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ASSESSMENT IMPACTS OF COVID-19 ON ETHIOPIA AGRICULTURAL PRODUCTION, MITIGATION AND ADAPTATION STRATEGY

[1]Suleyman Abdureman Omer, [2]Nuradin Abdi Hassen

[1]Research Facilities Management, Institution of Haramaya University, Oromia Region, Ethiopia, [2]Rural Development and Agricultural Extension Department, Institution of Haramaya University, Oromia Region, Ethiopia.

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Abstract

The COVID-19 pandemic is a recent outbreak in almost all parts of the world including Ethiopia influencing the socio-economy of people and mainly threatening the agriculture and food security of the least developed countries. The current desk review and opinion synthesis by a multi-disciplinary team of experts from Haramaya University aimed at assessing the probable impact of the virus on the Ethiopian agriculture and food security and suggesting the possible mitigation and adaptation strategies to all responsible. Experts' opinion and desk review of existing information were employed for the analysis and conclusions drawn, due to the difficulty of data generation at this time of movement restriction and poor database availability on websites of relevant institutions. Accordingly, the information gathered were synthesised and described following the major stages of food supply chains as production, handling and storage, processing and packaging, distribution and marketing, and consumption are key messages drawn from the overall assessment.

Keywords: COVID-19, Impacts COVID-19 on Agriculture, Mitigation strategies

1. INTRODUCTION

The current novel coronavirus (COVID-19) outbreak was assumed to have originated from a seafood and wild food wet market in Wuhan and has quickly spread across China and to almost all countries in the world (WHO, 2020). Two-third of the world has imposed control of movement both within its borders and at international boundaries to contain the pandemic. Though these measures are necessary, they could adversely affect food and nutrition security through disruption of food supply chains. All past pandemics like Ebola, Severe Acute Respiratory Syndrome (SARS), and Middle East Respiratory Syndrome (MERS) had negative impacts on food and nutrition security particularly for vulnerable populations including internally displaced people, children, women, the elderly, persons with disabilities and the poor (Reperant and Osterhaus, 2017). As it stood now, the COVID-19 pandemic is already having a significant impact on supply chains and logistics, both for producers and consumers as evidenced by closed borders, national lockdowns, and the reduction in air traffic. This will have many adverse effects on food and nutrition security, particularly in developing countries like Ethiopia, where there are many vulnerable populations to food security.

The first case of the pandemic was reported in Ethiopia on March 03, 2020, and to date, there are more than 100 reported cases almost in a month time. It is expected that the spread may increase until it reaches peak unless strong preventive measures are taken. Cognizant of this fact, the Ethiopian government has been taking several preventive measures including the state of emergency, partial to complete lockdown, quarantine, awareness creation and social protection to minimize the danger of the pandemic. Furthermore, resource mobilization from the community, private institutions and development organizations are going in an organized form. The government of Ethiopia has considered the probable effect of COVID-19 and to mitigate the effect and build resilience; the government announced a USD 154 million package to bolster health care and tax exemptions of imported products for the prevention and containment of COVID-19. The National Bank of Ethiopia (NBE) will avail 15 billion ETB liquidity in support of private banks, to allow them provide debt relief and refinancing to customers in need (World Bank, 2020b).

Such measures may continue depending on the intensity of the disease. However, there can be food security and agricultural risks emanating from the COVID-19 crisis unless clear directives and decisions for mitigations are outlined. Therefore, there is a need for careful planning in food supply considering the various actors along the food value chain and mainly on an inclusive basis, considering the vast, vulnerable groups of the nation to food insecurity. In connection with this, a team of researchers from Haramaya University, Ethiopia, compiled a brief synthesis of experts view on the impact of COVID-19 on Ethiopian food supply chains and its mitigation measures based on desk review from the experience of other countries and local observations, to inform the government, stakeholders and community possible ways of reducing COVID-19 related risks on agriculture and the food supply chains. The document contributes to the available information on the impact of COVID-19 on food supply chains and mitigation strategies for developing countries. It is a comprehensive document taking into account the possible effects on the major stages of food supply chains including, production, handling and storage, processing and packaging, distribution and marketing, and consumption

with possible mitigation strategies for the impact at each stage. The document can help decision making by federal, regional, and local administrations and other stakeholders who are supporting the agriculture and food supply systems of the country. It, however, prioritizes the negative effects of the COVID-19; the potential positive effects are not covered in this document, except the spillovers from the mitigation strategies. Therefore, this paper is a rapid synthesis of experts' desk review and opinions on the probable impact of COVID-19 pandemics on Ethiopian agriculture along the food supply chains.

2. MATERIALS AND METHODS

2.1. Data Sources, Data Collection and Analysis

A multidisciplinary team of experts involving crop and livestock production experts, and socio-economic experts was established for conducting this rapid desk review and expert opinion assessment of the impact of COVID-19 on Ethiopian agriculture and food security. The team shared specific tasks clustered by the thematic topics along the food supply chains. Brainstorming sessions were conducted among the experts to describe the key areas of probable.

