

# The impacts of the COVID-19 shock on sustainability and farmer livelihoods in Sri Lanka

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## ABSTRACT

The COVID-19 pandemic and its handling in Sri Lanka has affected vegetable farmers in numerous ways and these impacts will constrain the country's move towards sustainable development. A field level study with vegetable farmers and key informants was carried out using exploratory research to understand, describe and analyze the impact of COVID-19 on the livelihoods of vegetable farmers and its relevance in achieving SDG 1. Data were supplemented by an extensive literature review. The analysis showed that the pandemic's impact on vegetable farmers in Sri Lanka is multidimensional and will increase vulnerability among vegetable farmers, for the long run. Adapting alternative inputs and marketing strategies, provision of immediate financial support, promoting innovative technology and service provision, and implementing intervention strategies tailored to farmer heterogeneity will improve farmer livelihoods and the prosperity of the sector.

## 1. Introduction

The entire world experienced the complex and inter-related consequences of the fatal pandemic; COVID-19. This is an infectious, respiratory disease caused by the newly discovered coronavirus (WHO, 2020) that is assumed to have originated from the region of Wuhan in China in December 2019. Within a very short period, the virus spread throughout the world and as a result, in March 2020, WHO declared COVID-19 a global pandemic. The pandemic has had direct and indirect impacts at the individual, household, community, district, regional, national and international levels (Talukder et al., 2021). In developing countries, COVID-19 has had major negative impacts on sustainable development goals (SDGs) (Talukder et al., 2021; Adhikari et al., 2021). This has been particularly important in rural areas where COVID-19 has impacted farming households (Jaacks et al., 2021a). These impacts are discussed in the following section.

### 1.1. Implications on agriculture

Almost all socio-economic sectors in society have been affected by the COVID-19 pandemic, and the agriculture sector is no exception

(Gray, 2020; Rozaki, 2020). To control the spread of the virus various health guidelines were put in place in almost all the countries, such as: maintaining social distancing, regional and national lockdowns, travel restrictions, and placing people in quarantine (Lu et al., 2021; Memon et al., 2021). The emerging literature, both in developed and developing countries, suggests that it is mitigation strategies, rather than health impacts, that have had the greatest negative impact on the agricultural sector and domestic and international food supply systems (Talukder et al., 2021; Adhikari et al., 2021; Kumar et al., 2021; Tamru et al., 2020; Weersink et al., 2021). The mitigation measures have resulted in market closures in India (Kumar et al., 2021), low demand for farm produce in Bangladesh (Hossain, 2020), shortages in agricultural inputs in many countries (WHO, 2020), and labor availability problems for farming activities in Nepal (Adhikari et al., 2021). As a consequence, farmers' incomes and purchasing power have been reduced, leaving farm households financially vulnerable (Tripathi et al., 2021). Studies in India and Bangladesh show that farmers who produce perishable products, such as vegetables, were severely impacted by COVID-19 because of the loss of conventional markets and farmers having little option but to destroy unsold produce (Adhikari et al., 2021; Alam and Khatun, 2021). Impacts such as this have badly affected small scale farmers'

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incomes and long-term financial security in Tanzania and South Africa (Tripathi et al., 2021). Small scale farmers in many developing countries are struggling to remain financially viable and many are now living in poverty (Workie et al., 2020). The consequences of government's COVID-19 mitigation strategies on farmer's livelihoods will make the nations difficult to achieve the SDG targets in relation to poverty reduction (United Nations, 2021).

Agriculture is the main source of income for a large proportion of the population in developing countries (Kumar et al., 2021). The agricultural sector in many of these countries was already fragile, being susceptible to various kinds of shocks and stresses, such as climate change, market failure, and pest and diseases outbreaks. As such, the agricultural sectors in most developing countries were argued to be vulnerable to the pandemic (Béné, 2020). As a developing country in south Asia, the island nation of Sri Lanka was no exception.

COVID-19 was identified in Sri Lanka in March 2020 and the country underwent several waves of the pandemic through 2020 and 2021 (Health Promotion Bureau SL, 2021). The disease was still a problem in Sri Lanka in 2021 with a high number of confirmed cases and associated deaths (Health Promotion Bureau SL, 2021). The social and economic impact of the pandemic has reduced the agricultural sector's contribution to Sri Lanka's GDP for 2020 by 2.4% compared to 2019 (Central Bank Sri Lanka, 2020a). With 25.3% of the country's employed population involved in the agricultural sector, any unfavourable economic conditions in the sector are expected to influence the livelihoods of 2,071,940 individuals (Department of Census and Statistics Sri Lanka, 2019). According to two studies, COVID-19 has had a significant impact on farmers growing perishable products such as vegetables in Sri Lanka (Alam and Khatun, 2021; Gu and Wang, 2020).

### 1.2. Vegetable sector in Sri Lanka

Favorable agro-climatic conditions allow farmers to grow some 40 varieties of vegetables year-round in Sri Lanka (Weerakkody and Mawalagedera, 2020; Sandika, 2012). The types of vegetables produced are broadly categorized as upcountry<sup>1</sup> vegetables (temperate vegetables e.g. carrots, beetroot, leeks, cabbage, etc.) and low country vegetables (tropical vegetables e.g. brinjal, pumpkin, snake gourd, bitter gourd etc.) (Rajakapsha et al., 2021).

The vegetable sector provides an important source of livelihoods for many Sri Lankan farming households (Weerakkody and Mawalagedera, 2020). Vegetable production is labour intensive (Central Bank Sri Lanka, 2020b). In the Nuwaraeliya district, for example, to cultivate 0.4 ha of cabbage and carrots requires 100 and 117 man days, respectively. In the Kandy district, 133 man days are required to cultivate 0.4 ha of land for tomatoes (Socio Economics and Planning Centre, 2019a). The sector also plays a role in the national economy. The local marketing channels for vegetables are diverse and dominated by the private sector (Sandika, 2012). In 2019, Sri Lanka produced 23,957 MT and exported \$US 32.0 million worth of vegetables to overseas markets (Central Bank Sri Lanka, 2020a). The main types of export vegetables included green beans, leeks, capsicums, cabbage, carrots, tomatoes, bell peppers and gherkins (Esham and Usami, 2006). The sector contributed 0.6% to the Sri Lankan GDP in 2019 (Department of Census and Statistics Sri Lanka, 2021).

Vegetable farmers in Sri Lanka are likely to be more financially vulnerable than other farmers due to: 1) the absence of a guaranteed price for their produce (Sandika, 2012), 2) little access to community irrigation systems as found in the paddy sector, 3) limited access to good information sources (Perampalam and Perera, 2018), 4) higher transaction costs in marketing (Silva and Ratnadiwakara, 2008) and 5) a lack of subsidies on inputs. Unlike rice, vegetables are perishable, and this

makes them a difficult product to manage post-harvest if the supply chain is disrupted (Hailu and Derbew, 2015). Being perishable, vegetables need immediate transport to market before they deteriorate (Sandika, 2012), hence timely marketing is required. In Sri Lanka, vegetable marketing is governed mainly by the private sector and the role of middlemen is significant (Vidanapathirana, 2008). Because of this, and due to the lack of a guaranteed price, farmers' profit margins from vegetable selling is relatively low and unpredictable (Sandika, 2012). This makes vegetable farmers potentially more prone to shocks than other farmers who do not face these problems.

