



## Rapid assessments of the impact of COVID-19 on the availability of quality seed to farmers: Advocating immediate practical, remedial and preventative action

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### ABSTRACT

Rapid assessments of the impacts of the COVID-19 crisis on the seed sector were conducted by a coalition of partners in Ethiopia, Myanmar, Nigeria, and Uganda in May and June 2020. The method was rapid, iterative, inclusive and valuable in revealing threats to the availability and timely access of farmers to quality seed and to food, nutrition and income security, and in advocating for remedial and preventative action. Via mobile application and web survey, and focus group discussions on virtual conferencing platforms a panel of 36 or more local experts operating particularly in formal seed systems in each country identified potential disruptions to activities in the seed sector and recommended immediate practical action to ensure continuity in performance. Recommendations, and the stakeholders best positioned to propel their action, were proposed to and approved by senior leadership in the sector. The entire process from survey to publication of a seed alert in each iteration was completed within two weeks. Due to the highly seasonal nature of agriculture, and recognition that activities are time-bound, quick turnaround on assessments was essential. Dashboards indicated where impact was felt the hardest, also showing how dynamic the situation was. Countries were at different stages in their agricultural seasons, which made the data highly contextual, but also interesting for getting a glimpse into the future. Lessons were offered from one country to another. Reduced mobility was the root cause of many disruptions in supplying seed to farmers. Disruptions caused seed and related industry to operate at reduced capacity. The cost of transactions and doing business during these times may have increased the scarcity and price of inputs beyond what farmers can recover. Sales of quality seed in formal markets were perceived to decline due to delays in distribution, weakened promotion efforts and fewer farmers present. Farmers are less likely to benefit from investments in crop improvement for more seasons to come due to delays in the development and release of new varieties. Social distancing prevents stakeholders from meeting to exchange goods, services and information, but the sector is gradually getting up to speed with information technology. For all concerns, practical options were offered and often implemented. The pandemic has exacerbated structural weaknesses in the organization of the seed sector, for which reforms are not only justified, but overdue.

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## 1. Introduction

Over the first half of 2020, COVID-19 has expanded across the globe, officially declared a pandemic on March 11th. We are deeply concerned about the impact of the pandemic on people's lives and livelihoods, and on its disruption to the economy and society. A vast majority of national governments and their health agencies are trying to combat the pandemic by placing restrictions on mobility and encouraging social distancing. We share our appreciation of their efforts, as these measures contribute to a reduction in the likelihood of human mortality, severe health consequences and the spread of the disease, especially among vulnerable people and communities.

Regrettably, public health efforts have unfortunate effects on the functioning of our economy and food systems. The [World Bank \(2020\)](#) has projected that economic growth in Sub-Saharan Africa will decline from 2.4% in 2019, and contract by between 2.1% and 5.1% in 2020. This predicts the first recession in the region in 25 years. Agriculture is expected to be one of the most seriously impacted sectors, resulting in many countries in the region facing serious risk of food insecurity. With trade blockages, agricultural production could shrink by 2.6% to 7%. Food imports are expected to decline substantially also, with estimates varying from 13% to 25%. The outlook for Asia is not good either. The [Asian Development Bank \(2020\)](#) forecasts that regional economic growth in developing Asia will decline in 2020, suggesting a downward revision of 3.3% to 2.2%. The [High Level Panel of Experts \(2020\)](#) under the Committee on World Food Security indicates that the COVID-19 crisis is leading to instability in both local and global food markets, causing a disruption to food supply and availability. The poorest people will be the most affected by these disruptions. At the same time, there is a fear that government and development partners will cut agricultural spending and shift priority towards managing the immediate effects of the crisis in public health care. As the crisis unfolds, forecasts are certain to be outdated in the near future.

In this paper, we synthesize the outcomes of rapid assessments of the seed sector that were conducted between May and June in Ethiopia, Myanmar, Nigeria and Uganda, and complement these with lessons learned, to inform stakeholders in other countries facing similar challenges, and provide insights and a set of options to help them address these challenges. We examined how the crisis impacts multiple functions within the seed sector, with emphasis upon formal and regulated operations of and service provision to the seed value chains of several important food crops. The crisis has negatively affected the availability of, in particular certified seed of new and improved varieties and farmers' timely access to it, but also material sold at what are commonly referred to as local, traditional and informal markets that is used as seed. We assessed the perceptions of key informants in the four countries of the impacts on future crop productivity and production, and consequently the food, nutrition and income derived from it. If the seed sector is not resilient in these difficult and uncertain times, the current health crisis has the potential to progress into a hunger crisis. This is an eventuality that some foresee inevitable at this stage ([Oxfam, 2020](#)).