COVID-19 impact and sort specific mitigation strategies. Relevant up-to-date documents were retrieved from blogs and relevant websites, to supplement the expert opinions.

The primary data sources are therefore mainly expert opinions and judgments, and that of secondary data were collected through review of materials published on lessons learned from previous pandemics as well as short notes and expert opinions published by different reputable sources such as International Food Policy Research Institute (IFPRI), Food and Agriculture Organization of the United Nations (FAO), International Livestock Research Institute (ILRI), World Bank (WB), United Nations Office for the Coordination of Humanitarian Affairs (OCHA), World Health Organization (WHO) and Ethiopian Economic Association (EEA). However, as the COVID-19 is a recent phenomenon and under investigation, very little literature directly dealing with its effects on agriculture is available. Therefore, to address the evidence gap, the experts team conducted several triangulation and cross-checking validations for ensuring the validity of the opinions.

Accordingly, the possible negative effect of COVID-19 and the adaptation/mitigation strategies were assessed at each food supply chain stages and food security dimensions simultaneously. The synthesis of findings follows a qualitative value chain approach where key concepts are thematized under each food supply chain stage. Though the team believes that COVID-19 can have positive effects, focus was given to the probable negative effects and their mitigation strategies. However, some measures, if successful, indirectly imply the opportunities from the pandemic outbreak.

Team aimed at assessing the probable impact of the virus on the Ethiopian agriculture and food security and suggesting the possible mitigation and adaptation strategies to all responsible. The potential impacts of the pandemic and possible mitigations have been assessed considering the implications along the supply chains functions and stages, and each has been elaborated under

the following topics: Production, Handling and storage, Processing and packaging, Distribution and marketing and, Consumption level. Experts' opinion and desk review of existing information were employed for the analysis and conclusions drawn, no statistical analyses were conducted using these data. The results are regarded as only indicative and were used only for synthesized narratively, subjective analysis and interpretation, due to the difficulty of data generation at this time of movement restriction and poor database availability on websites of relevant institutions.

3. RESULT AND DISCUSSION

3.1. Impact of Covid-19 on Agricultural Production, and Mitigation and Adaptation Strategy

The world is struggling to fight the COVID-19 pandemic, and the rural population – especially in developing countries – may face a dual burden: lack of information and health services coupled with poverty will expose them to health risks as well as the disastrous socio-economic consequences of the crisis. Meanwhile, they need to continue working in agriculture to ensure not only their livelihoods but also national and global food supply and, in turn, food security. The impact of COVID-19 is not uniform across the globe and all agricultural commodities. Different strategies and measures need to be taken to ensure food security and address bottlenecks along the food supply chains. While the disruption in food supply chains mostly concerns logistics, labour, transportation and marketing of perishable and fresh products due to restricted mobility and lockdowns, the COVID-19 outbreak leaves the agriculture sector in an extremely difficult situation that puts food supply at serious risk for 2020 and beyond.

The challenges faced by the food and agriculture sector include: access to agricultural inputs, marketing, the availability of the labour force at critical times of agricultural production and harvesting, and agricultural extension and other necessary services. Those who are hardest hit by the COVID-19 outbreak are the poorest, most vulnerable populations as well as smallholder producers whose household incomes and food security are at risk. Rural communities and producers are not always well informed and supported; there is increasing demand to ensure that they have access to basic services and accurate information during this unprecedented crisis.

Agriculture (the mainstay of the country's economy) is another key sector that may be severely hit by the COVID-19 pandemic in Ethiopia. If the virus spreads to rural areas, it may severely affect the farm workforce hindering production, harvesting and marketing processes. In fact, the general population infection rate may remain relatively low as compared to urban cases. The sparse settlement in rural areas may slow down the spread, unless the farmers contracted the virus and spread it through market places, religious/cultural events, and group-based working traditions such as debo and walfala. Particularly, market places may be the main point of spread. If the worst comes, the spread of the virus may end up in sickness and/or death of the farm workforce, making them out of the farm work. Particularly, the elderly workforces are at high risk level, as data from other countries that have done more extensive testing suggest that COVID-19 has a much higher level of severity for those in their 60s and older. If they become ill or constrained by restrictions on movement or activity, they will be prevented from

working their land, caring for their animals or accessing markets to sell their produce, buy food, or get seeds and supplies. Hence, the spread of the pandemic to rural areas may reduce agricultural output, which in turn, worsens the food scarcity situation in the country. This indicates that preventive and protective recommendations from health experts are critical for our farming population. Hence, a wide-ranging awareness creation work should be carried out to safeguard the farmers.

