Mechanizing Philippine Agriculture for Food Sufficiency[1]

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I. Introduction

Agriculture is one of the prime movers of Philippine economy. The country has abundant raw materials that can be used to produce a wide spectrum of products for food, feed, and industrial applications. About 32% (9.56M has) of the total land area of 29.817 million hectares is under intensive cultivation, where 51% and 44% are arable and permanent croplands, respectively (Figure 1, BAS, 2010). In 2010, the major agricultural land utilization by area harvested is devoted to palay, corn, coconut, fruits and vegetables as presented in Table 1 (BAS, 2010).

Of the 94.01 million population with a rate of 2.04% (NSO, 2010), about 86% lives in the rural areas. Seventy-five percent (75%) of them depend on agriculture for employment and income. Although about 32% of the employment share comes from agriculture, many Filipinos remain unemployed or underemployed.

In 2010, the agricultural sector alongside fishery and forestry, contributed to about 12% of the gross domestic product (GDP) of PhP 9,003 Billion and accounts for about 8% of the county's export revenues (PhP 185 billion FOB)(BAS, 2010). The present condition of agriculture to the export market can be improved and expanded to include non-traditional products and processed products. There is a high potential of generating labor and livelihood activities in the areas of agricultural products and by-products processing, expansion of areas for cultivation, and intensification and diversification of agricultural production systems. These potentials however, are being hindered due to lack of appropriate agricultural engineering and mechanization technologies.

The application of environment-friendly and suitable technologies can possibly enhance and sustain cultivation of an additional eight million hectares. The introduction of environmentally sound agricultural machinery will, among others, enable the agricultural sector to fully utilize farm products and by-products; cultivate uplands, hilly lands, swamplands and other non-arable lands on a sustained basis; intensify and diversify farming systems which will, in turn, generate employment; conserve or even earn foreign currencies through local manufacturing and export of agricultural engineering technologies; reduce or minimize postharvest losses; increase the value added to farm products through secondary and tertiary processing; reduce pressures in the environment and help bring equity to the access of basic production resources.

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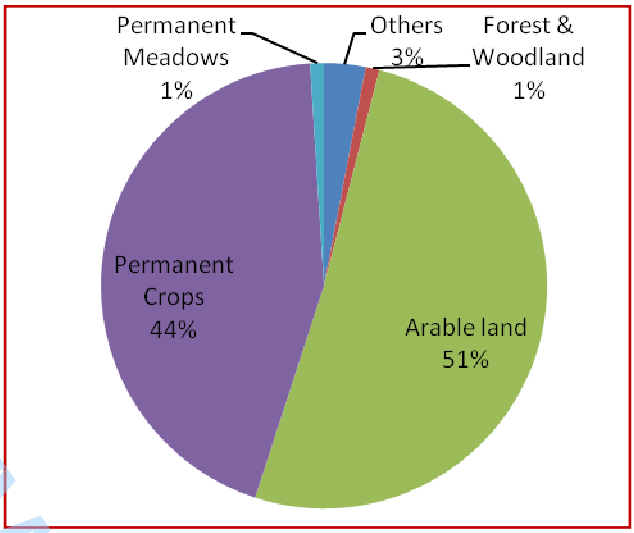

Figure 1. Distribution of agricultural area by type of utilization.
Source: BAS, 2010. Facts and Figures on the Philippine Economy

Table 1. Agricultural production of the Philippines, 2009.

(Year 2009) Crop	Area (Has)	Value (Million PhP)
Palay	4,532,310	238,353.57
Corn	2,683,896	76,952.29
Coconut	3,401,500	64,663.12
Sugarcane	404,034	29,906.86
Fruits	714,245	118,759.70
Rootcrops	330,373	17,068.40
Legumes	66,893	1,831.62
Vegetables	65,387	12,321.80
Fiber	135,081	2,355.04
Coffee	122,645	5,528.91
Cacao	9,538	-
Tobacco	26,104	3,057.74
Rubber	128,337	13,227.92

Source: Bureau of Agricultural Statistics.2009. http:countrystat.bas.gov.ph.

With the new government in place, efforts are being exerted to increase the production of agricultural products in the countryside. This intensified effort from the agricultural sector can reduce the dependence of the country on importing basic food products and expanding its capacity to export agricultural products. In 2010, the major agricultural products exported were coconut oil (31%), banana fresh (8%), tuna (9%), pineapple and products (6%). Major markets include the Netherlands, USA, Japan, Germany and Iran. The total value of agricultural imports on the other hand, was PhP 334 billion which accounted to 13% of the total import. The top agricultural imports

were rice (22%), milk and cream and products (8%), wheat (7%) and soybean oil/cake meal (5%) (BAS, 2010).

