

CHECK Rebuilding the Farm-to-fork Model: A Resilient Agricultural Food Supply Chain

Described as the worst disaster to hit the 21st century, the coronavirus disease (COVID-19) pandemic has paralyzed the world and halted economic activities in the efforts to prevent its further transmission. Similar to other countries, the Philippines imposed lockdowns to mitigate the risks and damages of the outbreak.

With heavy restrictions in place, production and other parts of the supply chain were interrupted. From the input side, sourcing raw materials have been challenging. At the distribution level, suppliers and manufacturers were faced with logistic problems, while farmers and fisherfolk were left with very restricted means to sell their produce. These resulted in an interim supply-demand gap, which had been more evident in regions that source their supply of agricultural food products from other areas.

This briefer highlights how the disruption worsened the preexisting inefficiencies across the agricultural food supply chain. This also identifies the opportunities brought by the "new normal" (Figs. 1 and 2) and other recommendations that are vital in developing a resilient supply chain.

AMPLIFYING EXISTING SUPPLY CHAIN ISSUES

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The COVID-19 pandemic and the restrictive measures that followed have magnified the pre-existing problems on agricultural value chains—efficiency problems, such as high transaction costs, high wastage, and information asymmetry; equity issues involving the distribution margins; value creation limitations, such as barriers to innovation and technology adoption; and sustainability concerns and environmental impacts.



Fig. 1.New normal in public markets. (Anton Amosco,
CNN Philippines. 2020)Fig. 2.Customers queuing and seating one meter apart
in a fastfood chain. (Florentino Floro. 2020)

Since the lockdown, access to raw materials and transportation of produce from farms to markets have been restricted. Farmers had to deal with decrease in buyer turnouts, high wastage (Fig. 3), and relatively higher transaction costs (Rivas 2020). This disruption affected not only the availability and variety of food in public markets and grocery stores but also the profitability of agro-enterprises.

Likewise, in the first few weeks of the 2020 lockdown, problems in the implementation of travel restrictions severely hampered the access of farmers and food processors to inputs like feeds, medicines, packaging, and other supplies (ABS-CBN News 2020). This is due to the various interpretations and translations of the policies to local settings according to sub-national governments. In some cases, quarantine rules imposed by the sub-national governments are even more stringent than the regulations set by the national government through the Inter-Agency Task Force for the Management of Emerging Infectious Diseases (IATF-MEID) (NEDA 2020).

Aside from stringent checkpoint protocols (Fig. 4), delays in deliveries could also be traced back to the congestion of ports (ABS-CBN News 2020). Due to enhanced community quarantine (ECQ), businesses were shut down, including trucking services and warehouses, which led to backlogs in the transportation of goods (Fig. 5). Incoming deliveries, therefore, continued to pile up in Manila and other port areas.

The NEDA business survey for agriculture and fisheries sector in 2020 showed a 14% disruption in the activities of farmer-respondents resulting in 1,169 hectares (ha) of land left unplanted. Also, 35% of the respondents were not able to sell their produce. In value terms, Cavite, Laguna, Batangas, Rizal, and Quezon (CALABARZON) recorded the highest income loss at P26.33 million (M) followed by Central Luzon with P24.84 M. By crop sector, high-value crops recorded the highest income loss at P36.82 M.

On the consumer side, 60% of the respondents' food consumption was reduced partly due to difficulty in accessing groceries and wet markets. Physical and on-the-spot transactions, which are the usual practices in the production and sale of agricultural products in the country, posed risks as channels for viral infection.



Fig. 3. Ifugao farmers throwing away their oversupply of carrots. (Jaren Lamhi, as cited by GMA News)

The pandemic also brought new challenges, such as restricted mobility of labor, which resulted in shortages in agricultural labor supply. Under the COVID scenario, Gregorio and Ancog (2020) estimated a reduction in the volume of agricultural production equivalent to 2.97 M tons (t) due to drop in farm labor supply as a result of mobility restrictions.