Rural -urban supply chain slowdown and shortage of agricultural outputs in urban areas are among the feared outcome of the COVID-19 plague in Ethiopia. If transportation is disrupted to slowdown the spread of the virus, multiple connected industry sectors may be impacted. As an example of supply chain interruptions on farms, milk collection from smallholders may be hampered and in short supply for dairy processors in cities. In the same way, urban consumers' association may be challenged by interruption of supplies of key agricultural outputs (such as cereals, fruits and vegetables) leading to scarcity of the products in urban markets. Hence, a comprehensive and well-thought-out planning is essential to buffer the impact of unforeseen events. Recommendations for social/physical distancing, reduced travel, avoiding crowds, closures and other protective practices to slowdown the spread of COVID -19 may force the urban consumers to make tough choices about food, eating away from home, and overall spending. This may lead to some disruptions in food service sales, particularly dairy products, fruits and vegetables. This will likely have an adverse impact on market chains and prices. Concerns about the impact of the virus on the broader economy are likely to have an even larger impact on prices of agricultural outputs. Similar to many countries and economic blocks such as China, EU and USA, Ethiopia may experience slower economic growth owing to the pandemic. This may worsen the already precarious food security situation of the country.

Movement restriction due to COVID-19 has caused reduction in availability and delay of timely distributions of agricultural inputs; shortage of labor for intensive agriculture; disruption of existing social collaboration among smallholder farmers (Debo, Wonfel, Idir, Equb, etc) for labor sharing during peak agricultural activities. On the other hand, there is labor layoff in floriculture industry as a result of down scaling of farm activities due to absence of market (sudden demand drops in consumer countries) for floriculture products. The government needs to subsidize the commercial farms and encourage them to pay wages to workers to avoid labor layoff. Movement restrictions could also affect the pastoral and agro-pastoral communities since they sustain their livelihood through feed and water searching for their livestock. The livestock sector requires more attention to sustain productivity of animals through planned arrangement of feed stocks (like feed safety net in pastoral and agro-pastoral areas). To avoid water and veterinary medical supply shortages, producing and conserving sufficient feeds for the next season has to be emphasized. The farmers need to focus on family labor as the school closures have made students stay with family which is an added advantage for the farmers to fill their labor gap. The supply of labor saving farm tools/machines suitable to smallholder farmers, promotion of contract farming and irrigated agriculture are some of the important long-term interventions to boosting production during such crisis period.

The diversion of financial, human and material resources is one of the early actions that the government has taken to limit the potential spread of COVID-19. This, however, could affect

the capacity of various actors not to ensure agricultural development and food security in Ethiopia. Therefore, keen attention must as well be given to agricultural development, and the government and donors need to allocate fund to agricultural cooperatives and financial institutions that lend money to the small holder farmers. Relaxing the payback period for agricultural loans for agricultural cooperatives and farmers and establishing agriculture banks/ insurance companies are also possible long-term mitigation measures.

Agricultural research activities in Ethiopia might be disrupted due to budget limitations and restriction of movements. Recognizing relevance of agriculture in achieving food and nutrition security and containing the pandemic, agricultural and food research activities are required to continue, and especially during this crisis period, researchers are expected to prepare rapid response evidence on impact of the pandemic on agriculture. Therefore, proper budgeting is required for running agriculture research activities sustainably.

The COVID-19 pandemic may also have negative effects on local administration decision-making process. During this pandemic period, loose linkage is being observed among the various government bodies, including zonal and district administers, and among other relevant stakeholders. Therefore, strengthening linkage among the various actors, while also defining clear task and decision-making role of each actor, is required to fill the gap. Enhancing communication using existing IT (e.g., Woreda Net) is also an innovative approach to further strengthen linkage among the various actors.

Agricultural Extension Advisory Services can make critical contributions to minimizing the impact of COVID-19 in the following main action areas: Raising awareness about COVID-19 in rural areas: this will help reduce the spread of the pandemic while ensuring that adequate support is given to rural producers in terms of both production and compliance with new rules in force. Assessing the field situation and advocating for urgent solutions to farmers' needs: as trusted partners of producers and rural communities, EAS are uniquely positioned to assess the field situation, provide tailored services, and keep governments informed, thus allowing rapid and adequate decision-making for ensuring health and food supply. Ensuring continuous support to rural producers in a situation of physical distancing: EAS assistance is even more critical than before in supporting rural producers, men and women, elderly and youth, to overcome the new and unfamiliar challenges. EAS can provide trusted sources and contact details to ensuring easy access to inputs, seeds, transport and finances that are critical to ensure guarantee food production during COVID-19 in the field. To that end, the EAS providers are increasingly being challenged to innovate to cope with physical distancing, in particular when using remote communication and digital extension, or when playing an information and brokerage role in a specifically rural COVID-19 reality.

The current pandemic has forced the government to implement restrictions of movements, divergence of the available resources more to health related materials like personal protective equipment (PPE), increased unemployment rate on the one hand and shortage of labor force, especially on labor intensive agricultural activities. Summaries stating potential short- and long-term effects of COVID -19 pandemic on production of agricultural products (assessed in terms of availability and access to inputs; energy/fuel availability and affordability; labor

shortage and layoff; agricultural extension system, system; supporters/service providers: finance, cooperatives and unions, NGOs, grassroots community groups, research and development; local administration, desert locust control, restriction of pastoral movement etc.) and their respective adaptation and mitigation.