II. Present Farming Conditions

A. Soil Conditions

The Philippines has 15 regions with different soil characteristics which are as follows:

a. Well drained High fertility soil: Region 4
b. Well drained, generally acidic, high fertility volcanic soils: parts of Region 4
c. Well drained, deep, low fertility soils: most of Regions 1,2,3-5, 8-15
d. Poorly drained, flood prone soils: parts of regions 2-4, 6, 10-12
e. Poorly drained, high to moderate fertility soils: parts of Regions 3, 5, 6, 11, 12
f. Heavy textured soil with shrink-swell potential: parts of Regions 1-4, 6, 11, 12
g. Droughty, low fertility sandy soils: Parts of Regions 3 and 6.

B. Irrigation and Drainage

Irrigation and drainage play an important role in producing agricultural crops in the country. In 2002, about two million farms (41.1 percent of the total farms in the country) with a total area of 2.9 million hectares were supplied with water, or 30.3 % of the total farm area of the country. Individual system of irrigation is most common which supplied water to 660.8 thousand farms with an irrigated area of one million hectares. The national irrigation system administered by the National Irrigation Administration (NIA) followed next, which covered 774.7 thousand hectares of farms while communal irrigation system came in third, supplying water to 581.5 thousand hectares of farms. There were other systems of irrigation used by farms such as water fetching, waterwheels, etc., which supplied water to 522.8 thousand farms with a total irrigated area of 573.6 thousand hectares (NSO, 2002).

C. Cultivation System

The average landholding of farmers in the country is around 2 hectares with plot sizes ranging from 500 to 10,000 sq. meters (NSO, 2002). There are around two cropping seasons implemented by farmers per year with rice as the main crop and some cash crops or leguminous crops as the second crop. In areas where water is abundant throughout the year, three croppings are being observed

The main draft animal used in land preparation operation is the carabao with a single native moldboard plow trailing behind. This system is used in land preparation for rice and corn. It is also utilized in coconut growing areas when the area is being intercropped with corn and other agronomic crops. In recent years however, the use of two wheel tractor has been increasing. Most farmers especially those that are growing rice and corn which are the staple food of Filipinos use 2wheel tractors for land preparation operations. For sugarcane plantations however, four-wheel tractors are being utilized. The main tillage implement used are as follows: for draft animals- native moldboard plow; for power tillers- disk plow, single moldboard plow, rotary tillers; for four wheel tractors- moldboard plow, disk plow, disk harrow, rotavators.

D. Availability of Labor

Although the country is experiencing a soaring population, the available labor in the farm has been decreasing over the years. In 2008, there were 12.03 million persons employed in the agriculture sector which accounts 35% of the total employment in the country and about three-fourths were male workers. In 2010, it went down to 11.96 million persons accounting to 33% of the total employment share (BAS, 2010). It is also interesting to note that the average age of farmers is about 57 years old. In the CALABARZON region, most of the farmers involved in the farm ages 41 years and older consisting of about 65% and this proves that the active farmers are aging as shown in Figure 2 (Amongo, 2011).

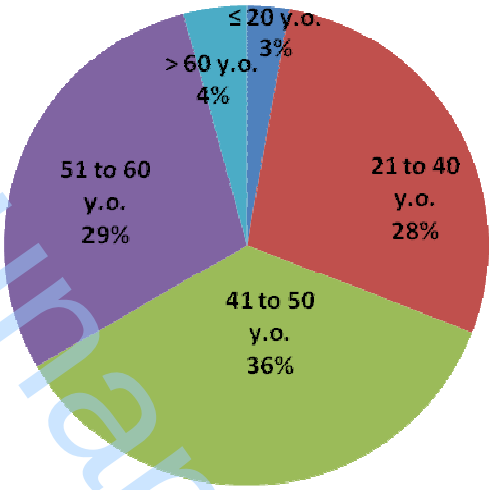

Figure 2. Age distribution of farmers in CALABARZON region.
Source: Amongo, 2011

III. Present Situation of Agricultural Mechanization

A. Levels of Mechanization

In the Philippines, there are three major levels of mechanization according to UPLB-BAR, 2001. These are as follows:

1. Low mechanization which means that the operations are done with the use of non-mechanical power source such as man and animal.
2. Intermediate mechanization which means that the operations are done with the use of non-mechanical power source in combination with the use of a mechanical power source operated by man.
3. High mechanization which means that the operations are done solely with the use of mechanical power source operated by man.