Farmers and fisherfolk's access to and use of information and communication technologies (ICT) also became a more prominent

issue. This is due to increasing digitization of market transactions, as evidenced by emergence of online buy and sell and e-wallets, among others, which are barely accessed by most farmers and fisherfolk. Despite the wide mobile network coverage (99% of the population in 2014) in the country, farmers may find it difficult to actively participate due to high cost of information and communication technology (ICT) services and lack of digital devices. Albert et al. (2016) cited that the Philippines has one of the highest prices of ICT services in the ASEAN



Fig. 4. Checkpoint in Manila during the ECQ. (Armed Forces of the Philippines, South China Morning Post)



Fig. 5. Container vans piling up inside the Philippine Ports Authority (PPA) compound in Manila during ECQ. (George Calvelo, ABS-CBN News)

region. To be specific, mobile cellular and fixed broadband services in the Philippines are valued at \$22.2 and \$51.6 per month, respectively. This makes the Philippines with the second-highest price of mobile services and the third-highest price of broadband services in the ASEAN. The country also ranks lowest in the Asia Pacific in terms of the average internet speed at 5.5 megabits per second (Mbps) in 2017 (Quimba and Calizo 2018). These constraints brought by poor physical infrastructure in the Philippines continue to widen the already existing digital gap. Given the limited mobility and rise in popularity of online markets due to the pandemic, equipping the farmers with proper resources and knowledge to participate will help ease the burden caused by the heavy restrictions.

Food production is a critical and complex process that is prone to unexpected, pandemic-induced changes. This pandemic has stressed the need for a robust food system, especially at times like these where food security is the topmost priority. The major challenge is rethinking the paradigm that guides the way the government designs and provides interventions to adapt to the new obstacles, and at the same time address the pre-existing challenges.

TOWARDS A RESILIENT AGRICULTURAL FOOD SUPPLY CHAIN

This clearly illustrates that there is still a multitude of improvements needed to make the food value chains resilient such that these can withstand, immediately recover from, and adjust or adapt to such disruptions (Fig. 6). In designing and developing a resilient supply chain, three main principles are crucial. First, value creation, efficiency, and inclusivity objectives should still drive the development of food supply chains. As seen in the actual cases above, what disrupted most operations is the mobility restrictions, affecting both the supply and consumer's sides. Shifting to processes like digital transactions, well-coordinated supply chains, mobile markets, etc. may overcome such restrictions. However, this shift requires financial resources, technological investment and appropriate infrastructure to support and sustain such system. Thus, enterprises should be profitable or productive enough for the key actors to take risks and invest in innovations.

Second, the capacity to adapt and recover from shocks largely depends on the coordination among key actors and access to innovations. One of the ways better coordination can be achieved is by making smart technologies and other innovations work for the key actors in the food systems, especially the marginalized. This would require that quality data and seamless connection are available and accessible to key actors. As an example, supply chain analytics meant to house localized yield projections and volume requirements can inform prospective buyers where to source supply or inform producers of the buyers' requirements. This is most relevant especially during a pandemic where mobility is restricted as buyers or distributors can optimize their transport costs and instantly determine where to look for sources of supplies. Other smart technologies appropriate for farm production are also now available and help the farm optimize the use of resources. As farms become more efficient, gains in the form of income increase afford them some sort of insurance and make them resistant to shocks.

Third, sustainable and diversified consumption can contribute to improving resiliency by presenting other opportunities that can be explored by producers during a pandemic. This may be achieved by influencing consumer behavior and reorienting the Filipino diet towards nutritious alternatives to rice such as white corn, cassava, sweetpotato, and banana, among others. The shift in diet hopes to transform the demand side and open wide opportunities to the production of alternative healthy foods. Aligned with the three main principles, the succeeding section presents the focus areas and interventions that can be undertaken for a resilient supply chain.

Production

Diversify and develop reliable intra-region production base. There is a need to strengthen intra-region agricultural supply chains that can operate in both lockdown and postlockdown scenarios. Production bases within the regions shall be diversified, ensuring continued supply chain operations despite limited cross-border transfers. This requires developing the capacity to produce suitable commodities within the region. This may also need incentives for the farmers to shift to diverse production. As we diversify production, it is anticipated that local ancillary agro-enterprises (from production and storage to distribution and retail) will create income-earning opportunities for the local communities.

Promote urban agriculture and backyard farming (Fig. 7). The essence of urban agriculture in meeting the increasing demand for food in metropolitan areas cannot be overemphasized. The same thing is true for rural areas



Fig. 6. A framework for a resilient agricultural food supply chain.



Fig. 7. Dr. Eduardo P. Paningbatan, Jr. of UPLB demonstrating how to use enriched potting preparation (EPP) bottles.

where backyard farming may be an option. Apart from ensuring food for families, this can also be a potential source of income in the long term.

