9657	3088.9391	300.00	12000.00

ANOVA

HiredLabour

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5204714.286	2	2602357.143	.317	.732
Within Groups	147547666.7	18	8197092.593		
Total	152752381.0	20			

HiredLabour

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Large	3	933.3333
Medium	3	1166.6667
Small	15	2143.3333
Sig.		.575

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.091.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

CowAdult

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	28	9.4643	8.63448	1.63176	6.1162	12.8124	1.00	30.00
Medium	11	17.0000	15.02664	4.53070	6.9050	27.0950	2.00	55.00
Large	11	21.7273	18.32534	5.52530	9.4161	34.0384	2.00	60.00
Total	50	13.8200	13.52200	1.91230	9.9771	17.6629	1.00	60.00

ANOVA

CowAdult

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1330.234	2	665.117	4.098	.023
Within Groups	7629.146	47	162.322		
Total	8959.380	49			

CowAdult

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05	
		1	2
Small	28	9.4643	
Medium	11	17.0000	17.0000
Large	11		21.7273
Sig.		.127	.335

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 13.791.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

CowYoung

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	23	5.2174	3.77740	.78764	3.5839	6.8509	1.00	15.00
Medium	10	10.0000	9.00617	2.84800	3.5574	16.4426	1.00	25.00
Large	9	9.8889	11.67738	3.89246	.9129	18.8649	2.00	40.00
Total	42	7.3571	7.59917	1.17258	4.9891	9.7252	1.00	40.00

ANOVA

CowYoung

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	232.841	2	116.420	2.127	.133
Within Groups	2134.802	39	54.739		
Total	2367.643	41			

CowYoung

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Small	23	5.2174
Large	9	9.8889
Medium	10	10.0000
Sig.		.146

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 11.784.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

TotalCow

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Landless	3	24.0000	15.09967	8.71780	-13.5097	61.5097	10.00	40.00
Small	31	12.8710	11.32473	2.03398	8.7170	17.0249	1.00	45.00
Medium	11	26.0909	21.07821	6.35532	11.9304	40.2514	2.00	80.00
Large	11	29.8182	27.89200	8.40975	11.0801	48.5563	2.00	100.00
Total	56	19.3929	18.87632	2.52245	14.3377	24.4480	1.00	100.00

ANOVA

TotalCow

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3071.328	3	1023.776	3.221	.030
Within Groups	16526.029	52	317.808		
Total	19597.357	55			

TotalCow

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Small	31	12.8710
Landless	3	24.0000
Medium	11	26.0909
Large	11	29.8182
Sig.		.103

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 7.307.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

GoatAdult

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	22	15.1364	13.66363	2.91310	9.0782	21.1945	3.00	63.00
Medium	4	8.7500	5.31507	2.65754	.2925	17.2075	3.00	15.00
Large	6	25.6667	26.62831	10.87096	-2.2780	53.6114	5.00	66.00
Total	32	16.3125	16.39716	2.89864	10.4007	22.2243	3.00	66.00

ANOVA

GoatAdult

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	784.201	2	392.100	1.506	.239
Within Groups	7550.674	29	260.368		
Total	8334.875	31			

GoatAdult

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Medium	4	8.7500
Small	22	15.1364
Large	6	25.6667
Sig.		.083

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 6.492.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

GoatYoung

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	21	7.2857	3.75690	.81982	5.5756	8.9958	2.00	20.00
Medium	4	13.0000	10.32796	5.16398	-3.4341	29.4341	1.00	25.00
Large	6	12.3333	9.24482	3.77418	2.6315	22.0352	2.00	28.00
Total	31	9.0000	6.38227	1.14629	6.6590	11.3410	1.00	28.00

ANOVA

GoatYoung

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	192.381	2	96.190	2.616	.091
Within Groups	1029.619	28	36.772		
Total	1222.000	30			

GoatYoung

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Small	21	7.2857
Large	6	12.3333
Medium	4	13.0000
Sig.		.120

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 6.462.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

GoatTotal

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	26	21.4615	14.10597	2.76641	15.7640	27.1591	3.00	70.00
Medium	5	18.4000	14.80878	6.62269	.0125	36.7875	4.00	40.00
Large	6	38.0000	29.79262	12.16278	6.7346	69.2654	10.00	81.00
Total	37	23.7297	18.09489	2.97478	17.6966	29.7629	3.00	81.00

ANOVA

GoatTotal

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1497.636	2	748.818	2.474	.099
Within Groups	10289.662	34	302.637		
Total	11787.297	36			