Despite the importance and the vulnerability of the vegetable sector in Sri Lanka, little is known about the impact of COVID-19 on the country's vegetable farmers. Therefore, this study explored and identified how the Sri Lankan government's COVID-19 mitigation strategies affected upcountry vegetable farmer's production, marketing and income levels. The potential impact of this loss of income on vegetable farmers is also explored.

## 2. Methodology

This study used an exploratory research design (Edgar and Manz, 2017), useful for studies where little is known about the phenomena of interest. In an exploratory research design, interviews with key informants, people with knowledge of the problem domain, are undertaken to obtain a good understanding of the phenomena (Lokot, 2021). This study sourced data from the Nuwaraeliya and Kandy districts in the upcountry region of Sri Lanka because these are important vegetable growing areas (Rosairo and Potts, 2016). To obtain an understanding of the impact of COVID-19 on vegetable farmers, 25 key informants from the Nuwaraeliya and Kandy districts were purposively selected for data collection. Data saturation was realised after 25 key informant interviews, where adding more interviews was assessed as not likely to add any new information (Guest et al., 2006). Creswell and Poth (Creswell and Poth, 2016) recommend 25 interviews as an appropriate number for an exploratory qualitative study.

Two types of key informants were interviewed in the study, agricultural service providers who interact with the vegetable farmers in the area and vegetable farmers. It was believed that key informants from agricultural service sector would provide a good understanding of the impact that COVID-19 had on vegetable farmers. The criteria for the selection of the service provider key informants included: they have frequent contact with vegetable farmers in the area and have more than five years working experience in the vegetable sector. Five service providers who have an overall understanding on both Nuwaraeliya and Kandy districts were selected, and it included three extension officers from the public sector and two marketing officers from the private sector. These were identified in discussion with senior officers of the Department of Agriculture Sri Lanka.

Vegetable farmers were also used as key informants to obtain greater insights into the impacts of COVID-19. The criteria used to select the key informant vegetable farmers included: they earned more than half of the household income from vegetables, and they had started vegetable cultivation before the arrival of the pandemic (i.e., prior 2020 March). We selected 20 farmer key informants across two districts. The 20 farmer key informants were identified through discussions with senior staff at the Department of Agriculture and the service providers mentioned above. The farmers who had experienced devastating negative impacts from the pandemic were not selected for this study as asking further questions from them may have put them into psychological distress.

Semi-structured interviews with key informants were carried out between July–August 2021 and were undertaken face to face (Irvine et al., 2013) or over the telephone (Cachia and Millward, 2011) depending upon the COVID-19 health guidelines at the time. The key informants were first contacted over the telephone and asked to participate in the study. The nature and purpose of the study and the types of questions to be asked was explained and if the key informant

<sup>1</sup> The geographical classification (based on the elevation) is named as upcountry (>900 m), mid country (300 -900 m) and low country (<300 m) (Punyawardena, 2020).

agreed to participate a time and date for the interview was set. The respondents were contacted at the agreed date and time. To make the respondent feel comfortable and build rapport, the researcher began the interview with ice-breaker questions. Once the researcher assessed that respondent was relaxed, permission to voice record the interview was sought. If agreement was given, questions were asked of the key informant. All the interviews were supported by an interview guide with open-ended questions. The questions on the interview guide were prepared based on the literature review.

Using open and probing questions interviews with service provider and farmer key informants elicited information on the production and marketing of vegetables before and during the pandemic, the financial implications of the pandemic on farmers and the strategies they had adopted in response to the pandemic (see the supplementary file for details). In all interviews, clarification questions were asked by the researcher to ensure clarity and probing questions were also used to gain adequate information from the respondents.

Secondary data was collected about the impact of COVID-19 on vegetable farmers in the region from research articles on related regional studies, journal papers, government reports and websites, media reports and other web sources (Hox and Boeije, 2005).

The audio-recorded interviews were transcribed verbatim (Halcomb and Davidson, 2006) and thematically analyzed using MS Excel software (Tripathi et al., 2021). The next section sets out the research context and findings which are then discussed.

### 3. The research context

Sri Lanka identified its first COVID-19 local case on 11th March 2020 and as of 14th June 2021, some 225,922 total confirmed cases and 2203 deaths had been reported (Ministry of Health Sri Lanka, 2021). In line with the rest of the world, the government adopted various measures to cope with the pandemic and these measures were adapted during subsequent waves of the pandemic. The measures were designed to prevent the community transmission of the virus via close human interactions while attempting to maintain economic activity and social life (Ministry of Health Sri Lanka, 2020). The government also put in place measures to protect financially vulnerable groups within Sri Lankan society who had lost their primary sources of income due to the COVID-19 pandemic (Official Website for Sri Lanka's Response to COVID-19, 2020).

The first measure introduced by the Sri Lankan government was to move to a stringent lockdown over a two-month period, to control people's movements and limit direct physical interactions (Hettiarachchi et al., 2020; Jayasena and Chinthaka, 2020). A curfew was imposed, and social gatherings were prohibited (Hettiarachchi et al., 2020). Schools, universities and leisure venues (e.g. cinemas, public gardens, museums) and the majority of businesses were placed under lockdown (Hewage et al., 2020). Under lockdown only essential services, such as health services, could operate. Farming and fishing activities were declared to be essential services and farmers were allowed to carry out their activities during lockdown (Galappattige, 2020; Weerahewa et al., 2020). This policy decision prevailed throughout the COVID-19 pandemic in Sri Lanka and it is still in place at the time of publication.

In June 2020, the lockdown measures were eased because of a reduction in the number of confirmed COVID-19 cases (news A, 2020). A curfew and travel restrictions were still imposed in identified hot spots for the virus, especially in the western province, where the capital Colombo is located. In other areas, these restrictions were lifted but then reimposed in response to COVID-19 outbreaks (WORLD G, 2021). A national lockdown map was updated as conditions changed, and this was communicated to the public in real time via government and private media (Lanka GS, 2021). COVID-19 was diagnosed through random PCR testing, and contact tracing was used to identify individuals that might be infected with the virus (Lanka GS, 2021). Quarantine centers were set up to isolate confirmed cases and limit the spread of the virus (Lanka GS,

2021).

To maintain basic social and economic activities while preventing the transmission of the virus, a 'work-from-home' strategy was introduced (Ministry of Health Sri Lanka, 2020). In non-lock down areas, people could go to nearby markets to buy essential items, but only on selected days of the week. As travel restrictions were tightened, suppliers started to provide a home-delivery service for essential items (India TTo, 2020). Consumers too, exhibited more interest in online-purchasing, because of concern for their personal safety from the virus.

In order to look after vulnerable groups whose source of family income had been affected, the government provided a relief package of LKR 5000 (25 US\$), or supplied free essential food items (Official Website for Sri Lanka's Response to COVID-19, 2020). In the early stages of the pandemic, the government requested that commercial banks provide a recovery period over which their debtors could re-pay loans because of financial hardship created by COVID-19 (Lanka CBS, 2021). These measures had several impacts across Sri Lankan society including the agricultural sector (Galappattige, 2020). Similar to other countries (Kumar et al., 2021), farm production and marketing were hampered particularly for perishable crops such as vegetables (Sachitra and Padmini, 2021).