DOST-PCAARRD, in cooperation with the University of the Philippines Los Baños (UPLB), has developed the EPP technology, a form of urban gardening that uses plastic bottles and potting medium, which can be installed in small spaces. such as condominiums and apartments. It can be used to plant lettuce, mustard, tomato, eggplant, cucumber, mint, parsley, rosemary, and ornamental plants, among others. For backyard farming in rural areas, apart from vegetable production, purebred native chicken and its attendant management technologies are now available for use among rural households.

Invest in build-up, management, and analysis of localized data on agriculture and farmers. In making this possible, guality data on

agriculture and farmers or fishers

are needed. At DOST-PCAARRD, projects like "Smarter Approaches to Reinvigorate Agriculture as an Industry in the Philippines (SARAI)" (Fig. 8) developed suitability, rainfall, and vegetation index maps, which help initiate or develop decisions for agricultural industries in the regions (Project SARAI 2020). Data products like yield estimates, cropping calendar, and insect pest and disease outbreak models will be useful in tracing and projecting supply, as well as matching suppliers and buyers. Through localized production data, the distribution and retail of food and other agricultural products to the regions can be easily facilitated. An updated and possibly georeferenced data indicating location of farmers or farms and fishponds will lead to an efficient and targeted provision of support services. Technologies for the capture of said data are now available in the country and currently await investments in its scale-out and deployment.

Invest in development and diffusion of smart agriculture

technologies. The crisis has emphasized the need to develop and use smart technologies in agriculture that will allow seamless connectivity across the supply chain and at the same time ensure optimal use of resources. Some specific examples are internet of things (IoT) tools that gather realtime information, such as automated farming equipment, drones, pest and disease detection tools, livestock wearable technologies, moisture sensor, water salinity sensors, and radio frequency identification (RFID); geographic information system (GIS)-based and decision-support technologies, such as agricultural monitoring system, remote sensing, and site-specific crop management; and other intelligent technologies in agriculture, such as automated water management and yield monitoring and forecasting.

Programs or policies on incentives for manufacturing smart technologies, capacity-building activities, and infrastructure development are also needed to address barriers in the development and deployment of these technologies. With this, DOST-PCAARRD has invested over P300 M in the last five years for the development of a crop monitoring and forecasting system that is intended to be institutionalized at the national, regional, and community levels. Through this, sample advisories, such as planting dates, early warning for pest and disease infestation, water management strategies for specific areas, sitespecific nutrient management, and daily weather condition notifications may be developed to help farmers decide on the optimum management solutions suitable

to their farm conditions. Among the technologies developed are soil moisture sensors and insect pests and diseases detection and monitoring.

Align intervention designs with inclusive and innovative business models. Farmers will start and

continue innovating and investing in technologies if they see the value of doing so. For this reason, sustained improvement in the efficiency and competitiveness of the agriculture production base as a supplier of staple, high-value, and cash crops (either for processing or as final goods) depends on the incentives to be received by the farmers. Incidentally, emerging now are inclusive and innovative business models that facilitate smallholder farmers' participation in the market and greatly ensure benefits accrue to the smallholder farmers and the community in general. Examples of drivers of inclusive business models are: a) producer-driven models, such as small-scale producer organizations motivated by improving market access through collective action and b) public institutional-driven models or institutions, such as schools and hospitals procuring food daily, and community-supported agriculture where producers and consumers share the benefits and risks of production (Kelly, Vergara, Bammann 2015 and DeMuth 1993). To ensure that incentives are present and benefits are received by the farmers, interventions like the development of value chains must then align its strategies with inclusive and innovative business models.



Fig. 8. Screenshots of SARAI website.

Processing and New Products

Invest in biofortification technologies and designer food.

Malnutrition and acute hunger are pre-existing conditions in the Philippines. Together with the elderly and people with severe underlying conditions, the under-nourished, who are mostly the poor, are considered to be highly threatened by the virus. Hence, it is essential to make food not only available and affordable but also nutritious. This can be addressed by biofortification and development of designer food, which refers to food with enriched nutrients other than its traditional nutritional value (Fig. 9). The country can take advantage of biofortification technologies now widely available for use-from genetic engineering to tissue cultures to molecular breeding (Saeid 2018).

Develop technologies to produce shelf-stable vegetable. As

consumer behavior shifts to the "pantry stockpiling" attitude while production and distribution are disrupted, a supply gap may be imminent, as well as the possible increase in wastage due to stockpiling of perishables. Technologies that will make perishables shelf-stable at the distribution and consumer level will help slow down—if not stop—the supply gap. This may be in the form of new sustainable packaging, biopreservation, edible coatings, healthy meal packs, etc.