3.1.1. Input supply and distributions (crop and livestock)

Availability of agricultural inputs: Application of a range of agricultural packages and inputs including appropriate use of fertilizer and improved seeds, judicious use of pesticides and improved agronomic practices are required to increase agricultural production and productivity. In Ethiopia fertilizer and high yielding variety of crops are the most important technologies to increase crop production. Smallholder farmers rely on primary cooperatives, cooperative unions and, most significantly, informal markets to access agricultural inputs (HGT and LIFT, 2019). Fertilizers are often imported from Saudi Arabia, Morocco, China, Russia and Ukraine, and Agricultural Inputs Supply Enterprise (AISE), using operational service providers (transporters), transports fertilizers from Djibouti port to central warehouses, and through cooperative unions to farmers. Lockdowns due to the pandemic in input producing countries could affect timely delivery/transport of the inputs, which could in turn delay their supply to Djibouti port, and to end users within the country.

Animal production is also largely affected by such inputs and services like feeds and healthcare. In Ethiopia, imbalances have already been witnessed between the available feed (in terms of quantity and quality) compared to what is required. According to FAO (2018), the difference between availability of feed resources as dry matter (DM), ME and CP and the requirements of all animal species (i.e. feed balance) showed that feed deficiency in Ethiopia is 9 percent as DM,while ME and CP deficiencies are 45 percent and 42 percent respectively, again suggesting lack of good quality feeds in the country.

Unprecedented COVID-19 pandemic has caused lockdowns/restriction of movements, closure of some input producing companies, and borders which has in turn reduced imports from countries such as China (Mahendra, 2020). Important inputs including fertilizers, improved seeds, feeds and pesticides are either not available or their prices are high due to shortages (FAO, 2020). Farmers will thus have lower incentives to produce crops and livestock, likely leading to lower yields and production in the near future. Long-term impact could lead to decline in agricultural production and productivity, increase in input price, and food insecurity may persist.

Ensuring the availability of agricultural inputs to farmers at the right time of the season, with reasonable prices, and assuring incentives for production, should be a priority for the government in the next few months to avoid disruptions to input supply. Hence efficient transportation of agricultural inputs from one part of the country to another through creation of multiple channels for their timely delivery could be achieved by involving government bodies, cooperatives, unions and private sector. To this effect, lessons from Chinese ‘Green channel’ model (innovative initiative to help get inputs to farmers and produce to market) for import and distribution of agricultural inputs to keep the supply chains alive even during lockdown. For

agricultural inputs imported from abroad, availability of inputs could be achieved through negotiations with producing countries. Furthermore, mobilizing local community so that resources and best practices are pulled together and used for food security could be helpful. To enable sustained good production of crops and livestock, smallholders need urgent support from government as well as private sector. Small poultry and dairy farmers in urban and peri-urban areas need more targeted help, as their pandemic-related input supply are urgent; while at the same time demand for livestock products has been affected due to closure and/or reduced demand of cafés and restaurants.

Government preparedness to fill the food scarcity gap through purchase and food aid is among short as well as long-term mitigation measures. It is also important that the country builds local capacity to produce agricultural inputs; example fertilizer demand could be met by completing construction of the local fertilizer blending plants, which is one of the goals to raising productivity and encouraging commercialization to reduce poverty and food insecurity (ATA, 2015). These fertilizer blending plants, if made operational, are expected to have capacity of over 250,000 tonnes per year. Flexible design of these plants allows them to accommodate a variety of new formulas, so, availability of fertilizer will be on board for crop production in the country. With regards to livestock production, majority of the feed processing plants are located in and around Addis Ababa while farmers in other urban and peri-urban areas face supply shortage or higher cost of transportation. Hence, incentivizing private agribusiness sectors like feed mills at different parts of the country will be essential as a long-term strategy since potential animals for commercial supply are found far from Addis Ababa.

Access to agricultural inputs: Movement restrictions imposed following the COVID-19 pandemic has resulted in sluggish supply due to longer collection and transportation time, higher loading and unloading markup, higher distribution cost and longer retail filling. Slowdowns could also impact the availability and movement of fertilizer, fuel and other inputs. This in turn results in decline in agricultural production and productivity, increase in input price, and food insecurity may persist. Therefore, the government needs to develop policies in the long-term to respond to these varied impacts to avoid the supply chain disruptions, higher input prices etc. Other possible areas of mitigation include subsidy for access to inputs, increasing access points, credit facilities (loan finance) for recovery from adverse effect of the pandemic, and encourage saving and investment by farmers.

