PHILIPPINE YELLOW CORN INDUSTRY ROADMAP 2021-2040

DEPARTMENT OF AGRICULTURE
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YELLOW CORN INDUSTRY

ROADMAP 2021-2040

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NATIONAL CORN PROGRAM

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

ACEF	Agricultural Competitive Enhancement Fund
ACPC	Agricultural Credit Policy Council
AEC	ASEAN Economic Community
AFTA	ASEAN Free Trade Area
AI	Artificial Intelligence
AMAS	Agribusiness and Marketing Assistance Service
ASEAN	Association of Southeast Asian Nations
ASF	African Swine Fever
ATI	Agricultural Training Institute
ATIGA	ASEAN Trade in Goods Agreement
BAR	Bureau of Agricultural Research
BSP	Bangko Sentral ng Pilipinas
BSWM	Bureau of Soils and Water Management
CIF	Cost, Insurance and Freight
DA	Department of Agriculture
DRC	Domestic Resource Cost
DTI	Department of Trade and Industry
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FAW	Fall Armyworm
FCAs	Farmers' Cooperative and Associations
FFRS	Farmers and Fisherfolk Registry System
FIs	Financial Institutions

FOB	Freight on Board
GATT-WTO	General Agreement on Tariffs and Trade - World Trade Organization
GIS	Geographic Information System
GM	Genetically Modified
GVA	Gross Value Added
HA	Hectare
HP	Horsepower
ICTS	Information and Communication Technology Service
IDN	Indonesia
IEC	Information, Education and Communication
IP	Intellectual Property
ISAAA	International Service for the Acquisition of Agri-biotech Applications
KPI	Key Performance Indicators
KRA	Key Result Areas
LGUs	Local Government Units
M&E	Monitoring and Evaluation
MAV	Minimum Access Volume
MFN	Most Favored Nation
MIS	Market Information System
MSMEs	Micro, Small and Medium Enterprises
MT	Metric ton
NAFMIP	National Agriculture and Fisheries Modernization and IndustrializationPlan
NCP	National Corn Program
NEDA	The National Economic and Development Authority
NIA	National Irrigation Administration
NYCIR	National Yellow Corn Industry Roadmap
OECD	Organisation for Economic Co-operation and Development

OER	Official Exchange Rate
OPV	Open-pollinated Variety
PAFMI	Philippine Association of Feed Millers, Inc.
PCIC	Philippine Crop Insurance Corporation
PhilMaize	Philippine Maize Federation, Inc.
PhilMech	Philippine Center for Postharvest Development and Mechanization
PHILSAN	Philippine Society of Animal Nutritionists
PHL	Philippines
PhP	Philippine Peso
PSA	Philippine Statistics Authority
R&D	Research and Development
RAC	Return Above Cost
RCR	Resource Cost Ratio
RDE	Research, Development and Extension
RDIs	Research and Development Institutions
RFOs	Regional Field Offices
SCUs	State Colleges and Universities
SDG	Sustainable Development Goals
SWOT	Strengths, Weaknesses, Opportunities and Threats
TWG	Technical Working Group
UBRA	United Broiler Raisers Association
USA	United States of America
USD	US Dollars
VAT	Value-Added Tax
VC	Value Chain
VGF	Viability Gap Fund
VNM	Viet Nam
WB	World Bank

MESSAGE

I commend the Yellow Corn Industry Roadmap Development Team, the National Corn Program, and the various stakeholders from the academe, private institutions, and farmer associations and cooperatives for making possible the crafting of the Yellow Corn Industry Development Roadmap.

This roadmap arrives at a critical juncture. As the country prepares for a post-pandemic recovery, policy-makers must consider the factors and forces driving performance in the corn industry. Against this background, this roadmap identifies the performance drivers of the corn industry and assesses its opportunities and challenges across the value chain to formulate a vision, mission, and strategies to achieve goals for the years 2021-2040.

The corn industry has been challenged not only by natural causes but by a host of factors such as low farm technology adoption, poor or absence of mechanization and postharvest facilities, failings in market and support services, and inadequacies in governance.

This roadmap outlines strategies and actions that will guide continuous improvements across corn value chains, particularly the less endowed producers, by providing a strengthened governance network to sustain development initiatives over the course of short, medium and long terms.

The Department of Agriculture is therefore proud to partner with its Bureaus, attached agencies, and especially the private sector for this noteworthy endeavor. We are confident that the plans developed from this collaboration will greatly contribute to the Department's twin goals of Masanang Ani at Mataas na Kita.

Mabuhay!

WILLIAM D. DAR, Ph.D.
Secretary
Department of Agriculture

FOREWORD

The Philippine Yellow Corn Industry Development Roadmap is a blueprint for the development of the industry spanning a 2021-2040 timeframe that starts with a short-term implementation plan, 2021-2025. Spearheaded by the Department of Agriculture, this roadmap results from discussions and consultations with stakeholders, industry partners, and representatives of the country's corn farmers' federation.

The roadmap provides decision-makers with reliable information on trends in agriculture, specifically corn, and the factors driving demand, supply, trade, and prices. It provides the situation and performance of the corn sector across the value chain; assesses its opportunities, challenges, and competitiveness in food and industrial uses; formulates its vision, mission, and strategies to achieve goals.

The roadmap suggests strategies and actions through the short, medium, and long terms for the continuous improvements across corn value chains, foremost by providing a strengthened governance network to sustain development initiatives. This roadmap also outlines specific recommendations for policy reforms, harmonized research and development (i.e. private, public), capacity development towards instilling agri-preneurship at the farm level, and the integration of value chain framework. These investments are critical for enabling sustainable yield improvements and allowing production to be driven by productivity growth rather than expansion of agricultural areas.

While policymakers are understandably focused on addressing the immediate pandemic-related challenges, decisions made now will shape the agriculture sector's future. This is a unique opportunity to set the industry on a sustainable, efficient, and resilient path. The Yellow Corn Industry Development Roadmap provides insights to support the country as it navigates the risks and opportunities over the next 20 years.

ENGR. ARIEL T. CAYANAN
Undersecretary for Operations and Agri-Fisheries Mechanization
Department of Agriculture

PREFACE

In the sunshine, a dried cob of corn glistens like gold. The opportunity this simple grain offers is life and wealth for a nation. Though the Philippines' staple grain is rice, corn comes a close second. However, its pervasiveness across our food system is often veiled because unlike rice, it is often consumed indirectly by us through the animal protein we consume or the food products we purchase from our grocery shelves. In other parts of the world, corn also serves as a source of biofuel – a trend which may continue as the world demands more sustainable energy sources.

This Roadmap was an opportunity to review how our corn sector has been faring, the challenges, and the vast opportunities it faces today and tomorrow. This project could not have been more timely as the country gears itself for a post-COVID 19 pandemic recovery where agriculture and food are expected to be significant engines of "building back better" as these sectors offer large multiplier effects across our society and economy – job creation, poverty reduction, food security, economic prosperity…

The value chain approach this Roadmap adopts breaks away from the traditional siloed, commodity-based approach – linking corn to the downstream industries it serves, especially livestock and poultry which together already consume three-fourths of total local yellow corn production. As our country continues towards its upper-middle income status aspiration, propelled by a growing middle class, the demand for more corn can only grow. We have seen that today's yellow corn production is inadequate to meet current demand – growing imports of wheat and other corn substitutes are testaments to this. This only means we need to double-up our collective

efforts to enhance our local production in a manner that produces large, affordable volumes of corn at sufficient quality that services downstream requirements while at the same time ensuring sustainable and fair incomes for our corn farmers whose hard work have been and will be key to eventually achieving food sovereignty.

There is much work to be done and this updated Roadmap is only a first step in the right direction. But now the rubber must meet the road and it is crucial that we see this not as another Roadmap that is expected to be done by the Department of Agriculture alone, but as one that requires multi-stakeholder, whole-of-nation involvement. This is, therefore, a call for other national and local government agencies, private sector companies, farmers and farmer organizations, academe, and civil society groups to come together and put these Roadmap plans into action. It is our hope that the Industry Cluster Governance Network proposed in this Roadmap is immediately established as this will ensure a true Food Systems Approach can take root to turn the ideas and vision presented here into tangible and real results on the ground.

Thank you so much to my fellow Project Team members whose valuable insights and wisdom have made this Roadmap possible. To the Department of Agriculture who had the initiative to undertake this effort in the first place. To the National Corn Program who served as the muscle behind this entire effort. To all stakeholders who took the time to contribute to this Roadmap and make it as reflective as possible of a cross-sectoral perspective which can serve as the initial foundation for a multi-stakeholder approach moving forward.

Like the corn that glistens in the sun, may our corn sector glisten too for the Filipino nation as we plant the seeds today for a bountiful harvest in years to come.

CHRISTOPHER MATTHEW A. ILAGAN, Cargill Philippines, Inc.
Team Leader
Yellow Corn Industry Roadmap Development Team

EXECUTIVE SUMMARY

The Philippine Yellow Corn Industry Development Roadmap is a blueprint for the development of the industry spanning a 2021-2040 timeframe that starts with a short-term implementation plan, 2021-2025. Spearheaded by the Department of Agriculture, this roadmap results from discussions and consultations with stakeholders, industry partners, and representatives of the country's corn farmers' federation around a working document prepared by the National Corn Program.

The domestic corn sector has grown four-fold since the mid-1990s serving the markets for feeds, food, other industries, as well as home consumption. About 84 percent of the local production is utilized in the livestock industries. In 2020, the country achieved only 57 percent sufficiency in yellow corn for feed use; thus, is a net importer of yellow corn, feed wheat, and soya meal from Indonesia, Myanmar, the United States, and Ukraine among others. While yellow corn yield improved four times since the mid-1980s, it still lags behind Asian producers. The corn industry performance has been challenged not only by natural causes but by a host of factors like low farm technology adoption; poor or absence of mechanization and postharvest facilities; failings in market and support services (e.g. information, logistics infrastructure, credit, extension); and inadequacies in governance.

Demand for yellow corn grows with the increasing demand of the livestock sector. Bridging the current 40% supply gap will need yield-increasing technologies particularly among small growers, adequate postharvest machinery/facilities, streamlined marketing systems, enhanced support services, and enabling policy environment. Further, opportunities exist in tapping food and non-food value chains with available innovations; and exploring global niche markets.

The roadmap provides the situation and performance of the corn sector across the value chain; assesses its opportunities, challenges, and competitiveness in food and industrial uses; formulate its vision, mission, and strategies to achieve goals. Specific recommendations for action, needed policies, and governance network are detailed to operationalize the roadmap. Developments like the Magna Carta for Small Farmers (R.A. 7607), the agreements from the National Food Security Summit, related development plans, and partner-stakeholders' consultative discussions provided inputs to the roadmap. The NAFMIP, SDG, and AmBisyon 2040 provided context to this charted course.

This roadmap draws out the strategies and actions through the short, medium, and long terms that will guide the continuous improvements across corn value chains, particularly the less endowed producers, by providing a strengthened governance network to sustain development initiatives. Foremost is the setting of institutional mechanisms for innovative information systems, policy reforms, harmonized research and development (i.e. private, public), capacity development towards instilling agri-preneurship at the farm level, and the integration of value chain framework.

INTRODUCTION

Rationale And Objectives

The National Yellow Corn Industry Roadmap (NYCIR) has been developed considering the crucial role the corn sector plays in the economy within a range of socio-cultural and environmental context. The corn-livestock-poultry sector contributes 28% of gross value added (GVA; 2020); 5.8% share in agri-fishery sector, i.e. 102.5 billion pesos (GVA, 2018; constant price), engaging at least 850 thousand farm households, and industry workers. Corn is second to rice as staple food crop grown in 9.67% of crop area (PSA, 2020); and comprises a number of strategic value chains in food, feeds, and multi-industries involving farmers and industry players of various scales. It is widely grown by small farmers in resource-poor environments; thus, contributing to food and nutrient security, and community resilience. With such significance and value to offer to the country, the corn sector remains a strategic commodity that requires a detailed roadmap and plan to fully realize the potential benefits the sector has to offer.

This roadmap aims to address the challenges and opportunities of the corn sector amidst increasing demands in the feeds, food and other industrial markets; persistent inefficiencies in supply and market chains; and inadequacies in policies and governance. The NYCIR strives to be consistent with the larger strategic goals of nation building including the Department of Agriculture's inclusive and sustainable growth within the agriculture, fisheries and forestry sector (i.e. NAFMIP); the 2030 Sustainable Development Goals; and the NEDA-crafted AmBisyon Natin 2040 vision of "matatag, maginhawa at panatag na buhay" where agriculture development is one of the eight priority sectors that impact on its effective reach.

While NYCIR is mainly geared to craft a plan that gets all players (i.e. farmers to users/ industrialists and consumers) to reach the corn sector's vision, this specifically aims to:

- understand the realities, dynamics, and conditions that prevail in the corn sector and its value chains;
- analyze the corn industry's value chains; their competitiveness, strengths, weaknesses, opportunities, and threats towards identifying gaps/challenges, opportunities, prospects, and potential with appropriate interventions;
- develop the vision, mission, goals, objectives, and specific targets for the corn sector, which can lead to the formulation of a clear plan of action over the short- (2021-2025), medium (2025-2030), and long-term (2030-2040) detailing strategies, policies, programs, timeframes, resource requirements and responsibilities towards achieving the vision and goals articulated; and
- establish a clear industry governance network and an institutional mechanism that will effectively take charge in implementing, monitoring, and updating the implementation, and the roadmap, where feasible.

At the outset, the roadmap embodies the needed paradigm shift among all players and stakeholders in their perspective, mindsets, and behaviors in terms of value chains (i.e. from input suppliers to producers up to consumers); efficiency, competitiveness and comparative advantage in value chain processes, and the importance of institutional and governance innovation.

Definition of Terms

Industry Situation and Outlook. An assessment of the yellow corn industry structure and performance. It includes the corn industry definition, its product forms, and the profile of corn farmers. It analyzed industry performance across several parameters such as production, trade, supply utilization, and prices. It also provides the outlook for yellow corn production from the base year until 2040.

Supply/Value Chain Analysis. A supply chain is a network of connected and interdependent organizations naturally and cooperatively working together to control, manage and improve the flow of materials and information from suppliers to end users. It includes input subsystem, production, post-harvest processing, and marketing including logistics between each subsystem. The value chain is an offshoot supply chain management. Value chain analysis describes the activities within and around each subsystem and relates them to an analysis of the competitive strength of the industry. The ability to perform certain activities, manage the linkages between these activities and build trust is a source of competitive advantage.

The supply/value chain analysis discussed the supply chain segments and players. It looked into the cost-build up along the supply chain, including margins. It also dealt with the factors supporting growth of the industry particularly key and support industries, program and institutions. Finally, it identified the key constraints to value chain stability.

SWOT Analysis. Assesses the strengths (S), weaknesses (W), opportunities (O), and threats (T) involved in the industry. It identified internal (SW) and external (OT) factors that were favorable and unfavorable in achieving the industry objectives.

Costs and Returns Analysis. Estimates the costs (both implicit and explicit) incurred by farmers and possible profits that can be derived from corn production. It provides insight on the share of production inputs, labor, and capital as well as the returns on investment.

Benchmark Analysis. The analysis utilized both quantitative and qualitative measures such as price, cost, income and farm practices. The performance measurements were used to identify corn farms whose performances were significantly better and which,

therefore, may have the best practice. Based on the data, typical and benchmark farms were compared on the basis of productivity, cost, income, use of inputs, and other farming practices. Moreover, the local corn sector was benchmarked with its ASEAN counterparts to tell how the local corn industry fares in terms of performance.

Competitive Analysis. Competitive advantage indicates whether a country can successfully compete in the trading of a commodity in the international markets. The pattern of input cost allocation is crucial to the cost competitiveness of corn. The cost competitiveness of yellow corn production in selected major producing provinces is assessed based on two trade scenarios. An export trade scenario measures the competitiveness state if corn producing provinces will be exporting their produce given the selling price in the international market (i.e., border price), rate of exchange between two currencies (i.e., official exchange rate), and the cost structure of producing yellow corn, then processing it and bringing it to the port of exit.

Data Sources

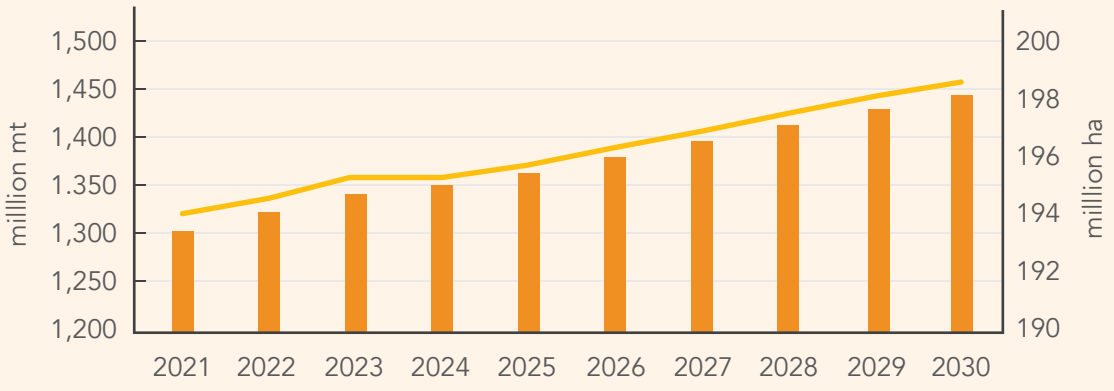
Primary and secondary data from the Regional Field Offices (RFOs), private sector stakeholders through consultation meetings, the Philippine Statistics Authority (PSA), Food and Agriculture Organization (FAO) of the United Nations (UN), Organisation for Economic Co-operation and Development (OECD), Bangko Sentral ng Pilipinas (BSP), World Bank, Department of Trade and Industry (DTI), and the Internet were used in this document.

INDUSTRY SITUATION AND OUTLOOK

Industry Definition

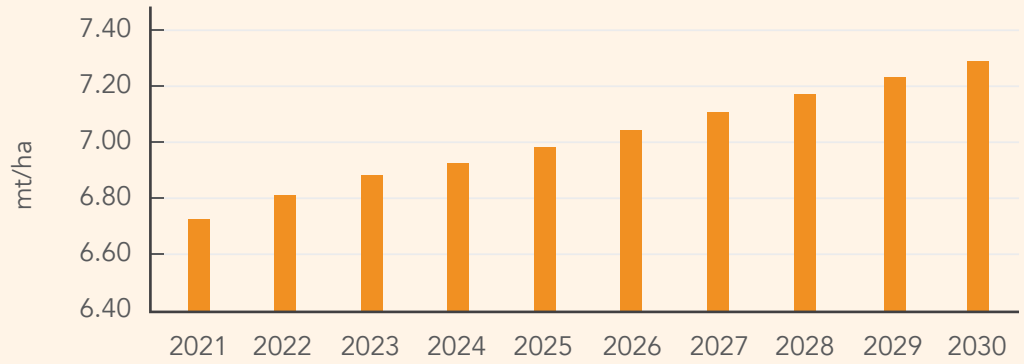
Globally, corn, rice, and wheat contribute the most human calorie intake at 19.5, 16.5, and 15 percent, respectively. Production, area harvested and yield of corn has been projected to consistently grow, 2021-2030 (Figures 1 and 2). Global corn production and consumption are expected to increase over the next decade due to area expansion triggered by increasing demand for feed and food. Feed use is expected at 68 percent of the increase in consumption (OECD, 2020; 2021). Trade is expected to expand by 36 to 194 million mt in 2029 with the United States as top exporter of corn. The Philippines ranked 3rd in production volume in the ASEAN; yet ranked 8th in yield (FAOSTAT, 2021).

FIGURE 1. GLOBAL PROJECTION OF MAIZE PRODUCTION AND AREA HARVESTED, 2021-2030



Source: OECD, 2021

FIGURE 2. GLOBAL PROJECTION OF MAIZE YIELD, 2021-2030



Source: OECD, 2021

In the Philippines, corn or maize *(Zea mays)* is next to rice as most important crop. A distinction between yellow and white corn defines the corn industry more clearly as they have distinct uses. Yellow corn is mainly used for animal feed; about 46 and 62.5 percent of livestock and poultry mixed feeds, respectively. The corn-livestock-poultry sector accounts for 28 percent of Gross Value Added (GVA) in 2020 (PSA, 2021); 5.8% share in agri-fishery sector with 102.5B pesos GVA in 2018 constant prices (PSA, 2020). White corn is grown mostly for food either as staple or snack food. Other colors usually dark (e.g. red, purple, brown), which are of native genetics origin, are minimal in supply and used more for their nutritive value in food.

The demand for yellow corn has been growing due to increasing demand from the livestock sector, and its productivity increasing to the Asian yield levels. The demand for white corn as food, and its productivity, have been relatively flat (Salazar et al, 2021). About 580,000 farm households depend (fully/partially) on corn as a livelihood; while thousands more like input suppliers, traders, transport services, and processors directly benefit from corn production, processing, marketing, and distribution.

The domestic corn sector has been expanding since the mid-1990s (PSA, 2021), disrupted at times from unfavorable weather. Low technology adoption rates, high post-harvest losses, transport and marketing costs due to inadequate infrastructure brought about production and marketing inefficiencies.

The country's corn industry consists of the feed manufacturing, food processing, and other industry uses value chains. Yellow corn has mainly the feed and industrial uses value chains; white corn mainly has food value chains in raw or processed forms. Industrial value chains, where yellow corn mostly supply to, tend to be longer with complex links of actors and stakeholders under a relatively complicated regulatory regime. The actors/players in these value chains include input suppliers (e.g. seeds, fertilizer, herbicide), producers (i.e. small/medium/big farmers, postharvest workers), traders (i.e. associations/cooperatives, private middlemen), processors/manufacturers (e.g. feedmillers, oil mills, starch factories, food processors), wholesalers, retailers and consumers (e.g. institutional, households). Stakeholders constitute the government agencies, research institutions, trade associations, and industry groups that hold interest on the value chain or any nodal actor; while support service providers include the financiers or credit providers, extension, crop insurance, logistics, warehousing.