A fourth level considered is full mechanization, which means that the operations are done with the use of mechanical power source with limited human intervention such as computerized machines or robots.

In spite of the various advancements in mechanization technologies, the level of agricultural mechanization in the Philippines in terms of available mechanical power in the farm is still low at 1.68 hp/ha (Rodulfo & Amongo, 1994) compared to other Asian countries such as Japan, Korea and China.

The level of agricultural mechanization in the different farming operations of selected crops is shown in Table 2. In rice and corn production, only land preparation and threshing are done with the use of mechanical power source operated by man, while milling operation is highly mechanized. The use of locally fabricated, imported or second hand (imported) hand tractors in plowing and harrowing operations has increased over the years. Threshing is done using axial flow threshers powered by diesel engines while cleaning and bagging are done manually. At the farmers' level, sun drying is still the predominant method of drying in multipurpose pavements (e.g. basketball courts) and rakes for mixing palay, although some farmers are using the flatbed dryers. Traders and millers who buy wet palay from farmers utilize mechanical dryers (e.g. continuous flow or batch recirculating dryers). Rice milling operation is done using rubber roll rice milling machines by small-scale rice millers, while big rice millers utilizes modern and energy-efficient rice mills.

For corn production, harvesting is done manually although in clustered farms, there is an effort to introduce mechanical harvesting. Dehusking is either done manually or through the use of a husker sheller. Shelling is predominantly done using mechanical shellers while drying is done through sun drying or with the use of flatbed dryers or other mechanical dryers.

Table 2. Mechanization levels in various operations of selected crops.

Operation	Rice & Corn	Vegetables Legumes & Root crops	Coconut	Sugarcane	Fruits	Fiber Crops
Land Prep	Intermediate to High	Low		Intermediate to High	Low	Low
Planting/ Transplanting	Low	Low	Low	Low to Intermediate	Low	Low
Crop care cultivation	Low	Low	Low	Low to High	Low	Low
Harvesting	Low	Low	Low	Low		Low
Threshing/ shelling dehusking	Intermediate to High	Low (Legumes)	Low			
Cleaning		Low				
Drying	Low	Low (Legumes & Rootcrops)	Low			Low
Milling/Village level processing	High	Low	Low		Low	Low

Source: PCARRD, 2009

The predominance of manual operation and absence of mechanical power in the production of other crops yields a lower level of mechanization than those of rice and corn. However, the level of mechanization is high for sugarcane, pineapple and banana due to the presence of imported machines for large-scale operations of

multinational corporations. Although harvesting is still done through manual labor, there are attempts to introduce mechanical harvesters, especially in large-scale sugarcane plantations. The other postharvest and processing operations are mostly done using mechanical machines.

B. Distribution of Farm Machinery

Table 3 shows the data of the census of major farm machinery in the Philippines in 2002. There had been a rapid increase in the utilization of hand tractors from about 200,000 units in 1998 to 1.5 million units in 2002 because of the need at that time to produce more food for the increasing population.

Table 3. Census of major farm machinery in the Philippines, 2002.

Farm Machinery	Number of Units
Plow	2,723,850
Harrow	1,643,325
Sprayers	1,941,050
Hand Tractor	1,526,557

Source: Bureau of Agricultural Statistics.2002. http:countrystat.bas.gov.ph.

C. Farm Machinery Manufacturing

There are around 350 identified agricultural machinery manufacturers and dealers in the country as shown in Table 4. Sixty nine percent are located in Luzon, 11% in the Visayas and 20% in Mindanao. About one-third of them are based in the National Capital Region. Many of these agricultural machinery manufacturers and dealers are not organized except for a few who are members of the Agricultural Machinery Manufacturers and Dealers Association (AMMDA) with only about 30 members.

A mixture of importation and local manufacturing characterizes the local agricultural machinery manufacturing industry. Four-wheel tractors and engines are wholly imported (Table 5). The demand for four-wheel tractors has increased in the last four years and is estimated to be 500 units per year. The increase in the demand may be due to the competitive price of sugar in the world market and the increasing production of yellow corn for animal feeds. Another potential use of the four-wheel tractors are the recent developments in the production of raw materials for alternative fuels such as sugarcane and Jatropha (Canapi, 2010).Tractors with 90 Hp are at the forefront of land development of crop plantations for alternative fuel.

Other machines such as power tillers, pumps, transplanters, seeders, weeders, reapers, and postharvest equipment are locally manufactured. However, these manufactured machines have high import content since the engines, electric motors, gearboxes, bearings, chains, sprockets, cold roll steels and perforated sheet metals are all imported.