## 4. Results and discussion

Vegetable production and marketing and nature of vegetable farming and farmer livelihoods are covered in the first part of this section. Later the COVID-19 impact on supply chains, markets, household dynamics and income from vegetables is presented and discussed.

### 4.1. Vegetable production & marketing, nature of vegetable farming and farmer livelihoods in the Nuwaraeliya and Kandy districts of Sri Lanka

The farmers interviewed from the Nuwaraeliya and Kandy<sup>2</sup> districts grew upcountry vegetables. Nuwaraeliya is a recognized area for upcountry vegetable production and vegetables can be grown year-round with 3–4 crops grown per year. In contrast, farmers in Kandy district cultivate vegetables only in the *yala*<sup>3</sup> or dry season because they mostly cultivate Paddy during *maha* or the wet season. Carrots, leeks, cabbage, beetroot, lettuce, and potatoes were the main types of vegetables cultivated by Nuwaraeliya vegetable farmers. In contrast, farmers in Kandy cultivated carrots, tomatoes, luffa, snake gourd, capsicum, hot chilies, and salad cucumber. Among the vegetable farmers in Nuwaraeliya district, the land area used for vegetable production was typically between 0.20 and 2.00 ha (average - 0.72 ha) and in the Kandy district it was between 0.04 and 1.00 ha (average - 0.50 ha). Another study ( $n = 120$ ) reported that the landholding size of 40% of vegetable farmers in their sample from the Nuwaraeliya district was equal to, or less than 0.10 ha (Padmajani et al., 2014). This indicates that there is a mix of vegetable farmers in the district with respect to land area cultivated with vegetables.

Family labor was used by the farmers in both districts. Some better-off farmers who had 0.8 ha or more vegetable cultivated lands, especially in the Nuwaraeliya district, used hired labor for production, harvesting and marketing. Usually, in the Nuwaraeliya district, some 48% of hired labor was used for cabbage production and some 49% for carrot production (Socio Economics and Planning Centre, 2019a). In Kandy district, the portion of hired labor for tomato cultivation is about 45% (Socio Economics and Planning Centre, 2019b).

Farmers in both areas are heavily dependent on agro-chemicals for vegetable production. A key-informant from a private agrochemical firm indicated that there was a large farmer base in both districts. An intensive cultivation system was used in both areas and farmers tended

<sup>2</sup> Some of the areas in the Kandy district are in the upcountry.

<sup>3</sup> *Yala* and *maha* are the main cultivation seasons in Sri Lanka

to apply high rates of fertilizers and pesticides to their crops to promote growth and to control the large number of pests and diseases that exist in this humid climate (Padmajani et al., 2014). Fungicide use was high in Nuwaraeliya district because of the humid conditions (Padmajani et al., 2014). In that district, potato farmers used the highest number of different types of pesticides followed by farmers growing leeks (Padmajani et al., 2014).

The vegetables produced in Nuwaraeliya and Kandy districts were marketed at the domestic and export level. Fig. 1 illustrates the supply channels used by vegetable farmers in Nuwaraeliya before the pandemic. Before the pandemic produce was normally sold to wholesalers who came to farmer's fields. Some farmers transported vegetables to the markets. In Nuwaraeliya district, vegetables were also marketed through the dedicated economic centre, hotels, supermarkets and retail markets in Kandapola area which has a fairly good market for vegetables.

In contrast, Kandy district vegetable farmers used different types of supply channels as shown in the Fig. 2. They sold produce to the markets in Kandy, Katugasthota (a sub-urban area closed to Kandy), and to the dedicated economic Centre,<sup>4</sup> Dambulla, which is a main vegetable market in the country and the central wholesale market in Colombo. Mobile collectors visited farmer's fields to collect vegetables and some farmers also practiced direct marketing. Hotels, supermarkets, Good Agricultural Practices (GAP) outlets and export markets were the other marketing channels for Kandy farmers.

Among farmers interviewed, some sold their produce to private sector supermarkets on a contract basis. In the Kandy district, some farmers sold their produce to agents that on sold into export markets. These buyers also visited farmer's fields to purchase vegetables. When compared to vegetable farmers in Nuwaraeliya, vegetable farmers in Kandy had more options for marketing and hence it could be assumed that comparatively they experienced a lesser impact from market disruptions due to COVID-19 pandemic. However, future research in this area is needed to verify this assumption.

Among the 20 farmers interviewed, the main occupation for ten of the farmers was vegetable farming. The other 10 farmers cultivated vegetables part-time and were either employed in the public or private sectors or were self-employed. Laboring work was an additional source of income especially for the Nuwaraeliya vegetable farmers. Some worked for large scale vegetable farmers, primarily assisting with land preparation, weeding, and harvesting. None of the farmers that were interviewed in the Kandy district worked as laborers which may reflect the lack of large-scale vegetable lands in the district. Some farmers interviewed in the Kandy district were retired government officers and some owned small grocery stores.

#### 4.2. The impacts of COVID-19 on vegetable farmers in the Nuwaraeliya and Kandy districts of Sri Lanka

The COVID-19 pandemic impacted vegetable farmers in several ways in Nuwaraeliya and Kandy districts in Sri Lanka. This research highlights that the mitigation strategies the government put in place to manage COVID-19 impacted on vegetable farmers in both districts. As found by other scholars the main impact for farmers was not COVID-19 itself but the mitigation options imposed by the government that had the greatest impact (Adhikari et al., 2021; Jaacks et al., 2021a; Gray, 2020). Three main causes are identified as having led to reduced incomes for vegetable farmers. These three causes are: 1) the disruption of input supply, 2) the disruption of markets and 3) unemployment in the wider population that meant family members returned to the home farm (Fig. 3). This categorization of causes that have impacted farmer's incomes adds

<sup>4</sup> Dedicated economic centers are established under the purview of the Ministry of Agriculture, Sri Lanka to provide a marketing avenues for the farmers and buyers.

clarity to the literature. Lioutas (Lioutas and Charatsari, 2021) identified loss of farmer's income and shortage of agricultural inputs as the two main direct impacts from COVID-19 pandemic for agricultural production in general (Lioutas and Charatsari, 2021). Some scholars have discussed in detail the impacts on input supply, market disruption, transport issues and labor issues in different farming systems in general (Tripathi et al., 2021; Jaacks et al., 2021b). However there has been little discussion on the impact on vegetable farmers and their income specifically, except studies that explored the impact on vegetable supply and marketing chain in Bangladesh (Alam and Khatun, 2021) and China (Gu and Wang, 2020). Such studies also indicated that the pandemic has affected vegetable marketing and because of that, farmers income was reduced which will likely lead to future vulnerability and food insecurity. These are quantitative rather than indepth qualitative studies. Nirmal (Gadal et al., 2020), developed a detailed impact pathway diagram for COVID-19 on vegetable farmers in Nepal (Gadal et al., 2020). However, that diagram is very complex, and it is very difficult to differentiate the types of impacts on vegetable farmers. Therefore, with the experience from vegetable farmers in Sri Lanka, this study fills knowledge gap by identifying the main impacts on vegetable farmers as shown in the Fig. 3.

The following sections discuss the causes separately.