Energy (fuel) availability and affordability: In recent years, power-driven farm activities such as pump-driven irrigation, tractor-based land preparation, combine harvester/thresher, feed and milk processing, etc. are growing in the country. These all farm activities require dependable power source accessible when needed. Movement restrictions due to the pandemic could cause fuel scarcity and price hike, which in turn affects crop and livestock production. Possible mitigation areas to alleviate these challenges include establishing fuel reserve for farm implements and establishing sustainable energy supply system for agriculture sector, among others. Mechanized farming could be attractive to involve youth in food and feed production. In the long run we suggest the launching of environmentally friendly solar energy supply for small scale irrigation pumping.

3.1.2. Labor shortage/layoff

One of the short-term effects of COVID-19 is shortage of labor due to restriction of movement to contain the pandemic. Measures affecting the free movement of people, such as seasonal workers, might have an impact on food production. Agriculture labor force shortage in fear of the disease and because of illness could significantly affect the production of crops and livestock in Ethiopia. Such restriction of movement impedes many laborers not to move to their places of work or carry out their jobs. For instance, in the Central Rift Valley of Ethiopia, where most vegetable production occurs, labor is becoming scarce (Tamiru et al., 2020). Vegetable production is labor intensive and usually attracts a large number of daily laborers. In response to the restriction on travel and gatherings, these workers are increasingly returning to their villages.

Reverse migration of labor from towns to villages as well as from schools to families in fear of the pandemic may add workforce to family labor although the risk of COVID-19 spread and competition for family food become high. On the other hand, there is labor layoff under floriculture industry due to marketing problem. Export of floriculture products (cut flowers, herbs, bedding plants etc.) has dropped by 70 percent due to lockdowns in consumer countries. The volume of flower export has dropped following the outbreak of COVID-19 pandemic. Consequently, in Ethiopia's flower industry a total of 150,000 employees are on the edge of losing their jobs (labor layoff) (Addis fortune, 2020). In the long-run, COVID-19 could result in area and production reduction especially of labor-intensive agriculture, such as flowers and vegetables production. The reverse migration due to COVID-19 could also increase unemployment in rural areas. Moreover, in the long-term, foreign currency the country generates from export of horticultural crops could be reduced. The pandemic also increases inefficiency of commercial farms as a result of which some of them might even be closed.

The short-term solution for enhancing the availability of labor could be facilitating careful movement of temporary or seasonal farm workers to areas where labor-intensive production (example vegetable production) are practiced. For reducing the risk of COVID-19 spread, self-quarantine of the returnee and establishing emergency shelter should be implemented in each location/region. Encouraging the returnees to engage in farming activities and minimizing reverse migration by stimulating agribusiness firms to operate safely (by applying COVID-19 prevention measures) should be taken as short-term solution to minimize unemployment. The government could also subsidize the commercial farms and encourage them to pay wages to workers to avoid labor layoff. Availing labor-saving farm tools/machines suited to smallholder farmers and promotion of contract farming using irrigation to boost production could be practiced as a long-term solution for the available labor to avoid such unexpected risks. Promotion of bi/multilateral negotiations and versatility in production (i.e. possibility of growing alternative crops) needs to be encouraged in the future to avoid labor layoff from commercial farms in Ethiopia.

3.1.3. Disruption of the agricultural extension system

Ethiopia's extension system has great potential to help farmers throughout the country, with approximately 21 development agents (DAs) per 10,000 farmers, it is considered as one of the countries with strong public extension systems among Sub-Saharan African (SSA) countries in terms of human capital. As a result, the agriculture sector is an engine of growth in the country.

The COVID-19 could have short and long-run impacts on Ethiopian agriculture in general and extension systems in particular, thereby affecting the food security. The probable short-run impacts of the COVID-19 on the Ethiopian extension system could be the disruption of the normal and major activities of the extension services (advice, training, input delivery etc.) due to restrictions on movement, gathering, and meetings. Ban on movement restricts extension personnel from providing training at Farmers Training Centers (FTCs), demonstrations, field days, and visits to groups of farmers in contrast to what has been happening in the past. The other possible impact of COVID 19 on Ethiopian agricultural extension is related to prohibitions of market gatherings that disconnect farmers from the cash economy. These further limit the farmers' purchasing power of farm inputs and the adoption of farm technologies.

A customized extension approach should be devised to mitigate the short-run disturbances on the extension functions related to COVID-19 and provide farmers with necessary information and inputs. To customize the extension service to COVID-19, the individual and mass extension methods should be adopted. Individual based extension method: Individual extension methods are time and labor-consuming but can be used for family extension approaches for communicating the household head on one to one basis for providing extension messages and advice. Alternatively, potential individuals and model farmers in each village can be contacted by the extension personnel. Then the model farmers can do the farmer-to-farmer extension in a protected manner from the pandemic. For instance, farmers with landholding of more than one hectare or who own livestock could be given priority services during the individual family extension services. Also, for extension workers, to reach a wider population, primary education teachers can be deployed with adequate training for dissemination of extension messages provided that they are adequately trained.