Product Forms

TABLE 1. CHARACTERISTICS OF YELLOW AND WHITE CORN AND THEIR USES

Type of corn	Flint	Glutinous	Sweet
Yellow	milled (hammer type) for feeds; used in cereals, '*chippy*', brewery	not common	boiled at soft dough stage
White	milled into grits for food	Conduct IEC activities for the promotion of the commodity - Formulate policies on shellfish gathering	not common
Other colors	not common	not common	not common

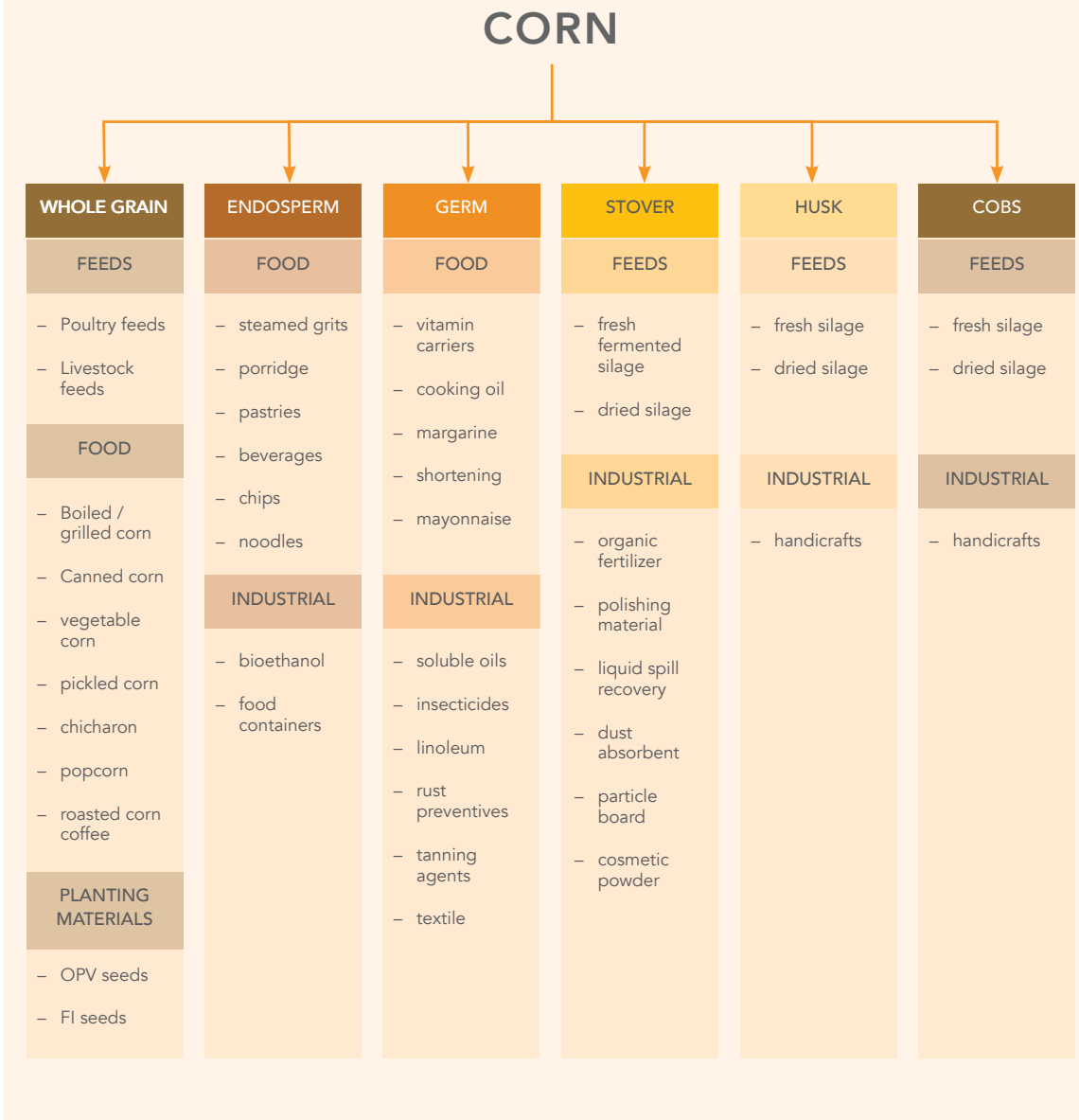
Source: Salazar et al., 2021

About seventy-four percent (74%) of yellow corn grains produced in the country are used for feeds. Corn husk and stover are also used as feed either as fresh or dried silage for livestock. Corn can be transformed into food products in small or village types to large

scale food manufacturing; and into industrial products like feeds, oil, and starch. In Table 1, Salazar et al., (2021) characterized corn across the nature of grain (hard, flint; sticky, glutinous; and sweet), and color (yellow, white, and other colors). As shown in Figure 3, the corn produced in the Philippines can be processed into four (4) uses – for feed, food, planting materials, and other industrial use.

FIGURE 3. UTILIZATION OF CORN IN FOOD, FEEDS, PLANTING MATERIALS AND OTHER INDUSTRIAL USES

CORN MAPPING



Corn kernels are eaten as whole grain, boiled or grilled on a cob; or into different food products processed to add value, improve shelf life and durability. Frozen corn mixed with vegetables (e.g. sliced carrots, peas), Ilocos' chichacorn, and corn coffee have become popular. The germ and endosperm parts of corn kernel are used to produce cooking oil, margarine, and syrup; from both yellow and white corn. The kernel is processed into flour and starch, which have numerous culinary applications. Native starch turns into alcoholic drinks or beverages, or as donner in ice cream; or modified to make plastics, adhesives, or medicinal purposes. The other colors (red, purple, brown, and combinations) are characterized with high nutritive value due to their high antioxidant content. These genetic materials, however, are not common and usually have low productivity. Corn husk, often considered as waste, is also used for handicrafts such as bags, artificial flowers, housewares and baskets.

Seed companies use corn grains for breeding, although seed companies still import corn seed from neighboring countries like Thailand. Particularly white corn farmers save seed from the current harvest for planting the next cropping season.

Profile of Corn Farmers

Age and Education

Corn farmers are on the average 49 years old; 38.4 percent, had elementary education. 37.3 percent and 15.6 percent reached high school and college education, respectively; 4.7 percent attended vocational school; 0.8 percent is post-graduate. The rest, 3 percent, did not attend school. The younger generation are moving out of the farm; getting more education or work in towns, cities or industry zones. Farming had not been a profitable enterprise particularly among small farmers; and currently an avocation for retirees.

Labor use

Planting and harvesting activities use labor intensively, both family and hired. Labor can be contracted in either planting or harvesting individually, or as group of farmers in some contract arrangement called the 'pakyaw' system where total labor is paid on a per

hectare rate basis during planting. Harvesters are paid either in cash at per-sack rate or in kind (i.e. share of the total harvested cobs). Informal work groups are common, and is a strategy to address labor constraints. About 64% males, and 36% females are involved in corn production.

Farm Size and Tenurial Status

Corn farming is dominated by small farmers where diseconomies abound: 82 percent have farms less than 1 ha (average of 0.54 ha); 16.1 percent have 1-3 ha (average of 1.95 ha) based on Farmers and Fisherfolk Registry System as shown in Table 2. 70 percent of farmers have one parcel of land with average 0.95 ha; 22 percent have two parcels with average of 1.62 ha; about 7 percent have 3-4 parcels with average total area of 3.3 ha; and 0.04 percent have about 10 parcels with a total area of about 38 ha (PSA, 2012). The 2020 registry shows further fragmentation of land that could partly reflect the system of division of land by inheritance. Overall, corn farm size in the country ranges from 0.8 to 4.3 ha with average of 1.14 ha; compared to 0.4 to 2.5 ha in Indonesia with average of 1.2 ha; and average of 7.3 ha in Thailand.

About 36 percent of corn farms in the country are fully owned; 25 percent tenanted; 16 percent, owner-like possession; 14 percent, rent-free; and 9 percent either leased/rented, amortized, held under Certificate of Land Transfer/Certificate of Land Ownership Award, stewardship, mortgaged and those under Voluntary Offer to Sell (YC Roadmap, 2015-2022).

TABLE 2. AVERAGE LANDHOLDING OF CORN FARMERS, 2021

FARMHOLDING	NO. OF FARMERS	PERCENT SHARE	AVERAGE FARMHOLDING (HA)	TOTAL AREA COVERED (HA)
1 ha and below	703,234	82.44	0.54	376,797.17
1.01 - 3 ha	137,198	16.08	1.95	267,530.07
above 3 ha	12,603	1.48	5.11	64,434.74
TOTAL	**853,035**	**100**	**0.83**	**708,761.98**

Source: Farmers and Fisherfolk Registry System

Irrigation

From Table 3 below, only 21 percent of farmers are growing corn in irrigated lands; 79 percent are farming in rainfed (60% upland; 19%, lowland) areas. This large dependence on natural rainfall makes farmers greatly vulnerable to fluctuations and extreme weather conditions; thus, corn productivity is less certain, and supply chains unstable.

TABLE 3. CORN FARMS AND NUMBER OF FARMERS BY IRRIGATION AND SIZE OF AREA

FARM TYPE	FARM SIZE (NO. OF FARMERS)			TOTAL
	1 HA AND BELOW	1.01 – 3 HAS	3.01 HAS ABOVE	
Irrigated	160,730	17,617	1,644	179,991
Rainfed Upland	402,374	99,252	9,166	510,792
Rainfed Lowland	140,128	20,329	1,793	162,230
TOTAL	**703,232**	**137,198**	**12,603**	**853,033**

Source: Farmers and Fisherfolk Registry System (FFRS), 2021

Cropping Pattern

81 percent of corn farmers practice two (2) croppings per year; about 13 percent, three (3) croppings; the rest with one (1) cropping. The rainfed lowlands have two cropping seasons, with corn grown either as the main crop; or post-rice during the dry season. In the upland sloping, rolling-to-hilly area, farmers often grow two crops, with some farmers planting a third crop of corn, legumes, vegetables, or combination. Corn is usually planted in the months of March (11%), April (18%), May (25%) and November (14%) depending on expected moisture in respective areas. Thus, harvesting has been reported to be in August (25%), March (18%), July (15%) and September (14%).

In Luzon, cropping starts with the first monsoon rains in the summer months in April to June; and the second crop in September-October, following the harvest of the first crop. Other farmers wait until November-December to plant the second crop. In some areas, corn is grown post-rice and planted in October-November when the monsoon rains

have subsided. In Visayas, the first corn crop is planted from April to July; the second cropping is from August-September until November-December. With good weather and rainfall, a third crop of vegetables or root crops may be grown from December to March, right before the onset of summer. In Mindanao, the first corn crop is planted in February-March and harvested in June-July. The second crop comes in July-August; harvested in November-December. In the upland slopes, rolling-to-hilly areas, farmers may plant a third crop of corn or legumes in November-December and harvest in February-April.

Social Factors

The big, industry-oriented farms in top productivity regions and provinces lead the modernization and better performance of the yellow corn sector. However, the opportunity for expansion can come from the small uneconomic farms that dominate the farming structure. With low education level, these farmers pose challenges to mechanization and technology adoption. Usually, they have short planning horizons and have less market perspective.

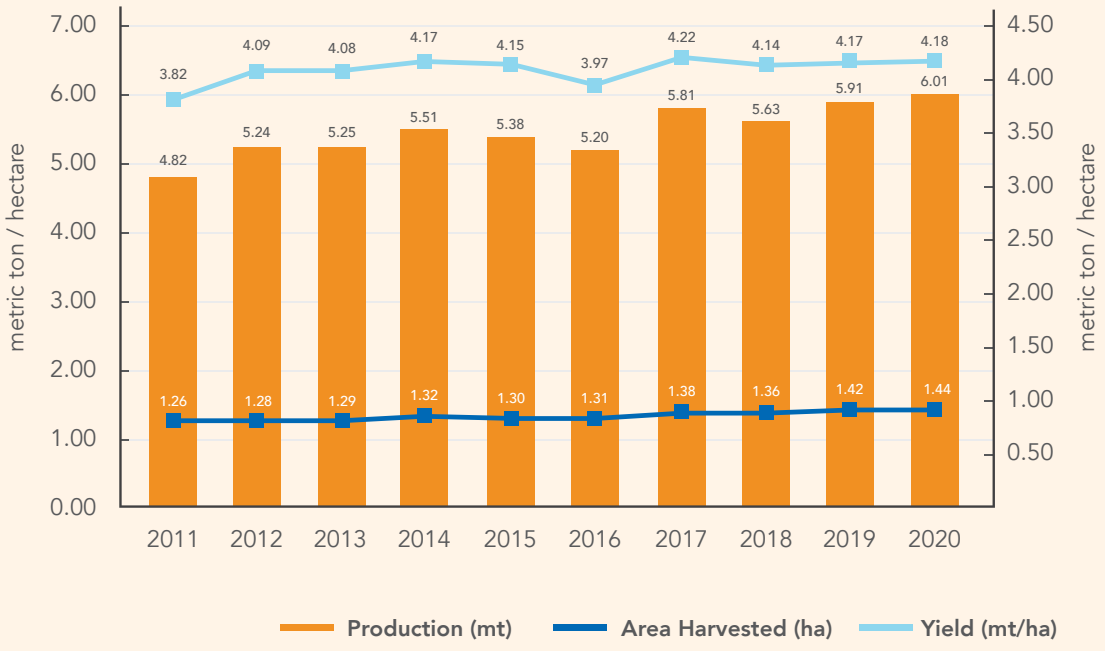
Local extension usually operates by organizing farmers for a variety of purposes. In the farmers' registry, 60 percent of corn farmers are not members of organizations. Historically, farmers' organizations are not strongly organized, and a huge room of improvement often has stumbling blocks in attitudes and values. Capability and skills building through groups is important in facilitating the learning and adoption of technologies; carefully designed to be creative and veer away from ineffective ways of the past.

Industry Performance and Outlook

Yellow Corn Production Performance

Yellow corn production in the country improved 25 percent from 4.8 million metric tons in 2011 to 6.0 million metric tons in 2020 (Figure 4); resulting from improved productivity or yield (i.e. from 3.8 tons/ha to 4.2 tons/ha, same period) through technological innovation (e.g. use of hybrid and GM seeds, good agricultural practice), and area growth (1.2 to 1.4 million ha) through increasing scale of operation. Before the turn of the century from 1987 to 2000, yellow corn production grew by an average of 4.7 percent (Table 4) mainly from the effects of hybridization in the 1980s that improved farm productivity by 4.8 percent.

FIGURE 4. YIELD, PRODUCTION AND AREA HARVESTED OF YELLOW CORN, 2011-2020



Source: PSA, 2021

The succeeding decade from 2000 to 2010 sustained production growth of 5.2 percent, which was evenly shared by expanding area and increased yield. In 2002, farmers started to adopt biotechnology corn seed that are resistant to corn borer, resulting in significant yield improvement. This partly led to shifts to yellow corn. In 2010 to 2020, production slowed down to 3.9 percent, with growth coming from yield (1.5 percent) and area expansion (2.2 percent). Yellow corn productivity growth flattened at 4.1 to 4.2 mt/ha starting 2013; with production growth mainly due to area increases. This opens opportunities to improve productivity by other means like optimization of available rainfall, efficient use of fertilizer, and farm mechanization, among others.

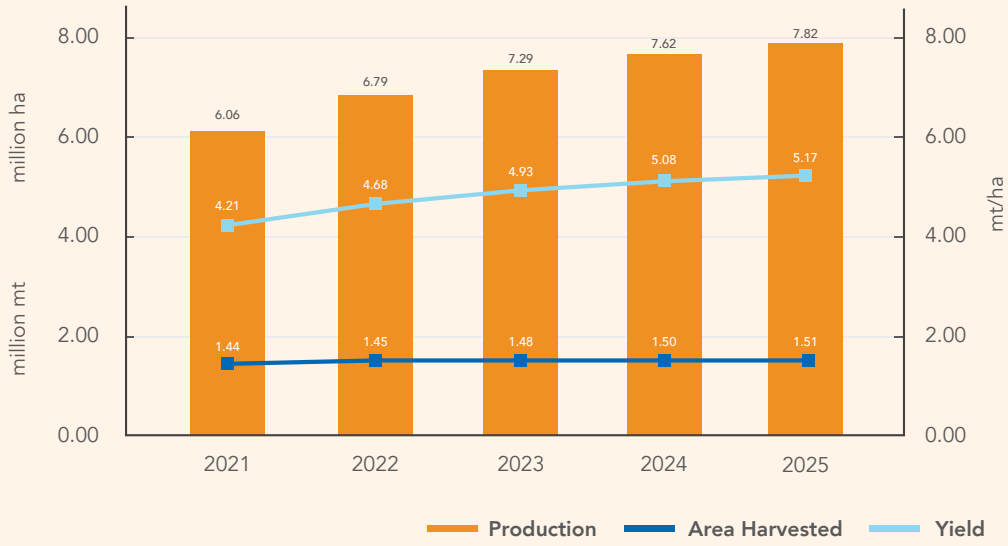
TABLE 4. AVERAGE GROWTH RATES OF PRODUCTION, AREA HARVESTED AND YIELD OF YELLOW CORN, 1987-2020

YEAR	PRODUCTION GROWTH (%)	AREA GROWTH (%)	YIELD GROWTH (%)
1987-2000	4.7	-0.1	4.8
2000-2010	5.2	2.5	2.7
2010-2020	3.7	2.2	1.5

Source: PSA, 2021

From historical trends and agronomic studies, yellow corn yields are projected to increase from 4.68 to 5.17 mt/ha; area increases yearly from 1.45 to 1.51 million hectares in 2022-2025; resulting in increased volume of production from 6.79 to 7.8 million metric tons in 2025 (Figure 5). These targets will be achieved through technological innovations in production and postharvest infrastructure, market efficiency interventions, information and R&D support systems, enabling policy environment, and improved governance network. Such increases are expected to improve sufficiency levels in feeds and other uses; and increased producer incomes.

FIGURE 5. PROJECTED YELLOW CORN YIELD, AREA AND PRODUCTION, 2021-2025



Intensification and extensification strategies to support the projections of increased productivity and production (Figure 5) include expansion of corn areas to provinces with available land such as Cagayan, Isabela, Mt. Province, Tarlac, Quezon, Rizal, Occidental Mindoro, Zamboanga Sibugay, Misamis Oriental, Saranggani and Agusan del Sur; and in areas where corn-coconut intercropping is feasible like Zamboanga del Sur, Agusan del Sur, Cebu, Negros Oriental, and Quezon. In provinces with lower yield than the national average such as North Cotabato, Sultan Kudarat, Negros Occidental, Albay, Lanao Del Sur, Quezon, Leyte and Samar, appropriate technologies such as irrigation facilities; seed, fertilizer and initial capital inputs shall be provided; and credit facilitated.

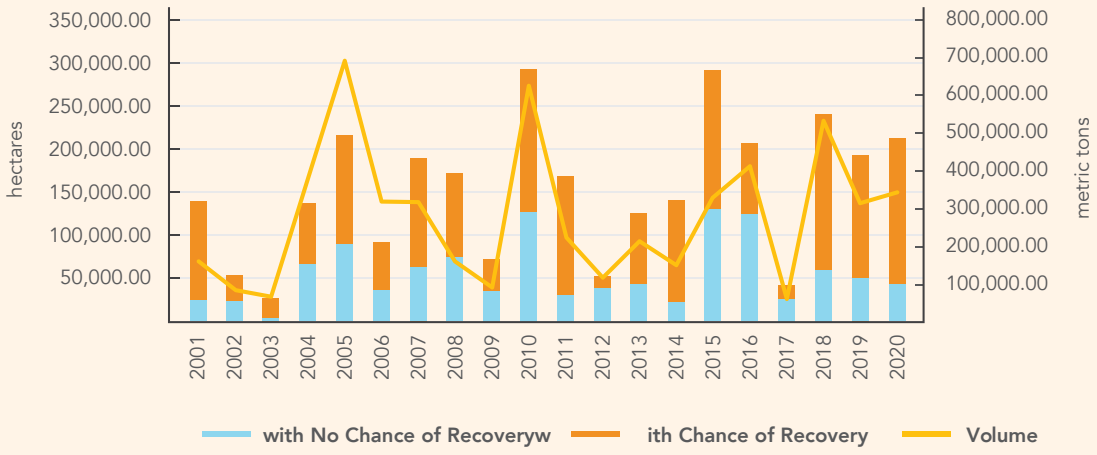
A big part of corn production increase was the commercialization and use of GM seeds in the country. Such that yellow corn production still figured increases despite the decrease in area harvested in some years. Salazar et al. reported shifts from white corn and other crops to yellow corn especially in leading yellow corn provinces driven by increasing demand in the livestock and poultry industry.

Production Challenges

Natural calamities. Figure 6 shows corn areas damaged by natural calamities. Major calamities like the El Nino, typhoon Labuyo and super-typhoon Yolanda affected more than 96 percent of the total area (122,350 ha) in 2013. In 2016, 69 percent of 210,041 ha affected by calamities were due to El Nino. Typhoon Nona (2015) affected 125,992 ha and typhoon Ompong (2018) affected 214,546 ha.

2010 experienced the highest area damaged at about 300,000 ha and the highest production loss in a decade; thus, the lowest area harvested and corn produced for the year. Almost 44 percent of the total area damaged by typhoons and flooding did not have a chance of recovery; and similarly, in 2015-2016.

FIGURE 6. TOTAL CORN AREA DAMAGED AND PRODUCTION LOSS TO NATURAL DISASTERS



Note:
With chance of recovery: Areas that are partially damaged and corn can still be harvested to be sold commercially.
With no chance of recovery: Areas that are totally damaged and no harvest of that period cannot be saved. Instances where some corn planted is still harvested for personal consumption is also considered no chance of recovery.

Weather pattern; impact on crop produce and grain quality. The two major cropping patterns earlier differentiated constitute the dry and wet seasons, which have distinct conditions, opportunities, and limitations. Some regions have distinct dry season (e.g. Regions, 1, 2, and 3) while others have bimodal rainfall pattern (mostly Visayas and

Mindanao). The peak corn harvests during the wet season months are huge challenges since corn has relatively higher pre-drying moisture content at 25-32 percent to be dried to 13 percent. The current small scale mechanical dryers still are not feasible; hence the huge dependence on solar drying, which is not reliable in quality, and high likelihood to postharvest losses. Storage facilities are also inadequate. The warehouses of big integrators and industry players usually cannot absorb the season's produce since the stocks of imported feed ingredients like feed wheat and yellow corn fill up the spaces. Imports are usually a hedge against the non-reliable quality of domestic corn supply during the wet season since final feeds quality cannot be compromised.

Dependence on and high costs of imported inputs. Major costs in yellow corn production are seeds and fertilizer, which have high import component. The yellow corn seed industry expanded significantly since the commercialization of genetically modified (GM) corn in 2003. Growing concerns are rising seed prices and the limited participation of new players in the seed market. The high cost of fertilizers further deters the use of fertilizers especially among resource-poor or capital-stricken farmers; limiting the maintenance or enhancement of soil health; thus, negatively impact corn yield.

Seeds can either be open-pollinated variety (OPV) or a hybrid; the latter has higher-yielding ability and uniformity; thus, higher price. Farmers always buy hybrid seeds; but the OPV harvest can again be used to plant the next crop. Almost all the yellow corn hybrids now sold are genetically engineered, costing about five times the cost of conventional hybrids. GM corn is grown in about 0.60 million hectares out of 1.3M hectares of yellow corn in 2017 (ISAAA, 2017). A STRIVE Foundation study (2012) found that use of GM had positive impacts: 19 percent yield increase, 10 percent cost reduction, and 8 percent increase in farm income.

Pest and diseases. The corn borer and corn downy mildew are traditionally the most devastating pest and disease, respectively, of corn. With the use of bt-corn hybrid varieties, the corn borer was contained. With the discovery and use of Ridomil, corn downy mildew was controlled. These pest problems, however, remain as threats to open pollinated varieties (OPV), and small corn farmers who do not treat the seeds before planting. Currently, the Fall Armyworm (FAW), corn leafhoppers (Stenocranus pacificus),

Fusarium ear rot and bacterial stalk rot are the pests of concern. FAW was first reported in Thailand and Myanmar in 2018, and has spread rapidly in almost all ASEAN Countries. FAW reached the Philippines in June 2019, initially recorded in Piat, Cagayan; and infested 66 towns and 17 cities within four months. As of November 2021, the infestation rate is 20.06 percent, with 96 percent of the total affected area treated. FAW is the main concern of corn farmers who use OPV and traditional varieties, in addition to the pests and diseases that infest corn at various growth stages, from pre-emergence to post harvest. Another great threat to yellow corn production is the dynamism of minor pests becoming major pests. There are reports in Bukidnon of the presence of white spot of corn (causal organism: Phaeosphaeria sp.) – a new fungal disease reported for the first time in the Philippines. Glyphosate resistant weeds is also alarming as this can hamper the reliability of current and future hybrid yellow corn varieties.

Mechanization. The country's mechanization level in agriculture is only at 1.23 hp/ha, one of lowest in the Asia; with the rice and corn sectors the highest level of farm power at 2.31 hp/ha, Table 5 (PHilMech, 2011); lagging behind Japan (18.87 hp/ha), South Korea (9.38 hp/ha), China (8.42 hp/ha) and Thailand (4.20 hp/ha).

UNESCAP-CSAM cited by Sikap/Stripe Foundation in 2013, reported that the Philippines has only a total of 9,306 four-wheel tractors and around 1 million of hand tractor; far from Thailand's 8.65 million tractors (Dares Kittoyopas, 2020).