## 2. Methodology

Rapid assessments of the seed sector ([WCDI, 2020a](#)) were piloted in May 2020 for advocacy purposes by a coalition of partners in Ethiopia, Myanmar, Nigeria, and Uganda, and repeated a month later. It was the opinion of our partners that a third or more successive reiterations would yield diminishing returns on investment as they perceived their advocacy to have been successful in addressing many of the concerns. By identifying alerts and remedial and preventative actions, partners informed decision makers in government, industry, science and civil society on where impact was felt the most, and advocated for the immediate implementation of recommended practical actions to cope with the impact. Partners and their efforts aimed to increase the resilience of the seed sector. For more information, see the methodological note

([WCDI, 2020b](#)) and the series of alerts that were published in May ([WCDI, 2020c, 2020d, 2020e, 2020f](#)) and June ([WCDI, 2020g, 2020h, 2020i, 2020j](#)).

### 2.1. Guided by sector transformation

Rapid assessments are conducted at national level through remote survey and focus group discussions (FGDs). Their structure of analysis is inspired by the sector model developed by [Aidenvironment \(2020\)](#), as adapted by the Wageningen Centre for Development Innovation (WCDI), a part of Wageningen University & Research, to guide transformation in a range of sectors, including seed.

WCDI's approach to seed sector transformation involves assessment within and across six interrelated functions of the sector, namely: service provision; production systems; market development; revenue generation & reinvestment; sector coordination; and sector regulation ([WCDI, 2020b](#)). [Table 1](#) defines the scope of each one of these functions in the seed sector. The methodology is outlined in [Section 2.3](#).

### 2.2. Formal and informal seed systems

Farmers in low- and middle-income countries may be obtaining 86% of their seed, on average, from informal sources including what they save themselves, exchange with others and purchase at unregulated markets. This information comes from the world's largest dataset on the seed systems that farmers use ([McGuire and Sperling, 2016; SeedSystem.org, 2020](#)), which records 16,344 transactions, and counting, across 13 countries, including Ethiopia ([CRS et al., 2016](#)), but not Myanmar, Nigeria nor Uganda. Although these data were generally gathered by seed system security assessments during or after (protracted) periods of stress (e.g. natural disaster or civil unrest), seed experts concur that the overwhelming majority of seed utilized in low- and middle-income countries comes from informal seed systems.

Whilst in our own study we did take into account the impact of the COVID-19 crisis on: the mobility of farmers to informal markets and on the accessibility of seed from informal sources in general; the quantity and quality of seed sown and produce likely to be harvested; and on food, nutrition and income security as outcomes, rapid assessments did give disproportionately higher attention to the activities of formal seed systems. Further, the composition of the panels from which data was obtained (refer to 2.4 Expert panel, survey and FGDs; see also [Table S1](#) of the supplementary materials) correlates with these activities and as a result conclusions should not be extrapolated beyond the contribution that formal seed systems make to food, nutrition and income security.

**Table 1**

WCDI's model of the seed sector and its six functions.

Seed sector performance	Performance of the sector to become more competitive, resilient, profitable, innovative and adaptive, sustainable, inclusive, resistant and transparent
1. Service provision	Capacity of the seed sector to provide high quality, inclusive and differentiated services
2. Production systems	Viability and sustainability of seed production systems
3. Market development	Efficiency, fairness and transparency of seed value chains and seed markets
4. Revenue generation & reinvestment	Capacity of the seed sector to generate revenues and make strategic reinvestments
5. Sector coordination	Degree of coordination, alignment and accountability among different seed stakeholders
6. Sector regulation	Rules and systems that govern seed markets, production systems, service provision, and coordination

Source: [WCDI, 2020b](#).

### 2.3. Different levels of infection, restriction on mobility, and activity in agriculture

During assessments, we noted that the countries differed in terms of the scale of their epidemics and in measures each government was taking to control the spread of the virus. Table 2 illustrates this at the time of assessment.

We also considered the stage in the growing season of each country's primary crops (Fig. 1). For the May assessments, we were in the midst of, or had just missed, maize planting in several countries in sub-Saharan Africa, whilst the assessments a month later in June coincided with sowing of wheat in Ethiopia and rice in Myanmar. These variations provided a setting for learning lessons on the different contexts, features and stages of the crisis, their impact on the seed sector, and the options available to address immediate challenges.