The mass media or ICT based communication will help in efficient communication of large number of farmers at the same time and is cost-effective. For this purpose, mobile applications (e.g. mobile SMS messages), and local radios such as FM radios can be used to provide extension messages in local languages. The timing of extension broadcasting through radio needs to be conducive for farmers (e.g. evening is preferred to morning). For those farmers who are able to read and write, printed media and extension leaflets can be developed and distributed in local languages. The extension agent can provide technological packages, training, and advisory services to the targeted farmers in a protective manner from COVID-19. To be successful, the extension agents have to be oriented and trained and provided with Personal Protective Equipment (PPE) such as masks and gloves to protect themselves and

farmers from the virus. In this regard, a new collaboration framework between health extension workers (HEWs) and development agents (DAs) has to be established.

In the long-run (after six months) in the worst case, there could be lower crop/livestock production and productivity and farmers may also be indebted and fail to repay input loans. For farmers and producer cooperatives, during such a big crisis time, a waiver policy for inputs purchased and long-term credit supply or in-kind contractual arrangements has to be prioritized. Besides, a tax waiver for agricultural inputs (seeds, feed, fertilizer, pesticides) import will stabilize price of farm inputs, as well as for waiving debts and loans associated with agricultural inputs.

In the long-run, the Ethiopian government can improve the agricultural extension system by (i) developing more innovative ICT based communication channels (e.g., mobile-based agricultural information delivery), (ii) rural radio-based extension training, and (iii) geographical information systems (GIS) for planning and monitoring extension activities. The application of GIS for agriculture extension would help the planning and forecasting of agricultural activities. (iv) initiating private extension systems. In many African countries such as Kenya and South Africa, private extension service providers have played a significant role in improving the agriculture sector. Diversification and involvement of the private sector in extension service delivery will create employment opportunities for agricultural graduates and provide innovative services to farmers.

Research: Research activities in Ethiopia could be disrupted as COVID-19 continues to spread. Resource could also be diverted from agricultural research to COVID-19 prevention. Nevertheless, researchers in the Ethiopian research system can contribute through making their latest research findings and analysis on COVID-19 available to support authorities and the public in making informed decisions during the current crisis (CGIAR, 2020). Researchers are expected to prepare rapid response evidence on impact of the pandemic on agriculture. Recognizing relevance of agriculture in achieving food and nutrition security, agricultural and food research activities should not be disrupted and there must also be proper budgeting for running the designed problem-solving research activities sustainably.

Choularton and Mallory (2020) have pointed out the following four major focus areas, among others, that the research and development community can start to take now: (i) increasing assessments of the effects of COVID-19 on agriculture and food systems. Just as increased testing for COVID-19 is critical for public health, so too is measuring its impact on agriculture and food systems, (ii) Supporting farmers to continue producing and marketing food. The research system can help farmers adopt labor-saving practices that compensate for reduced labor availability, for example, by sick family members, limitations on collective labor, and restrictions on the movement of people to producers' fields, (iii) Accelerating the deployment of relevant agricultural technologies and digital agriculture solutions. Agricultural technologies, especially digital agriculture solutions, offer a range of important opportunities to address the impacts of COVID-19 on agricultural production, labor availability, input supply, and logistics, and (iv) Assessing the impact of COVID-19 on agriculture-based livelihoods and food security using a gender lens. Approaches to address COVID-19 that

carefully consider the gender dimensions of food security, labor, health, and vulnerability are essential.

3.2. Impact of Covid-19 on Handling and Storage of Agricultural Products, and Mitigation and Adaptation Strategy

The other challenge due to restriction of movement in response to COVID-19 is disruption of handling and storage of food which leads to damage of perishable foods like vegetables. Thus, as a short-term intervention, ensuring continuous supply of foods mainly through cooperatives and unions; accessing low-cost handling and storage technologies (e.g., evaporative coolers, crates) and taking measures on social protection due to artificial price hikes could help. In the long-run, however, the country needs to work aggressively to have cold storage rooms for perishables and establish efficient postharvest handling and storage system with improved temperature and ethylene management. Encouraging private investors to open more vendors and malls in main towns could be another intervention area as this could create more market for the perishables. Roughly one-third of all food produced in the world is lost or wasted (FAO, 2019). Non-optimized handling (drying, cooling, cleaning, sorting, transportation etc.) and storage during supply chain processes are responsible for high share of the postharvest losses (Yahia et al., 2019). The pandemic is expected to hamper the handling and storage operations and consequently the extent of postharvest losses could only get worse.

Once the COVID-19 has been declared a pandemic, a sudden drop of consumer demand is noticed at the destination market; for some products, orders have been cancelled (e.g., flowers for mothers' day, poultry products, milk etc.). The demand for Ethiopian flower export drops by 70 percent (Addis Fortune, 2020). These cancellations have made farms to downsize or halt entirely handling, and storage practices and some farms have disposed of harvested flowers and milk as a waste.