TABLE 5. COMPARATIVE LEVEL OF MECHANIZATION, SELECTED COUNTRY, HORSEPOWER PER HECTARE

COUNTRY	LEVEL OF MECHANIZATION (YEAR)
Japan	18.87 (2011)
South Korea	9.38 (2011)
China	8.42 (2012)
India	2.22 (2011)
Thailand	4.20 (2011)
Vietnam	1.20 (2011)
Philippines	1.23 (2011) For all crops
	2.31 (2011) For rice and corn
Bangladesh	1.46 (2008)

Source: Source: PHilMech, 2011

The average power utilized from land preparation to shelling is 172.12 hp-hr/ha with land preparation (plowing, harrowing and furrowing), the most power-intensive at 66.8 percent (114.98 hp-hr/ha) (Table 6). Land preparation is considered fairly mechanized at 49 percent (Dela Cruz and Malanon, 2017). In rainfed lowlands where machines for land preparation could be used effectively as those in the provinces of Pangasinan, Isabela, Tarlac and Occidental Mindoro, mechanization level is high, greater than 75 percent. The relatively low degree of mechanization during land preparation is due to farm terrain: rugged uplands, rolling to hilly agro-ecologies make tractors difficult to operate; and the lack or absence of access roads (Gerpacio et al. 2004). With greater percentage of yellow corn areas especially among small farmers, characterized with hilly terrain, farm mechanization poses yet a big challenge.

TABLE 6. LEVEL OF FARM POWER UTILIZED, PRODUCTION OPERATION; CORN PRODUCTION AREAS, PHILIPPINES, 2012-2013

FARM ACTIVITIES	HP-HR PER HA
Land Preparation	114.98
Planting	7.34
Crop care and maintenance	4.88
Harvesting	9.77
Shelling	35.15
Total	**172.12 20.4%**

Source: Dela Cruz and Malanon, PHilMech (2017)

Key Production Areas

Yellow Corn Production, Area and Yield by Region

Cagayan Valley is the top yellow corn producer in 2020 with 1.84 million mt, followed by SOCCSKSARGEN at 901 thousand mt; and Northern Mindanao, 831 thousand mt. Cagayan Valley and SOCCSKSARGEN shared the largest area devoted to yellow corn with 29 and 19 percent of the total area, respectively. Central Luzon yields the highest with 6.66 mt/ha followed by Ilocos Region at 6.21 mt/ha and CARAGA, 4.85 mt/ha (Table 7). The three regions of Cagayan Valley, SOCCSKSARGEN, and Northern Mindanao share close to 60 percent of total yellow corn production (Figure 7).

TABLE 7. YELLOW CORN PRODUCTION, AREA AND YIELD, 2020

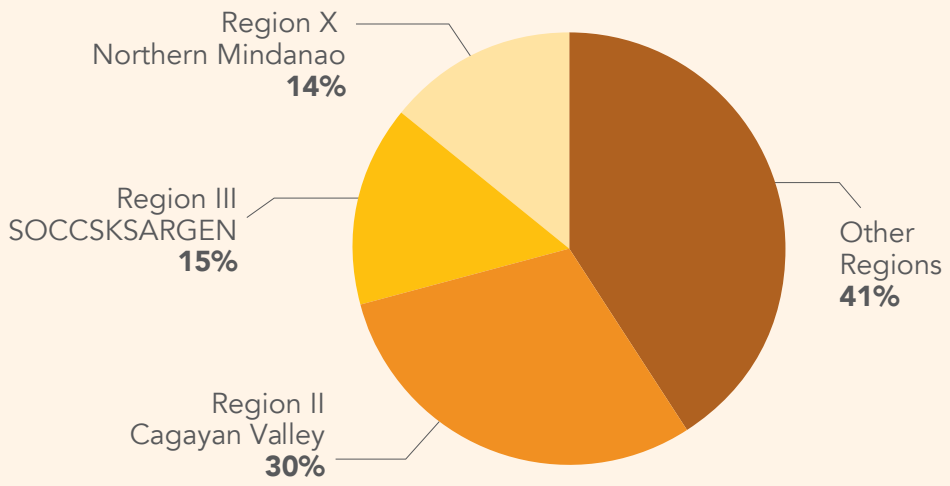
REGION	PRODUCTION (MT)	AREA (HA)	YIELD (MT/HA)
PHILIPPINES	6,011,046	1,438,508	4.18
CAR	226,523	56,850	3.98
ILOCOS REGION	516,795	83,180	6.21
CAGAYAN VALLEY	1,835,121	419,232	4.38
CENTRAL LUZON	234,760	35,227	6.66
CALABARZON	52,073	13,705	3.80
MIMAROPA	105,468	23,607	4.47
BICOL REGION	211,332	57,429	3.68
WESTERN VISAYAS	227,594	61,366	3.71
CENTRAL VISAYAS	2,715	850	3.19
EASTERN VISAYAS	6,741	3,889	1.73
ZAMBOANGA PENINSULA	23,339	8,167	2.86
NORTHERN MINDANAO	830,785	173,807	4.78

cont'd ▶

REGION	PRODUCTION (MT)	AREA (HA)	YIELD (MT/HA)
DAVAO REGION	66,062	23,102	2.86
SOCCSKSARGEN	901,128	279,707	3.22
CARAGA	93,645	19,316	4.85
BARMM	676,963	179,074	3.78

Source: PSA, 2021

FIGURE 7. PERCENTAGE SHARE OF TOP PRODUCING REGIONS, 2020



Source: PSA, 2021

Top Yellow Corn Producing Provinces, 2020

With the current national average of 4.18 mt/ha, Table 8 shows the top 10 provinces with greater than average yield; Tarlac as highest with an average yield of 6.99 mt/ha. The top-producing province is Isabela with 18.33 percent share of the total yellow corn production. The ten provinces comprise 611,931 ha of the total area planted, and contribute 49.22 percent to the total yellow corn production. Seventy percent of these provinces are in central to north Luzon; and it will be helpful to look at factors that give high yield: agro-ecological (topography, soil, moisture availability and photosynthetic period), crop management practices, and mechanization.

TABLE 8. TOP PRODUCING PROVINCES WITH YIELD ABOVE THE NATIONAL AVERAGE, 2020

RANK	REGION	PROVINCE	PRODUCTION (MT)	AREA (HA)	YIELD (MT/HA)
1	Isabela	1,102,050	18.33	244,123	4.51
2	Bukidnon	713,441	11.87	149,778	4.76
3	Pangasinan	337,251	5.61	54,090	6.23
4	Quirino	169,117	2.81	39,879	4.24
5	Camarines Sur	167,241	2.78	39,700	4.21
6	Tarlac	138,116	2.30	19,773	6.99
7	Ilocos Sur	94,676	1.58	15,408	6.14
8	Agusan del Sur	82,654	1.38	16,375	5.05
9	Occidental Mindoro	81,668	1.36	17,019	4.80
10	Nueva Vizcaya	72,300	1.20	15,786	4.58
TOTAL		**2,958,514**	**49.22**	**611,931**	

Source: PSA, 2021

Table 9 shows the top producing provinces with yield below the national average. Maguindanao has the highest production among these provinces contributing 9.01 percent to total yellow corn production. Cagayan follows with 8.18 percent share, but with relatively higher yield at 4.12 mt/ha compared to 3.89 mt/ha of the latter.

TABLE 9. TOP PRODUCING PROVINCES WITH YIELD BELOW NATIONAL AVERAGE, 2020

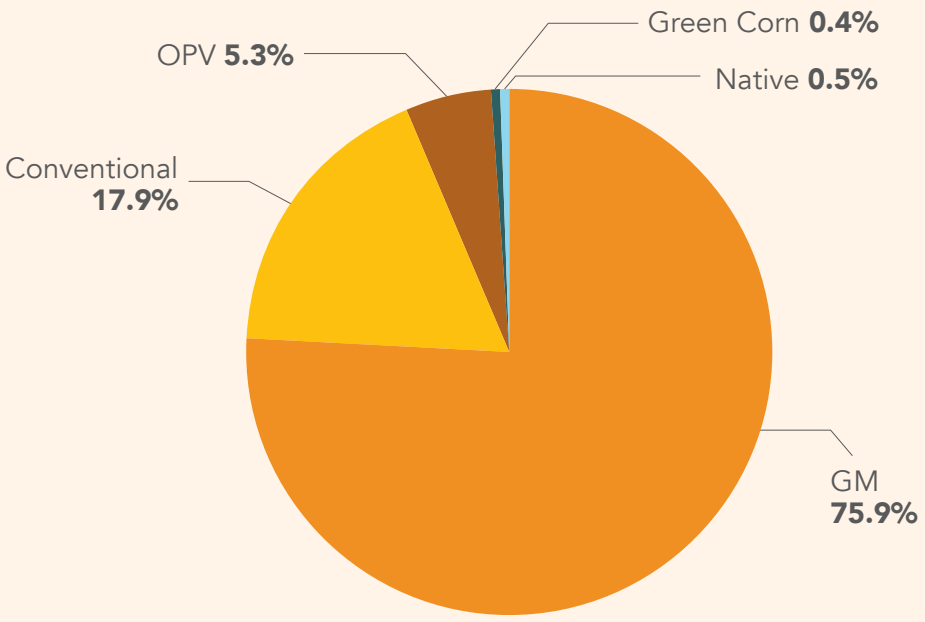
RANK	REGION	PROVINCE	PRODUCTION (MT)	AREA (HA)	YIELD (MT/HA)
1	Maguindanao	541,446	9.01	139,350	3.89
2	Cagayan	491,443	8.18	119,375	4.12
3	South Cotabato	362,557	6.03	105,776	3.43
4	North Cotabato	244,778	4.07	79,408	3.08
5	Sultan Kudarat	207,431	3.45	67,462	3.07
6	Lanao del Sur	135,518	2.25	39,724	3.41
7	Ifugao	109,783	1.83	28,462	3.86
8	Sarangani	86,362	1.44	27,071	3.19
9	Negros Occidental	81,576	1.36	28,310	2.88
10	Kalinga	51,916	0.86	12,929	4.02
	TOTAL	**2,312,809**	**38.48**	**647,857**	

Source: PSA, 2021

Six provinces in BARRM and SOCSARGEN are top producers with three in north Luzon and one in Western Visayas. They present opportunities for increased production by addressing challenges to below average yields.

Effective Area Utilization by Seed Variety

FIGURE 8. EFFECTIVE AREA UTILIZATION BY SEED VARIETY, 2020



Source: PSA, DA-RFOs Planting Report

Figure 8 shows that GM hybrid varieties are grown in almost 76 percent of corn area that leaves 24 percent of the total area highly vulnerable to FAW and other pests and diseases. This implies an opportunity of increased yield by 1 – 2.5 mt/ha in this 24 percent of the total corn area with the use of GM seeds. These areas should be considered in selecting key investment areas for the support services by both the government and private sector.

Production Outlook

The demand for yellow corn grains is expected to increase in the next 10 years from the increasing demand for animal feeds globally. The livestock industry in the Philippines, although struck by the African Swine Fever (ASF) in 2019, is also expecting a positive growth in demand in the same period. These should be met by increased local supply of yellow corn through strategies drawn in this roadmap. The projections done here are based on the past performance of yellow corn in three scenarios:

1. Business as usual: 2 percent production growth due to 2 percent area expansion, no yield improvement, which reflects the recent trend from 2013-2020,
2. Optimistic scenario: 4.8 percent production growth due to 4.8 yield growth, no area expansion, which reflects the situation from 1987-2000 during the time of corn hybridization, and
3. Highly optimistic scenario: 7.0 percent production growth equally shared by 3.5 percent growths in area and yield, which reflects the situation from 2000-2009 during the time of commercial biotechnology adoption.

Yellow corn production is expected to improve by 1.5 times from 6.01 million mt in 2020 to 8.93 million mt in 2040, assuming no interventions are pursued. Production can significantly improve 2.5 times by 2040 assuming an adoption of a new technology similar to the conditions experienced during the 1980s up to 1990s. A highly optimistic scenario of 3.8 times production growth can be achieved if the country will again experience the similar benefits brought by biotechnology adoption during the 2000s (Table 10).

TABLE 10. YELLOW CORN PROJECTIONS, 2020-2040

YEAR	BUSINESS AS USUAL			OPTIMISTIC			HIGHLY OPTIMISTIC		
	(million mt)	(million ha)	(mt/ha)	(million mt)	(million ha)	(mt/ha)	(million mt)	(million ha)	(mt/ha)
2020 Base	6.01	1.44	4.179	6.01	1.44	4.179	6.01	1.44	4.179
2025	6.64	1.59	4.179	7.60	1.44	5.283	8.43	1.71	4.963
2030	7.33	1.75	4.179	9.61	1.44	6.678	11.82	2.03	5.894
2035	8.09	1.94	4.179	12.14	1.44	8.442	16.58	2.41	7.001
2040	8.93	2.14	4.179	15.35	1.44	10.672	23.26	2.86	8.315

Source: PSA basic data, 2021

In 2020, the total supply of live cattle was estimated at 3.39 million heads, an increase of 0.03 percent compared to 2019, while the total supply of live carabao was estimated at 3.35 million heads (PSA, 2021). Although the beef and carabeef markets has seen slow growth worldwide, it is one of the major consumers of corn silage in the Philippines. In addition, the market for fresh liquid milk and other dairy products is expected to grow steadily in the coming years.

The dairy industry's goal over the next five years is to strengthen the foundation for a more productive, competitive and sustainable dairy sector, with silage playing a crucial role. Since the available feed resources are only sufficient to feed a few animals, the commercial cattle sector is heavily reliant on forage, such as corn for silage (Dairy Roadmap, 2021). Table 11 shows the corn silage projections for 2021-2040 with production in 2020 as base data. The decrease in yield in 2025 is brought about by the opening of new areas with yield less than the 2020 national average.

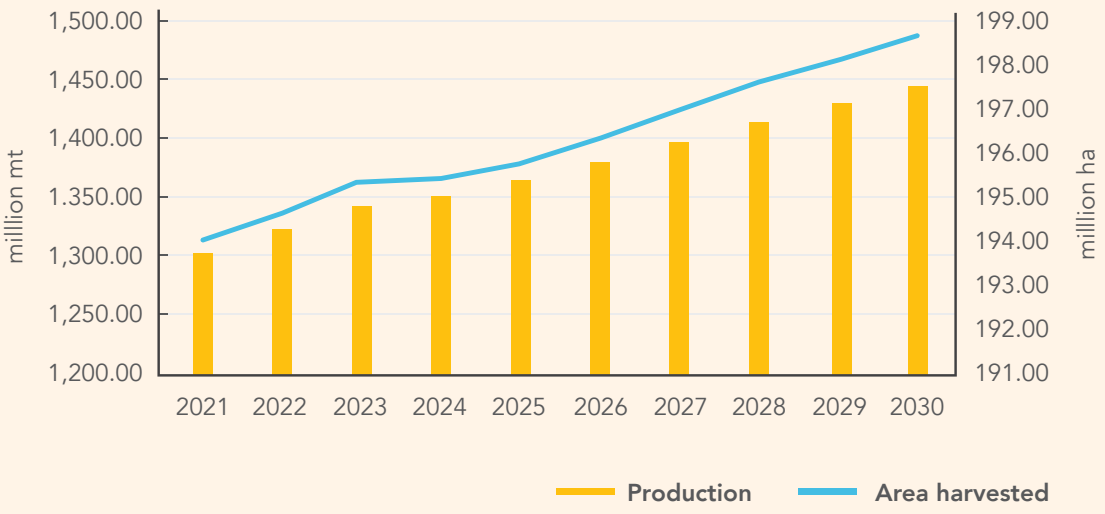
TABLE 11. CORN SILAGE PROJECTIONS, 2020-2040

YEAR	PRODUCTION (MT)	AREA HARVESTED (HA)	YIELD (MT/HA)	HIGHLY OPTIMISTIC		
				Production	Area Harvested	Yield
2020 Base	16,804	487	34.52	-	-	-
2025	35,319	1,263	27.97	110.18	159.32	-18.98
2030	38,557	1,308	29.47	9.17	3.61	5.37
2035	41,183	1,359	30.31	6.81	3.83	2.87
2040	43,737	1,411	31.00	6.20	3.84	2.28

Source: DA-RFOs, 2021

The area harvested for corn silage is expected to increase by 159.32 percent from 487 ha in 2020 to 1,263 ha by the end of 2025. This will significantly improve the production of corn silage from 16,804 mt in 2020 to 35,319 mt in 2025. Some of the regions with targeted area expansion are Ilocos Region, Cagayan Valley, CALABARZON, Bicol Region, Davao Region and SOCCSKSARGEN.

FIGURE 9. PROJECTED GLOBAL MAIZE PRODUCTION, 2020-2030



Source: OECD, 2021

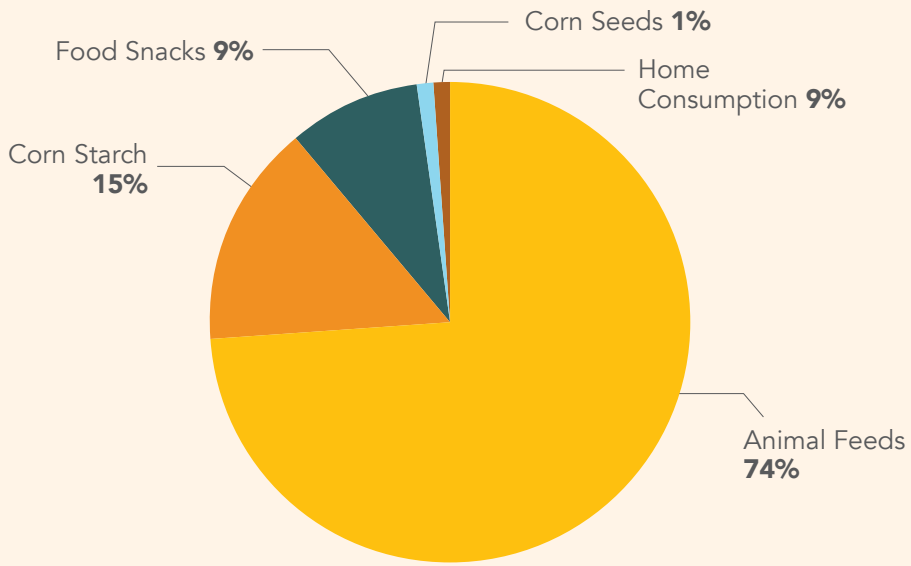
Figure 9 shows the global corn production is projected to increase steadily by 1.60 percent annually. Harvested area for corn is expected to have a slower growth due to the increasing soybean area and relatively higher wheat area. Production growth will be mostly driven by increase in yield especially in developed countries. In the Philippines, production is expected to increase between 2 to 7 percent annually from 2021 to 2029 based on past experience.

Consumption

Utilization of Local Yellow Corn

The utilization figures show the strong integration of yellow corn industry into the livestock and poultry industries. Seventy-four percent (74%) are used in animal feeds, which translates to more than 4.4 million mt out of 6.01 million mt produced in 2020 (PSA, 2021). The processing industry (e.g. corn starch, oil, syrup) uses about 12 percent of the total yellow corn production. About 1 percent of corn grains locally produced is used as seeds since most growers use the hybrids/GM seeds from suppliers. About 1 percent also goes to home consumption, and about 2 percent are processed into various snack food items (Figure 10).

FIGURE 10. UTILIZATION OF LOCAL YELLOW CORN PRODUCTION



Source: Del Rosario et al., 2015

Supply and Utilization Analysis

In 2020, 4.4 million mt (74%) of yellow corn grains produced were used in animal feeds; summing up to 5.1 million mt including the beginning stock from 2020 and the cassava dried chips used for feeds at 80 percent corn equivalent. This reflects a sufficiency level

of only 63 percent with the year's total requirement of 8.1 million mt. With the yellow corn imports, the sufficiency level reached 67 percent; and 100 percent with the feed wheat imports. Feed wheat is more cost competitive than the local yellow corn as feeds input. Increasing cost and price competitiveness of yellow corn through improving production efficiencies and addressing non-economic constraints should be one of the goals of the Philippine corn industry. Table 12 shows the supply and utilization analysis of yellow corn grains for feeds in 2020.

TABLE 12. SUPPLY AND UTILIZATION ANALYSIS OF YELLOW CORN GRAINS FOR FEEDS, 2021

PARTICULARS	TOTAL COST
ESTIMATED LOCAL SUPPLY	
Beginning stock of yellow corn for feeds	323,661.00
Yellow Corn for all uses	5,924,040.01
Yellow Corn for feeds (74%)	4,383,789.60
Cassava (Corn equivalent at 80%)	455,132.13
TOTAL LOCAL SUPPLY FOR FEEDS	**5,162,582.73**
ESTIMATED IMPORT ARRIVAL FOR FEEDS	5,400.00
Yellow Corn	307,768.07
Feed Wheat	2,665,774.54
TOTAL IMPORTATION	**2,973,542.61**
TOTAL REQUIREMENT[1]	**8,136,125.35**
Sufficiency level2	
Local YC only	54%
Local YC with beginning stock (YCB)	58%
YCB + Cassava (C) at corn equivalent	63%
YCB + C + YC Imports	67%
YCB + C + YC & FW Imports	100%

[1]Total requirement is estimated as the sum of total local supply and total YC and FW importation
[2]Self-Sufficiency Ratio = (production/total requirement) x100
Source of basic data: PSA

However, due to the occurrence of drought, typhoons, pests and diseases, and other natural calamities that have severely impacted the 3rd quarter YC production, the local yellow corn produced in 2021 is lower than the 2020 production of the same period. The YC production for the 4th quarter is estimated to decrease further by at least 10,000 mt due to the damage incurred by Typhoon Odette.

Trade

The insufficiency of local corn supply to meet the demand of the feeds industry brought in imports of yellow corn and feed substitutes as feed wheat to meet needs of an increasing livestock sector. In the mid-1990s, Philippines binds itself to international trade agreements where under the GATT-WTO, the country provides a minimum access quota or volume (MAV) for imported corn. This allows the private sector importation of corn and corn substitutes in mixed feeds, i.e. feed wheat, sorghum, and barley.

The global market exposes the domestic corn sector to competition that tests the productive efficiency of local corn. This implies that the industry must economically survive in trade with declining tariff protection—producing adequate quality corn at prices that ensure farmer profitability as well as the competitiveness of the domestic livestock and poultry sectors. Through 2015, corn imports have five percent (5%) duty in ASEAN Free Trade Area (AFTA) while Most Favored Nation (MFN) tariff rates are 35 percent and 50 percent for in-quota and out-quota, respectively (Tariff Commission, 2020). There are reported manipulations of importing feed substitutes from high tariff country source through the low tariff ASEAN member country port (Salazar et al. 2021).

Globally, corn and protein meal will remain the most important commodities used as feed, accounting for over 60% of total feed used by 2030. Feed demand for corn and protein meal is projected to grow at 1.4% p.a. and 1.2% p.a., respectively, over the next decade. About 1.7 billion tons of cereals, protein meals and processing by products were used as animal feed in 2018-2020; and projected to increase by 14 percent in ten years to reach 2 billion tons. The liberalization of the grain market since 2016 in China led to a drop in feed grain prices, which favors the use of corn (relative to protein meal) in the feed mix (OECD, 2021).

On a positive note, funds from tariff proceeds relative to minimum access volume quota become a large part of the ACEF (Agricultural Competitive Enhancement Fund) managed by the Department of Agriculture. This fund will need to be rationalized so that it can be accessed for agricultural development purposes by rural enterprise groups (farmers-fisherfolks, peoples' organizations), private businesses, local government units (LGUs),

and research, development and extension (RDE) institutions; and in particular, the corn industry target groups and enterprises.

Economic Significance

The corn sector contributes significantly to agriculture and the economy as a whole where about 850,000 farmers depend on it for livelihood. The corn industry employs thousands in food manufacturing (i.e. starch, oil, micro-small scale enterprises) and ancillary industries (i.e. trading/marketing logistics, primary processing); indirectly, in the corn-livestock/poultry feeds sector. Moreover, 84 percent of yellow corn production is input to the feeds industry. In 2020, corn contributed 5.8 percent or a total of Php102.5 billion to total Gross Value Added (GVA) of agriculture (Table 13).