Table 4. Distribution of agricultural machinery manufacturers and dealers

REGION		NUMBER	PERCENT
Luzon:	I	18	5.1
	II	22	6.2
	III	35	9.9
	NCR	113	31.9
	IV	29	8.2
	V	27	7.6
Visayas:	VI	30	8.5
	VII	2	0.6
	VIII	7	1.9
Mindanao:	IX	13	3.7
	X	18	5.1
	XI	19	5.4
	XII	21	5.9
TOTAL:		354	100

Source: AMTEC Data 1999

Table 5. Sales of agricultural machinery by AMMDA (as of January 2009).

MACHINE	Brand	YEAR				
		2006	2007	2008	2009	Total
Tractors						
Standard (>32 hp/ 23.87kW)	John Deere, Valtra, Kubota, Daedong, Massey Ferguson, New Holland, Same, and Eurostar	195	242	182	10	629
Compact (≤ 32 hp/ 23.87kW)			1	10	2	13
Combined Standard & Compact Tractors		195	243	192	12	642
Two-wheel Tractors						
Pull Type	Fieldstar Orec Kuliglig Kato	1608	552	485	28	2673
Floating		314	49	44	4	411
With rotary			75			
Postharvest/ Structures and Farm Processing Equipment						
Reaper	ACT, Kuliglig, Kato	2	100			102
Rice Thresher		1020	8	45	18	1091
Corn Sheller		6	9			15
Farm Trailer				55		55
Rice Mill		71	61	207	6	345
Dryer						
Flatbed Type	Fix, Casareno, KOLBI, Kuliglig, Kaneko, ACT	7	1	5		13
BPRE Type	PADISCOR	7	1	3		11

Source: PCARRD, 2009

D. Agricultural Machinery Testing and Evaluation

The Agricultural Machinery Testing and Evaluation Center (AMTEC) of the College of Engineering & Agro-industrial Technology (CEAT), University of the Philippines Los Baños (UPLB) was established in 1977 to ensure the standard quality of agricultural machineries being distributed in the country. Its main job is to establish technical standards and test the machines to meet these standards. However, testing of machines is voluntary and only manufacturers participating in government bidding for agricultural machinery are required to submit their machines for te mandated to issue certificates of performance on machi

Figure 3. AMTEC Facilities for agricultural machinery testing.

AMTEC has been active in performing its role. To date, about 152 standards were developed and adopted through the leadership of AMTEC. Moreover, 263 machines (Figure 3) were tested from 2006 to 2009 which consisted of prime movers, irrigation machinery, production machinery and postharvest equipment (AMTEC, 2010).

E. Maintenance and Repair System of Farm Machinery

The manufacturers and dealers of various farm machineries offer after sales services. These services come in the form of parts replacement and guarantees. To some extent, they also provide free service and repair. The government also conducts training on operation, repair and maintenance (ORM) of machines as part of its extension activities. The Agricultural Mechanization Development Program (AMDP) of the Institute of Agricultural Engineering (IAE), College of Engineering & Agro-industrial Technology (CEAT), University of the Philippines Los Baños (UPLB) is one of the government agencies that conduct training on ORM of agricultural machineries.

CEAT established the Agricultural Mechanization Development Program (AMDP) in 1979 in response to the project of the United Nations Development Programme (UNDP) implemented by the Economic and Social Commission for Asia and the Pacific (ESCAP) named then as the Regional Network for Agricultural Machinery (RNAM) and now known as the Asia and the Pacific Center for Agricultural Engineering and Machinery (APCAEM). The program remains an essential activity of CEAT with APCAEM being the Philippine representative in the promotion of technical cooperation among developing countries for the advancement of agricultural mechanization in Asia and the Pacific. AMDP serves as the research and extension arm of CEAT which conducts policy formulation, research, development and extension (RDE) of agricultural mechanization technologies. It has assisted various levels of government through its RDE activities and manpower training.

Particularly, AMDP had developed tools, implements and/or technology packages for rice, corn, coconut, cassava, fiber, vegetables, livestock production and processing, technologies for farm waste treatment and management, and technologies on renewable sources of energy; and drilling equipment for shallow tube irrigation. The

shallow tube well technology then became the centerpiece of the Agricultural & Fisheries Modernization Act of 1997 (AFMA). Some of the technologies developed by AMDP included the UPLB hand tractor, village-level rice mill, cassava lifter, UPLB drilling rig, manual corn sheller, motorized corn sheller, multicrop dryer, oil expeller, forage chopper, whole-nut cashew sheller, corn mill, organic fertilizer applicator, mini-hand tractor, windmill, village level ethanol production system, and corn planter.