GoatTotal

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05	
		1	2
Medium	5	18.4000	
Small	26	21.4615	21.4615
Large	6		38.0000
Sig.		.737	.076

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 7.405.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

PurchaseFeed

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Landless	4	132.5000	83.01606	41.50803	.4029	264.5971	30.00	200.00
Small	73	1194.6301	2991.97993	350.18476	496.5496	1892.7107	10.00	19600.00
Medium	7	1702.0000	3666.83260	1385.93245	-1689.2545	5093.2545	64.00	10000.00
Large	11	2799.9091	4713.61306	1421.20781	-366.7393	5966.5574	90.00	14000.00
Total	95	1373.1684	3227.29128	331.11310	715.7356	2030.6012	10.00	19600.00

ANOVA

PurchaseFeed

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	31632364.38	3	10544121.46	1.013	.391
Within Groups	947416082.9	91	10411165.75		
Total	979048447.3	94			

PurchaseFeed

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Landless	4	132.5000
Small	73	1194.6301
Medium	7	1702.0000
Large	11	2799.9091
Sig.		.135

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 8.041.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

BreedingCost

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	27	1072.4074	2287.52359	440.23412	167.4932	1977.3216	50.00	12000.00
Medium	3	5466.6667	8271.23530	4775.39993	-15080.2209	26013.5542	200.00	15000.00
Large	5	466.0000	491.20261	219.67248	-143.9086	1075.9086	30.00	1000.00
Total	35	1362.4286	3118.57301	527.13505	291.1613	2433.6959	30.00	15000.00

ANOVA

BreedingCost

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	56823263.39	2	28411631.69	3.320	.049
Within Groups	273843655.2	32	8557614.225		
Total	330666918.6	34			

BreedingCost

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05	
		1	2
Large	5	466.0000	
Small	27	1072.4074	
Medium	3		5466.6667
Sig.		.739	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 5.260.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

SellingMeat

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Landless	3	2666.6667	2081.66600	1201.85043	-2504.4783	7837.8117	1000.00	5000.00
Small	44	7294.3182	14404.94996	2171.62791	2914.8131	11673.8233	100.00	80000.00
Medium	9	14833.3333	18764.99400	6254.99800	409.2821	29257.3846	2000.00	50000.00
Large	6	25533.3333	47513.01576	19397.10746	-24328.5188	75395.1854	1700.00	121500.00
Total	62	9929.8387	20315.86931	2580.11798	4770.5739	15089.1035	100.00	121500.00

ANOVA

SellingMeat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2141096219	3	713698739.6	1.797	.158
Within Groups	2.304E+10	58	397167432.4		
Total	2.518E+10	61			

SellingMeat

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Landless	3	2666.6667
Small	44	7294.3182
Medium	9	14833.3333
Large	6	25533.3333
Sig.		.066

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 6.311.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

MeatConsumption

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	19	59.0526	119.26172	27.36052	1.5703	116.5349	1.50	500.00
Medium	6	10.6667	10.72691	4.37924	-.5905	21.9239	2.00	30.00
Large	3	3.3333	2.51661	1.45297	-2.9183	9.5849	1.00	6.00
Total	28	42.7143	100.46101	18.98535	3.7596	81.6690	1.00	500.00

ANOVA

MeatConsumption

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15886.767	2	7943.383	.774	.472
Within Groups	256608.447	25	10264.338		
Total	272495.214	27			

MeatConsumption

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Large	3	3.3333
Medium	6	10.6667
Small	19	59.0526
Sig.		.401

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 5.429.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Descriptives

VaccineParasiteCost

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	32	282.8125	532.53038	94.13896	90.8148	474.8102	10.00	3000.00
Medium	7	385.7143	320.09671	120.98518	89.6742	681.7544	40.00	1000.00
Large	7	747.1429	1451.39834	548.57701	-595.1767	2089.4624	100.00	4000.00
Total	46	369.1304	719.35102	106.06252	155.5095	582.7513	10.00	4000.00

ANOVA

VaccineParasiteCost

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1240604.057	2	620302.028	1.210	.308
Within Groups	22045361.16	43	512682.818		
Total	23285965.22	45			

VaccineParasiteCost

Duncan[a,b]

Treatment	N	Subset for alpha = 0.05
		1
Small	32	282.8125
Medium	7	385.7143
Large	7	747.1429
Sig.		.190

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 9.465.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

APPENDIX C

Carnival Of Research and Innovation (CRI2021)