### 2.4. Expert panel, survey and FGDs

The methodology is further elaborated in the methodological note prepared by WCDI (2020b). National partners kicked off the process by establishing a panel of, on average, 36 local experts in each country representing policy-, seed regulatory-, non-/government-, research-, extension-, and farmer organizations, and seed companies, seed producers and/or local seed businesses, and agro-dealers. Table S1 (supplementary materials) provides an overview of the numbers, types (in terms of stakeholder groups) and gender of panellists and participants in focus group discussions across the four countries. Whilst generally successful in attaining our target of at least four panellists per stakeholder group, few women were included in the panel, the highest proportion being a little over 40% in Myanmar. Partners were responsible for panellist selection, and report that in general few women occupy, in particular, leadership positions within organizations in the seed sector in these countries. It was the strategy of our partners to engage many leaders from the main stakeholder groups in the FGDs for more effective

follow up of recommended actions. In hindsight, even greater diversity may have yielded a different quality of data.

Panellists answered a fifteen-minute survey, tailored to their respective areas of expertise and in triangulation of others', delivered by an application on their smartphone or on the web. The survey recorded their perceptions of the extent of impact of the crisis on activities across all six functions of the seed sector at that present moment in time. The generic list of questions is shared in Table S2, but bear in mind that surveys were tailored to the national context and subsequent to the experience generated in the first iteration. Their perceptions were scored on a five-point Likert (1932) scale, from 'highly negatively impacted' on one end (-2); through 'not significantly impacted' (0); to 'highly positively impacted' on the other (+2). Summary statistics were generated, including weighted scores. Scores were weighted by the number of panellists in each stakeholder group since the number of panellists was not the same in each group and since every question was not answered by all panellists. This was done to avoid that scores be skewed towards the perceptions of stakeholder groups with the fewest numbers of panellists. Results were presented on a dashboard and fed into FGDs on different crops.

Each FGD brought four-seven experts together, virtually, to review results, identify areas of alert, propose actions, and indicate responsible stakeholders to take them up. Their expertise with each crop and their practical experience in the seed sector determined their participation, and was used to triangulate the data. The FGDs typically took 60–90 min, and the output in each case was a draft narrative. It did occur that FGDs yielded different insights to the survey, which were acted upon. For example, "concern that substandard seed will make its way onto the market is heightened" was reported in the May seed alert for Ethiopia (WCDI, 2020c), but this case is exceptional.

The draft narrative, or preliminary seed alert, was validated, consolidated and endorsed during a final virtual meeting with senior leadership in the sector. Existing platforms were used to this end. By engaging bona fide experts and leaders in the sector in identifying

**Table 2**

State of the COVID-19 epidemics in Ethiopia, Myanmar, Nigeria and Uganda, including the respective governments' responses in relation to public health, mobility and the agricultural sector, at the time of assessment<sup>a</sup>.

Level	Indicator	Ethiopia	Myanmar	Nigeria	Uganda
COVID-19 toll <sup>b</sup>	# confirmed cases	287	261	5445	203
	# confirmed new cases (7 days)	19	21	1244	43
Government measures (health & mobility)	Mandatory use of face masks in public spaces & sanitary practices	Yes	Yes	Yes	Yes
	Lockdown	Not complete; free movement but with precautionary measures	Not complete; free movement but with precautionary measures	Not complete; free movement but with precautionary measures	Complete for all non-essential activities
	Curfew	None	00:00–04:00	22:00–04:00	19:00–06:30
	Land travel (public & private vehicles)	Significantly reduced	Allowed	Significantly reduced	Not allowed
	Domestic travel between regions, provinces or states	No restrictions	No restrictions	Non-essential travel prohibited; transportation of goods and services is allowed	Non-essential travel prohibited; transportation of goods and services is allowed
	Social distancing between people in workplaces and other public spaces	Promoted	Mandatory: 2 m	Mandatory: 2 m	Mandatory: 4 m
	Meetings	Large public meetings and demonstrations are restricted	Large public meetings and demonstrations are restricted	Meetings of >20 people outside of the workplace are prohibited	Meetings are prohibited
Agricultural sector	Access to public spaces, including markets, locations of economic activities	Controlled access	Controlled access	Controlled access	All closed
	Exemptions from restrictions for agricultural activities and services; conditions for exemptions	Yes; on condition of taking all the necessary precautions	Yes; maximum of 5 staff allowed to travel; farm visits allowed with a permit	Yes; domestic (interstate) movement of seed and its ancillary services allowed with a permit	Yes; farm-visits allowed with a permit

<sup>a</sup> Based on inputs from national partners (15 May 2020).