Reorient diet by promoting more nutritious alternatives. To achieve this, there should be a diverse production base such that plantbased protein sources will be abundant. The diet would include fruits, vegetables, whole grains, and legumes. Aptly for an archipelagic



Fig. 9. Comparing white rice and golden rice, which is a biofortified rice infused with beta-carotene. (Erik De Castro, The Western Producer)

country like the Philippines, inland aquatic resources and mariculture must be further developed for higher fish supply as an alternative protein source. The succeeding initiatives must ensure that such food options will be accessible or affordable, especially to low-income groups.

Distribution and Retail

Ensuring a continuous distribution of goods and raw materials has been one of the greatest challenges especially during the earlier part of the pandemic. This section lists down several recommendations meant to improve the sourcing and delivery of products, especially when stringent mobility restrictions are in place.

Invest in software solutions for sourcing, distribution, and retail of agricultural products. Postpandemic consumption behavior shift points to increasing online food shopping (Fig. 10). This has been proven to be one of the most convenient and useful platforms to secure food with home guarantine measures in place. The government, in partnership with private institutions, may invest and implement programs and projects to develop and strengthen the digital or software solutions for online buying and selling of food and other agricultural products (FAO 2020). This will most likely take the center stage in a "new normal" agricultural marketing scenario as it offers convenience and increased selection for consumers. Most importantly, it will make the food chain more efficient as it facilitates, mostly in real-time, market linkage and matching of consumer's demand and supply. Likewise, this will help micro, small, and medium enterprises (MSMEs) ensure a market for their produce.

Move towards financial inclusion.

As we propose for the agricultural food supply chain to adopt software solutions, key players such as farmers and consumers, especially in the provinces, must also be

encouraged to migrate to digital transactions like through mobile wallets. Policies must be designed and implemented to remove barriers to participating in the digital economy. Financial services that would make that possible must be available and accessible to key players along the supply chain. The Philippines does not need to start from scratch as it can benchmark against models in other countries like Kenya and Zimbabwe that have already started moving to digital transactions. Simultaneously, ICT infrastructures must be built, especially in rural areas.

Build and re-engineer regional warehousing and cold chains for agricultural produce. To support the long haul of agricultural products and

long haul of agricultural products and reduce wastage from perishables, there should be a system of warehousing and delivery accessible to the farms via different forms of collaboration among the local government, the private sector, and the farmers themselves. Movements and processes shall be linked to online retail platforms for agricultural produce. This warehouse system will serve as the venue for local farmers and fisherfolk to bring in and store their produce to be delivered to or picked up by wholesalers, retailers, and institutional buyers. It will ensure market for the farmer's produce and reduce the need for mobility, which is greatly hindered due to community guarantine. This will also be significant in ensuring food security and availability in times of pandemic and other calamities. Each warehouse should have highcapacity and temperature-controlled storage to be able to store a large volume of produce while preserving the quality of products and reducing food wastage (Cullen and FAO 2020).



Fig. 10. Home Grown and Online Palengke are some of the local online shopping platforms catering agricultural products. (HomeGrown and Online Palengke)

Bring market closer to consumers. Mobile markets and online food delivery options are effective ways to avoid crowding in public markets and grocery stores and reducing the risk of virus exposure. Online shopping (Mahendra 2020) is the current trend for both nonperishable and perishable goods. Meanwhile, mobile markets are a great help for areas that do not have reliable internet access. Some local government units (LGUs) in Metro Manila such as Pasig City, Valenzuela City, and Mandaluyong City have already deployed their versions of mobile markets or socalled "mobile palengke" (Fig. 11). However, safety measures should be followed in implementing mobile markets and online deliveries.

Link farmer's produce to emergency food assistance

(Fig. 12). Distribution of relief goods is crucial for the survival of many Filipino families during a crisis. While non-perishable food is a wise

option to stockpile and to give as a relief, it is also important to provide diverse and nutritious food such as vegetables, fresh meat, and fish, among others. This is a good opportunity for the government to directly purchase agricultural produce from smallholder farmers and fisherfolk, which will then be provided as relief goods to families (Cullen 2020).