AMDP had conducted various training programs such as trainors' training for the DA Agricultural Extension Workers on the operation and maintenance of agricultural machinery; and training for agricultural machinery manufacturers. Moreover, it has published and disseminated journals namely, the Philippine Agricultural Mechanization Journal (PAMJ) and the Philippine Journal of Agricultural and Biosystems Engineering (PJABE). These publications provided the researchers, extension workers and students with the recent developments in agricultural engineering and machinery. The PJABE is the only refereed journal in the Philippines on agricultural and biosystems engineering.

CEAT/IAE-AMDP's participation to APCAEM (formerly RNAEM) has been proven beneficial in terms of manpower development through attendance in training, study tours, regional workshops, and seminars on agricultural mechanization. It has provided a venue for technical cooperation among the member agencies in terms of prototype exchange of agricultural machinery; exchange and sharing of accumulated experience of the National Institutes; access to valuable and up-to-date publications and information on agricultural mechanization, information and communication technology networking among member countries; and access to the RNAM testing codes for the improvement of the quality of agricultural machinery for increased efficiency and environmental and safety standards.

AMDPs RD&E efforts developed a pool of experts, engineers and technical staff with expertise in design, development and testing of agricultural technologies; packaging of technology for extension effective delivery system; publication of journals on agricultural and bio-systems engineering; continuing collaboration/ networking and providing policy recommendations for the improvement of the agricultural sector the country.

At present, the current RDE efforts of AMDP focused on corn mechanization, high-value commercial crops (HVCC) mechanization, farm power and renewable energy mechanization, and other special projects towards the promotion of agricultural mechanization utilization/adaptation in the country. The list of current AMDP projects is shown in Appendix A.

F. Cooperative and Financing System

The Cooperative Development Authority (CDA) in the Philippines is tasked to deal with the formation and promotion of cooperatives in the countryside. Credit for agricultural machinery may come from bank or non-bank sources. The non-bank source comprises mostly of machinery dealers and landlords. Manufacturers and

distributors also extend in-house credit which requires a 50% downpayment. The remaining balance is payable after the first harvest, where the machine cost is mainly based on the list price which is 20% higher than the cash price. The government banks or financing institutions such as the Land Bank of the Philippines (LBP) and the Development Bank of the Philippines (DBP) grant loans to farmer cooperatives for the acquisition of different farm inputs including farm machineries. These banks also grant loans for livelihood programs related to the processing of agricultural commodities for food and other products.

G. Enacted Laws that Support the Advancement of Agricultural Mechanization

Basically, the main targets of agricultural development in the Philippines are the farmers and fisherfolks in the countryside. These are the people who produce the country's basic food requirement and the raw materials needed in the industrial sector.

In the past, various agricultural policies were enacted into laws to ensure the delivery of various goods and services for the development of the agricultural sector in the country. Among the most popular laws that were enacted are the Comprehensive Agrarian Reform Law (CARP) of 1988 and the Agriculture and Fishery Modernization Act (AFMA) of 1997. CARP is pursued to promote social justice among landless farmers/farm workers and to move the nation toward sound rural development and industrialization. On the other hand, AFMA is pursued to modernize the agriculture and fisheries sectors of the country to enhance their profitability and prepare these sectors to the challenges of globalization through an adequate, focused and rational delivery of necessary support services.

Another law, known as the Biofuels Act of 2006 was enacted to reduce the country's dependence on imported fuels with due regard to the protection of public health, the environment, and natural ecosystems consistent with the country's sustainable economic growth that would expand opportunities for livelihood. The law mandates the use of biofuels as a measure to develop and utilize indigenous renewable and sustainably-sourced clean energy sources to reduce dependence on imported oil, mitigate toxic and greenhouse gas (GHG) emissions; increase rural employment and income, and ensure the availability of alternative and renewable clean energy without any detriment to the natural ecosystem, biodiversity and food reserves of the country. With this law, greater potentials were opened for the agricultural industry to produce the raw materials that would be used in producing biofuels. This also opens the opportunity of utilizing mechanization technologies in biofuels production and post production processes.

To date there is a pending bill for legislation on agricultural mechanization which would rationalize the implementation of agricultural mechanization in the country.