<sup>b</sup> Source: national COVID-19 dashboards (15 May 2020).

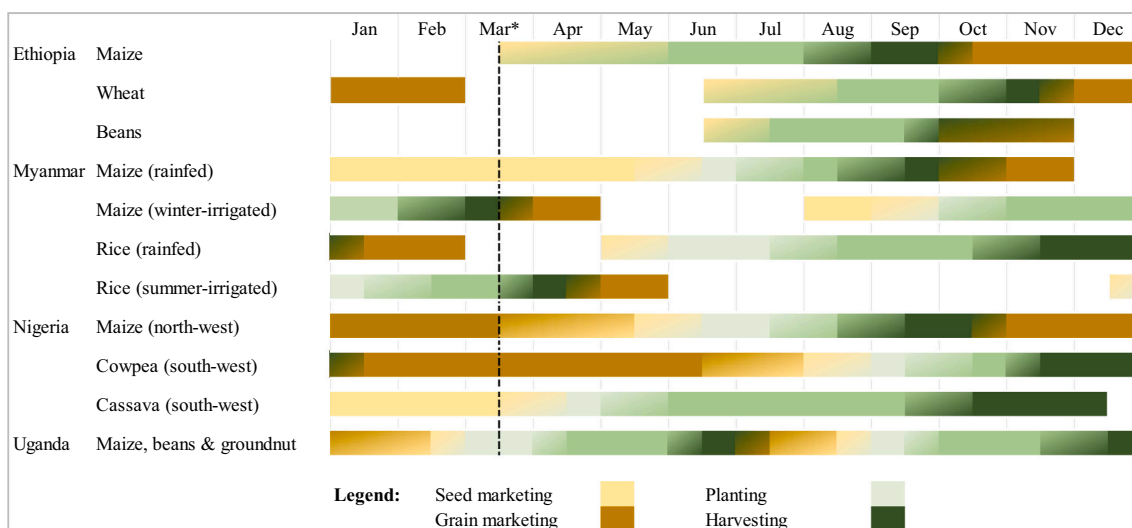


Fig. 1. Cropping calendars for selected crops in areas where they are predominantly grown in Ethiopia, Myanmar, Nigeria and Uganda.

\* COVID-19 officially declared a pandemic on March 11th 2020, and lockdowns followed shortly afterwards.

threats, suggesting actions, and proposing who takes these up, we aimed to increase their commitment to ensuring that these were carried out with immediate effect. Afterwards, the alerts were published, disseminated to all panellists, participants in FGDs, and senior leaders directly via email, and with the wider community through social media campaigns. (De)briefing webinars/meetings have taken place with concerned stakeholders for the purpose of setting actions into motion.

### 3. Results and discussion

Synthesis of results and lessons across the four countries' rapid assessments in May and June has been written up in a seed alert synthesis (WCDI, 2020k), and, drawing upon the experiences in the African region only, included in the African Union (2020) White Paper on the COVID-19 Crisis and the Seed Sector in Africa: Impact, Options for Actions and Recommendations, which informed ministers of African Union member states responsible for agriculture, trade and finance in their 27 July Joint Ministerial Declaration and Action Agenda. A summarized description of the impact is given in the following sections, along with corresponding practical actions either recommended or, where indicated, actually implemented, according to reports in country. Fig. 2 shares the dashboards of the four countries for both survey intervals.

#### 3.1. Reduced mobility

Reduced mobility was the root cause of many of the disruptions in the supply of seed and complementary inputs to farmers. Reduced mobility was a result of lockdown to all but essential services, curfew, prohibition of gatherings, closure of public property, social distancing measures, precautionary behaviour, and fear among the population. More than three-quarters of the survey panel reported this. We calculated such frequencies by the number respondents that perceived the impact to be negative divided by the total number of respondents to those specific questions. This has been aggregated across related questions, the four countries and the two survey intervals. Disruptions included the low availability of labour, reduced processing output, and delays in distribution, causing seed and related industry to operate at reduced capacity.

If governments had not already, they were advised to classify agriculture and input provision as essential to ease the movement of seed and workers during lockdown. The decision needed to be communicated at all levels of administration and with police and security forces enforcing lockdowns. In Uganda this was not communicated clearly

despite the exemption having been made at the onset. This had to be confirmed during the country's first media briefing after entering lockdown. Those two weeks in late March-early April were crucial for sowing, and as a result many farmers could not access markets for quality seed. In Nigeria, the National Agricultural Seeds Council (NASC) communicated the essential nature of seed and its supply to farmers with inter-ministerial task-forces, state governors, security forces and health authorities, thereby facilitating inter- and intrastate movement to and from markets. NASC held a series of virtual meetings with stakeholders in the seed sector to galvanize their support, and sponsored media campaigns to convince farmers not to abandon their fields.