TABLE 13. ECONOMIC VALUE OF CORN AND OTHER AGRICULTURAL COMMODITIES, 2019-2020

INDUSTRY	2019		2020		% CHANGE
	GVA (Million PhP)	% SHARE	GVA (Million PhP)	% SHARE	
Total in Agriculture, Forestry and Fishing	1,783,855	100	1,780,544	100	-0.19
Palay	357,982	20.07	369,205	20.74	3.14
Corn	100,085	5.61	102,515	5.76	2.43
Coconut	84,403	4.73	82,000	4.61	-2.85
Sugarcane	25,484	1.43	30,910	1.74	21.29
Cassava	20,216	1.13	20,020	1.12	-0.97
Other Crops	312,618	17.52	310,047	17.41	-0.82
Livestock	232,534	13.02	216,495	12.16	-6.90
Poultry and egg production	179,875	10.08	175,507	9.86	-2.43
Fishery	226,140	12.68	223,203	12.54	-1.30
Forestry and logging	3,028	0.17	2,897	0.16	-4.33
Support activities	170,583	9.56	179,123	10.06	5.01

Note: Prices are based on constant 2018 prices.
Source: PSA, 2021

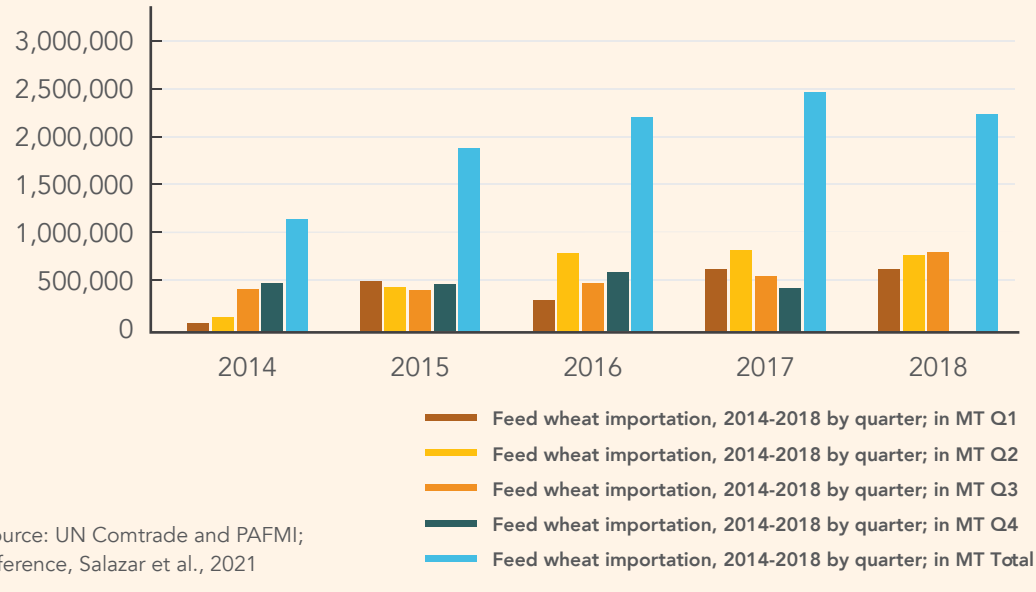
Importation and Demand

Corn is imported mainly from the US, Argentina, and some member countries of the Association of South-East Asian Nations (ASEAN). Domestic yellow corn production, already affected by adverse weather events, especially during the wet season, is further challenged by such competition.

Most of the country's feed wheat imports recently came from Australia. Total imports of feed wheat in 2018 until the third quarter was around 2.2 million metric tons (UN Comtrade). Quarterly data show that importation can be substantial at any quarter, or any month of the year irrespective of the time of corn harvest (Figure 11). With the significant import volume any month, the price of the local harvest would inevitably be affected, especially during the wet season, which is the primary domestic production season, and mechanical dryers are not enough.

Industry sources confirm a degree of substitution between feed wheat and corn with some cut-off price as a deciding factor. But there is a limit to replacement because of nutrient considerations in the feed mixes. There is a standard formula programmed for this substitution mixing. Nutritionists still prefer yellow corn as economically feasible.

FIGURE 11. FEED WHEAT IMPORTS, 2014-2018 BY QUARTER (IN MT)

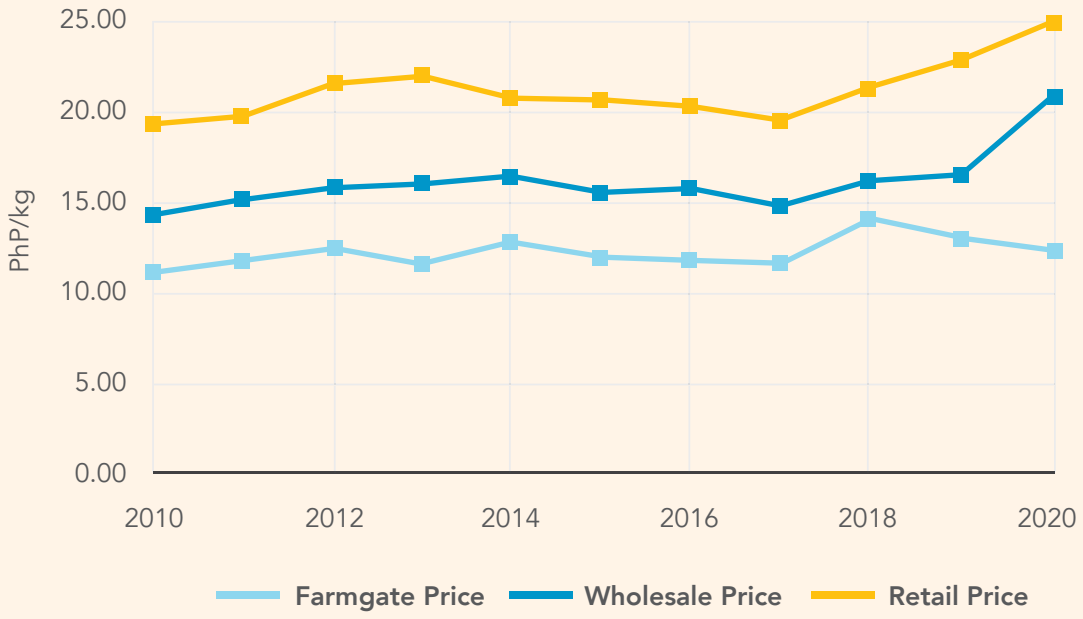


Source: UN Comtrade and PAFMI; reference, Salazar et al., 2021

Prices: Domestic and Substitutes

From 2010 to 2018, the farmgate, wholesale and retail prices of yellow corn have exhibited fluctuations although it continued to increase as shown in Figure 12. In 2018 through 2020, the same can be said true for the wholesale and retail price of yellow corn. However, the farmgate price decreased from PhP 14.01/kg in 2018 to PhP 13.07/kg in 2019 and further decreased to PhP 12.36/kg in 2020. The gap between farmgate and wholesale/retail prices are due to the add-on costs from logistics, services and regulatory fees paid for by the industry sector.

FIGURE 12. YELLOW CORN PRICES, 2010-2020



Source: PSA, 2021

A recent Philippine study that observed price trends of traded (1) local corn, (2) corn import, and (3) feed wheat import, with and without tariff shows that the prices of these three inputs generally exhibited an upward trend from 1990 to 2004. But from 2005-2018 (i.e. GATT-WTO and AFTA commitments), the competitive edge of local corn against imported substitutes in terms of price, without tariff, started to decline. The border prices of imported corn and feed wheat decreased while that of domestic corn did not. In terms

of price alone, feed wheat would be the foundation of the local feed milling industry, and local yellow corn would be added to compensate for the low quality of feed wheat (Salazar et al. 2021). This implies that the price movement of feed wheat and the added ingredient to be at par with yellow corn be carefully monitored; and cautious with tariff policy and trading manipulation. Importantly, improving corn production efficiency and yield directed to be price competitive with wheat; and the assurance of adequate supply with postharvest facilities and storage infrastructure.

OECD (2021) noted that prices of agricultural commodities exhibited a downward trend since the 1960s resulting from productivity improvements in agriculture due to technologies that lowered the incremental production costs (e.g. Green Revolution, GM seeds, precision agriculture, mechanization). Deviations from the general trend like the price increase during the oil crisis in the early 1970s, or other price peaks during 2007-2014, were temporary and did not alter the long-term declining trend. This implies that the local corn production, which is sensitive to import prices, should perform efficiently according to science-based solutions, with adequate support services under a rationalized governance of the corn industry.

ANALYSIS OF THE CORN INDUSTRY

Value Chain Analysis

The value chain of corn in the Philippines has five distinct segments that include input provision, production, marketing, processing, and consumption (Figure 13). Each segment comprises all the processes and stakeholders involved in the value-creating activities in the production-distribution process.

The long-established trading-consolidation and processing/manufacturing segments of the multi-product corn industry have made the yellow corn industry consist of long value chains in both food and feeds. This means the chain spans several regions across segments to user-processors, and final consumer. Moreover, the diverse production structure across diverse agro-ecologies where small resource-poor farmers dominate have complicated the relationships and dynamics in the corn value chain.

Input Provision

The value chain starts with the provision of input supply such as seeds, fertilizers and agro-chemicals, farm machineries and equipment, and capital. Setting the minimum value YELLOW CORN INDUSTRY ROADMAP 2021-2040 35

added to the yellow corn produced, this input segment consists of seed producers/ suppliers, local suppliers and importers of agro-chemicals, farm machineries, tools and equipment, and capital sources. Access to, quality, and timely provision of inputs makes a significant difference in productivity. With lack of capital one of major problems in corn production, the Department of Agriculture has been providing assistance through its regional field offices in terms of provision of seeds, fertilizers, farm machineries and equipment, irrigation services, and capability building through trainings and seminars.

Production

The second segment of the value chain is production, which includes all farm activities from land preparation to post-harvest. Specifically, it includes clearing, land preparation, planting, fertilizer and pesticide application, weeding, pest/disease management, and harvesting. Some post-harvest activities like hauling, shelling, and drying are done immediately. Farmers sell to traders (i.e. private business, cooperatives) the dried corn grains as final products, which then are marketed to food processors and feed millers. Farmer cooperatives also consolidate corn-on-cobs, and marketed to seed companies.

Corn farmers with less than three (3) hectares of land dominate the production segment. These lands are, in many cases, located in less favored environments of rugged uplands or slopes, less in fertility, and usually difficult to access. The latter makes mechanization not feasible. Addressing the constraints of small-scale farmers are critically important so their being part in the value chain can provide them access to larger markets, and have greater stability, income security, increased productivity and better contribute to revenue growth. Larger markets, however, prefer to deal with those farmer-suppliers who are more skilled in business, efficient, and compliant to quality standards. Such condition brought about the move of the Department of Agriculture towards clustering in order to capture economies of scale. This needs to be detailed in terms of institutional mechanism and logistics to be operational.

Postharvest

This segment of the chain may be loosely defined. Most corn farmers rely on solar drying since the small scale mechanical dryers are not economically feasible with relatively high cost of drying per kilogram; thus, non-reliability of quality produce, and high losses. The dried grains are then sold to traders with storage facilities. Many farmers also sell cobs at non-attractive price. Storage and warehousing facilities are not adequate even at the trader or consolidator levels. A few milling-drying systems run by cooperatives or private business are still not at par technically with the more advanced Asian neighbors.

Due to the overall lack of storage capacity, when import deliveries (e.g. corn, feed wheat, etc.) coincide with the local harvest, local corn prices go down even if international

market prices for yellow corn may be high. Lack of dryers especially during the wet season harvest further depresses the situation, which dampens the interest and capacity of farmers to plant the next season. The feed millers then buy high during reduced local supply, but not quite so cause of importation. Thus, despite the yellow corn productivity already comparable to neighboring Asian countries, the yellow corn industry remains in a precarious situation. Corn yield in the Philippines, Thailand and Vietnam are in the range of 4.2 to 4.6 metric tons per hectare.

Postharvest machinery and facilities remain a persistent formidable challenge to the yellow corn industry, and needs to be addressed seriously in this roadmap.

Marketing

The marketing segment links the producers across the relevant chain segments to final users or consumers. Private traders, farmer cooperatives and associations are in this segment, and usually have arrangements with seed companies, processors and feed millers. Activities include the point of sale from production to consolidation and distribution of corn grains, corn-on-cobs, and other agreed upon final product to processors. Traders and consolidators, generally, offer storage for small-scale farmers due to the latter's lack of storage facilities. Hence, producers commonly market their produce to traders immediately after harvest or drying.

Distributors are responsible for linking processors and feed millers to end-consumers. They include the seed distributor, feed distributor, wholesaler, retailer, and wholesaler-retailer, which market final products like feeds, corn starch, and corn oil. They usually provide logistics and storage services from the point of sale from processors to retail stores.

Processing

The processing segment of the value chain is where corn is transformed into various product forms like animal feeds, starch, oil, snack food, grits and other final products including the utilization of wastes and residuals.

The marketed corn grains are distributed to various type of processors such as corn millers, snack food processors, starch millers, commercial farms, integrators and feed millers. Some corn millers process the grains into snack food and grits; the bran are then processed into animal feeds. Starch mills produce starch then sold to processors of starch-based food, and to starch wholesalers, then retailers. Some feed and starch mills are big integrators, which manufacture both primary (i.e. starch, feeds) and secondary or final products (e.g. snack foods). The corn germ, part of the corn kernel, is also separated by starch processors and is processed again into corn oil. Another product by the starch processors is the corn gluten/meal, which is processed by feed millers as ingredient in animal feed. Commercial farms and feed millers also process corn grains directly into animal feed products. Corn-on-cobs produced are processed by seed producing companies into seeds.

Intermediate and final products are subsequently handed over to the distributors or accredited marketing channels of the processors to be distributed to end-users or consumers.

Consumption

The value chain begins and ends with the market. From the numerous product forms, the corn industry market is substantially diverse, which consist of a number of intermediate users till the final household and individual consumers. These markets define opportunities but definitely are not devoid of challenges. They create the different environments that enable businesses to thrive, and within which the value chain actors and stakeholders interact. Figure 8 presents the use-market structure of yellow corn.

Currently, the corn industry caters to the domestic markets across all regions where Filipinos are heavy consumers of livestock products in fresh and processed forms. Filipino cuisine, both local and foreign-oriented, uses a lot of oil; and starch-based snack foods are heavily stacked in mall decks, grocery-specialty and sari-sari stores. Rural enterprise initiatives especially among women continue to create corn residual-based handicrafts (e.g. flowers, decorative items) and improved or novel corn-based delicacies for niche markets.

Market opportunities for other corn products and derivatives do exist. Many are yet to be explored by the local corn industry. But huge challenges remain in the supply (i.e. input provision, production) side, and supply-market chains (e.g. linkages, facilities, logistics) of the equation.

Support Service Providers

For the different segments of the value chains to be improved or developed collaborative partnerships and support service providers are key. Support services can be provided by government, the private sector, and industry partner-stakeholders. The services provided take many forms including research and development (e.g. science-based solutions, technologies), extension services (e.g. learning platforms, skills and capability building, technology dissemination), input provision (e.g. seeds, fertilizers, machineries/equipment, seed capital), and institutional support (i.e. networking for operational support and monitoring, sustainability partnerships).

Government agencies tasked to provide support to the yellow corn value chain include the Department of Agriculture through the Regional Field Offices (RFOs) and relevant affiliate agencies, Bureau of Agriculture Research (BAR), state colleges and universities (SCUs), Agricultural Training Institute, Bureau of Plant Industry and Philippine Corn Board, among others. Industry associations including PhilMaize, the Philippine Association of Feed Mills, Inc. (PAFMI), Philippine Society of Animal Nutritionists (PHILSAN), and United Broiler Raisers Association (UBRA), among others usually advocate policies beneficial to the corn and related industries.

Accessing the different support services are usually challenging to small farmers and operators who have the least power and resources in the value chain. This is where the value chain approach becomes most meaningful as the process highlights and promotes the critical importance of establishing and nurturing collaborative partnerships among actors, stakeholders and support providers in order to deal with the internal strengths and weaknesses, and address challenges and opportunities in the external environment that should eventually benefit all chain actors.

Enabling Environment

The enabling environment refers to the set of relevant policies that permit the efficient movement of products and provision of services from the farm to market. These policies are summarized in Table 14.

TABLE 14. RELEVANT POLICIES AFFECTING THE YELLOW CORN VALUE CHAIN

Chain Segment	Policy	Description
Seeds	RA 7308 (Seed Industry Development Act of 1992	– Regulation of new crop varieties through the National Seed industry Council
	RA 9168 (Philippine Plant Variety Protection Act (PPVPA of 2002) DA Administrative Order 8 of 2002	– Provides the legal basis of a sui generis system of intellectual property rights and provides "plant breeder's rights".
Fertilizer and Farm Chemicals	FPA Fertilizer Regulatory Policies and Implementing Guidelines	– Provides guidance on fertilizer and pesticide registration, licensing, accreditation, and regulatory requirements
	Tariff on imported fertilizer	– Most Favored Nation (MFN) rate of 1-3 percent – Zero for ATIGA in ASEAN plus Australia, China, Japan, Korea, and New Zealand
Credit	RA 10000 (Agri-Agra Law)	– Requirement for commercial banks to set aside at least 25 percent of loan portfolio for agriculture and fisheries
Mechanization	R.A. 106011 (Agriculture and Fisheries Mechanization Law)	– Aggressive implementation of farm mechanization: R&D, fabrication, dissemination, regulation, and monitoring of appropriate machinery/equipment for production and postharvest operations.
Trade	For yellow corn, Import quota or minimum access volume (MAV) For feed wheat	– Minimum Access Volume (MAV) of 217,000 mt per year – MFN rate of 50 percent out-quota and 35 percent (in quota)
Feed milling	A 1556 (Livestock and Poultry Feeds Act of 1956), now the Animal Feeds Act of 2016	– Regulation and control of the manufacture, importation, exportation, labeling, advertising, distribution and sale of animal feeds for use of livestock and poultry animals

Source: Salazar, et al., 2021; Tariff Commission, 2021

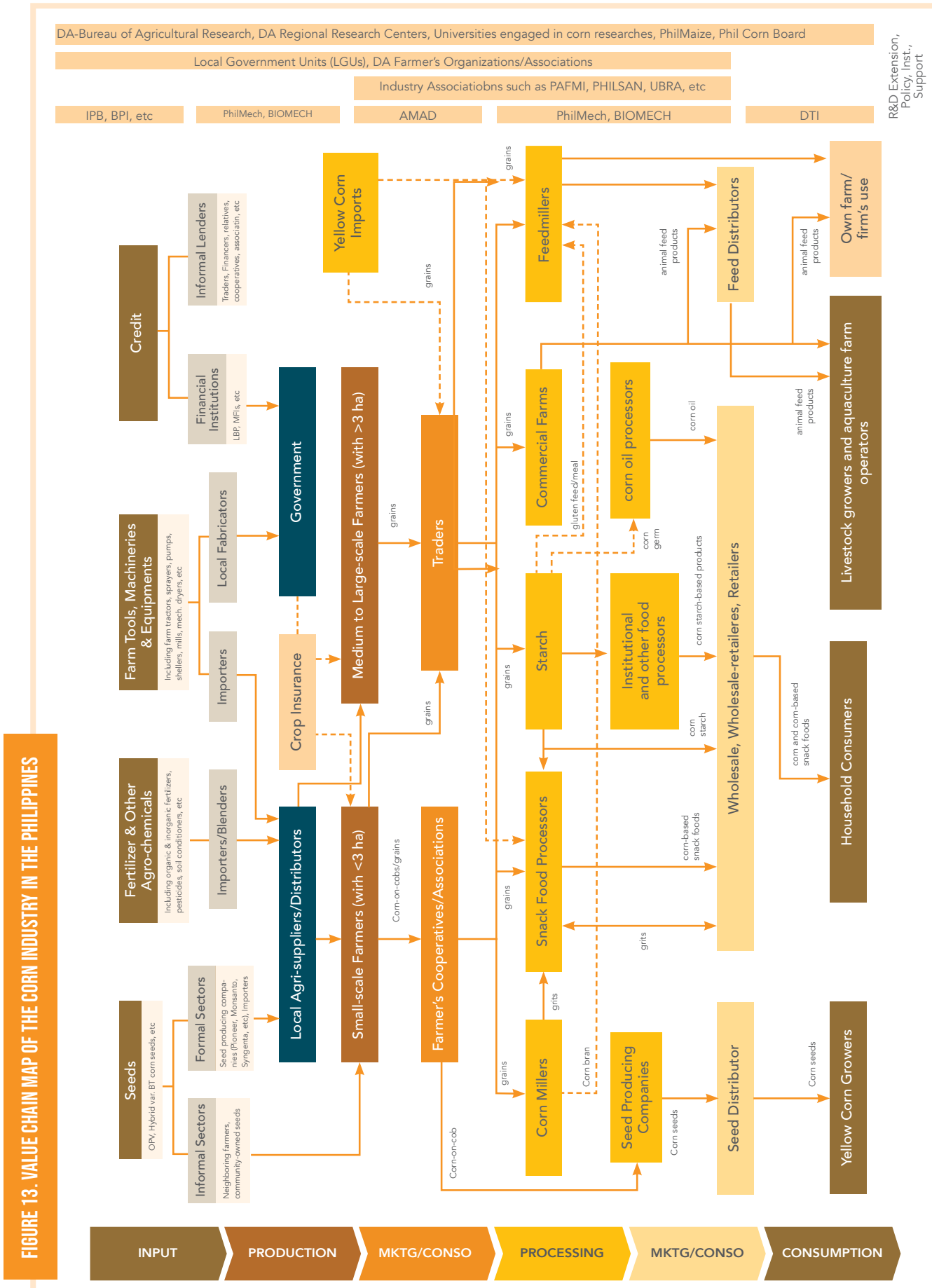


FIGURE 13. VALUE CHAIN MAP OF THE CORN INDUSTRY IN THE PHILIPPINES

Source: Del Rosario, et. al., 2015

Supply Chain Analysis

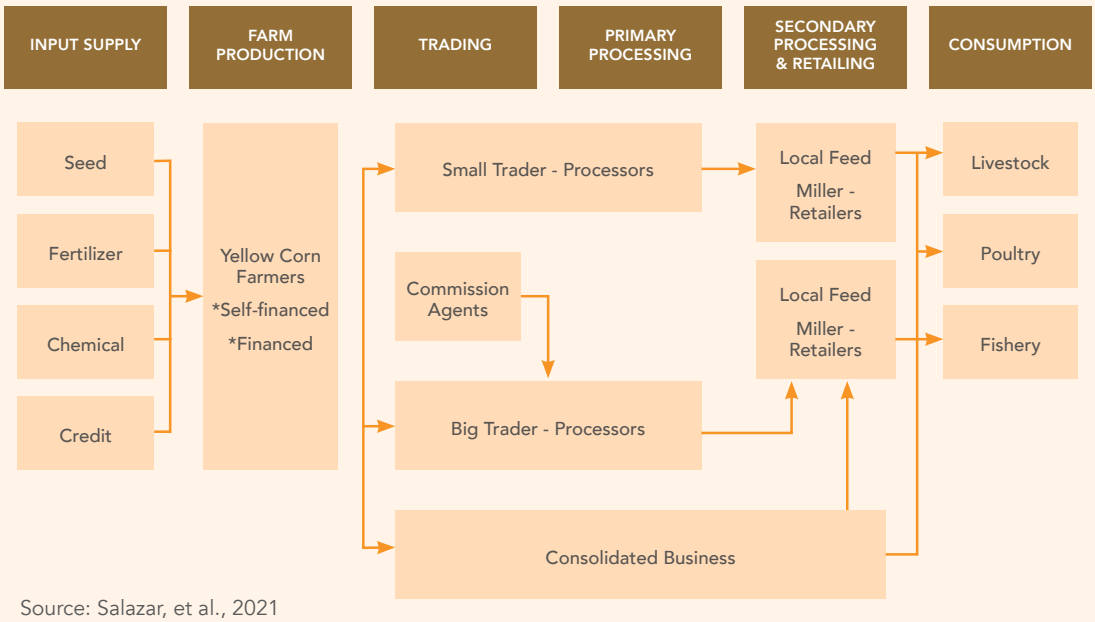
From the more detailed value chain of yellow corn (Figure 14), specific supply chains in selected major producing provinces, such as Isabela (Cagayan Valley) and Bukidnon (Northern Mindanao), can be highlighted as gleaned from the study of Salazar, et al., (2021). This section highlights the cases.