##### 4.2.1. Disruption of supply chains

The disruption of input supplies caused by the pandemic was a significant impact on vegetable farmers in this research. The inputs can be grouped according to where they are used in the production and post-harvest cycle of vegetables. The impact of COVID-19 on agricultural inputs has been identified in other studies (Jaacks et al., 2021b; Harris et al., 2020). Alam, and Khatun compared the supply chain of vegetables prior to the pandemic and during the pandemic in Bangladesh (Alam and Khatun, 2021). Though the studies on supply chain disruptions due to COVID-19 have identified production activities and post-harvesting activities as separate entities (Sharma et al., 2020; Aday and Aday, 2020) the studies on COVID-19 impact on farmers have not categorized such impacts into these two entities. This study describes the impact from the pandemic on inputs used for harvesting and post-harvesting operations of vegetables in Sri Lanka.

This study identifies four categories of inputs used for crop production that were disrupted by COVID-19: agro-chemicals, seeds, labor and advice. Farmers reported difficulties in accessing agrochemicals such as fertilizer, herbicides, pesticides and fungicides. They also had problems accessing seeds. Lack of agro-chemicals and seeds were reported to be an impact of the pandemic in Bangladesh, India, Myanmar, Papua New Guinea, and Timor-Leste (Adhikari et al., 2021; Hossain, 2020; Boughton et al., 2021; Davila et al., 2021). COVID-19 also impacted farmer's access to labor with implications for cultivation, planting, weeding, spraying, and harvesting. Labor supply issues have been reported in Nepal also (Adhikari et al., 2021). COVID-19 also limited vegetable farmer's access to advice from government extension agents and information from private service providers such as input suppliers. This impact of COVID-19 on advice for farmers has not to date been reported elsewhere. In contrast, Boughton (Boughton et al., 2021) identified issues in access to machinery, it was not evident in this study, may be due to relatively low use of mechanization on vegetable farm in Sri Lanka or the widespread ownership by farmers of their own machinery.

The COVID-19 mitigation strategies to manage COVID-19 caused food market closure and domestic and international travel restrictions. Consequently, the functioning of the marketing channels depicted in Figs. 1 and 2 were disrupted in both Nuwaraeliya and Kandy districts during the pandemic. Farmers had two options; either they sold their produce to nearby markets, or they were unable to sell vegetables at all. In the first option, farmers received a lesser price due to oversupply of vegetables whenever dedicated economic centers or supermarkets opened with the ease of travel restrictions. In the second option,

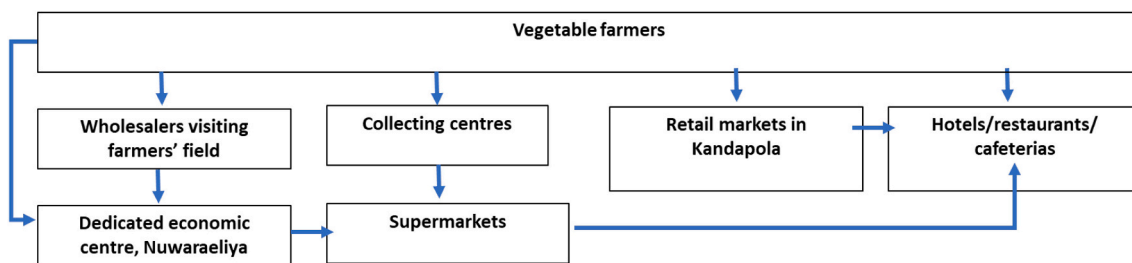


Fig. 1. Supply channels of vegetables in Nuwaraeliya district pre the pandemic (Source: field data).

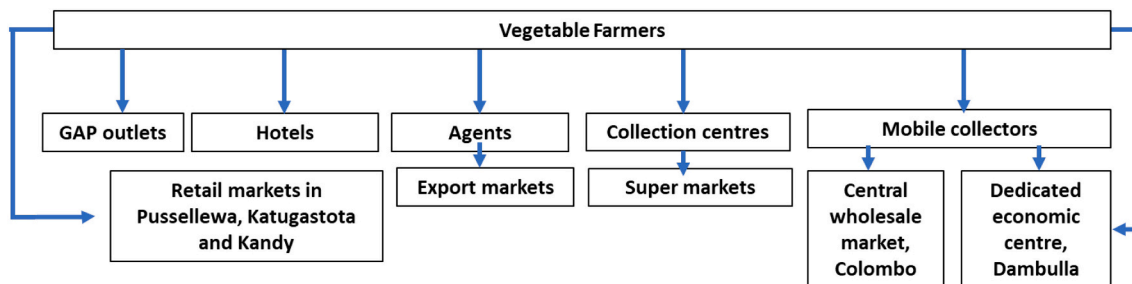


Fig. 2. The supply channels for vegetables in the Kandy district pre pandemic (Source: field data).

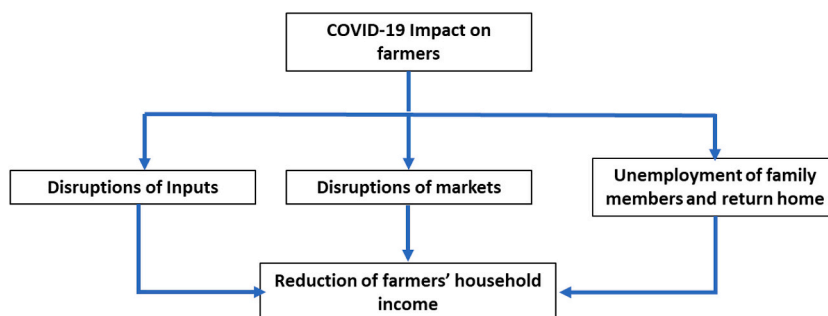


Fig. 3. The main types of impacts from the COVID-19 pandemic on vegetable farmer's household income.

whenever the markets were completely closed and farmers did not have anywhere to sell their produce, they were forced to dump vegetables, to compost them or to give them away to neighbors and others. Both options resulted in a decreased income from vegetables for farmers in both Nuwaraeliya and Kandy districts.

The other aspect of impact on inputs was on post-harvest activities which could include collecting, sorting, washing, grading, milling, grinding, transporting, and warehousing, packing, and compacting (Sharma et al., 2020). Due to travel restrictions many farmers in Nepal, Bangladesh and many other countries in Asia faced difficulties in finding transport facilities to send their produce to markets (Talukder et al., 2021; Adhikari et al., 2021; Dixon et al., 2021). This study also confirmed that with respect to impact on post-harvesting activities, difficulties in transporting was the main issue indicated by the vegetable farmers in Sri Lanka. In addition, vegetable collection was also affected which will be discussed later. The respondents did not mention the impact on other post-harvest activities such as sorting, washing, and grading. Because, due to perishability, sorting, washing, and grading of vegetables, were carried out by different stakeholders in the value chain including farmers themselves, hence there may be less impact from the travel restrictions. Some studies indicated that lack of storage facilities also affected farmers during this period (Talukder et al., 2021). In contrast, lack of storage facilities was not identified as a constrain within this study. It was because being a perishable, vegetables cannot be stored for a long period of time.