Government departments of agriculture and public health collaborated in raising awareness among stakeholders in agriculture about COVID-19 and the precautions that can be taken to limit the spread of the disease. In Myanmar, public health advice of the Ministry of Health and Sports was translated into standard operating procedures for different agricultural activities and communicated by the Department of Agriculture (DoA) of the Ministry of Agriculture, Livestock and Irrigation (MOALI). Employers have a responsibility to see to the enforcement of safety protocols in the workplace. In all four countries, agricultural workers have been encouraged to practice non-pharmaceutical interventions including social distancing and good personal hygiene, and to wear face masks.

#### 3.2. Increased cost of transactions

Due to the increased cost of transactions and doing business during these times, the scarcity and price of inputs including EGS and labour for seed production is likely to continue to rise. It was believed that this would come at a cost to either the producer or the farmer, possibly beyond what they can recover, but we were not able to validate this empirically. Seed sales and farmers' willingness to pay for seed were believed by, respectively, 64% and 62% of the survey panel to have declined. The outlook for seed production in 2020, and availability of seed to farmers in future cropping seasons was a concern of 72% of our panellists.

Producers in all four countries have faced significant difficulty in obtaining sufficient volumes of quality EGS of desired varieties, reported by 79% of panellists. Efforts are being made in Myanmar for the efficient utilization of EGS by regular inventory of demand and planning for supply by means of an app (Roy Gupta, 2019). Some governments have decided to subsidize supply of EGS, as is the case in Nigeria. This is not extraordinary, but has intensified in response to the crisis. In instances of