A supply chain focuses on the flow of material inputs and products, processing into other products, and the provision of services by chain participants. A supply chain is similar to the value chain in terms of mapping the flows of inputs and products; but without the discussion of support service providers and enabling environment.

Supply Chain in Isabela

Seeds, fertilizers, and farm chemicals are the main raw materials needed to produce yellow corn GM seeds are sourced from three major players including Syngenta (bought by China Chem), Pioneer (now Corteva) and Monsanto (now Bayer) (Figure 14).

FIGURE 14. YELLOW CORN SUPPLY CHAIN IN ISABELA



Source: Salazar, et al., 2021

Yellow corn farmers in Isabela are either self-financed, or financed by money lenders (i.e. from trader-financiers). The latter is some form of embedded service as farmers sell their produce to their financiers.

Farmers sell their produce to trader-processors (i.e. small or big), or to a big consolidator. A small trader-processor handles a maximum operation of 6 metric tons per day direct from farmers; while commission agents assemble or collect produce from far-flung locations to a common location for the big trader-processor. The big trader-processor then transports the produce to a warehouse for storage and drying. The dried grains are then delivered to the feed millers in Northern or Central Luzon; shipping about 28 trucks with a load of 35 metric tons per truck.

Mindanao Grains is a big consolidator of yellow corn in Isabela province that can absorb 60 trucks per day; with 30 to 45 mt capacity per truck. Corn grains are classified either for feed or food processing. For feed milling, corn is delivered to the sister company, Foremost Milling Corporation. Markets are various feed users, which include the livestock, poultry, and fisheries industries. For food processing, they produce this into a rice-shaped corn called Rico.

In the feed supply chain, the breakdown of consumer's peso shows the share of each chain participant in coming up with a finished product (Table 15) from feeds with retail market price at Php 22 per kilogram. For every peso of the final price of feeds, the contributions are: 33 percent from the farmer, 3 percent from the trader-processor, and 63 percent from the feed miller-retailer. This large contribution by the feed miller-retailer mainly comes from significant investments in fixed capital and relatively bigger profit margin.

TABLE 15. BREAKDOWN OF THE CONSUMER'S PESO FROM YELLOW CORN GRAIN TO FEED, ISABELA

Chain Player	Buying Price (Php/kg Feed Basisb)	Selling Price (Php/kg Feed Basis[b])	Marketing Margin[a] (Php/kg Feed Basis[b])	Breakdown of Consumer's Peso
Farmer	0.00	7.30	7.30	0.33
Trader - Processor[c]	7.30	8.05	0.75	0.03
Feed miller - Retailer[d]	8.05	22.00	13.95	0.63

[a] Selling Price - Buying Price [b] All prices for farmer, trader and cooperative-processor were divided by two. This is to account for the conversion ratio of 500 grams yellow corn content per one kg of feed
[c] Processing in terms of drying [d] Retail price of feed is based on the average price of various feeds given to hogs
Source: Salazar, et al., 2021

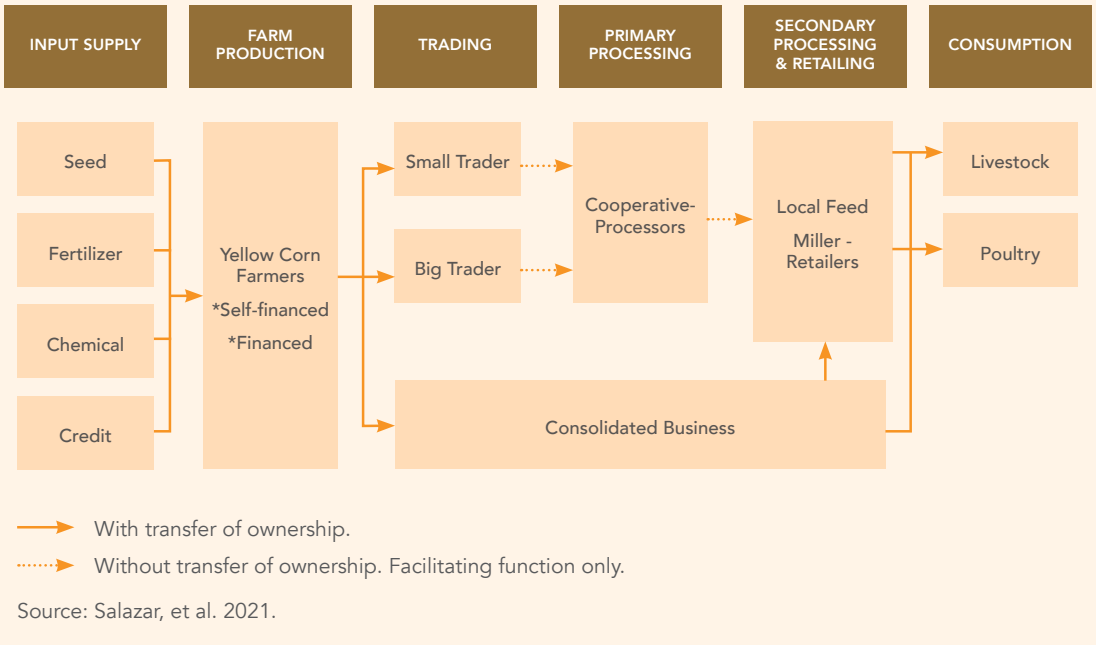
Supply Chain in Bukidnon

Input supplies and sources of financing are similarly structured in Bukidnon as in Isabela. A unique business alternative for corn farmers in Bukidnon is the renting of their land to multinational companies producing pineapple. The usual arrangement is to rent the land at Php18,000 to 25,000 per year; contracted for 10 to 25 years lease. This significantly affected the area allocated for corn production in Bukidnon (Figure 15).

Farmers sell the yellow corn to small or big traders, which are classified by scale of procurement and disposal. A small trader can buy 200 metric tons per week, which are later sold to local miller-retailers. The decision on where to sell corn grains depends on the buying price of feed millers and processing time of payment.

Cooperative-processors serve as intermediary between grain traders and feed millers, which provide postharvest processing services (i.e., storage and drying) to traders and farmers. The end users of feeds in Bukidnon are the livestock and poultry establishments.

FIGURE 15. YELLOW CORN SUPPLY CHAIN IN BUKIDNON



Source: Salazar, et al. 2021.

The breakdown of consumer's peso in Bukidnon has similarity to that of Isabela where the feed miller-retailer and farmer contribute more than the grain traders and the cooperative-processor (Table 16).

TABLE 16. BREAKDOWN OF THE CONSUMER'S PESO FROM YELLOW CORN GRAIN TO FEED, BUKIDNON

Chain Player	Buying Price (Php/kg Feed Basisb)	Selling Price (Php/kg Feed Basis[b])	Marketing Margin[a] (Php/kg Feed Basis[b])	Breakdown of Consumer's Peso
Farmer	0.00	6.00	6.00	0.25
Trader	6.00	6.25	0.25	0.01
Cooperative - Processor[c]	6.25	6.35	0.10	0.004
Feed miller - Retailer[d]	6.35	24.00	17.65	0.74

[a] Selling Price - Buying Price
[b] All prices for farmer, trader and cooperative-processor were divided by two. This is to account for the conversion ratio of 500 grams yellow corn content per one kg of feed
[c] Processing in terms of drying
[d] Retail price of feed is based on the average price of various feeds given

Source: Salazar, et al., 2021

SWOT Analysis of The Value Chain and Industry

A summary assessment and understanding of the corn industry can be gleaned from an analysis of its strengths, weaknesses, opportunities and threats across the value chain. Figure 26 presents this summary both of the chain segments, and overall view. The simplified SWOT is basically based on the situation and performance of the different sub-sectors detailed in this roadmap.

Inputs

The high dependence on imported inputs such as GM seeds and fertilizers bring about volatility and rising costs. GM seeds gained popularity since local hybrids and open-pollinated varieties are more vulnerable to pest and diseases. About 75 percent of yellow corn area in 2020 were planted with GM hybrid varieties, and expected to expand partly to the DA's initiative to promote GM through its seed and fertilizer subsidy program.

The high cost of inputs dilemma becomes more serious due to the lack of capital and access to credit especially among small growers. Most smallholder producers have no link nor access to formal financing through microfinance and other financial institutions either from lack of knowledge or means, or wary of bureaucratic procedures. Assistance from relatives, if any, is the common help. Previous fund assistance programs have not helped much due to inadequacies in support assistance. What could work out is a carefully designed (i.e. simple procedure, realistic tranche releases, workable repayment scheme) and supervised fund assistance that goes with crop insurance and continuing technical assistance; the latter to improve the feasibility of profitable farming.

The initiative of the public and private sectors to produce modern and cost-competitive technologies and machineries through continuous research is one of the core strengths of this segment (e.g. PhilMech, private machine/equipment fabricators). Locally manufactured farm machinery such as tractors, are currently thought to be of inferior quality when compared to imported machineries. The latter are relatively costly and spare parts are sourced from the outside as well; and after-sales service may not be easy.

Investment to support the sourcing of seeds, fertilizer and machinery at reasonable cost should be rationalized and given high priority. The Department, through its regional and local partners, should intensify the establishment of learning sites and techno-demo farms to practically immerse farmers with appropriate technologies in inputs application and management.

Production

Low yield is still a challenge especially to a greater percentage of small farmers due to poor quality seed (especially with local hybrids/OPV), poor soil, lack of inputs from lack of capital, low mechanization, pest and disease, poor crop management; in addition to losses from extreme weather disturbances. The latter occurred frequently in recent decade from the impact of climate change. Production losses from natural disasters cost the industry at least 45 thousand MT a year. Inefficient production results from constraints that led to relatively low yield; thus, high cost per kilogram.

Emerging pests and diseases are important threats to corn production including those induced by extreme climate disturbances. In 2018, FAW, that was first reported in Thailand and Myanmar, has spread rapidly in almost all ASEAN Countries. FAW reached the Philippines in June 2019 and was initially recorded in Piat, Cagayan. Within four months, it had infested 66 towns and 17 cities. As of March 2021, the infestation rate is 20.06 percent, with 92 percent of the total affected area treated. FAW has been the main concern of corn farmers especially those who use OPV and traditional varieties. There are also pest and diseases that infest corn at various growth stages, from pre-emergence to post harvest.

Yield-inducing production can be intensified by the increase in cropping intensity and improved practices by the adoption of multi-cropping, adoption of quality seeds/new varieties and by investments in land use improvements (e.g. irrigation system). Expansion of area can be done in regions with untapped large scale farm potentials like the SOCCSKSARGEN, and BARRM that are expected to be profitable with due investments in cultivation.

Postharvest

Majority of farmers still have high post-harvest losses due to lack of suitable drying and storage facilities; relying mainly on solar drying, which is not reliable especially during wet season when harvests tend to peak. Locally fabricated small scale mechanical dryers have not been feasible due to relatively high drying cost, which made solar drying the most feasible yet unreliable solution to small producers; thus, unstable quality of dried grains, and high wastage or losses.

Large scale warehouse facilities are needed to store dried grains during the peak harvests. Such investment needs supply chain functioning at economies of scale: from a clustered and coordinated producer farms to large scale drying-milling system with matched warehousing that stores large stocks. Seriously addressing persistent postharvest inefficiencies could be the major step for the corn industry to be competitive and sustainable. A business model worth public-private partnership should be in order.

Processing

The demand for the industrial processing users has been unmet for years. Yellow corn is processed largely into feeds (84%), commercial snack food (12%), and micro-scale popular native delicacies (2%), and growing. The failures in postharvest infrastructure brought corn sufficiency level only about 60 percent; thus, the sector is dependent on imports.

With the feeds sector the biggest user, the increasing availability of corn substitute as energy source for feeds like feed wheat and imported corn, to bridge the shortfalls, are posing a threat to the corn industry. It may be said that wheat has become a major feed ingredient in feeds because of its cost competitiveness and reliability of supply.

Marketing

The marketing of yellow corn has been with traders linked to accredited assemblers at the local level, and with few big buyers at national level; the latter's central warehouses and plants located in strategic locations in Luzon and Mindanao. However, the capacity of warehouses of the big integrators usually are not adequate to store the imported feed

ingredients and the peak harvests produce during the wet season. Imports during the peak supply are relied on to hedge for the poor quality of the local dried grains; and corn supplies can be irregular due to natural calamities.

Innovative measures to the persistent inefficiencies in the production-postharvest-marketing chain are needed. A totally different business model that corrects diseconomies in the current farm-market should be in order. Cluster and consolidation designed supply chain linked to economically feasible postharvest systems (i.e. drying-milling-storage).

Consumption

According to PAFMI, only about 70 percent of locally produced yellow corn is of good quality for animal feed. Projected increasing demand in the feeds and food sectors need increased yellow corn production. Interventions come from area expansion and intensification through increased yield and cropping intensity; and interventions in postharvest and quality of corn.

Costs and Returns Analysis

The national average cost and return of yellow corn in the Philippines in 2019 is shown in Table 17. Production inputs share the highest cost comprising more than 45 percent or PhP 25,848.72 per ha.

Inputs and labor share the highest costs at 45.3 and 38.9 percent, respectively; postharvest share 15.8 percent. Inorganic fertilizer comprises 18 percent of total material cost while seeds comprise 17 percent. Labor costs in land preparation and harvesting comprise 7.4 and 6.9 percent of the labor cost, respectively. With postharvest, shelling has the highest cost at 7.1 percent. The total cost of production (including postharvest) per ha per cropping is PhP 57,017.19, on average. Considering the yield of 5,466.69 kg per ha, the cost of producing 1 kilo of yellow corn is PhP 10.43. In 2019, farmers have a net income of PhP 18,889.14 per hectare in a cropping season on the average; with a return above cost of 33.1 percent.

TABLE 17. COST AND RETURNS ANALYSIS OF YELLOW CORN PER HECTARE PER CROPPING, 2019

COST ELEMENT	QTY	UNIT	TOTAL COST	% SHARE OF COST
INPUTS			**25,848.72**	**45.33**
Seeds	2.00	bags	9,890.82	17.35
Fertilizer:				
Organic	5.09	bags	2,072.95	3.64
Inorganic	8.69	bags	10,448.24	18.32
Herbicide	1.43	liter	1,161.06	2.04
Insecticide	1.16	liter	805.83	1.41
Fuel and Oil	21.65	liter	990.56	1.74
Others			479.25	0.84
LABOR			**22,170.66**	**38.88**
Land Preparation	1.00	ha	4,226.94	7.41
Planting	5.50	MD	2,916.76	5.12
(machine rental/fuel and oil)			333.33	0.58
Fertilizer Application	4.74	MD	1,507.29	2.64
Herbicide Application	3.50	MD	1,104.18	1.94
Pesticide Application	3.50	MD	938.81	1.65
Off-barring	3.16	MD	1,095.48	1.92
Hilling-up	3.16	MD	1,239.64	2.17
Weeding	2.33	MD	717.22	1.26
Irrigation	1.46	MD	482.14	0.85
Harvesting	11.78	MD	3,952.18	6.93
(machine rental/fuel and oil)			3,000.00	5.26
Others (food for laborers)			656.7	1.15
POSTHARVEST			**8,997.82**	**15.78**
Hauling	6.04	MD	1,728.24	3.03
Drying	8.24	MD	2,150.18	3.77
Shelling	170.3	bags	4,038.62	7.08
Others (sacks, twine)	93.41	pcs	1,080.76	1.90
TOTAL COST			**57,017.19**	
Average Yield Dry (kg/ha)			5,466.69	
Farmgate Price Dry (PhP/kg)			13.89	
Cost per Kilogram			10.43	
Gross Income			**75,906.33**	
Net Income			**18,889.14**	
Return above Cost (RAC) (%)			**33.13**	

Source: DA-RFOs

Benchmarking Analysis

Local Benchmarking

Qualitative Parameters

Farming practices are important as these affect productivity and quality of produce. Land preparation is the critical first step. Farms yield better where mechanization is used; weeding well done and fertilization adequate. To a significant degree the use of GM seeds increases plant performance due to superior genetic material and the prevention of pest/diseases.

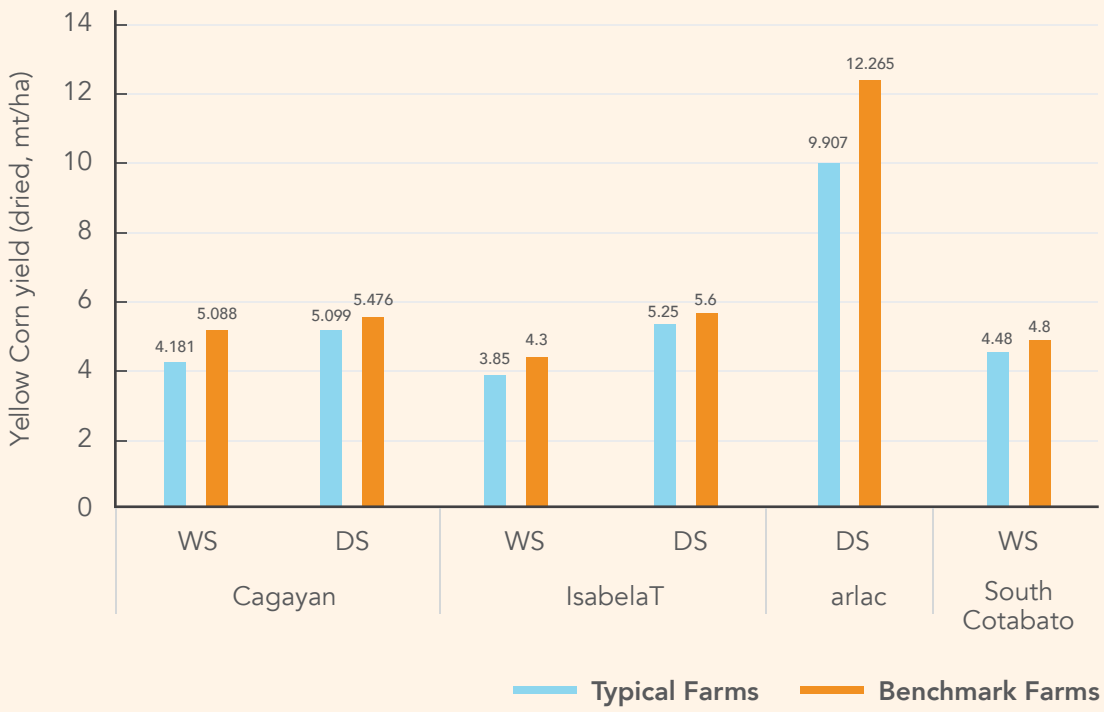
TABLE 18. FARM PRACTICES OF CORN FARMERS

Chain Segment	Policy	Description
LAND PREPARATION	– Plow the area one month before planting. – Harrow the soil to break big clods and to control re-emerging weeds two weeks before planting. – Plow the soil again one week before planting.	– Plow the area one month before planting. – Harrow the soil to break big clods and to control re- emerging weeds two weeks before planting. – Plow the soil again one week before planting.
PLANTING MATERIAL	– GM (stack) varieties	– Ordinary hybrid seeds
PLANTING METHOD	– 1 seed per hill – 20 cm between hills and 75 cm between rows	– Requirement for commercial banks to set aside at least 25 percent of loan portfolio for agriculture and fisheries

Quantitative Parameters

Productivity Comparison. Benchmarking the average or typical farms from the best operations or benchmark farms for yellow corn shows opportunities of improving farm productivity through (1) adoption of GM seeds by farmers in transition from planting conventional hybrid seeds to GM hybrid seeds; (2) improved land preparation; (3) improved crop management (soil enhancement); (4) improved postharvest machinery and facilities. The highest increase in productivity can be achieved in Tarlac with a 24 percent yield increase during the dry season. In major corn growing areas in Northern Luzon including Cagayan and Isabela, farm yields can improve in the range of 12 to 22 percent during the wet season and 6 to 7 percent during the dry season (Figure 16).

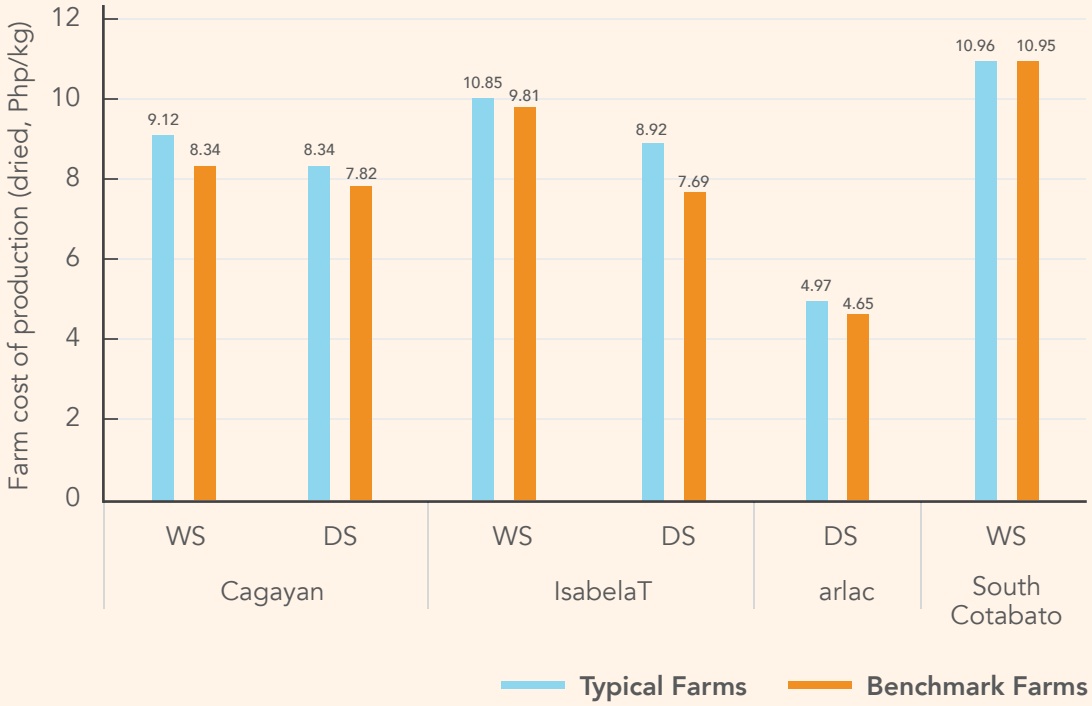
FIGURE 16. YELLOW CORN YIELD COMPARISON BETWEEN TYPICAL AND BENCHMARK FARMS, 2020



Note: typical farms use conventional hybrid seeds while benchmark farms us GM hybrid seeds
Note: Please see appendix tables for details of the cost and return estimation
Source: DA-RFOs

Cost Comparison. The comparison of cost revealed that benchmark farms are more cost efficient than typical farms across season and corn producing provinces; a cost advantage of more than 6 percent in Luzon provinces except during the wet season in Isabela. The cost advantage in South Cotabato was only 0.1 percent (Figure 17). This means that given the same amount of resources, some farms can save on cost by producing more or have chosen the right combination of farm inputs.