Fig. 4 depicts how COVID-19 has disrupted input supplies for the farmers of the Nuwaraeliya and Kandy districts, and how those disruptions have impacted on the farmer's household income from vegetables. Impact pathway diagrams on the effect of COVID-19 pandemic on small holder vegetable farmers has been developed by other scholars in the context of Nepal (Gadal et al., 2020). Though there are studies discussing the pandemic effect on inputs supply, there is little work found on this in the Sri Lankan context. The information presented in Fig. 4 summarizes and communicates the contextual information.

The domestic and international travel restrictions were imposed by the government of Sri Lanka to mitigate the spread of COVID-19. Consequently, farmers faced difficulties in finding transport services to take their vegetables to the markets, as occurred in other countries such as Bangladesh (Talukder et al., 2021) and Nepal (Gadal et al., 2020).

Domestic travel restrictions disrupted transport links to get vegetables to the remaining markets and this reduced sales and income from vegetables for farmers in Nuwaraeliya and Kandy districts. A similar situation was observed among farmers in other countries such as India (Kumar et al., 2021) and Bangladesh (Talukder et al., 2021). In addition, the travel restrictions limited face-to-face interactions between vegetable farmers and service providers in the vegetable sector including extension service officers and mobile vegetable collectors. Vegetable farmers in both Nuwaraeliya and Kandy were used to getting advice and information from the government extension officers, field officers from agrochemical companies and from the chemical stores available in the

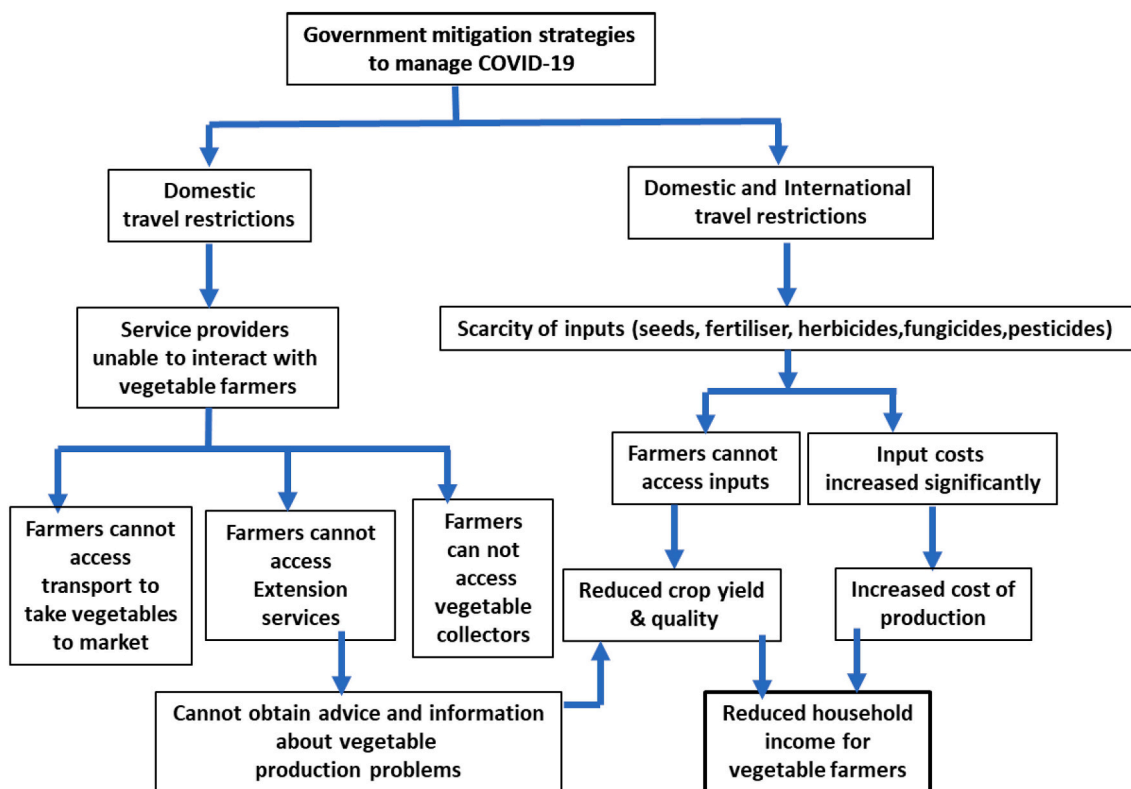


Fig. 4. The factors related to disruption of input supplies to vegetable farmers in Nuwaraeliya and Kandy districts due to COVID-19.

area. Lack of access to these information services led to poor crop yield and reduced quality of vegetables which ultimately contributed to a reduced income from vegetables, also.

Mr. B is a full-time vegetable farmer in Nuwaraeliya district who cultivated 0.9 ha of carrots. He has six dependent family members and about 75% of the household income came from vegetables. Mr. B outlines the impact of not being able to access information:

*‘Very often I receive some advice from the private sector fertilizer companies. But, recently I could not manage to meet, discuss and get advice from these officers regarding pest attacks occurring in my field. I tried the same type of pesticides I used to use, but it seems it is not working this time’* (a quote from Mr. B).

The country’s extension and advisory system were not prepared for the pandemic, as with most other countries. When face to face direct interactions were restricted during the pandemic, use of ICT became a promising and viable option. There are several ICT initiatives in agricultural extension and advisory set up in Sri Lanka including the so-called ‘1920’ telephone based agricultural advisory service (Kumari et al., 2009), and Cyber extension units (Wijekoon and Rizwan, 2011). It would be interesting to explore if farmers have used these services more during this period. The ICT competencies of field extension officers and farmers will determine the success of this type of communication and improving the ICT competency of both parties would increase the resilience of advice and information channels for the future.

Sri Lanka mainly imports agrochemicals for the agricultural sector. International travel restrictions imposed to mitigate COVID-19 limited the import of these inputs and domestic travel restrictions disrupted the distribution of available inputs to farmers. Input supply issues due to the pandemic were common in other countries as well (Béné, 2020). All the vegetable farmers in the Nuwaraeliya district interviewed were affected by the scarcity of inputs and were able to only apply reduced amounts of fertilizers to their fields. As a result, yields were reduced with consequent impact on their financial return from vegetables. Due to limited

supply of fertilizers, in the Nuwaraeliya district a fertilizer black market emerged through which fertilizers could be sourced but at an inflated price increasing the production cost for vegetables. Upcountry vegetable production had a high cost of production compared to other crops before the pandemic. For instance, the total cost of cultivation of Paddy under irrigated water regime, was LKR 50,425 (252 US\$) per 0.4 ha (including imputed cost) and it was LKR. 35,434 (177US\$) per 0.4 ha (excluding imputed cost). In contrast, the total cost of cultivation (including imputed cost) reported for 2018/19 maha season for upcountry vegetables varied from LKR 194,513 (976 US\$) to LKR 267,289 (1342 US\$) per 0.4 ha (Socio Economics and Planning Centre, 2019a).

Mr. C is a vegetable farmer in the Nuwaraeliya district with 1.3 ha of vegetable cultivated land with potatoes and leeks, he describes the impact of the fertilizer shortage:

*‘I could not find enough fertilizers for my field in this season. Even if I managed to find some, it was expensive. The normal price of fertilizers is about LKR 1650 (8 US\$) per 50kg bag. But this time I had to pay LKR 2000 (10 US\$) per 50 kg bag and I needed 20 bags’* (a quote from Mr. C).