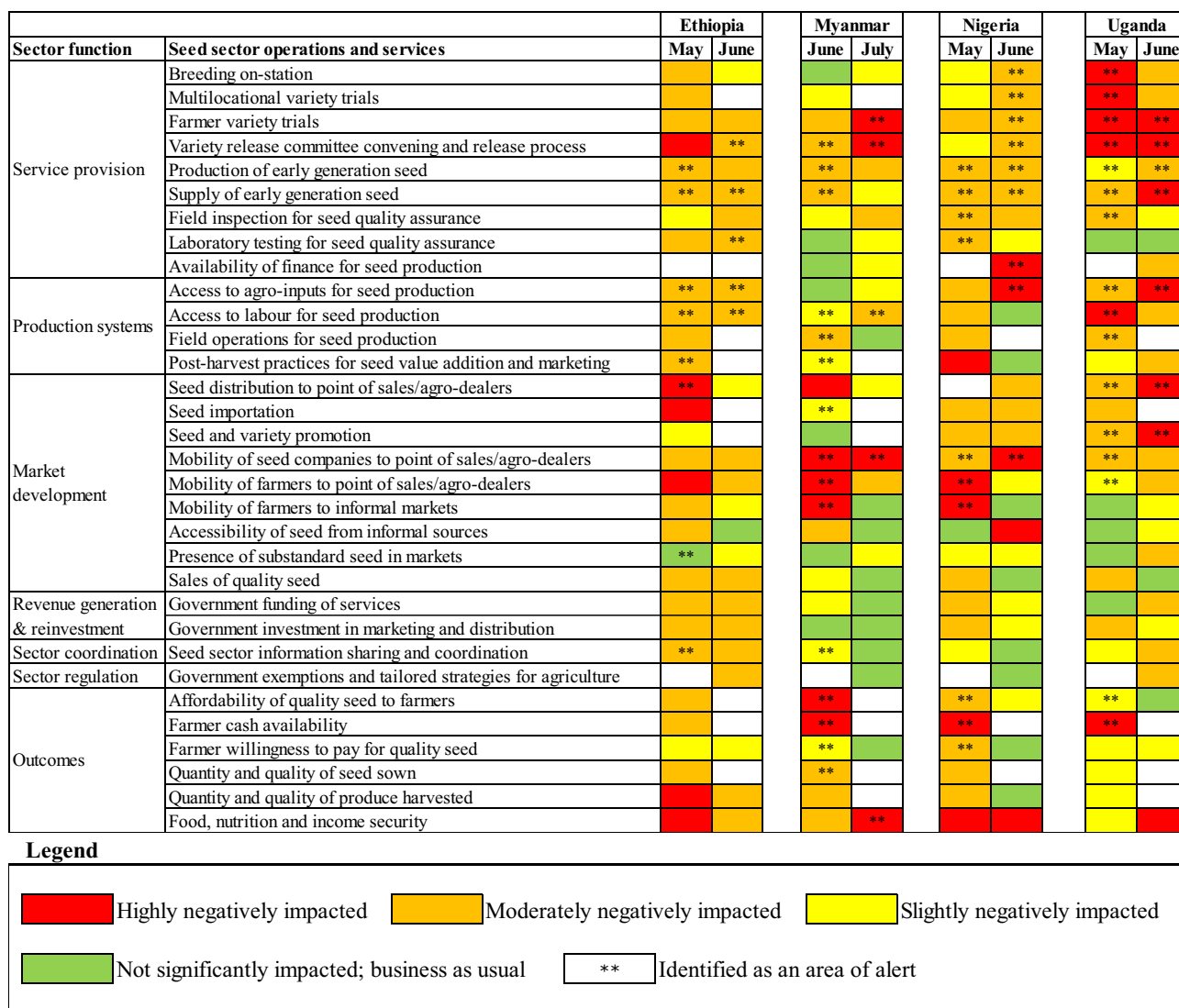


Fig. 2. Dashboard of impacts of the COVID-19 crisis on activities across the six seed sector functions and seed sector outcomes perceived by panellists in four countries during the May and June 2020 surveys. Note: blanks denote omissions from given iterations, as surveys were adapted to the local context and experience.

delayed payment and collection, available EGS in Ethiopia has been reallocated to seed producers that were willing to pay for it.

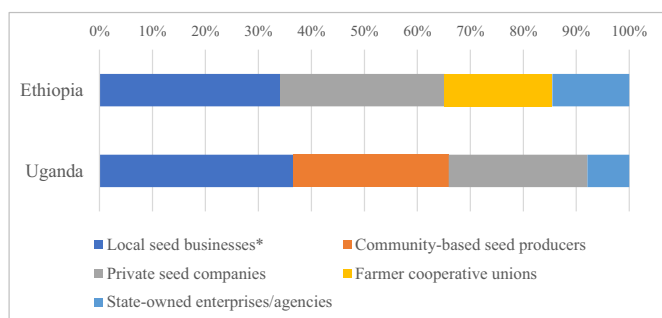


Fig. 3. Frequency of panellists in the rapid assessments in Ethiopia and Uganda that believed that one seed producer is more negatively impacted than another in its access to early generation seed and seed quality inspection, testing and certification services. \* Local seed businesses are farmer organizations, but differentiated from community-based seed producers by their business orientation.

Some producers are affected more than others. Derived from the survey, Fig. 3 shows the perceived inequality in access to EGS and seed quality assurance in Ethiopia and Uganda. Due to structural weaknesses in the supply of sufficient quality EGS and seed quality inspection, testing and certification service provision, these often go to the most powerful bidder; state-owned or larger commercial seed enterprises or agencies. In Ethiopia, the recommendations of the May and June seed alerts were championed by partners to enforce existing contractual agreements in the supply of EGS and convince both federal and regional state governments not to interfere in its allocation.

Selected seed producers, processors and traders need direct support from government. Additional and/or alternative sites should be allocated along with irrigation for off-season seed production, if possible. This was one recommendation made across all four countries during FGDs, and Ethiopia prepared for large-scale irrigated seed production in the September-October months of 2020. Seed producers should be facilitated access to affordable financial credit.

Through the COVID-19 fund and Economic Relief Plan (CERP), MOALI has provided MMK 14,911.33 billion (~ US\$11.4 million) for seed production on 12,847 ha during the monsoon season in Myanmar. This should in turn yield sufficient seed to sow 40,470 ha of paddy.

Allocation of these funds took place after the publication of the May seed alert and 7th convening of the National Seed Platform during which the alert was presented in detail.

Another recommendation was made to seed producers to attract, mobilize and secure labour by providing safe transport, board and lodging. The Oromia Seed Enterprise in Ethiopia, for example, provided personal protective equipment to workers and accommodated them in the company's processing compounds. Foreseen as an alternative, assistance in obtaining labour saving technologies was offered in Ethiopia, but labour-shortages turned out to be less of a concern than originally anticipated. National Agriculture Advisory Services in Uganda, implemented under Operation Wealth Creation, have stepped up efforts to equip farmers with tractors and other machinery. The Ugandan government also prohibited land evictions for the duration of the country's lockdown.