H. Current Government Efforts Toward Food Sufficiency

The recent worldwide problem on food, energy and environment has led to different scenarios in the Philippines. In 2008, the price of rice has soared to its highest level in 34 years, causing social and political unrest. The price of rice in the Philippine market

soared to $ 1.15 per kilo in March 2008 from as low as 50 cents few weeks earlier. This period also made most of the urban poor line up in the streets to buy rice. Thus, millions of Filipinos faced food insecurity and hunger.

To address this problem, the government provided stop gap measures. One of which is the importation of rice from other countries like Vietnam, Thailand and the United States amounting to 2.2 million tons. The government also imposed lower tariffs and doubled the import quotas to encourage more participation from the private importers (Grenfell, 2008). The Department of Agriculture planned to improve the agriculture sector by launching the program "FIELDS" meaning -- F for fertilizer, I for irrigation and infrastructure, E for extension and education, L for loans and insurance, D for dryers and other post-harvest facilities, and S for seeds in the middle of the rice crisis. This is to give assistance to rice farmers and other stakeholders in the rice industry and billions of pesos were allotted for this emergency agricultural program. The private sectors were also encouraged to practice corporate farming or to ensure that employees are given rice subsidies through planting of rice by the country's biggest corporations (Palatino, 2008).

However, some government officials were saying that the rice crisis was just an artificial phenomenon. They blame it to rice hoarders and smugglers for distorting rice inventories in the country. They believed that the Philippines is only experiencing a rice distribution crisis and that supply is stable. Many speculations came out because of the soaring price of rice. Some says that this is a political matter. Others say that it is a rice cartel scenario. Peasant groups on the other hand, believed that rice importation is the reason behind the worsening rice crisis and placing the country in greater food insecurity.

With the new government in 2010, the DA has rationalized its different units to address the current flagship program of the government in agriculture particularly to attain food sufficiency. The government launched the program Agri-Pinoy - Food Staple Sufficiency (FSS) Program. This program does not focus only on rice and corn but also on other root crops and plantain and consider these crops as critical for food and income security. It considers self-sufficiency to include policies that drive a wedge between the domestic and the world price of rice. With the FSS Program, they estimated the supply and demand of rice in the next 5 years which is expected to soar up as presented in Figure 4.

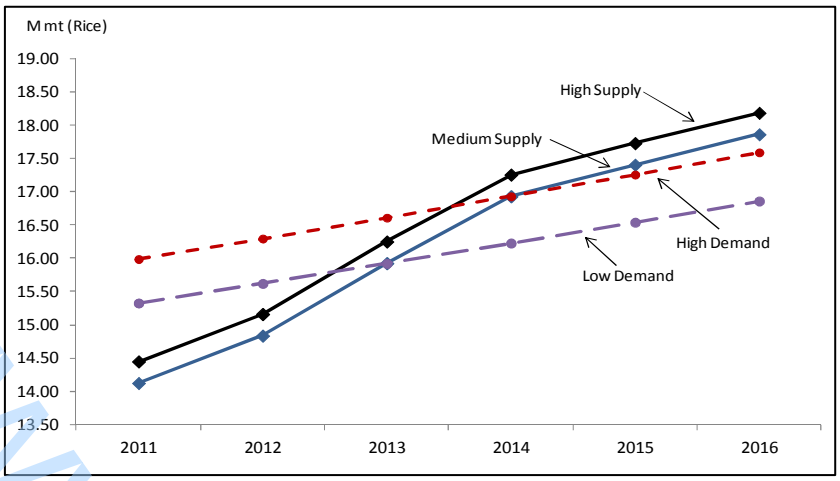

Figure 4. Rice supply and demand estimates, 2011-2016.
Source: DA Rice Program, 2011.

The FSS program aims among others the upliftment of productivity and competitiveness of farmers by enhancing economic incentives and enabling mechanisms to achieve food sufficiency. It also envisions to manage food staples consumption and strengthen the program management and implementation.

To enhance productivity and competitiveness of farmers, the FSS program include the generation, rehabilitation, restoration, and modernization of irrigation facilities; promote access of farmers to quality seeds be it inbred or hybrid seeds; promote R&D activities through Location Specific Technology Development (LSTD) and Impact Assessment and Policy Researches; ensure timely farm operations and reduce labor cost thru on-farm mechanization (tillers, transplanters, harvester-threshers); minimize losses in the drying and milling operations using mechanical dryers and modern rice mills. On the other hand, the enabling mechanism to implement the program needs market reforms by strengthening the price support and procurement policy of the government through its line agency, the National Food Authority. It must also strengthen its credit and insurance facilities for easier availment by the farmers and other stakeholders (DA Rice Program, 2011).