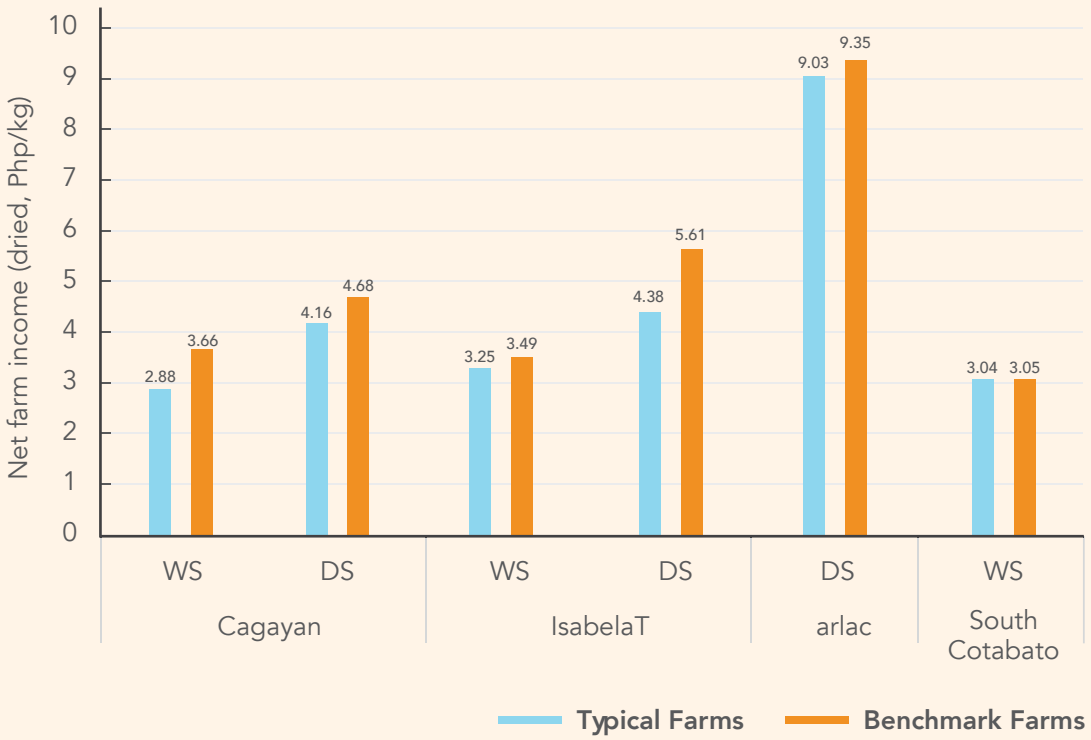
FIGURE 17. FARM LEVEL COST COMPARISON BETWEEN TYPICAL AND BENCHMARK FARMS, 2020



Note: typical farms use conventional hybrid seeds while benchmark farms us GM hybrid seeds
Note: Please see appendix tables for details of the cost and return estimation
Source: DA-RFOs

Income Comparison. Profitability motivates farmers to continue or expand their operation. Benchmark farms are profitable relative to comparable operations of typical farms; expressed as income advantages of benchmark farms in Cagayan (12 to 27 percent), Isabela (7 to 28 percent), Tarlac (4 percent), and South Cotabato (marginal 0.3 percent) over typical farms (Figure 18).

FIGURE 18. NET FARM INCOME COMPARISON BETWEEN TYPICAL AND BENCHMARK FARMS, 2020

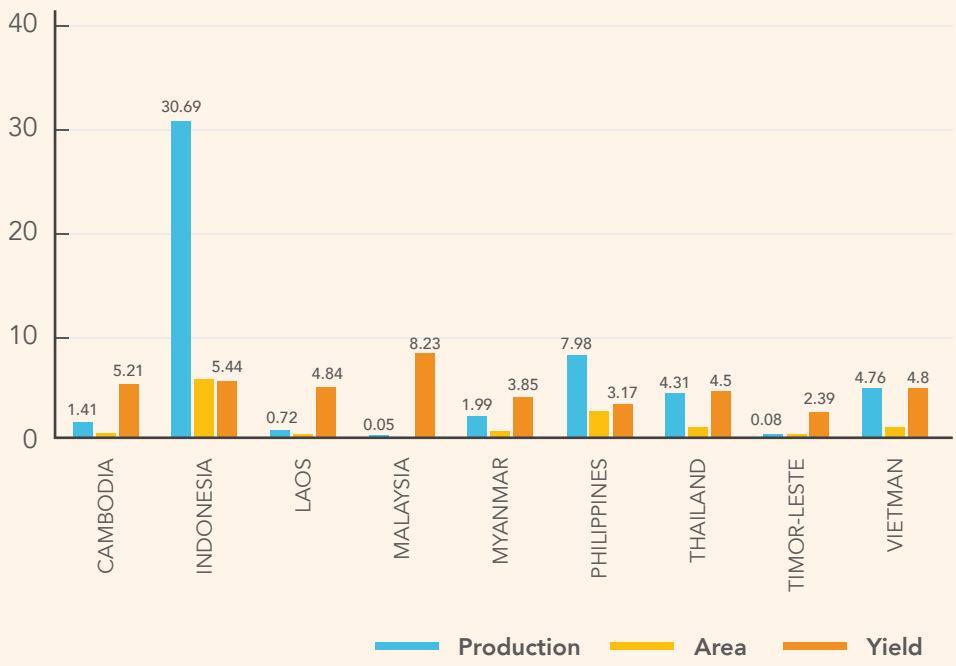


Note: typical farms use conventional hybrid seeds while benchmark farms us GM hybrid seeds
Note: Please see appendix tables for details of the cost and return estimation

International Benchmarking

Benchmarking the country's corn industry with its ASEAN counterparts like Indonesia and Vietnam, tells how the industry fares in terms of performance. Indonesia is the largest corn producer in the Southeast Asia with production volume of 30.7 million MT in 2019 and contributes 2.7 percent share to the total global corn production. Figure 19 shows the Philippines ranks second with 8.0 million mt followed by Vietnam at 4.8 million mt. However, in terms of average yield, Malaysia ranks first with an average yield of 8.23 t/ha, followed by Indonesia with 5.44 t/ha in 2019; then Vietnam, 5th place with 4.8 t/ha; Philippines, 8th place with average yield of 3.17 t/ha out of 9 Southeast Asian countries.

FIGURE 19. CORN PRODUCTION, AREA AND YIELD OF SOUTH EAST ASIAN COUNTRIES, 2019



Source: FAOSTAT, 2021

Production. The production performance of Philippines, Indonesia and Vietnam is shown in Table 19. Despite the obvious decline in 2010, the corn production in the Philippines steadily increased from 7.03 million mt in 2009 to 7.98 million mt in 2019; growing annually at an average rate of 1.45 percent. Vietnam grew at an average rate of 3.25 percent for the period of 2009 to 2015 that steadily increased production from 4.37 million mt to 5.29 million mt. However, corn production declined to 5.24 million mt in 2016 and further declined to 4.76 million mt in 2019. Philippines and Vietnam are the second and third largest corn producers in the ASEAN but combined, produced only 42 percent of Indonesia's total corn production in 2019; the latter reached a total of 30.69 million mt corn produced in 2019; an average growth rate of 6.04 percent.

TABLE 19. PRODUCTION, AREA HARVESTED, AND YIELD OF PHILIPPINES (PHL), INDONESIA (IDN) AND VIETNAM (VNM), 2009-2019

YEAR	PROTECTION (million mt)			AREA HARVESTED (ha)			YIELD (mt/ha)		
	PHL	IDN	VNM	PHL	IDN	VNM	PHL	IDN	VNM
2009	7.03	17.63	4.37	2.68	4.16	1.09	2.62	4.24	4.01
2010	6.38	18.33	4.61	2.50	4.13	1.13	2.55	4.44	4.09
2011	6.97	17.64	4.84	2.54	3.86	1.12	2.74	4.57	4.31
2012	7.41	19.39	4.97	2.59	3.96	1.16	2.86	4.90	4.30
2013	7.38	18.51	5.19	2.56	3.82	1.17	2.88	4.84	4.44
2014	7.77	19.01	5.20	2.61	3.84	1.18	2.98	4.95	4.41
2015	7.52	19.61	5.29	2.56	3.79	1.16	2.93	5.18	4.54
2016	7.22	23.58	5.24	2.48	4.44	1.15	2.91	5.31	4.55
2017	7.91	28.92	5.11	2.55	5.53	1.10	3.10	5.23	4.65
2018	7.77	30.25	4.87	2.51	5.68	1.03	3.09	5.33	4.72
2019	7.98	30.69	4.76	2.52	5.64	0.99	3.17	5.44	4.80

Source: FAOSTAT, 2021

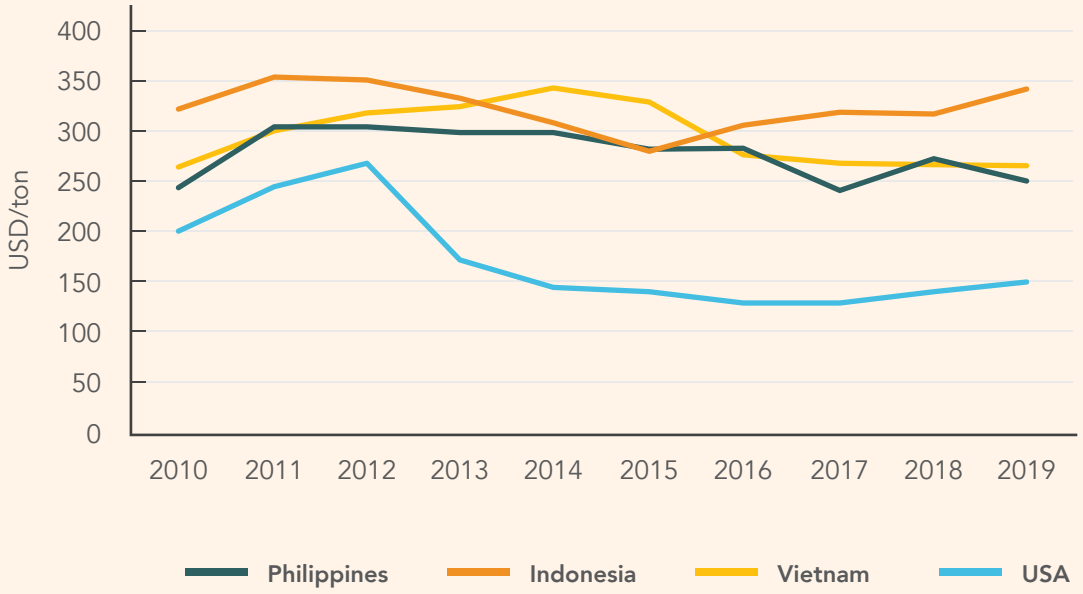
Area. The area harvested for corn in the Philippines is fluctuating as shown in Table 19. It declined from 2.68 million ha in 2009 to 2.52 million ha in 2019 at an average rate of 0.57 percent. The same pattern for Vietnam with an average decline of 0.91 percent. Area harvested for corn increased during the period 2009 to 2014; and drastically declined from 1.18 million ha in 2014 to 0.99 million ha in 2019 –that is only 39 percent of the Philippines' total area. Indonesia, on the other hand, has a generally increasing trend in total area harvested with an average growth rate of 3.47 percent; achieving 5.64 million ha in 2019. It has the largest area harvested for corn in Southeast Asia with 38 percent more area than the combined area of Philippines and Vietnam.

Yield. Although the Philippines is the second largest corn producer in Southeast Asia, its yield is still among the lowest with only 3.17 mt/ha in 2019. Vietnam achieved 4.80 mt/ha in 2019 from 4.01 mt/ha in 2009 and Indonesia reached 5.44 mt/ha in 2019 (Table 19). Salazar et al study reported an average yield of 4.12 t/ha in 2020.

International Prices

The producer prices of corn in Philippines, Indonesia, Vietnam and United States are shown in Figure 20. The United States has been the top global exporter of corn for the past decade and has the lowest producer price among the four countries presented. In the years 2011, 2016 and 2018, the producer price of corn in the Philippines and Vietnam were almost equal while in the year 2015, the Philippines has the same producer price of corn with Indonesia at 282 USD/ton. However, Indonesia's producer price generally increased in the succeeding years while the producer price in the Philippines has been fluctuating.

FIGURE 20. PRODUCER PRICE OF MAIZE IN USD PER TON, 2010-2019



Source: FAOSTAT, 2021

Competitive Analysis

Trade has been an engine of transformation in global agriculture. Trade policies have been critical in facilitating this transformation by changes in tariff and non-tariff barriers. The Philippines, as a member of the ASEAN Free Trade Area (AFTA), will be compelled to abide by the region's economic integration called the ASEAN Economic Community (AEC). One of the elements of AEC is free flow of goods that requires elimination of tariffs eventually on all products. Thus, the current competitiveness state of corn is assessed using the standard methods of cost and price competitiveness under the trade scenarios of export and import substitution.

Cost Competitiveness

Competitive advantage indicates whether a country can successfully compete in the trading of a commodity in the international markets. It employs financial/market price and official exchange rate (OER) in the domestic resource cost (DRC) and resource cost ratio (RCR) calculations.

DRC measures the opportunity cost of producing or saving foreign exchange in terms of real resources. RCR measures the competitive efficiency and reflects the notion that in comparing the DRC with the OER, the ratio indicates resource use efficiency. A commodity is said to have competitive advantage if the RCR is less than one (RCR<1). If its value is greater than unity (RCR>1), no efficiency gains can be derived from the additional expansion of a particular activity.

The cost competitiveness of yellow corn production in selected major producing provinces is assessed based on two trade scenarios. An export trade scenario measures the competitiveness state if corn producing provinces will be exporting their produce given the selling price in the international market (i.e., border price), rate of exchange between two currencies (i.e., official exchange rate), and the cost structure of producing yellow corn, then processing it and bringing it to the port of exit. The Manila port is used as a relevant reference point of cost competitiveness comparison. Cost competitiveness under the export trade scenario basically compares income that can be earned through

export and cost of domestic resources (i.e. factors of production) in producing, marketing, and exporting corn. Cost competitiveness under export is achieved when income is greater than cost of domestic resources.

Yellow corn produced in Cagayan, Isabela, and South Cotabato intended for export are not cost competitive. These provinces are not cost competitive primarily due unfavorable export prices during the last six years (border prices are flat around US$160/mt during the last five years compared to US$ 260/mt prices three years prior) and yield levels that would generate favorable revenues. Tarlac, on the other hand, was cost competitive under export primarily because of very high yield ranging from 9.9 mt/ha for typical farms and 12.3 mt/ha for benchmark farms (Table 20).

TABLE 20. COST COMPETITIVENESS OF YELLOW CORN PRODUCTION, 2020

Trade Scenario	Province	Season	Farm Type[a]	Resource Ratio [b]	Condition
Export	Cagayan	Wet Season	Typical	1.54	Not cost competitive
			Benchmark	1.39	Not cost competitive
		Dry Season	Typical	1.38	Not cost competitive
			Benchmark	1.28	Not cost competitive
	Isabela	Wet Season	Typical	1.72	Not cost competitive
			Benchmark	1.67	Not cost competitive
		Dry Season	Typical	1.54	Not cost competitive
			Benchmark	1.26	Not cost competitive
	Tarlac	Dry Season	Typical	0.78	Cost competitive
			Benchmark	0.73	Cost competitive
	South Cotabato	Wet Season	Typical	1.93	Not cost competitive
			Benchmark	1.95	Not cost competitive

cont'd ▶

Trade Scenario	Province	Season	Farm Type[a]	Resource Ratio [b]	Condition
Import Substitution	Cagayan	Wet Season	Typical	0.60	Cost competitive
			Benchmark	0.53	Cost competitive
		Dry Season	Typical	0.54	Cost competitive
			Benchmark	0.50	Cost competitive
	Isabela	Wet Season	Typical	0.68	Cost competitive
			Benchmark	0.66	Cost competitive
		Dry Season	Typical	0.56	Cost competitive
			Benchmark	0.48	Cost competitive
	Tarlac	Dry Season	Typical	0.31	Cost competitive
			Benchmark	0.28	Cost competitive
	South Cotabato	Wet Season	Typical	0.77	Cost competitive
			Benchmark	0.77	Cost competitive

a Typical farm use conventional hybrid seeds while benchmark farms use GM hybrid seeds
b Resource cost ratio was used as indicator of cost competitiveness. RCR < 1, competitive; RCR > 1, uncompetitive; and RCR = 1, neutral

The import substitution trade scenario is a comparison of the cost of locally producing yellow corn and the cost of importing the same product from foreign suppliers. To be cost competitive under import substation, the cost of local production must be less than the cost of importation. If this is the case, then the country is in effect saving import expenses since local production will be prioritized instead of importation. The results showed that all four provinces are cost competitive under import substitution. The most cost competitive is Tarlac because of its high yield. Cost of production (i.e., total cost over yield) is minimized whenever yields are high.

The above analysis provided a snapshot of the competitiveness state of corn production in the Philippines. An extended version of this is to determine conditions that will lead to attainment or deterioration of cost competitiveness. An appropriate method for this is break-even analysis shown in Table 21. For export trade scenario, major producing provinces will have to target improvement in farm productivity in the range

of 6.3 to 7.4 mt/ha. A pessimistic scenario where producing provinces will lose their cost competitiveness under import substitution trade scenario should be avoided. The threshold under this unfavorable scenario is when corn yield will decrease in the range of 3.0 to 3.7 mt/ha.

TABLE 21. BREAKEVEN ANALYSIS OF COST COMPETITIVENESS OF YELLOW CORN PRODUCTION, 2020

Trade Scenario	Province	Current Condition	Breakeven Scenario
Export	Cagayan	Not cost competitive	Become cost competitive by increasing average yield from 5.0 mt/ha to 6.3 mt/ha
	Isabela	Not cost competitive	Become cost competitive by increasing average yield from 4.7 mt/ha to 6.4 mt/ha
	Tarlac	Not cost competitive	Lose cost competitiveness if average yield will decrease from 11.1 mt/ha to 8.9 mt/ha
	South Cotabato	Not cost competitive	Become cost competitive by increasing average yield from 4.6 mt/ha to 7.4 mt/ha
Export	Cagayan	Not cost competitive	Lose cost competitiveness if average yield will decrease from 5.0 mt/ha to 3.0 mt/ha
	Isabela	Not cost competitive	Lose cost competitiveness if average yield will decrease from 4.7 mt/ha to 3.1 mt/ha
	Tarlac	Not cost competitive	Lose cost competitiveness if average yield will decrease from 11.1 mt/ha to 3.9 mt/ha
	South Cotabato	Not cost competitive	Lose cost competitiveness if average yield will decrease from 4.6 mt/ha to 3.7 mt/ha

Source of basic data: DA-RFOs

Price Competitiveness

The methodology simply compares the export and import parity prices expressed in domestic currencies, at the official exchange rates, with the wholesale domestic prices of commodities. The product is price competitive if the derived wholesale price is greater than the domestic wholesale price.

Export = Export parity price / Domestic wholesale price > 1

Import = Import parity price / Domestic wholesale price > 1

Price Competitiveness under Export Trade Scenario

Under an export trade scenario, corn produced in the Philippines was not price competitive for export. The export parity price ratio quoted at the Manila market was 0.32 (Table 22), which implies that the domestic wholesale price of corn was higher than the derived export price. It will be more economically beneficial to sell corn in the domestic market than the export market.

TABLE 22. PRICE COMPETITIVENESS OF YELLOW CORN UNDER EXPORT TRADE SCENARIO, 2020

ITEM	VALUE
FOB Price, USD/mt	199.83
Exchange Rate (PhP/USD)	49.62
Export Price (PhP/mt)	9,915.56
Handling and Distribution Costs (PhP/mt)	3,389.10
Export Parity Price (PhP/mt)	6,526.46
Estimated Actual cost (PhP/mt)	10,429.93
Estimated Farmgate Price (PhP/ton)	12,340.00
Transport and Distribution (PhP/ton)	3,352.45
Estimated Domestic Wholesale Price (PhP/ton)	20,710.00
Export Parity Price Ratio	**0.32**

Sources of Data: World Bank, BSP, DTI, PSA, RFOs

Price Competitiveness under Import Substitution Trade Scenario

The competitiveness of corn was calculated relative to imports from the US and Myanmar. The derived wholesale price is computed based on FOB price including tariff, freight and handling costs. Tariff rate from the ASEAN countries is 5% for in-quota and out-quota while from the US is 35% for in-quota and 50% for out-quota. However, tariff is assumed to be eliminated on substantially all products coming to the ASEAN Economic Community in 2015.

TABLE 23. PRICE COMPETITIVENESS OF YELLOW CORN UNDER IMPORT TRADE SCENARIO, 2020

ITEM	USA		MYANMAR	
	50% Tariff	35% Tariff	5% Tariff	0% Tariff
In USD/mt				
FOB Price	199.83	199.83	244.85	244.85
Freight and Insurance	53.93	53.93	21.46	21.46
CIF Philippines	253.76	253.76	266.31	266.31
OER	49.62	49.62	49.62	49.62
In PhP/mt				
CIF Philippines	12,591.57	12,591.57	13,214.30	13,214.30
Tariff	6,295.79	4,407.05	660.72	-
Handling and Distribution Costs	3,389.10	3,389.10	3,389.10	3,389.10
Derived Import Wholesale Price	22,276.46	20,387.72	17,264.12	16,603.40
Estimated Domestic Wholesale Price	20,710	20,710	20,710	20,710
Import Parity Price Ratio	**1.08**	**0.98**	**0.83**	**0.80**

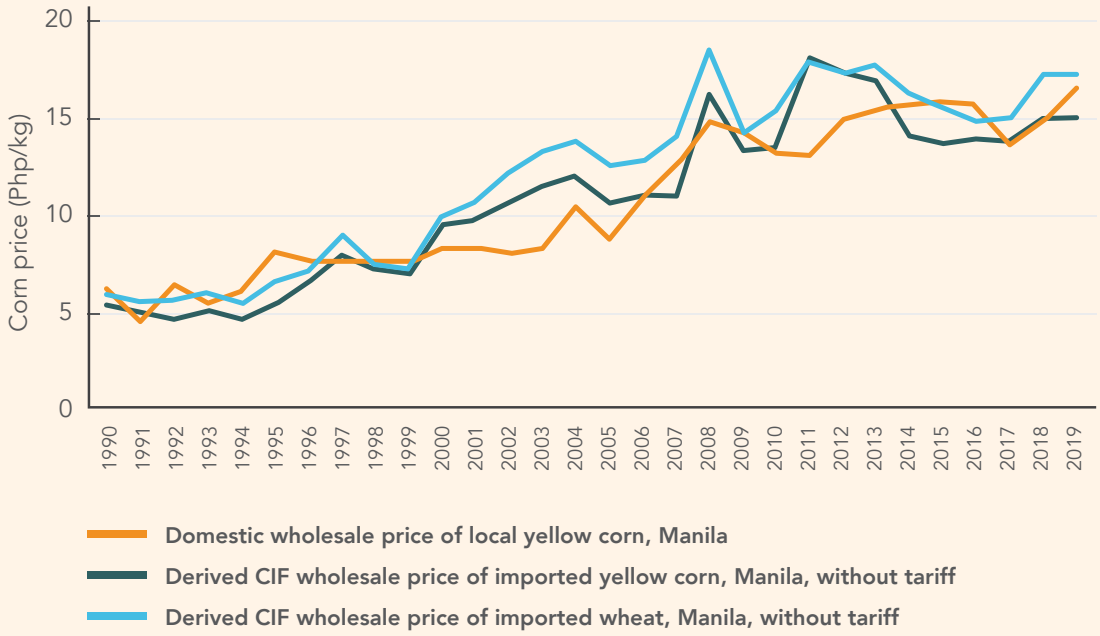
Sources of Data: World Bank, BSP, Philippine Tariff Commission, DTI, PSA

Given the computations in Table 23 at varying tariff rates, the corn industry in the Philippines is proven to be price competitive against imports from the US at 50 percent tariff rate. Hence, substituting local production to imports from the US at 50 percent tariff rate is more cost and price competitive and beneficial to the economy. However, in ASEAN, the Philippines is not price competitive at 5 percent or at 0 percent tariff rate. ASEAN, particularly Myanmar, is one of the top exporters of corn in the country. Aside from the benefit of low tariff rate in Myanmar, they also have lower wholesale prices than

the Philippines. Thus, considering the price competitiveness of Myanmar against the local yellow corn, importing corn from ASEAN is economically beneficial.

The above analysis compared prices using recent data in 2020. An important extension of this analysis is to compare prices using time-series data to identify past situations when domestic corn is competitive against imported substitute products. Since yellow corn is used as a main ingredient in feed formulation, it is worth pursuing price comparison of locally produced corn with imported yellow corn and imported feed wheat.