### 3.3. Delays in distribution

Delays in distribution have occurred because of lockdown, absenteeism of workers at processing and off-/loading facilities, and restrictions to inter- and intranational transport. Our dashboard (Fig. 2) shows that panellists perceived the distribution of seed and mobility of both seed companies and farmers to formal retail outlets to have been more negatively impacted than the accessibility of seed from informal sources, but that panellists in both Myanmar and Nigeria had concerns for both.

Reportedly, impediments have increased the cost of distribution in several occasions (TASAI, personal communication). Delay of exports and imports has resulted in traded goods like vegetable seed becoming less available to seed companies and agro-dealers looking to refresh their stocks and add new varieties to their portfolio. This was observed in Kenya, reportedly due to delayed response times and backlogs of officials in resolving common hiccups in issuing import permits to distributors by them not being at their usual place of work, or with limited communication capabilities whilst working from home (Rijk Zwaan, personal communication). Short term delays may not have had too great an impact on farmers' access to imported vegetable seeds, as they are less bulky and have relatively longer shelf-life than many of the field crops, making it possible to store them for longer. Certain governments have either suspended or reduced import duties and taxes on scarcely available agricultural inputs. Limited domestic reserves of globally-traded currencies have been an exacerbating problem, which requires prioritization of forex for much-needed agricultural inputs for import expenditure. National Bank of Ethiopia has been issuing letters of credit to local importers for this purpose, but for plant protection chemicals and not seed.

Seed trade associations in collaboration with government have issued seed producers with stickers for their vehicles that easily identify them in conducting essential services; Kenya for example (AFSTA, personal communication). Other good practice was the structured/ scheduled trade of agricultural inputs at designated market-places in Myanmar and Nigeria, which diminished congestion and complied with sanitary measures. Ethiopia's governments expedited the distribution of seed to selected rural areas to extend its period of availability and prevent a last minute rush of farmers to market. Recommendation was given during FGDs in Nigeria and Uganda for farmer organizations and agricultural extension workers to take stock of farming communities' needs in aggregating information to agro-input traders. AFSTA (personal communication) has received reports from national associations that farmers and traders are increasingly engaged in seed e-commerce. Digital seed tracking technologies are available and useful in coordinating supply, for example Seed Tracker™ (IITA, 2019). A new seed tracking and tracing system for Uganda is in the final stages of development for deployment by the Ministry of Agriculture, Animal Industry and Fisheries (ISSD Uganda, 2020). A similar technology referred to as Seedcodex is currently promoted for use by NASC in Nigeria. The crisis has

incentivized its use at scale in the context of making it conditional for seed companies to take part in government's seed distribution programs (WCDDI, 2020e). In addition, governments were urged to take measures to minimize seed price instability, manipulation and stockpiling in Ethiopia, Myanmar and Uganda.

### 3.4. Variety release and registration has been delayed

Among other important services like seed quality inspection, testing and certification, release and registration of new varieties has been delayed. Derived from the survey, 84% of panellists perceived the activities related to variety national performance trials, recommendation for release, and registration to have been negatively impacted.

At the time of writing the second seed alert for Ethiopia (WCDDI, 2020g), the National Variety Release Committee was yet to convene on the recommendations of candidate varieties for release in the country. The seed alert called for swift action. Had the process of variety release and registration not been concluded in the month of June, research organizations and breeding companies would not have been able to produce or make EGS of these varieties available, and pre-extension demonstration of the newly released varieties would not have taken place this year. Without the advocacy of our partners, farmers would not have been able to benefit from the investments in crop improvement for at least another year, which will likely be the case in Uganda.

Advancements in information and communication technology (ICT) offer great opportunity during times like this. The possibilities for going digital in seed service provision should be explored exhaustively. Variety release and registration is no exception. In Myanmar, the process is expedited by online applications to the Seed Division of the DoA through the recently established Myanmar Seed Portal (MOALI, 2020). Another recommendation made in Ethiopia was to keep a digital record of photographs and interviews at field days with a limited number of farmers that may serve as alternative forms of trial data for release committees to evaluate. Having a digital archive and decentralizing the collection of these data to the level of extension worker or lead farmer would facilitate more rapid variety release in the future. This was one example of how reforms could improve seed sector performance in the long run.