3.3. Impact of Covid-19 on Processing and Packaging of Agricultural Products, and Mitigation and Adaptation Measures.

Ethiopia is working strongly to explore the untapped agro-processing industries potential to boost its economy. Food and beverage processing industries are dominating the agro-processing industry in Ethiopia. Meat, fish, milk and dairy products, edible oil, fruits and vegetables, starch and starch products, pasta products, flour milling industries and different type of beverage products are the major products produced in the country.

Agro-processing industries, involved mainly in production of foods, are experiencing both negative and positive impacts of COVID-19. Raw milk and fish producers are the major actors negatively affected by the disease. Due to absence of market outlets for processed dairy and fish products, processors are not collecting raw milk and fish at collection centers. Because of this, processing industries either have scaled down or stopped their regular production and supply. However, fresh meat exporting abattoirs are positively impacted by the disease due to increased meat demand in the Middle East countries. The same is true for industries involved in production of shelf stable food products like edible oil, flour, pasta and macaroni, biscuit and other confectionary products which their demands were high in local markets. This is

mainly because consumers need to have enough food for their families during such crisis time. The current (short time) observation shows that, shelf stable food producers, meat exporters and coffee processors are less impacted by the disease. But in long-term, if the disease is not contained properly, all food and other agro-processing industries may experience shortage of raw materials, inputs (packaging materials) and labor forces. Unless and otherwise careful measures are taken very soon, shortage of raw materials and other inputs ultimately result in either down scaling or cessation of production of food items. This could lead to labor layoff, economic crises and food and nutrition insecurity in the country.

Impact on dairy and fish industry: According to Ethiopia Country Commercial Guide (2020), in the last 15 years, the volume of milk production has tripled, and the government aims to double its production by 2020. An increase in production is a good opportunity for expansion of dairy processing industries to be able to supply nutritious dairy products to the public. However, due to the occurrence of COVID-19, the local dairy demand and consumption has critically declined. This is mainly because of perception not to consume raw and chilled animal products with the assumption that such foods are the main routes for the transmission of the virus. As a result, consumers in major market destinations have either reduced the amount they buy or completely avoided consumption of raw fish, meat and chilled dairy products. This negatively affects the livelihood of producers, processors and value chain actors involved in the businesses. Restriction of movement, social distancing and closure of restaurants further limits the demand for milk and fish products. The high perishable nature (short shelf life) of milk and fish products means, the effect of the disease is more on producers than processors, as well other actors along the value chain. Based on guidelines of FAO and WHO (2020), there is no evidence as to whether food or food packaging are associated with the transmission of the disease and that no food recalls are anticipated if a person who works in a food or beverage production facility is diagnosed.

3.4. Impact of Covid-19 on Distribution and Marketing of Agricultural Products, and Mitigation and Adaptation Strategy.

Given Ethiopia has poor food distribution and marketing system, the pandemic will have adverse effects on food supply chains supply side as well as the demand side. One of the most important short-term effects is food scarcity in the urban and peri-urban areas. To this effect, strengthening the activities of cooperatives and unions for distribution and increasing access places closer to the consumers are essential as short-term adaptation strategies. Other options that can enhance food availability might include reducing the export of staple food items, importing food in bulk and requesting emergency food aid from humanitarian organizations. Moreover, strengthening the capacity of producer and consumer cooperatives by providing financial resources and thereby stabilizing the prices are important measures that can be put in place to transform the food supply chain from traditional and transitional to modern. Furthermore, it is important to encourage small and micro enterprises to emerge and distribute food, to look for alternative genuine and reliable individual distributors and entrepreneurs.

3.5. Impact of Covid-19 on Consumption of Agricultural Products, and Mitigation and Adaptation Strategy.

This section presents the probable impacts and potential mitigation strategies of COVID-19 pandemic on food consumption, including high-value food items (fruits and vegetables, animal products, sea food and fish products), food and nutrition security, food prices and purchasing power, and on service providers such as restaurants.

There are high foods and nutrition insecurity of vulnerable communities in the East Africa region, including Ethiopia (FSNWG, 2020) due to climatic effects, economic challenges induced by high food prices, an outbreak of livestock pest and diseases, desert locust outbreak, regional conflicts, and population displacements. In particular, for the current agricultural seasons, the ongoing desert locust outbreak demands increased concerns about further food security deteriorations. On top of this, the current COVID-19 crisis could significantly increase the food and nutrition insecurity of the vulnerable communities, both in the short, medium and long-term time frames bringing increased dependency on food aid. The government structure should make close monitoring in the most vulnerable areas, give emergency shelter and food assistance through donation and resource mobilization, strengthen social safety net mechanisms to maintain food and nutrition security of the poor and the most vulnerable. In the medium and long-term, the government needs to work on the rehabilitation of the displaced people, create more employment opportunities, and strengthen the small-and-medium-sized enterprises.