Avoid delays and disruptions in the production and movement of food and inputs to food

production. Community quarantine and lockdown must not impede access to sufficient, diverse, and nutritious food. This means that guidelines in lockdown, quarantine, or border closure should exempt any individual or business operations involved in food production and logistics, including production and delivery of inputs, such as fertilizer, pesticides, veterinary medicines, and feed supplies (Ibid n.d.). Permits to operate and work, which serve as passes and proofs that these businesses and individuals are involved in food production, shall be provided. Likewise, delivery trucks or vehicles with necessary and complete legal documents shall be allowed to enter and exit a locality, provided that they follow the imposed sanitation protocols.

In the case of checkpoints, special lanes shall be designated to avoid delays and minimize food wastage, especially for perishable goods such as fruits, vegetables, meat, and dairy products, among others.

Keep trade open and implement stringent cross-border inspection.

In relation to minimizing disruption in the food supply chain, the country shall not ban or restrict export and import of agricultural products and other raw materials essential for food manufacturing (FAO 2020). As a net importer of staple products such as rice, corn, swine and poultry meat, and dairy products, among others, keeping trade open would be crucial to ensure food security in the country. This would protect both producers and consumers and prevent panic and price shocks in the domestic and global markets (Cullen and Mahendra 2020). Crossborder inspection must be stringent and compliant to biosecurity policies.

Strengthen link to input suppliers.

The mobility restrictions affected not only the distribution of food products but also of agricultural inputs, such as feeds and medicines for livestock and fertilizers and pesticides for crops. Recommendations to ensure continuous distribution, such as direct and digital marketing through online platforms may also be applied to input sourcing. Movement restriction policies should consider agricultural inputs as priority commodities, similar to the usual agricultural food products. Bridging institutions, such as the farmers' association may be assisted in bulk agricultural input procurement to ensure raw material supply for the farmers.

Institutional Support and Safety

Strengthen extension services and infrastructure. The emergence of smart technologies for agriculture requires the subsequent development of extension services in rural areas. Extension service plays a vital role in ensuring that technologies are adopted and used properly by intended users. In some cases, knowledge products for farm production need to be transformed into versions that are easily understood by intended users.

Strengthen bridging institutions, such as cooperatives (Fig. 13) as channel for technology diffusion. The success of a technology boils down to its dissemination and adoption in the field. Technology is deemed useless if farmers will not adopt it, which is why understanding



Fig. 11. Mobile Palengke in Pasig. (ABS-CBN News)



Fig. 12. Packing of tomatoes purchased from the farmers of Albay as part of the relief assistance of the Provincial LGU to its constitutents. (Albay Provincial Agricultural Office [APAO])

a farmer's behavior towards the factors affecting their decision to adopt a certain technology, is crucial. Cuevas et al. (2019) showed that cooperatives/ruralbased organizations (RBOs) play an important role in stimulating adoption of technology to enhance production and marketing efficiencies. Similar studies have shown that collectively, smallholder producers share information, pool resources, and distribute costs and risks among themselves to improve yield and productivity. These are not possible if the smallholder farmer is working alone (Cuevas et al. 2019).

Improve access to finance.

Programs to enhance access to agricultural financing are crucial for smallholder farmers and fisherfolk to be able to continue and expand their production and subscribe to the various technologies prescribed above (Cullen 2020).

Advocate innovative national **biosecurity policies.** Biosecurity is strategically important as national security and the Philippines has yet to come up with an overarching policy on biosecurity. Its importance was particularly made more evident as the African swine fever (ASF) broke out and became a national concern. ASF emerged as a severe viral disease affecting domestic and wild pigs, impacting production and the whole livestock industry. Having innovative biosecurity policies may well prepare the country to face another pandemic and risks associated with invasive alien species, emerging animal and plant pests and diseases, and others.

Protect the "backliners." There should be a balance between sustaining the food supply chain amid an outbreak and protecting



Fig. 13. Members of Catalanacan Multipurpose Cooperative in Nueva Ecija.

the chain participants, such as farmers, fisherfolk, market vendors, delivery persons, factory workers, food service crews, port workers, and grocery store staffers, among others, against the virus (Mahendra 2020). Just like any other frontliners, these food chain participants or "backliners" (Figs. 14 and 15), are also at high risk of exposure to COVID-19 as they interact with each other or with their clients. Protocols should be continuously improved, following new evidencebased issuances, to effectively and efficiently integrate physical distancing, regular disinfection and use of PPEs, among others, in regular work operations while ensuring safe handling of food and other agricultural products. Appropriate protective gear, such as face shields, masks, protective suits, and gloves should also be provided. Shifting and a reduced number of workers and working hours should also be implemented (Cullen 2020).