According to the Philippine Center for Postharvest Development and Mechanization (PhilMech, 2011), there are three national major policy/programs needed to achieve rice self-sufficiency by 2013. These are: expansion of production area and irrigated land; improvement of productivity (yield) through provisions of HYVs, fertilizer, ESETS, mechanization, etc.; and reduction of postharvest losses. PhilMech is mandated to take the lead role in implementing the different plans and programs of the government in mechanizing the agricultural sector to increase yield and to attain food sufficiency. Among its goals are: to enable rice farmers to increase their access and use of appropriate production and postproduction systems and to be able to realize added income for farmers of at least 15% from efficient production activities, drying and milling operations. To achieve its goals, PhilMech plans to implement the provision of farm mechanization facilities and equipment to Farmer Associations (FAs). Primary machineries such as hand tractors,4-wheel tractors, threshers; ssecondary machineries such as seed cleaners, reapers, drum seeders, mini combine

harvesters and combine harvesters; and postharvest facilities such as dryers and multi purpose drying pavements will be made available to FAs in the form of grant under counterpart scheme. Moreover, rice milling system such as rice mills, warehouses and other milling facilities will be made available to farmers through the counterpart scheme and private millers through soft loans. The physical target of the Center is shown in Tables 6.

Table 6. Farm mechanization physical target of PhilMech for 2012-2016

Farm Machinery	Total
Primary	
Hand Tractor	31,000
4-Wheel Tractor	500
Thresher	10,333
Secondary	
Seed Cleaner	1,800
Drum Seeder	4,000
Reaper	3,000
Combine Harvester	80
Mini Combine	80
Postharvest Facilities	
Mechanical dryers	3,253
Multi purpose drying pavements	3,577
Rice mills for farmers	329
Rice mills for private millers	125
TOTAL	58,076

Source: PhilMech, 2011

Another government institution, the NFA supports the program of the government on rice sufficiency. Among the programs of NFA is the implementation of the NFA Grains Highway to improve the postharvest situation and reduce production and postharvest losses. The grains highway is defined as "the supply chain that links production, post harvest and marketing activities in both the major rice/corn production and consumption areas, including their support infrastructure for the efficient delivery and timely movement of quality grains and cereals from the farmers to ultimate consumers." These facilities will be established in major rice producing and distribution areas. The objectives of the program are to: improve and broaden the base to reduce post-harvest losses; facilitate the inflow of rice and corn at any time; make the rice and corn quality requirement available to traders and consumer; eliminate wide price fluctuations in the market and wide gaps between supply and demand; and allow access to NFA warehouses and other post-harvest facilities to small and medium scale food businessmen (Navarro, 2007).

The Philippine Grains Postproduction Consortium (formerly Philippine Rice Post Production Consortium) is an alliance of 5-government agencies and the International Rice Research Institute as collaborating agency, concerned with grains postproduction research and extension to address numerous problems of the grains industry. The government member agencies are the Philippine Center for Postharvest Development and Mechanization (PhilMech), National Food Authority (NFA),

Philippine Rice Research Institute (PhilRice), the University of the Philippines Los Baños (UPLB), and the National Agricultural and Fishery Council (PGPC Brochure, 2011).

IV. Problems, Issues and Constraints in Agricultural Mechanization and Recommendations

There are many problems and issues besetting the implementation of agricultural mechanization in the country. Many experts have analyzed the various factors that interplay in the success or failure of mechanizing the agricultural sector. Among others, these included:

a. Absence of a comprehensive national program for agricultural mechanization development.

The country has fragmented policies and programs aimed at only one or few aspects of agricultural mechanization. Although there are efforts of the government to create a body in charge of coordinating and orchestrating the various efforts being done by the government and private sectors toward the development of agricultural mechanization, there has been no comprehensive national program that will address the problems of agricultural mechanization. These efforts should be integrated and molded into a national program for agricultural mechanization to create the desired impact on the country's agricultural development.

The present mandate given to the Philippine Center for Postharvest Development and Mechanization (PhilMech) on mechanization is envisioned to integrate mechanization efforts for the agricultural sector in the country. This will be reinforced by the present bill on agricultural and fisheries mechanization which will give various research and development agencies (including AMDP) to have their respective roles concerning mechanization.

b. Inadequate coordination of agricultural mechanization R&D activities.