FIGURE 21. PRICE COMPARISON OF LOCAL CORN, IMPORTED CORN, AND IMPORTED FEED WHEAT WITHOUT TARIFF, 1990-2019



Source of basic data: WB, 2021; PSA, 2021, and BSP, 2021

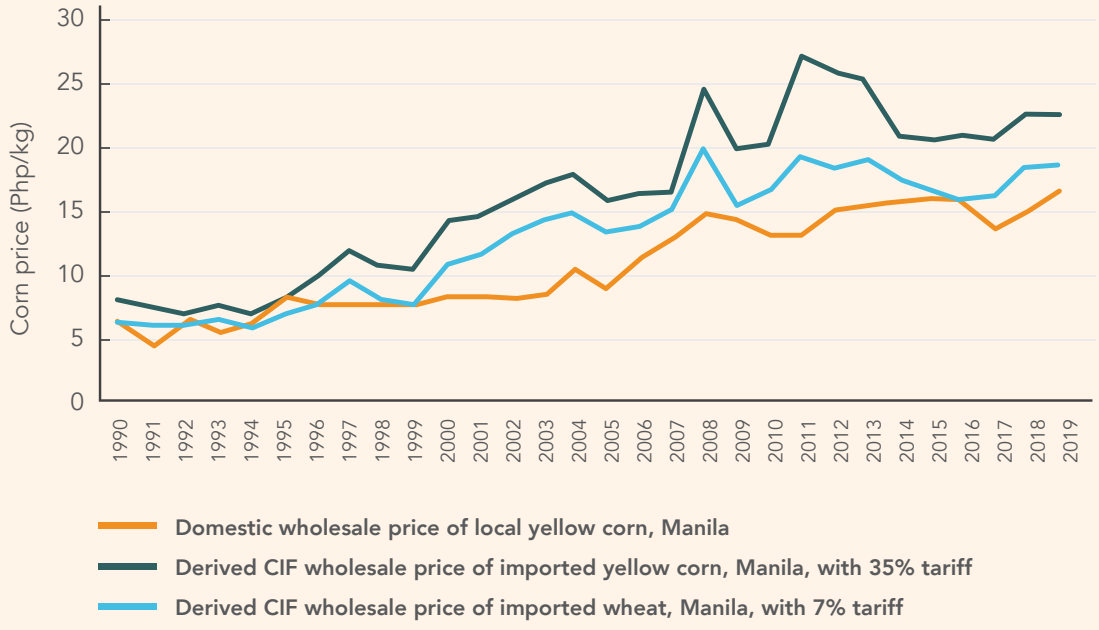
Figure 21 shows the comparison of three prices: 1) the wholesale price of domestically produced yellow corn quoted in Manila, which serves as a proxy for the buying price of feed millers usually quoted in Bulacan (there is a high concentration of feed millers in Bulacan so it is the most appropriate point of competition between local and imported products), 2) the import price or cost plus freight (CIF) of imported yellow corn from the

US and brought to Manila without tariff, and 3) the import price of imported wheat also from the US and brought to Manila without tariff.

Domestically produced yellow corn was most of the time price competitive against imported yellow corn without tariff. This means that from the viewpoint of feed millers, it will be cheaper to buy local corn than import corn. There were instances, however, when this price competitiveness was eroded from 1992 to 1996 and 2015 to 2016. Domestic corn was priced higher than imported corn during these periods. Feed wheat, on the other hand, is generally expensive than locally produced corn without tariff.

Locally produced yellow corn are much cheaper and therefore more price competitive against imported yellow corn and feed wheat given 35 percent tariff for corn and 7 percent tariff for feed wheat. From 1990 to 2019, the price competitiveness of domestic corn against imported corn and feed wheat continues to expand (Figure 22).

FIGURE 22. PRICE COMPARISON OF LOCAL CORN, IMPORTED CORN, AND IMPORTED FEED WHEAT WITH TARIFF, 1990-2019



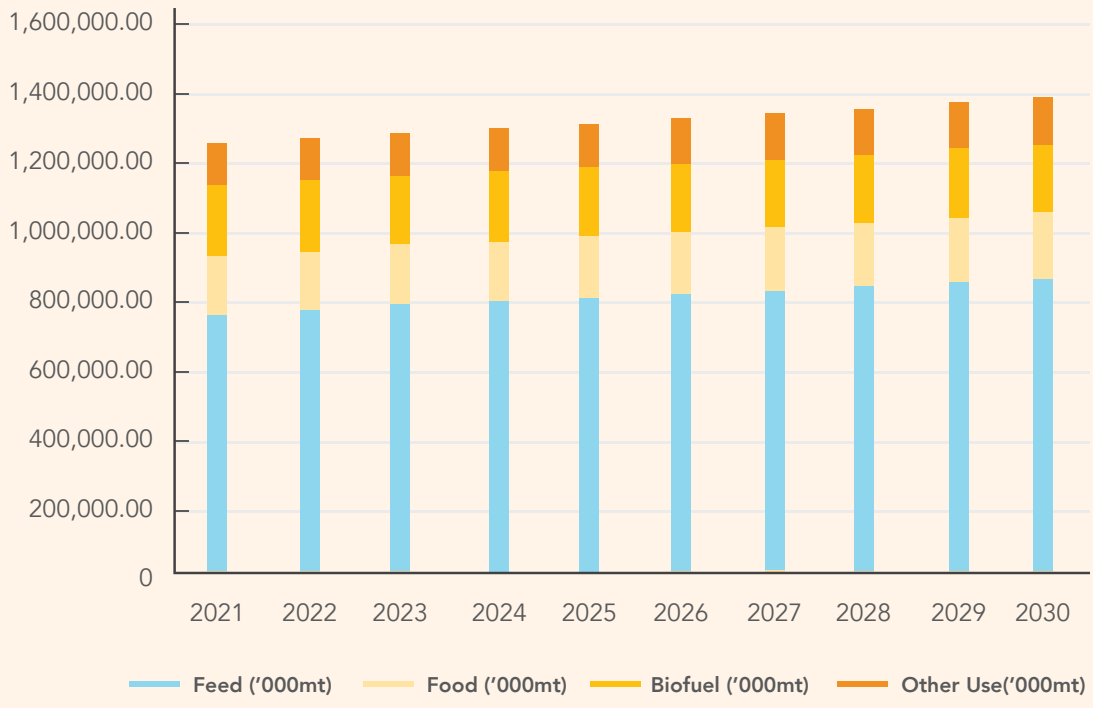
Source of basic data: WB, 2021; PSA, 2021, and BSP, 2021

MARKET TRENDS AND PROSPECTS

Key Demand Drivers

Global corn consumption is projected to grow over the 2020-2029 period (Figure 23) with the main drivers coming from the projected increases in the demand from the feeds and food industries.

FIGURE 23. GLOBAL PROJECTION OF MAIZE CONSUMPTION, 2021-2030



Source: OECD, 2021

Demand of livestock and poultry industry

OECD projects that global livestock and fish production are expected to expand by 14 percent; similarly with crop production, where the majority of this growth (82%) comes from middle- and low-income countries due to production intensification and expansion. Also, livestock production in Asian countries is expected to recover after the ASF outbreak in 2021. Both the livestock and fish sectors are projected to grow by a total of 17 percent over the next decade. Poultry meat production is expected to account for 52 percent of the global growth in meat production.

The main driver of demand for corn production, globally and locally, is the increasing feed demand by the growing meat, fisheries and dairy industries. Thus, global corn production is expected to grow over the next decade, with developed countries still the top exporters of corn.

Local price of yellow corn and availability of substitutes.

The country's corn production does not supply the feed requirement of the local livestock and poultry industry and continues to import corn and feed wheat. High wholesale price of yellow corn grains in the country affects the demand of local yellow corn since feed millers is forced to prefer its cheaper alternative.

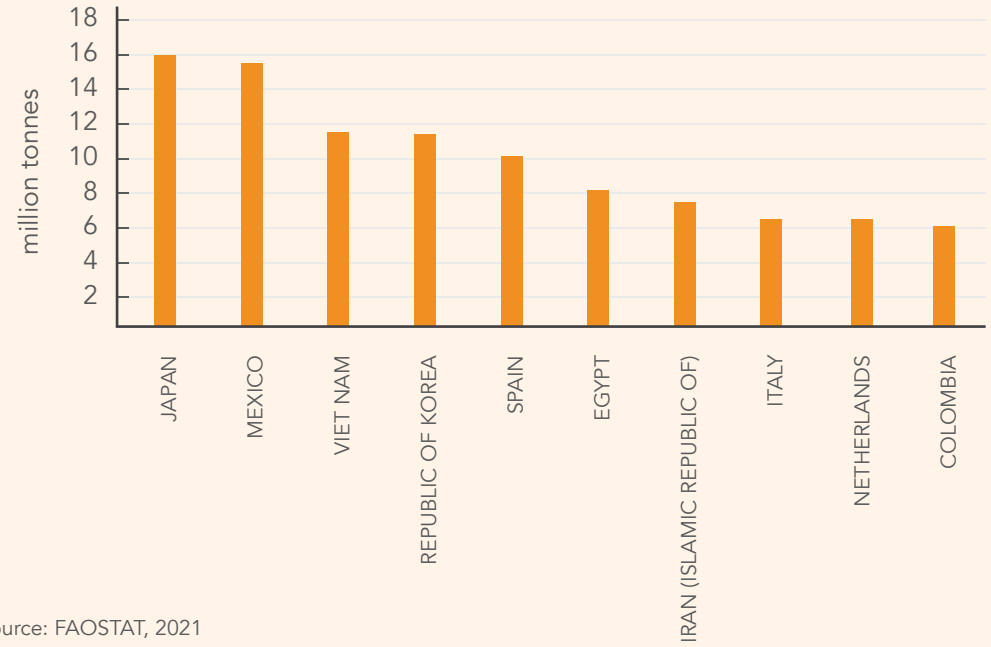
Consumption of corn and prospects for market expansion

In 2021-2030, the projected annual growth rate of feed consumption is 1.38 percent while food use is expected to increase at a rate of 1.53 percent on the average (OECD, 2021). Similarly, in the Philippines, food use of corn is increasing in importance with growing calls for food and nutrition security. Growth in food use may be primarily driven by the increasing importance of white corn in diets, but yellow corn can be processed into various food products that are not well explored and developed yet in the country. These markets can be explored and integrated into the corn value chain. There is a high potential of increasing the value of corn industry if the corn end products to be exported are not just raw materials such as grain.

International Market Prospects

In 2019, Japan imported the largest volume of corn, 15.99 million MT, valued at USD 3.52 billion. Other top importing countries included Mexico, Vietnam, Korea, Spain, Egypt, Iran, Italy, The Netherlands, and Colombia (Figure 24). If the Philippines decide to export corn, these countries will be among the favored destinations. Competitiveness along with proximity (i.e. to save on logistics, insurance), and changes in trade policies are among the factors that should be considered.

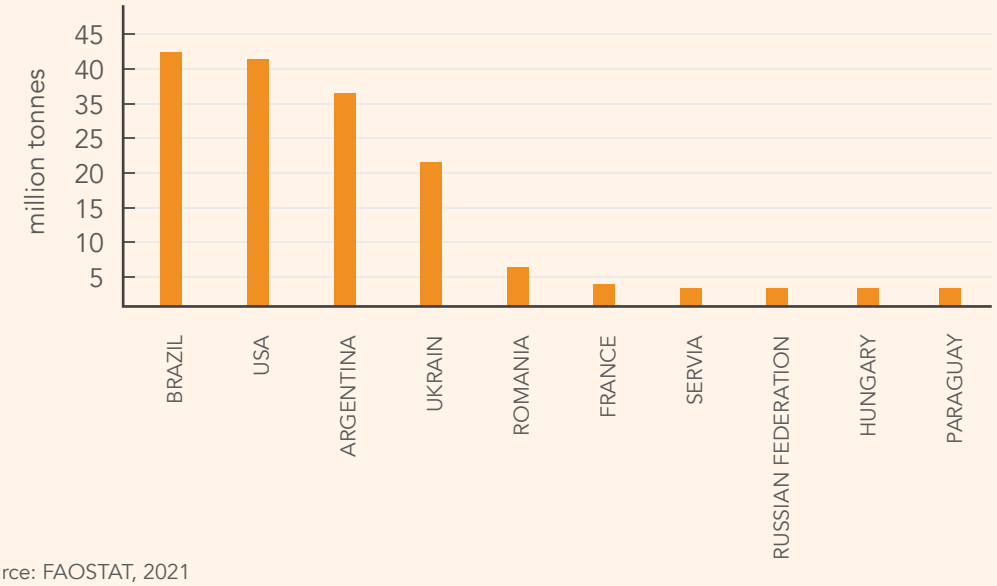
FIGURE 24. TOP 10 GLOBAL IMPORTERS OF CORN, 2019



Source: FAOSTAT, 2021

The United States, which has been the top exporter of corn through the years, has now a declining market share and is expected to remain so over the next decade. This can be attributed to the change in preference of Southeast Asian importers to South American corn in relation to moisture content and hardness of the kernel (OECD, 2020). The top 5 exporters of corn in 2019 as shown in Figure 25 are Brazil, United States, Argentina, Ukraine and Romania. If the Philippines decide to export corn, its quota price should be derived from the top exporter of corn, as it is a price-taker in the international market.

FIGURE 25. TOP 10 GLOBAL EXPORTERS OF CORN, 2019



Source: FAOSTAT, 2021

Table 24 lists down the potential export market for the Philippines. These are one of the top importing countries in the world and were also considered due to its proximity to the country thereby reducing the freight and insurance costs. According to OECD and FAO, the major countries that will account for the projected increase in demand are China, USA, Argentina, Indonesia, and Vietnam. Vietnam and Thailand in particular has a fast-growing poultry industry. Thus, their corn imports are expected to rise.

TABLE 24. POTENTIAL EXPORT MARKET FOR GRAINS

PROVINCE	YELLOW CORN PRODUCTION (MT), 2020	POTENTIAL EXPORT MARKET	CORN IMPORTS (MT), 2019
Isabela	1,102,050	Japan	15,986,045
Bukidnon	713,441	Korea	11,366,877
Maguindanao	541,446	China	9,615,335
Cagayan	491,443	Indonesia	1,028,522
South Cotabato	362,557	Malaysia	3,755,359
Pangasinan	337,251	Vietnam	11,447,667
		Thailand	400,679

Source: PSA, FAO

PRIORITY CONCERNS AND OPPORTUNITIES/ CONSTRAINTS

Implications on the Corn Industry

Strengths-Opportunities

The supply chain cases and the competitiveness analysis reveal that locally produced corn in benchmark regions and provinces are competitive against imports. Farmers in these areas (i.e. at least 3 regions and 10 provinces) used GM seeds, applied inputs and adopted crop management technologies; and produced yellow corn with above average yields (>4.2 tons/ha). They form the strength of the corn supply chain; yet other areas can be expanded to perform similarly if factors (e.g. seeds, soil enhancement, farm mechanization) limiting efficient production are addressed.

The increasing demand of corn for mixed feeds and other industrial uses (e.g. starch, oil, snack foods) locally and globally is a huge incentive to adopt interventions to increase productivity. The demand for feeds has two main drivers: (1) the demand for animal products (i.e. determines production level of the livestock and aquaculture sectors); (2) the structure and efficiency of the production systems (i.e. determine the amount of feed to produce livestock products (OECD, 2021).

Opportunities to expand markets by tapping other downstream value chains to supply domestic and global markets should motivate producers to increase the competitiveness of the corn industry. These industrial uses of corn are in general shaped by socio-economic conditions, policies (e.g. fiscal, trade, regulatory) and state of innovations/ technologies.

In the short run while in transition, the government may need to subsidize inputs like seeds and fertilizers together with appropriately designed capability and skills building methods (e.g. learning sites, demo farms, farmer field/business schools). Increased incomes from improved productivity eventually render subsidies no longer necessary as farmers fend for themselves.

Strengths-Threats

Climate change-induced extreme weather patterns and pests and diseases pose grievous threats to agriculture; the corn industry. Historically, the corn industry loses an average of PhP 3.9 billion of production to El Nino, typhoons and flooding. Forty percent of the total area affected has no chance of recovery. In addition, FAW is a major pest that has drastically affected the production of corn. After about 2 years, 92 percent of the total area infested had been treated. However, the possibility of recurrence or that current pests and diseases will evolve and/or new ones will emerge, is not far off. Hence, strategies and efforts to build resilient and climate smart corn farms should be seriously considered together with required learning platforms that farmers' adoption are facilitated. Mere lecture trainings have not been effective in technology transfer.

With liberalization, global trade for animal feed corn substitutes (e.g. feed wheat) has become more open, and the availability of these substitutes also increasing. Some feed millers prefer feed wheat for its lower price and higher protein content than local corn. Local feed millers consider yellow corn still the best energy source. Such revealed preference should be incentive enough to seriously craft a corn industry program beyond past failed efforts. Structural reforms in the production-marketing-utilization chains are critically urgent. The industry should aim for yield increasing interventions, more efficient postharvest-marketing systems, including the adoption of climate smart practices to be resilient, competitive and sustainable.

Weaknesses-Opportunities

The inability to sufficiently supply the corn industry's requirement and high dependence on imports for inputs and alternative ingredients have exposed the industry to a volatile global market, and inability to efficiently produce. Production is difficult to modernize due

to confounding constraints of ageing farmers and weakly organized farmer groups, lack of resources, difficulty of access to credit, fragmented and small farm size, lack of facilities, and weak extension services. Risks and vulnerabilities linked to climate change call for more intensive promotion of climate smart production practices with related capacity development strategies including effective communication strategies.

The Department of Agriculture advocates clustering (i.e. Bayanihan cluster) as a strategy of restructuring in order to achieve economies of scale from supply to market chain. Both government and private sector will need to explore more collaborative effort (i.e. towards a business model) to operationalize such schemes and agree on required investment (i.e. clustering, postharvest, distribution). A business model for this structural innovation will need to be developed as a basis for action planning.

OECD Outlook report stresses the importance of public and private investments in improving productivity; and projects that emerging economies will more intensively push on drivers of agriculture growth (OECD, 2021). The reality, however, needs a positive governance environment and strengthened industry partnership that enable the tapping of domestic and global opportunities. Yet these are simply necessary conditions. Sufficient conditions are provided by appropriate productivity-increasing technologies, infrastructure together with policies (i.e. that impact on value chain, trade, regulatory), enhanced support systems (e.g. timely market information, interactive map-based digital information systems, research and development, extension services), and good governance to effectively attain roadmap goals.

Summary of SWOT Analysis

In the existing yellow corn industry setting, the value chain is disjointed; evidenced by persistent supply inadequacies and market inefficiencies; as shown in the SWOT analysis. The discourses in this roadmap also show the huge opportunities of yellow corn in the growing demands for feeds, food and other industrial uses. Technologies are available, the policy environment offers bright twists for agriculture, industry players more open to positive dialogue, and resources can be accessed.

FIGURE 26. SUMMARY OF SWOT ANALYSIS

INPUT PROVISION	Improved access to production services and available high-yielding varieties. However, increasing cost of inputs and dependence on imported input may affect the growth of this segment.
PRODUCTION	Fragmented and small-scale far ms, high production cost, low yield and quality are still concerns which can be addressed through clustering and consolidation.
POST-HARVEST	High post-harvest losses that can be addressed through the integration of drying-milling operations for economies of scale and linkage with clustered producers. However, inadequate funding/capital for advance post-harvest facilities is still a threat to this proposed advancement.
PROCESSING	Small and large scale commercial corn-based snack foods manufacturing are steadily growing as main users of corn. However, limited local value adding activities is observed in the country. Tapping of downstream industries (local and international) can be done to boost value-adding.
MARKETING & CONSOLIDATING	The increasing rate of organization of farm clusters and cooperatives presents the opportunity for a strengthened farmer- processor linkage. However, despite increasing market efficiency, the volatility of agricultural commodity markets still poses a threat to the corn industry.
CONSUMPTION	There is an increasing demand for corn as feed ingredient due to the increasing demand for livestock and poultry industry. However, cheaper substitutes are also increasing its share in the market.

TARGET SETTING

Vision

In response to the industry concerns and in view of the significant contribution of corn to the country's agriculture and socio-economic development goals, the Department of Agriculture, together with partners and stakeholders, envisions a food sufficient and resilient corn industry with empowered and competitive corn farmers.

Thus, the vision: More efficient, competitive, and resilient corn industry players in the whole value chain.

Mission

Transform the corn industry players to be productive, competitive, resilient, and profitable by providing science-based solutions, support services, and collaborative partnerships.

Goals, Objectives and Targets

The strategic goals, objectives and targets of the program for the short-, medium- and long-term are shown in Table 25. These goals seek to help, catalyze, and boost the domestic corn sector towards a globally competitive corn industry.

The overarching goal of this roadmap is that of improving the efficiency and competitiveness of the yellow corn industry and the quality of life of farmers and value chain actors.

TABLE 25. SHORT-, MEDIUM-, AND LONG-TERM GOALS AND TARGETS

Goal	Base line	Targets		
		Short-term (2021-2025)	Medium-term (2025-2030)	Long-term (2030-2040)
1. Increased productivity and efficiency levels in the corn production sector				
a. Increase in volume of production (M mt)	6.01	9.8	11.5	13
a.1 Yellow corn, feeds	5.05	8.2	9.7	10.9
a.2 Yellow corn, other uses	0.96	1.6	1.8	2.1
b. Increase in yield (mt/ha)	4.18	5.45	7	8
2. Increased sufficiency of local corn across expanded and diversified markets supported by adequate infrastructure				
3. Increased income of corn producers and value chain actors				
a. Increase in farmers' income per cropping per ha (Php)	10,340	18,996	31,360	43,840
b. Increase in incomes of value chain actors (% increase)	Mixed base	At least 10%	At least 15- 20%	At least 25%

[1]subject to review and updating in coordination with NLP and BAI

RECOMMENDATIONS FOR POLICIES, STRATEGIES AND PROGRAMS

These refer to key strategies and activities that can enhance and strengthen support systems and promote enabling policy environment. These have wide-ranging impact across the value chain; thus, effectively attain roadmap goals.

a. **Pursue a more rationalized corn seed policy**
   Supporting the strategy of making available competitive inputs locally. A policy to eventually remove IP restrictions on GM/hybrid seeds will help lower the costs of seeds locally.

b. **Cost-reducing reform on seeds and fertilizer**
   With seeds and fertilizer having a large share of production cost, a review of regulations and VAT impositions should be made to reduce cost.

c. **Intensify the use of cost-reducing technologies**
   Encourage the use of bio-fertilizer, biocon agents, and organic fertilizers

d. **Advocate the passage of a Corn Reform Law**
   This proposed legislation will seek to overhaul the current framework governing the corn sector's operations and development. Key features to be incorporated include:

   – Establishment of a Corn Industry Development Administration
   – Review policy on Exportation and Importation of Corn and Substitutes
   – Creation of a Corn Competitiveness Enhancement Fund

- Incentivization of private sector participation and investment in the corn sector, especially for those which (1) enhance the local value chain, (2) support local consumption, (3) adopt sustainable practices, and/or (4) adopt inclusive business models.
- Review of the proposed removal of foreign investment restrictions (mandatory 30-year divestment period) in the use, storage, transportation, handling and processing of corn

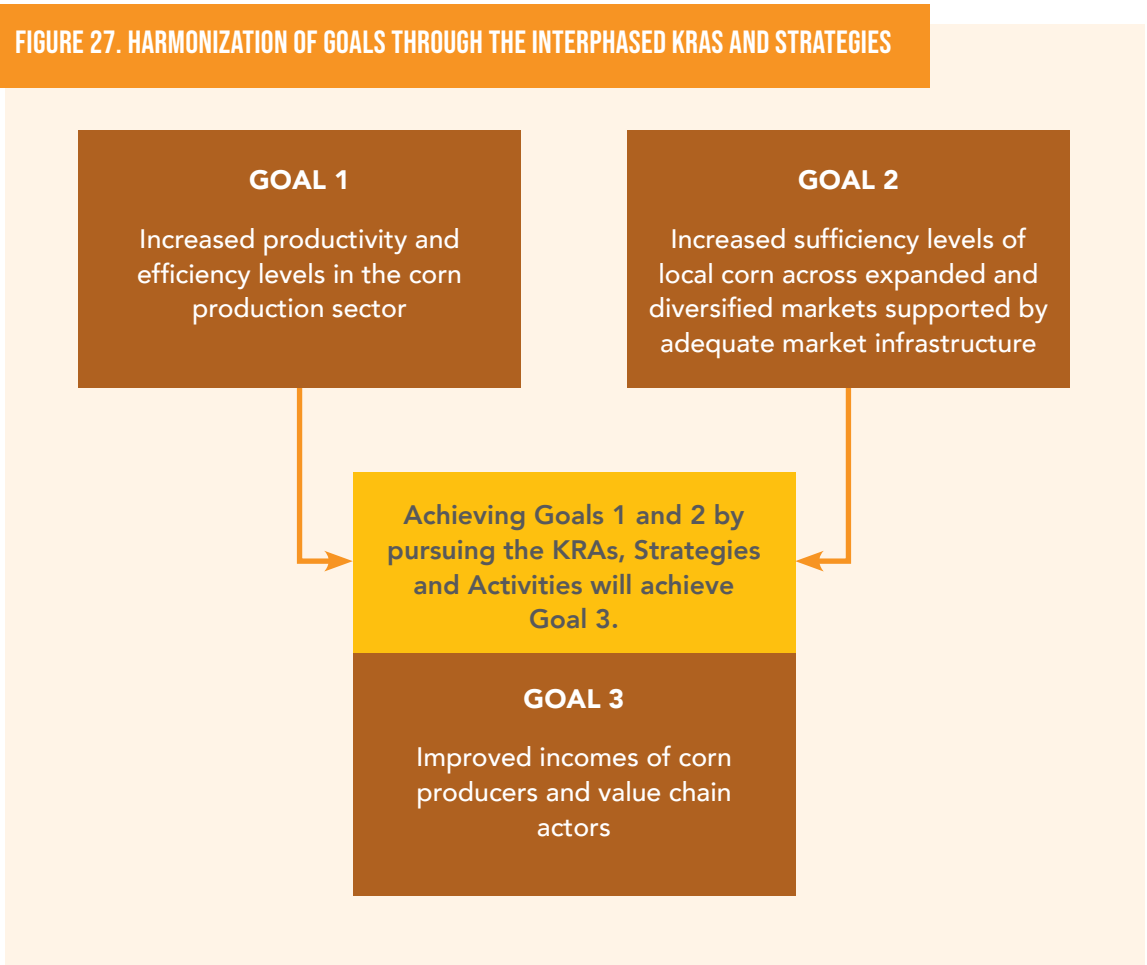
e. **Promotion of precision agriculture and regenerative agriculture**
Through a mixture of R&D, IEC and pilot testing, pursue projects that seek to introduce new technologies, innovations and best practices geared towards enhancing productivity as well as promoting sustainability, including:
   - Satellite-based agricultural land mapping/surveying to identify best/appropriate land use strategies
   - Use of new technologies - drones, sensors, etc.
   - Piloting areas to adopt regenerative agriculture for proof of concept and applicability, potentially developing an accompanying carbon credit system

f. **Establishment of a Corn Governance Network**
This Network should be a multi-sectoral agency composed of government, private sector, and academe tasked to regularly refine/review the National Corn Industry Roadmap as well as oversee the implementation of the roadmap through an elaborate M&E system. It can also serve as a review body for Executive policies directly affecting the corn sector.