### 3.5. Future food, nutrition and income security at stake

Agriculture is seasonal and its activities time-bound. The COVID-19 pandemic, and society's response to it, threatens continuity in the performance of these activities with potentially devastating knock-on effects for seasons to come. As many as 85% of panellists believed that the COVID-19 crisis will have a profoundly negatively impact on their country's food, nutrition and income security. Access to quality seed is a significant topic of concern, disproportionately in regards to some farmers and not others. Fig. 4 shows that subsistence farmers, notably

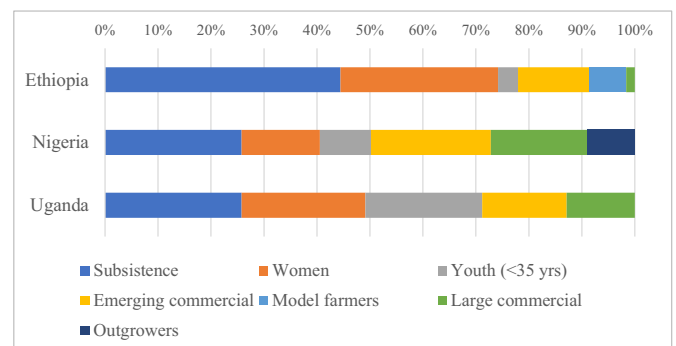


Fig. 4. Farmers/farming households most frequently ranked as being negatively impacted in their access to quality seed and varieties of their preference in rapid assessments in Ethiopia, Nigeria and Uganda.

women, were consistently ranked as negatively impacted in Ethiopia, Nigeria and Uganda.

#### 4. Conclusions

The assessments of the impact of the COVID-19 crisis on the functioning of the seed sector were conducted in Ethiopia, Myanmar, Nigeria and Uganda. They were rapid, iterative and inclusive in assessing the need for and advocating immediate practical, remedial and preventative action in ensuring continuity in activities in key functions of the seed sector. The four countries were at different stages of their agricultural seasons, making data, although highly contextual, interesting for getting a glimpse into the future. Lessons are offered from one country to the other. However, extrapolations should be constrained to the relative contribution that formal seed systems make to food, nutrition and income security in these countries. The impact of the pandemic on informal seed systems has not been adequately assessed. Further, our method assessed perceptions, leaving us with the important task of triangulating the data with observations in reality, which we have done with the partners in each country.

Reduced mobility was the root cause of many disruptions in the supply of, in particular, certified seed and other inputs to farmers, which included low availability of labour, reduced processing output, and delays in distribution, causing seed and related industry to operate at reduced capacity. We observe reports of the increased cost of transactions and doing business during these times, which we are concerned will raise the scarcity and price of inputs beyond what either producers or farmers can recover. Bottlenecks in the import of traded goods like vegetable seed will make replenishing stocks difficult for agro-dealers, exacerbated by the foreseen crunch to forex reserves in low- and middle-income countries like Ethiopia in the months to come (IFC, personal communication). Sales of quality seed were also perceived to be negatively affected due to delays in distribution, weakened marketing efforts and fewer farmers present at markets, but concerns have subsided. Due to delays in service provision, including the release and registration of new varieties and seed quality inspection, testing and certification, farmers are unlikely to benefit from investments in crop improvement for more seasons to come. Despite the resilience of informal seed systems and the seed security they offer at times like this, gains in closing farmers' yield gaps is foreseen to be diminished as a result.

The public health response may also call for strategic flexibility in the enforcement of regulations and standards. Existing legislation is unlikely to offer provisions for such exceptional circumstances. Prompt and unprecedented action to ensure continuity in the performance of essential activities in the seed sector will require regulatory concessions and/or exemptions by government.

Social distancing measures prevent stakeholders from meeting face-to-face to exchange goods, services and information or coordinate activities. The rapid assessments revealed how the pandemic actually facilitated the uptake of digital technologies by various stakeholders within the seed sector in the four countries. It has been a steep learning curve for many. Whilst some farmers and other stakeholders were reluctant in going digital, the pandemic forced many supporting organizations to apply these technologies. These have increased our own resource use efficiency in conducting an assessment of this kind.

In conclusion, the pandemic has further exposed structural weaknesses in the organization of formal seed systems, and applied pressure that exceeded limits to their resilience. Structural weaknesses were well-known to partners in the four countries where rapid assessments took place. Prior to the onset of the pandemic, reforms were not only justified, but also overdue. In a fortunate turn of events, the pandemic may just be the catalyst of reform. It is too soon to tell. Looking post-crisis, it is critical to keep the momentum up and seize the opportunity for addressing them.

#### Declaration of Competing Interest

None.

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#### Appendix A. Supplementary data

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