In contrast, during the data collection stage of this study, some farmers in the Kandy district were at the vegetable harvesting stage and hence were not forced to deal with the issue of accessing fertilizer for planting their crops. However, some farmers in the Kandy district complained that they could not find the required fertilizers and pesticides as the chemical stores were closed.

Ms. D is a farmer in the Kandy district and she has cultivated snake gourd, luffa and Chillie in 1.2 ha of land. She recounts the difficulties she experienced in finding fertilizer:

*‘I could not find fertilizers at the time of planting. The fertilizer shops were closed due to lock down and my harvesting became late. And also I had some fungal attacks in my harvest for which I could not find a solution’* (a quote from Ms. D)

In Nepal, some small-scale farming communities who did not rely on external farm inputs were more resilient during the pandemic than the large-scale farmers who were heavily dependent on international markets, both for inputs and for the marketing of their produce (Adhikari et al., 2021). The situation is different for the Sri Lankan up country vegetable sector. The scale of production of interviewed farmers varied from small scale (<0.4 ha of vegetable cultivated land) to large scale (> 2 ha of vegetable cultivated land) and both types were commercial farmers as they sold the majority of what they produced. The area has been used for intensive vegetable cultivation for a long time and is associated with high agrochemical use in farming. Therefore, the breakdown of the agrochemical supply chain is likely to have a considerable impact on amount and quality of vegetables produced, which will ultimately affect farmer's income. Using alternative inputs such as organic manure for vegetable production, may enable farmers to at least buffer the impact of the input supply breakdown. However, the feasibility of the large-scale use of organic manure for vegetable production in this cool hilly area has yet to be investigated.

All the vegetable farmers in the Nuwaraeliya and Kandy districts bought vegetable seeds from private stores. Potato farmers in the Nuwaraeliya district bought potato seed from the government owned farms located in the area. Before the pandemic, government farms imported potato seeds for a comparatively low price but in limited quantity. Some of the potato farmers interviewed indicated that access to seed from the government farms was granted on the basis of favoritism and was viewed as being corrupt. As a result, farmers interviewed complained that it was difficult to access reasonably priced potato seed.

Mr. E is a vegetable farmer in the Nuwaraeliya district who cultivated carrots, leeks, cabbage, potatoes, salad leaves and broccoli on 0.8 ha of land. He states:

*'The cost of production of potatoes is very high. But, we do not have many alternatives, this is the only thing we know and [it has been this way] for a long period of time'* (a quote from Mr. E).

Interestingly, no impact on labor availability or change in labor costs were identified in either Nuwaraeliya or Kandy districts. This is because labor was sourced locally from family or neighbors which was not

affected by travel restrictions. Low use of migrant labor for vegetable farming was an advantage to these farmers. However, there was a difference in vegetable farmer's land ownership in Nuwaraeliya and Kandy districts. All the farmers in the Kandy district interviewed cultivated vegetables on their own land, whereas some farmers in the Nuwaraeliya district cultivated vegetables on rented land. For those renting, the cost added to the high cost of production, as is illustrated in the following quote:

Mr. D is a farmer in Nuwaraeliya district and he has cultivated several types of vegetables.

*'I have 0.6 ha land with potatoes in rented land and I have to pay about LKR 20,000 (100US\$) per season'* (a quote from Mr. D).

The loss of income from vegetables had a compound effect on the types of resource poor farmers interviewed in both districts.

4.2.2. Disruption of the marketing system

Government mitigation strategies to manage COVID-19 led to closure of food markets, domestic and international travel restrictions and restrictions for peoples 'movement. Marketing channels were lost due to closure of food markets and therefore farmers were unable to sell their produce. Meanwhile oversupply of vegetables to remaining markets resulted in low prices for vegetables. Travel restrictions led to a drop in tourist arrivals and movement restrictions changed vegetable consumers' behavior. These two factors reduced the demand for vegetables and ultimately vegetable prices were also reduced (Fig. 5).

A farmer interviewed, Mr. A, was a fulltime vegetable farmer in Nuwaraeliya district who cultivated carrots, leeks, salad leaves, raddish, and potatoes on one hectare of land. Mr. A explains how the pandemic impacted him and how he responded:

*'Normally I sell my produce to the wholesalers coming to my field. Since they did not come during this period, I had no options to sell my Chinese vegetables such as leeks and salad leaves. I started to make compost out of my unsold vegetables, and it was about 2 LKR laks (about1000US\$) financial loss to me'* (a quote from Mr. A).

The demand for vegetables was also reduced due to several factors.

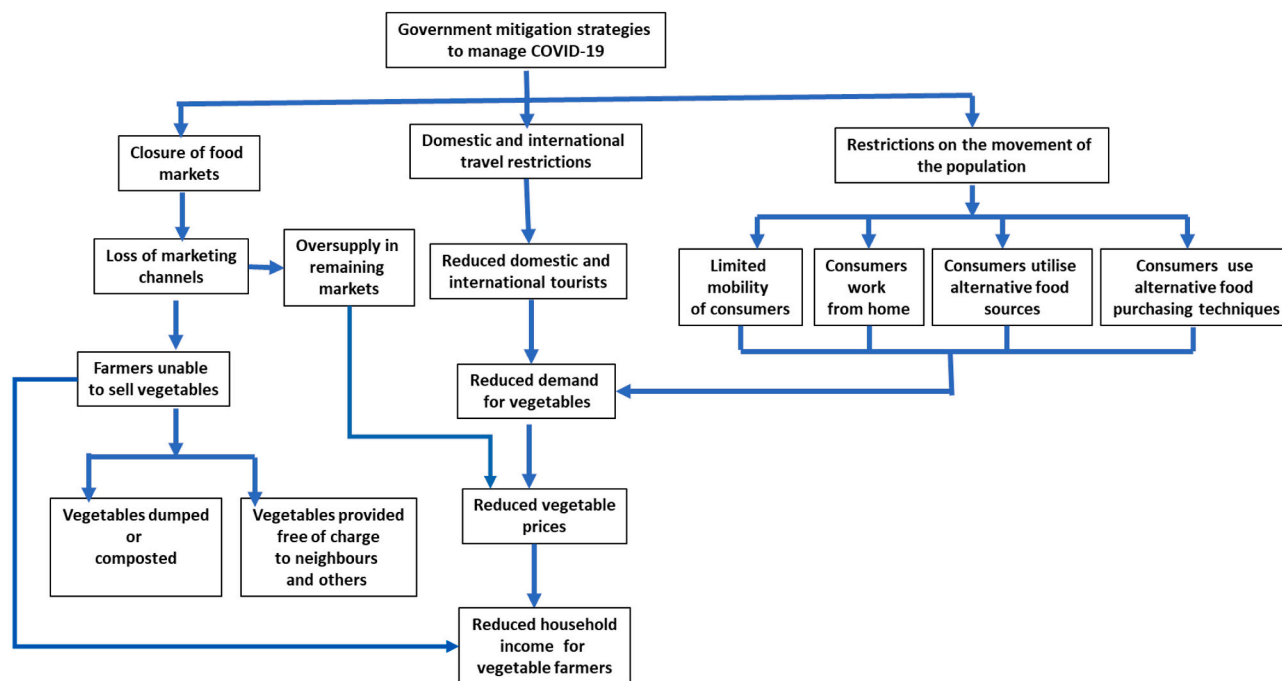


Fig. 5. The factors and outcomes related to the government's travel restrictions and the consequent disruptions in vegetable marketing systems for farmers in Nuwaraeliya and Kandy districts.