Develop sanitation and safe handling protocols (Fig. 16).

Safety measures, with emphasis on ways to avoid contamination and exposure to COVID-19 and the like, shall be developed for every critical point in the food chain from production and harvest to consolidation and storage to packaging and delivery. This shall also incorporate measures to assure proper distancing and reduce human contact in handling agricultural products. Programs, projects, and trainings about the developed protocols shall be implemented. This includes the adoption of an internal control system (ICS) in pesticide management. DOST-PCAARRD has funded a program on value chain development and piloting of conventional vegetable production and marketing that meet food safety standards through the adoption of ICS, which can be replicated and developed in other areas.

Devise information, education, and communication (IEC) materials and campaigns. To

protect all chain actors, especially consumers, the government must devise IEC materials and conduct massive campaigns on how to practice proper hygiene and sanitize food products when claiming food deliveries; buying from mobile markets; going to grocery stores, supermarkets, and public markets; and claiming relief goods, among others. Likewise, these materials are critical to avoid false information about COVID-19. Among these materials are television advertisements, social media, radio announcements, text messages, and flyers when distributing relief goods and other events.

CONCLUSION

The pandemic has dramatically impacted the country's food chain input supply, production, distribution, marketing, and consumption. It has amplified existing supply chain issues on efficiency, equity, value creation, and sustainability, which highlighted the need for a more agile and resilient agricultural food chain.

This farm to fork model highlights three key principles—the need to retain value creation, efficiency, and inclusivity goals in further developing the supply chains; promoting and adopting smart technologies and other innovative systems and solutions to improve adaptive capacity; and advocating sustainable and diversified consumption.

Following these principles, specific strategies should be done to ensure sustainable and reliable food production to strengthen localized food systems. These include the development of a diversified intraregion or intra-province production base adopting a data-driven approach (e.g., crop suitability maps, planting calendars), investing in smart agriculture technologies (e.g., GIS-based and decision support technologies, unmanned technologies), enhancing access to farm inputs and credit facilities, strengthening extension services and infrastructure, and encouraging



Fig. 14. New normal in Philippine local markets. (CNN Philippines)



Fig. 15. New normal for crew members in a Filipino fastfood chain. (Manila Standard)



Fig. 16. Biosecurity practices done in livestock and poultry farm. (Delaval and WattAgNet)

households to do urban agriculture and backyard farming. Investing in biofortification technologies and technologies that will make food shelf-stable are also necessary to guarantee a diverse and nutritious food supply.

To make sure that food is accessible, logistics and movement of food and inputs to food production must not be hindered by lockdown and travel restrictions. The country should also keep the trade open while ensuring that crossborder inspection will be stringent and compliant with biosecurity policies. Investing in software solutions for sourcing, distribution, and retail of agricultural products, and linking online platforms to regional warehouse and food chains should also be prioritized. Policies should also be designed and implemented towards digital transactions and financial inclusion.

It is also recommended to emphasize institutional support and safety protocols/policies on top of the said interventions along the food chain. Development and promotion of safety measures and protocols to protect food and all chain participants is a must. This can be done through devising effective IEC materials and campaigns, updating safety protocols at the workplace, improving food handling protocols and their implementation, and conduct of capacity building on food safety measures, among others. Lastly, the crafting of harmonized national biosecurity policies is also advocated to prepare the nation for another possible epidemic and risks associated with invasive alien species, emerging animal and plant pests diseases, etc.

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EDITOR'S NOTE

The Policy Action Group (PAG) of PCAARRD is delighted to introduce to you a farm-to-fork model built to address the present-day challenges and concerns in the agriculture, aquatic, and natural resources (AANR) sector. This Special Edition of DOST-PCAARRD's Policy Brief highlights the attendant policy options and strategies that are intended to address those issues. These issues and policy options are result of PAG's consultations and meetings with various government agencies, the academe, non-government organizations, and the private sector. Through this brief, we hope to emphasize the integral role of S&T in developing a resilient and sustainable food supply chain.

POLICY BRIEF is a quarterly publication of the Policy Advocacy Group (PAG) of DOST-PCAARRD that highlights the Council's stance on policy issues on S&T in agriculture, aquatic, and natural resources. PAG spearheads policy and advocacy related to PCAARRD Medium-term Plan.

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