There is a reduction in the number of customers in the restaurants, cafés and small and micro-enterprises such as roadside cultural coffee markets. This, in the long-run, can even result in the withdrawal of some of the restaurants and cafés from the economy. To encourage and keep such businesses operating, it would be helpful if the local tax and revenue authorities give them tax exemptions. In the medium and long-run, it is helpful to change their mode of delivery – delivering food at the door of their customers. Consumers may also have low purchasing power due to travel restrictions, layoff, low income and other crises. Mobilization of food banks and efforts by charities and NGOs to deliver food can play critical role to reduce the impact of this crisis. Therefore, organizing and strengthening of daily laborers in group under cash for work to vender food post-COVID-19 might also be essential to reduce the impact on the purchasing power.

4. CONCLUSION

In conclusion, the current pandemic of COVID-19 has a potential to increase the food insecurity of the country due to resource mobilization towards prevention of the disease, movement restriction subsequently affecting food production, transport, processing and consumption patterns. At production level, the pandemic outbreak is expected to negatively affect crop and livestock production inputs, labor, psychological aspects of producers, agricultural extension support system, supporters/service providers, local administration, control of desert locust, and pastoral movement. At the level of handling and storage, it can result in labor shortage, loss due to stockpiling, improper storage technologies, and cancellation of orders, transport restrictions and food safety. Processing and packaging are affected through reduction or cessation of production, labor layoff, production and supply of less safe and poor-quality product, shortage of running capital, absence or shortage of key technical personnel,

and psychological implication. At distribution and marketing level, it could result in scarcities of food in the urban due to movement restriction, withdrawal of value chain actors, slow down trading, import and export bans, food price hikes, reduced supply and demand for some food items due to information asymmetry and loss of hard currency. At the consumption level, the pandemic is expected to negatively affect the consumption (due to perceived misinformation) of some products such as fruits and vegetables, animal products, seafood and fish products; households' food and nutrition security, food prices and purchasing power, and restaurant services.

Adaptation and Mitigation Strategies: Based on the experts' opinions and desk review by the multi-disciplinary team, the following adaptation and mitigation strategies have been forwarded. To minimize disruptions to farm input supply, ensuring availability and timely delivery of agricultural inputs with affordable prices should be prioritized in the next few months. Labor shortage can be reduced through careful movement of labor to areas of labor-intensive production. It is also important to encourage returnees from cities and towns, and students to work on family farms. In the long-term it is important to encourage technical innovations and contract farming to come up with labor saving technologies. Labor layoff from commercial farmers can be reduced through encouraging farms to operate safely and through government subsidy so that they can maintain their labor and linking them to markets through multilateral negotiation among the countries that purchase the farms' products. Agricultural extension support systems can focus on family extension in the short-term and IT based extension system in the long-term. Enhancing rural financial access, support of cooperatives and unions to farmers, NGOs, grass root organizations, and paying attention to agricultural research and development to come up with long-term solutions are crucial.

Proper post-harvest management practices should be implemented to minimize quantitative and qualitative post-harvest food loss and waste through community mobilization, using combine harvester at potential areas, ensuring the safety of workers in the field, pack houses and store; improving postharvest technologies and ensuring food safety. At processing and packaging, ensuring the availability of raw materials and labor, subsidizing the companies to maintain their workers, giving them tax exemption, enhance better storage and distribution capacity, encourage product and market diversification, and putting in place quality control and monitoring are very important. Distribution and marketing should be strengthened through capacitating producers and consumer cooperatives; supporting value chain actors to function properly, opening new market places, controlling and monitoring prices, enhancing food availability through imports and probably reducing the export of staple food commodities and food aid, enhancing access to food by vulnerable community through creating cash for work schemes. Food utilization should be revitalized by providing transparent reliable and stable information on food safety, controlling prices, enabling cafés and restaurants to diversify their services with food and workers safety, and encouraging door to door food vending services. At the same time, it has created an opportunity of wider social mobilization and variety of innovations towards the prevention of the disease as well as minimizing food insecurity. Thus, the potential impacts of the pandemic on Ethiopian agriculture and food security have to be carefully mitigated and the possible opportunities are tapped for better resilience of the society.

Acronyms

COVID: Corona virus diseases

EAS: Agricultural extension and advisory services

EEA: Ethiopian Economic Association

ETB: Ethiopian Birr

FAO: Food and Agriculture Organization of the United Nations

HUREA: Haramaya University research and Extension Affairs

IFPRI: International Food Policy Research Institute

ILRI: International Livestock Research Institute

IT: Information Technology

MERS: Middle East Respiratory Syndrome

NBE: National Bank of Ethiopia

NGO: Non-governmental organization

OCHA: United Nations Office for the Coordination of Humanitarian Affairs

SARS: Severe Acute Respiratory Syndrome

USD: United Stated Dollar

WB: World Bank

WHO: World Health Organization

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