Goal 3. Improved Incomes of Corn Producers and Value Chain Actors

The value chain approach enables the chain-wide interventions (i.e. technological, commercial, institutional) where the strategies are designed based on value chain assessment, including SWOT analysis. In this roadmap, a thorough yellow corn industry situationer provides context to the chain assessment. The key result areas (KRAs) defined are meant to address gaps, need, opportunities, and viable options required by different chain segments. Thus, the goals set that target production and market efficiency (Goal 1 and Goal 2) will achieve Goal 3; the eventual improvement in incomes and quality of life of producers (Figure 27).

FIGURE 27. HARMONIZATION OF GOALS THROUGH THE INTERPHASED KRAS AND STRATEGIES



Recommendation Matrix

TABLE 26. RECOMMENDED STRATEGIES, PROGRAMS, PROJECTS AND POLICIES

VC Segment	Strategies	Expected Outcome	Time frame	Lead/Partners	Key Performance Indicators (KPIs)
Goal 1. Increased productivity and efficiency levels in the corn production sector					
KRA 1	**Efficient and stable supply chain of industry inputs like seeds, fertilizer, and other inputs**				
Input Supply	Input provision	Availability/access of quality corn seeds, fertilizers, and other inputs	2021-2025	DA NCP / BPI, LGUs, Private sector companies	No. of local centers for effective accessing & distribution of inputs; No./type/quantity of inputs accessed/ provided; No. of R&D stations upgraded
	Irrigation/ water source provision	Access to needed water/ moisture requirements	2021-2025	DA NCP/ NIA, PhilMECH, BSWM	No./type of irrigation/water availability systems; No. of farmers/area size served
	Rationalized capital/credit and insurance scheme	Access to capital funds for corn farmers, processors, business sector	2021-2025	DA/ ACPC, PCIC, ACEF Landbank, lending conduits	Loans (in PhP) provided to corn farmers, other chain actors; loan repayment rates
KRA 2	Corn produced in efficient production systems by empowered farmers amidst climate change challenges.				
Production	Bayanihan Agri-clusters	Expanded and strengthened corn clusters operating as viable business models (supply-market-value-chains)	2021-2025	DA NCP, RFOs / LGUs, FCAs, SUCs, Private sector	No. of farmers/organizations/ size of farm areas in clusters; no./type of arrangements established (i.e. physical, management, facilities, equipment, etc.)
		Expanded and strengthened corn clusters operating as viable business models (supply-market-value chains)	2021-2025	DA NCP, RFOs / LGUs, FCAs, SUCs, Private sector	No. of corn clusters/no. farmers involved/ size of farm covered; type of interventions (technologies, GAP, PH facilities/ infrastructure, marketing agreements, credit accessed, crop insurance, etc.)
	Bayanihan Agri-clusters	Increased productivity and production	2021-2025	DA NCP, RFOs / LGUs, FCAs, SUCs, Private sector	Technologies/practices adopted; no./type of appropriate inputs supplied; trainings conducted; techno-demo farms, learning sites: no. of farmers, size of area covered
					Crop systems adopted; alternative crop produce volume/value: no. of farmers, farm size adoptors

VC Segment	Strategies	Expected Outcome	Time frame	Lead/Partners	Key Performance Indicators (KPIs)
Goal 1. Increased productivity and efficiency levels in the corn production sector					
KRA 2	**Corn produced in efficient production systems by empowered farmers amidst climate change challenges.**				
Production	Farm mechanization	Farm efficiency improved	2021-2025	NCP/ RFOs PhilMECH, SUCs, LGUs, FCAs	No./type of machinery/ equipment adopted; percentage yield improvement, cost reduction
	Establishment of techno-demo farms and Learning sites	Improved technology adoption; Increased productivity	2021-2025	NCP/RFO ATI, LGUs, FCAs, SUCs	No. of techno-demo sites established; No. of farmers/users adopting technologies; size of farm area covered
	Implementa-tion of climate smart farm systems	Climate change adaptation and mitigation measures promoted and adopted; improved corn community resilience	2021-2025	NCP/RFOs ATI, BAR, LGUs, SUCs, FCAs	No./type of climate smart farm systems trainings conducted; No./type of climate smart practices adopted; no. of farmers adopted and size of area covered; demo sites and model farms established
KRA 3	**Efficient post-harvest systems for quality corn**				
Post-Harvest	Postharvest machineries and equipment support	Established pilot business model of Corn Drying-milling integration with warehouse/ storage facilities linked to cluster-based supply chain	2021-2025	DA-NCP/RFO FCAs, LGUs, Private Sector	Documentation of process and operations of the integration and supply chain of clusters operation; key postharvest efficiency (e.g. Corn quality, reduced losses, supply-delivery systems) and financial indicators
		Installed other PH equipment as needed	2021-2025	NCP/RFOs PhilMECH, LGUs, FCAs	No. of postharvest and processing facilities constructed/ installed
	Investment in facilities/ infrastructures	Established facilities for warehousing and storage	2021-2025	NCP/RFOs PhilMECH, LGUs, FCAs	No. of warehouses /storage facilities established.

VC Segment	Strategies	Expected Outcome	Time frame	Lead/Partners	Key Performance Indicators (KPIs)
Goal 2. Increased sufficiency of local corn across expanded and diversified markets supported by adequate market infrastructure					
KRA 4	**Efficient post-harvest systems for quality corn**				
Process-ing/ Utilization	Integration of value chain approach in livelihood/ enterprise development/ improvem ent	Corn value chains developed/ improved with enhanced farmer technical and entrepreneurial skills	2021-2025	DA/RFOs ATI, LGUs, SUCs, FCAs, Private sector	No. of trainings conducted; No. of enterprise/ value chains established or improved; No. of farmers/FOs beneficiaries
		Developed new uses/innovations of corn (value-added products)	2021-2025	DA NCP/BAR SUCs, RDIs, Private sector	No./type of innovations in products and required machineries, equipment, tools (including zero- waste systems)
KRA 5	**Efficient marketing infrastructure and information system**				
Marketing	Develop marketing information system and marketing infrastructure	Innovative inter-linked market information platform(s) established	2021-2025	NCP, AMAS-AMAD/RFOs, BAR, SUCs, DTI	Market information reach (no. of clients, farmers, industry users, etc.); timely data/information generation and dissemination
		Business model as in PH segment: drying-milling integration	2021-2025	DA NCP/RFOs PhilMech, Private sector, FCAs	As determined by accountability procedures; business load carry (financials); no. of farmers served
		Promotion of bulk-handling, transport supply chain and supporting infrastructure	2021-2025	DA NCP/RFOs, LGUs, FCAs, Private sector, PhilMech	Warehouse-receipt systems established; % goods moved in bulk, storage % (bulk vs. bagged)
		Enhanced corn-based downstream enterprises (MSMEs)	2021-2030	DA NCP/RFOs Private sector, FCAs, LGUs	% share of corn in various uses; No./type of corn- based enterprises; farmers and size of area covered

INDUSTRY CLUSTER GOVERNANCE NETWORK

This roadmap seeks to rationalize and strengthen the governance of the corn industry in ways that allow the facilitative and collaborative nature of enhancing the diverse corn industry value chains (i.e. feeds, food, other industrial uses). The schematic structure (i.e. roles, actors, responsibilities) is presented below but the principles and shared values, operational framework, and systems of collaborative partnership will be explicitly and concretely defined in a participatory manner as the roadmap gets go signal.

TABLE 27. INDUSTRY CLUSTER GOVERNANCE NETWORK

Roles	Actors	Responsibilities
Overall implementing and monitoring body	Department of Agriculture-Planning and Monitoring Service National Corn Program TWG	– Spearhead the implementation of the strategies and programs in the YC Industry Development Roadmap – Develop monitoring template – Conduct an internal periodic review of the YC Development Roadmap and initiate a partnership with external evaluators – Mediate planning and regular consultations between the public and private sectors – Catalyze private investment by providing strategic guidance to investors
Implementing Agency	Private Sector	– Provides support to scale-up investment in the corn industry; and develops a strategic plan and resolution to address the supply-market inefficiencies in the corn value chain
	DA Regional Field Offices Bureaus and Attached Agencies State Universities and Colleges (SUCs)	– Build capacities of local and national implementers of the YC Industry Development Roadmap through trainings – Conduct research on technologies/ innovations, development initiatives, and policy that enable and help develop/improve corn value chains
Implementing Agency	Local government units (LGUs): province, city, town, barangay	– Implement corn development initiatives, and extension services to enhance corn productivity, and develop/improve corn-based livelihoods/MSMEs in partnership with FCAs, private sector, GAs. – Perform key role in the transformation of fragmented lands to the clustering and consolidation scheme; and provision of funds for relevant local initiatives.
Monitoring Agency	DA Regional Field Offices	– Designate staff dedicated to monitor the implementation of the strategies and programs at the local level
	DA Regional Field Offices Bureaus and Attached Agencies SUCs Private Sector LGUs	– Provide support in the periodic assessment of the roadmap implementation

MONITORING AND EVALUATION

TABLE 28. MONITORING AND EVALUATION MATRIX AND SCHEDULE

Actor	Schedule	Objective
DA Regional Field Office	Monthly (within 7 calendar days after the previous month)	– Gather relevant data and reports on current corn industry situation from LGUs (ie. status of planting/harvesting, issues and concerns, potential market linkage, etc) – Review reports from LGUs vis-a-vis roadmap targets and submit report to the National Corn Program
	Quarterly (within 7 calendar days after the last month of the previous quarter)	– Conduct of assessment and consultation workshops with stakeholders – Review of roadmap targets and current status/ compliance *Note: The 4th Quarter Assessment and Consultation Workshop, must focus on the crafting of proposed budget for the next budget proposal season*
National Corn Program	Quarterly (within 10 calendar days after the last month of the previous quarter)	– Conduct of assessment and consultation workshops with stakeholders – Review of roadmap targets and current status/ compliance
	Semestral	– Conduct of assessment and consultation workshops with stakeholders – Review of roadmap targets and current status/ compliance
	Every January	– Review of succeeding year's budget proposal (if in line with the roadmap and the current industry situation
Planning and Monitoring Service	Every 3 years	– Conduct of third-party impact evaluation
	As the need arises	– Revision of the roadmap based on the third-party impact evaluation

REFERENCES

Bangko Sentral ng Pilipinas (BSP). 2021. Peso-Dollar Exchange Rate. Accessed from: https://www.bsp.gov.ph/SitePages/Statistics/External.aspx?TabId=9.

Bioco R. and Navarro R. 2020. Philippine Corn Industry Roadmap: The Bridge to Empower Farmers (In powerpoint presentation format). Philippine Maize Federation, Incorporated.

Dela Cruz R.S.M. and Malanon H.G. 2017. State of On-farm Maize Mechanization in the Philippines. Agricultural Engineering International: CIGR Journal, 19(4):20-28

Gragasin, M.A., A. Maruyama and M. Kikuchi, An Economic Evaluation of Postharvest Technology: The Case of Rice and Corn Drying in the Philippines, Japanese Journal of Tropical Agriculture, Vol. 48, No. 4, 2004, pp.253-264.

OECD. 2021. OECD-FAO Agricultural Outlook 2021-2030 © OECD/FAO 2021.

PSA (Philippine Statistics Authority). 2021. Statistics on yellow corn wholesale prices. Accessed from: http://psa.gov.ph/.

Salazar AM, Elca CD, Lapiña GF, and Salazar FJD. 2021. Issues Paper on Corn Industry in the Philippines. Philippine Competition Commission, Quezon City, Philippines. Accessed from: https://www.phcc.gov.ph/pcc-issues-paper-2021-01-issues-paper-on-corn-industry-in-the-philippines/.

Tariff Commission. 2021. MFN and ATIGA Tariff Rates of Selected Fertilizers. Accessed from: https://finder.tariffcommission.gov.ph/index.php?page=tariff-finder3.

World Bank (WB). 2021. World Bank Commodity Pink Sheet, 2021. Accessed from: https://www.worldbank.org/en/research/commodity-markets

APPENDICES

APPENDIX I IMPLEMENTATION PLAN (2021-2025)

VC Segment	Action Points	Lead Agency	Partner Agency	Key Performance Indicators (KPIs)					Total Budget ('000 PhP)	Proposed Private Sector Investment (PhP '000)				Total Budget ('000 PhP)	Remarks
				2021 GAA	2022 NEP	2023	2024	2025		2022	2023	2024	2025		
Goal 1. Increased productivity and efficiency levels in the corn production sector															
KRA 1	**Efficient and stable supply chain of industry inputs like seeds, fertilizer, and other inputs**														
Input Supply	Provision of seeds, fertilizer, other inputs like bio- fertilizer, biocon agents	DA NCP RFOs LGUs	BPI FCAs Seed and Fertilizer companies	470,870	312,700	328,335	344,752	361,989	1,818,646	163,082	171,665	405,248	638,011	1,378,006	2022 from DA NEP; 2023-2025 transferred to LGUs under the Mandanas- Garcia ruling; Support to crop diversificatio n, other income enhancement activities
	Irrigation/ water availability	DA NCP	LGUs Private Sector	34,900	33,520	35,196	36,956	38,804	179,375	142,769	150,283	177,538	191,546	662,136	
	Credit and Insurance Rationalized capital/credit and insurance scheme	DA	ACPC PCIC ACEF FIs	N/A	N/A	1,200,000	1,500,000	1,700,000	4,400,000	N/A	N/A	N/A	N/A	N/A	Proposed government budget shall be lodged under partner agencies
KRA 2	**Corn produced in efficient production systems by empowered farmers amidst climate change challenges.**														
Production	Clustering, consolidation, diversification, and adoption of other farming systems	DA NCP RFOs	LGUs FCAs SUCs	N/A	8,315	8,731	9,168	9,626	35,840	N/A	N/A	N/A	N/A	N/A	No specific activity for consolidation in 2021. However, corn clusters are prioritized as beneficiaries of interventions Includes trainings Climate smart systems, supply chains, other appropriate technologies
	Upscaling of cost-reducing technologies through techno-demo farms, model farms, and SCoPSA	DA NCP RFOs LGUs	ATI FCAs	N/A	65,762	108,225	112,033	115,639	401,659	N/A	N/A	N/A	N/A	N/A	2022 from NCP; 2023-onwards from LGUs in collaboration with DA

VC Segment	Action Points	Lead Agency	Partner Agency	Key Performance Indicators (KPIs)					Total Budget ('000 PhP)	Proposed Private Sector Investment (PhP '000)				Total Budget ('000 PhP)	Remarks
				2021 GAA	2022 NEP	2023	2024	2025		2022	2023	2024	2025		
Goal 1. Increased productivity and efficiency levels in the corn production sector															
KRA 2	**Corn produced in efficient production systems by empowered farmers amidst climate change challenges.**														
Production	Upscaling of pest and diseases management control technologies and protocol	DA NCP BAR	RFOs LGUs FCAs	N/A	21,089	22,143	23,251	24,413	90,896	N/A	N/A	N/A	N/A	N/A	
	Farm mechanization	DA NCP RFOs	PhilMech BAFE LGUs Private Sector	161,550	210,661	221,194	232,254	243,866	1,069,525	250,219	263,388	294,045	346,987	1,154,638	
KRA 3	**Efficient post-harvest systems for quality corn**														
Post-harvest	Postharvest machineries and equipment	DA NCP RFOs	PhilMech BAFE LGUs Private Sector	137,398	193,145	195,800	206,284	221,674	954,301	100,000	100,000	100,000	100,000	400,000	Focus on suitable infrastructure to clusters engaged in trading
	Investment in facilities/ infrastracture		Private Sector FCAs LGUs	14,200	18,200	19,110	20,066	21,069	92,644	2,356,846	2,480,890	2,979,935	3,478,931	11,296,601	Utilize VGF or viability gap fund for FCAs as start-up operating capital
Post-harvest and Marketing	Piloting large scale drying- milling systems with bulk handling - marketing linkage system	DA NCP BAFE RFOs	Private sector PhilMech PhilMaize FCAs FIs	N/A	N/A	N/A	N/A	N/A	N/A	1,500,000	1,500,000	1,500,000	1,500,000	6,000,000	Piloting shall be in key production areas (Reg 2, 10, 12); one pilot area per year

VC Segment	Action Points	Lead Agency	Partner Agency	Key Performance Indicators (KPIs)					Total Budget ('000 PhP)	Proposed Private Sector Investment (PhP '000)				Total Budget ('000 PhP)	Remarks
				2021 GAA	2022 NEP	2023	2024	2025		2022	2023	2024	2025		
Goal 2. Increased sufficiency of local corn across expanded and diversified markets supported by adequate market infrastructure															
KRA 4	**Developed/improved corn-based value chains in various scales of operation**														
Processing and utilization	Development and improvement of corn-based food value chains	DA NCP BAR	SUCs ATI FCAs RFOs Private sector	N/A	1,620	1,750	1,890	2,041	7,301	N/A	N/A	N/A	N/A	N/A	Includes technology commercialization
KRA 5	**Efficient marketing infrastructure and information system**														
Marketing	Development and maintenance of an Integrated Corn Industry Information System and Market Information Platform (e-trading)	DA ICTS AMAS	AMAD BPI DTI Private sector	N/A	N/A	20,000	20,000	5,000	45,000	N/A	N/A	N/A	N/A	N/A	This shall be a 2-phase development of corn MIS (with e- trading) to be initially lodged under AMAS in coordination with ICTS. It includes, data around planting intentions, harvest outlook, location and level of inventories, quality of commodity, prices, and other relevant information/data. It shall adopt state-of-the-art digital technologies such as satellite surveilling, use of GIS and AI. The previous e-trading platform developed by NFA shall also be revisited.
	Marketing assistance	DA AMAS	RFOs FCAs Private sector	N/A	N/A	15,000	15,000	15,000	45,000	N/A	N/A	N/A	N/A	N/A	Lodged under AMAS; includes market surveillance, linkaging, and investment clinic

APPENDIX II YELLOW CORN GRAIN PRODUCTION TARGETS (2021-2040)

YEAR	PRODUCTION (MT)	AREA HARVESTED (HA)	YIELD (MT/HA)
2021 [1]	6,057,783.01	1,438,056.43	4.21
2022	6,794,126.47	1,452,358.84	4.68
2023	7,289,141.27	1,479,183.52	4.93
2024	7,620,684.26	1,501,186.78	5.08
2025	7,820,648.43	1,511,460.67	5.17
2026	8,028,661.93	1,521,838.58	5.28
2027	8,251,083.37	1,533,812.91	5.38
2028	8,481,614.17	1,545,919.91	5.49
2029	8,717,970.20	1,558,164.61	5.60
2030	8,956,881.77	1,569,022.71	5.71
2031	9,235,812.73	1,579,930.37	5.85
2032	9,525,546.45	1,590,952.92	5.99
2033	9,835,680.98	1,602,097.53	6.14
2034	10,156,956.54	1,613,363.38	6.30
2035	10,511,971.02	1,624,748.74	6.47
2036	10,877,475.57	1,636,254.31	6.65
2037	11,260,030.52	1,647,887.24	6.83
2038	11,656,187.58	1,659,643.92	7.02
2039	12,076,785.15	1,671,540.44	7.22
2040	12,515,365.12	1,683,556.03	7.43

Notes:
[1] 2021 PSA Final Production Estimates
[2] 2022-2040 were estimated by DA-RFOs based on the 2021 PSA Production Estimate

APPENDIX III CORN SILAGE PRODUCTION TARGETS (2021-2040)

YEAR	PRODUCTION (MT)	AREA HARVESTED (HA)	YIELD (MT/HA)
2020 [1]	16,803.98	486.75	34.52
2021	28,588.00	1,065.00	26.84
2022	33,510.40	1,232.60	27.19
2023	34,075.45	1,247.70	27.31
2024	35,102.14	1,256.30	27.94
2025	35,319.28	1,262.91	27.97
2026	36,636.87	1,269.02	28.87
2027	36,833.40	1,273.63	28.92
2028	38,053.58	1,296.24	29.36
2029	38,251.22	1,300.85	29.40
2030	38,557.00	1,308.47	29.47
2031	38,967.54	1,318.08	29.56
2032	39,950.86	1,342.70	29.75
2033	40,200.17	1,347.32	29.84
2034	40,450.74	1,351.95	29.92
2035	41,183.00	1,358.57	30.31
2036	41,758.10	1,376.19	30.34
2037	42,505.65	1,384.82	30.69
2038	42,853.99	1,393.45	30.75
2039	43,204.13	1,402.08	30.81
2040	43,736.85	1,410.72	31.00

Notes:
[1] Corn silage production targets were simulated by DA-RFOs using 2020 regional production estimate as baseline
[2] Regions with existing corn silage production are as follows: Ilocos Region, Cagayan Valley, Central Luzon, CALABARZON, Bicol Region, Northern Mindanao, Davao Region and SOCCSKSARGEN