Nuwareliya and Kandy districts are recognized tourist destinations in Sri Lanka. However, with international and domestic travel restrictions tourism was halted and the demand for vegetables and subsequently farmers' incomes from vegetables was reduced. Due to the travel restrictions on people's movements, consumers did not move around the district and tended to work from home. This resulted in a move to source food from alternative sources to those traditionally used including on-line purchasing. These measures reduced the demand and price for vegetables and ultimately impacted adversely on vegetable farmers' incomes. An additional factor, job losses, identified by Alam and Khatun (Alam and Khatun, 2021) may also have been reduced consumer buying power.

Agro-produce wastage was also seen among dairy farmers in Bangladesh. They threw away unsold produce due to low consumer demand (Hossain, 2020). Vegetable farmers in India shared unsold vegetables with others as a coping strategy (CAK et al., 2020) which is similar to the findings in this study. Prior to the COVID-19 pandemic, it was reported that about 20% - 40% of the vegetable harvest in Sri Lanka was lost annually, which is about 370,000 metric tons in quantity and a value of approximately US\$ 110 million (Esham and Usami, 2006). The reasons seem to be poor-practice in the post-harvest stage, such as incorrect packaging, lack of knowledge and awareness among farmers, and other lapses in logistics including cold storage (Rajapaksha et al., 2021; Berkes, 2007). Wastage of vegetables in Sri Lanka during this pandemic may be much greater compared to the period before 2019 (Rajapaksha et al., 2021) and put increased pressure on vegetable farmers' livelihoods and the national vegetable supply chain. Both factors will be a challenge to the sustainability of the sector.

Farmers in other countries have adopted alternative marketing channels during the pandemic, including direct selling to consumers' door-steps (Alam and Khatun, 2021). This was not evident among interviewed vegetable farmers at the time of data collection. There were licensed mobile vegetable sellers during the lockdown period, but these tended to be middlemen, not farmers. The well-established conventional vegetable marketing channels which often involved several middlemen and practical difficulties may have discouraged farmers from direct selling of vegetables. For instance, being an essential food item the customer base for up-country vegetables were spread throughout the country, it is likely that it would be more profitable, effective and efficient for farmers to go through a conventional, established marketing channel than practicing direct marketing to a few customers in their local area.

#### 4.2.3. The loss of off-farm employment for family members

All forms of social gatherings were restricted during the lockdown and hotels, restaurants, cafes, and other businesses in the hospitality sector were closed with staff working in these sectors made redundant. In some of the households interviewed unemployed family members had returned home placing additional financial pressure on the farm households. The impact on travel restrictions on off-farm employment for farm family members had downstream effects which are shown in Fig. 6. This impact was observed also in other countries such as in Nepal (Adhikari et al., 2021). However, the shift in human resource availability may be an advantage with this labor fulfilling the labor requirements in vegetable farming, as was observed among vegetable farmers in Bangladesh (Alam and Khatun, 2021).

Mr. E, an unmarried vegetable farmer in the Nuwaraeliya district with four siblings, explains how he had to earn more money from vegetable farming to feed his unemployed brothers:

*'I have two brothers who worked in a hotel. But with this pandemic, they have lost their jobs and they are now staying at home. They do not have much interest in farming. So, I have to anyhow earn some more money to feed my whole family'* (a quote from Mr. E).

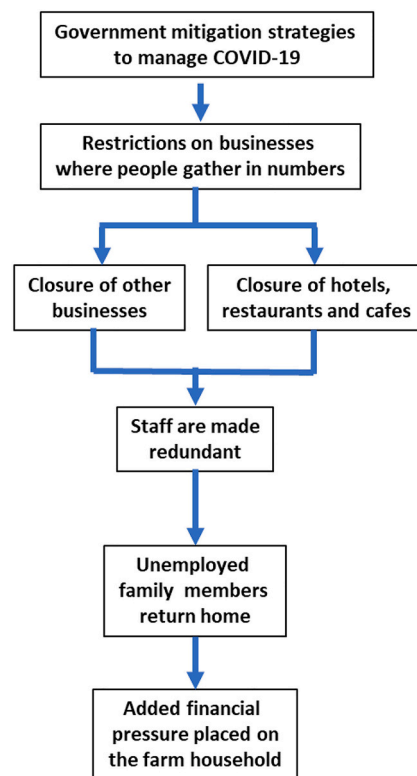


Fig. 6. The impact on travel restrictions on off-farm employments of farm family members and farm household.

#### 4.3. The impact of the loss of vegetable income on the farm households

Several downstream implications result from a reduced income from vegetable sales for farmers. Drawing on data from interviews and secondary data sources Fig. 7 diagrammatically illustrates these impacts.

With the low financial returns from vegetable farming, farmers interest in continuing to grow vegetables has waned as Mr. A, a vegetable farmer from Nuwaraeliya explains:

*'Although I have to make compost from my vegetables I have to continue vegetable farming since I do not have any other option. But, my children do not want to continue this as vegetable farming is really unprofitable'* (a quote from Mr.A).

Although youth moving away from agriculture is not a new phenomenon, the negative consequences of COVID-19 have potentially exacerbated the situation. This may suggest that securing vegetables farmers' incomes during pandemic, may contribute to the long-term sustainability of the vegetable sector.

The nutritional status and household wellbeing of households reliant on vegetables as a primary source of income are likely to be negatively affected from reduced purchasing and consumption of essential items (eg. animal protein) by household members. This was observed among vegetable farmers in Bangladesh (Alam and Khatun, 2021) and could potentially present a threat to national food security. Unmet nutritional needs during the pandemic may make farm households vulnerable to diseases and other health issues. Some farmers in both Nuwaraeliya and Kandy districts indicated that they had to use savings or to borrow from neighbors or friends to cover family expenses during the pandemic. Most farmers had mortgaged family jewellery to fund vegetable cultivation.

Mr. F, a vegetable farmer in Kandy district who cultivated luffa, tomatoes, beans, snake gourd on 1.6 ha. describes his situation:

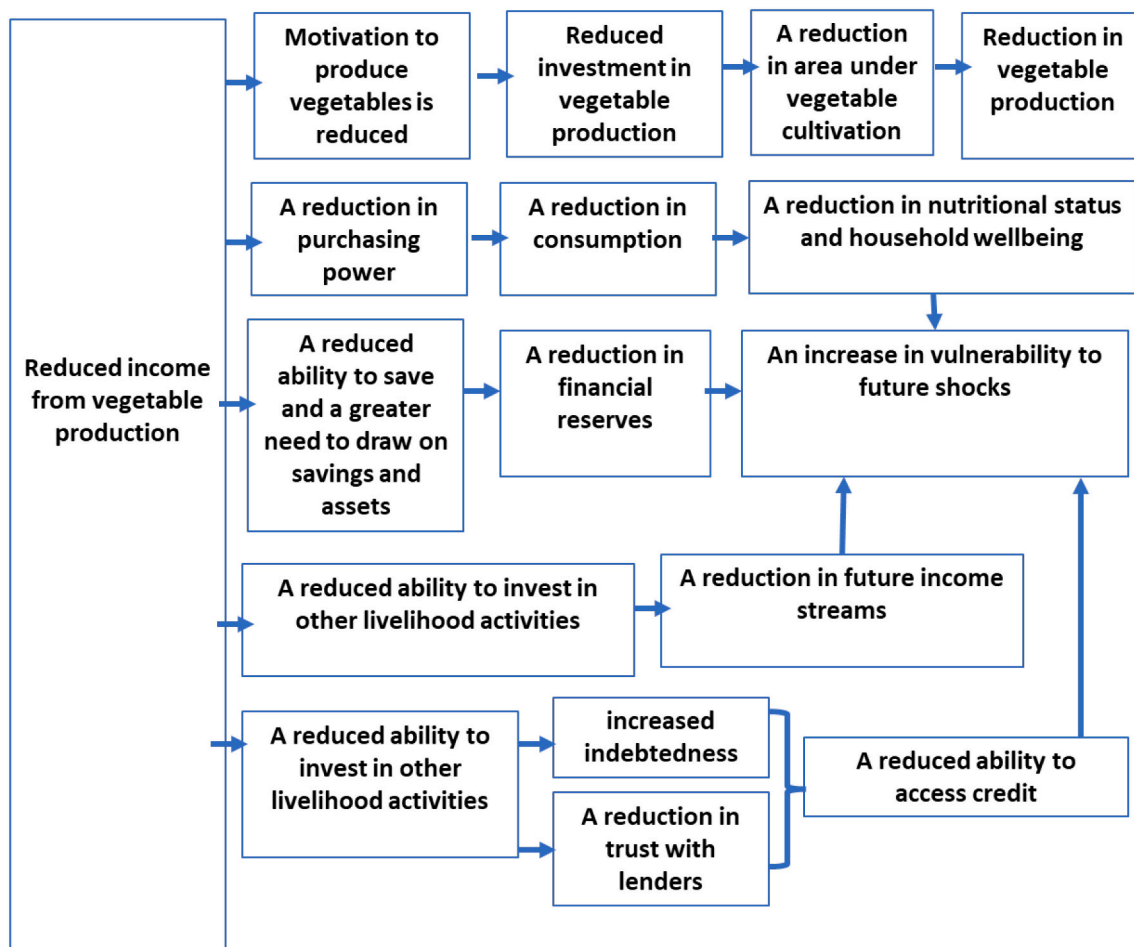


Fig. 7. The consequences of receiving low income from vegetables by farmers in the Nuwaraeliya and Kandy districts.

*'I do not have any bank loans. but I have mortgaged my jewellery to cultivate vegetables. I have had a 6-7 LKR lacs (3000-3500 US\$) loss in income between 2019 and 2020'* (a quote from Mr. F).

Low investment in other livelihood activities will likely reduce farmers' ability to accumulate financial reserves to face future shocks. In other words, their vulnerability will increase. This was evident among small holder farmers in Tanzania (Tripathi et al., 2021). In order to cope with financial issues in the household during the pandemic, some farmers had to borrow from their neighbors. This suggests that immediate cash support is needed to safeguard vegetable farmers.

Some farmers in both Nuwaraeliya and Kandy districts while received cultivation loans from state and private banks others had received credit in a form other than money. Mr. G a key informant from Kandy district owned a chemical store and also cultivated vegetables on 0.4 ha of land. He describes how he is trapped in negative circumstances because of the pandemic:

*'I had a loss about 3 lacs (1500US\$) due to sales reductions in chemicals and vegetables. Some farmers buy chemicals for credit, but they could not repay the loans as their income is also low'* (a quote from Mr. G).

Many impacts of the pandemic will contribute to lower financial returns for vegetable farmers in the short and long term. The negative consequences on this sector, therefore, will present a challenge to achieving SDG 1 target in the future.

## 5. Conclusions and recommendations for future research

Since vegetables are an essential nutritional component of the daily

diet of Sri Lankans, the effect of the pandemic on vegetable farmers will go far beyond the farming community. The findings of this study were consistent with other studies conducted in Asia. The COVID-19 pandemic mitigation strategies imposed by the Sri Lankan government have negatively impacted vegetable farmers, in terms of vegetable production and marketing in upcountry Sri Lanka. The pandemic has disrupted the input supply and vegetable marketing system. Some members of farm households have lost their jobs due to COVID-19 and have returned home. These impacts have resulted in loss of income and added financial burden on vegetable farmers. If this situation continues it will have ongoing serious negative consequences. Therefore, immediate, and strong strategic interventions by the government are needed to secure vegetable farmers income and to break this chain of effects. Providing financial support for farmers would be one strategy to assist recovery from this sudden income loss.

This study suggests that policies should be developed to ensure continuous input supply even during uncertainties. Maintaining a buffer stock of inputs at the local level such as fertilizers, promoting alternative soil nutrition management and agronomic practices that rely less on external inputs would be some viable solutions.

This paper argues that the pandemic effect is not consistent for all farmers across districts, and site-specific interventions are needed to address the particular set of issues vegetable farmers face. A comprehensive study is needed with vegetable farmers in Nuwaraeliya and Kandy districts to capture the diversity of impacts challenging farm households to inform tailored interventions to assist these farmers.

This research indicates that introducing new marketing channels would help farmers to absorb the multiple dimensions of the pandemic

shock and adapt. Practicing direct marketing or collective marketing would be an option. For instance, at present, vegetable farmers in both Nuwaraeliya and Kandy districts do not have a strong farmer organization set up for vegetable marketing, rather they market their produce individually. In Kandy district, although there are a few farmer organizations, they are not active. If farmers in both districts can organize themselves into a formal body and market vegetables as a group, it may increase farmers' bargain power. Establishing farmers' markets in Nuwaraeliya and Kandy districts where farmers can market directly to the end customers, would benefit farmers during closure of other markets. Such farmer markets could be operated solely based on the collective decision making of the member farmers involved. Such strategies can provide opportunities for self-organization and cross-scale linkages, which may be beneficial and build farmers' resilience during these types of shocks (Darnhofer, 2010; Beillard and Galappattige, 2021). Government direct support, such as providing interest-free loans to purchase delivery vehicles, would support and motivate farmers who are currently engage with direct mobile marketing.

The technological improvement in vegetable processing and dissemination of such technologies among farmers may also reduce the waste of vegetables during times of uncertainty and market disruption. However, such measures require a major investment. This study reinforces the necessity of research and development improvement of vegetable sector in order to protect farmers during this type of uncertainties.

The farmers who have been hard hit by the pandemic need to be financially supported by the government to compensate for the loss of vegetable income. The service providers in the vegetable sector could develop their own strategies (eg. providing information and advisory services over the telephone) to cater to farmer needs during these types of uncertainties.

Interesting implications for future research emerged from this exploratory study. The Sri Lankan government have restricted and banned the import of agrochemicals with effect from May 6, 2021 (Mudugamuwa, 2021). The upcountry vegetable production system is a main consumer of fertilizers and agro-chemicals. Therefore, a study is needed to understand the implications of this policy decision on vegetable farmers' livelihoods and whether the pandemic impact on vegetable farmers varies with the type of vegetable grown in Nuwaraeliya and Kandy districts.

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## Declaration of Competing Interest

None.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.crsust.2022.100131>.

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