At present, various government agencies and private sectors involved in agricultural mechanization conduct separate R&D activities that lead to duplication of efforts and misuse of resources. Moreover, only few have been done on the comprehensive assessment of the status, resources available and needs for agricultural mechanization. Hence, there should be an in-depth study of the status and needs for agricultural mechanization in the country to come up with an appropriate strategies for its successful implementation.

c. Small farm sizes

Small farm sizes and fragmented farms have always been the issue in the implementation of an economically sound agricultural mechanization strategy. Small farm size defies the principle of economies of scale and would not produce the volume needed for bulk processing. Hence, land consolidation or farm clustering should be encouraged for efficient utilization of agricultural machinery. It should be

noted that most countries implementing successful mechanization programs like Japan, Korea and Thailand, have consolidated their farms for a systematic, synchronized farming operations with the help of agricultural mechanization technologies that increased their agricultural and labor productivity and efficiency in performing farm operations.

d. Inadequate extension program and technology transfer mechanisms

The benefits derived from agricultural mechanization are still unclear to most farmers in the countryside. The education and training of farmers, operators and even extension workers are inadequate and need intensification from both government agencies and machinery manufacturing firms. Extension workers together with the machinery manufacturers are agents of change, hence they should be well-equipped in extending agricultural mechanization technologies. They must have the interpersonal communication skills as well as the technical qualifications (Paras & Amongo, 2004).

Moreover, the results of R&D do not reach the intended end-users and, therefore, could not create the necessary impact in the countryside. The breakdown of many machines in the field is mainly due to the lack of training of machinery operators. Hence, there should be a massive information campaign together with the formulation of a comprehensive program that would encourage the use of farm machinery in the countryside. Extensive demonstrations and training on the operation, repair and maintenance of agricultural machinery at the farmers/operators' level should also be undertaken to promote the adoption and use of mechanization technologies. Moreover, agro-industrial extension for the manufacture of agricultural machinery especially outside the NCR should be a continuing effort.

e. Inadequate support services

The demand for agricultural machinery is greatly dependent on the availability, cost, and ease of obtaining credit. The limited credit for machinery from government credit programs has resulted in the sales of agricultural machinery on a cash basis. Nonetheless, the purchase of agricultural machinery through credit via the commercial banks is no longer viable because of the high interest rates. Even where there is a credit facility available, the long and tedious processing of loans discourages both farmers and manufacturers/distributors. Also, the lack of comprehensive program in agricultural mechanization limits the acquisition of farm machinery through credit from cooperatives. Further, groups of farmers who are not members of cooperatives have no access in acquiring machines through credit.

There should be a comprehensive program to encourage acquisition of farm machinery outside the cooperative to allow small groups of farmers in availing such technologies. Aside from this, farmers, manufacturers and rural entrepreneurs should also be encouraged to join cooperatives and associations that have the leverage to transact business with government lending institutions and guarantee the repayment of loans. Aside from credit support, the government should also establish support facilities that would take care of after sales services and effective marketing systems

to ensure the machines' acceptability to farmers to further promote the use of agricultural machineries in the country.

Other support system from the various line agencies of the government especially those that directly involve in the agricultural production system have been in place. It is hoped that continued government support and interventions coupled with the appropriate investments on environmentally sound and appropriate agricultural mechanization technologies will improve productivity, income of stakeholders, reduce postharvest losses of rice and corn and other agricultural commodities to achieve food sufficiency.

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Appendix A. List of AMDP on-going projects

College/ Unit	Title of Project	Project Leader/In Charge
Corn Mechanization Sub-Program		
AMDP- IAE, CEAT	Design, Fabrication and Test of a Push-Type Fertilizer Applicator for Side Dressing	JC Orozco
AMDP- IAE, CEAT	Design, Fabrication and Test of a Push-Type Corn Planter	JC Orozco
AMDP- IAE, CEAT	Development of Corn Sheller for Seeds (High Moisture Sheller)	A.C. del Rosario
AMDP- IAE, CEAT/ w/ CA-FSTP	Development of Small-Scale Corn Machinery and Equipment for FSTP	J.D. De Ramos A.C. del Rosario
AMDP- IAE, CEAT	Design and modification of mini corn mill	VA Rodulfo, Jr.
High Value Commercial Crops Mechanization Sub-Program		
AMDP- IAE, CEAT	Development of a technology package for cassava flour processing	RS Pangan
AMDP- IAE, CEAT	Development of a low-lift pump utilizing locally available materials to be attached to a savonious windmill	RS Pangan /JD De Ramos
AMDP- IAE, CEAT	Establishment of HVCC Production Farm Training Center Utilizing Appropriate Mechanization Technologies	RS Pangan/BC Geronimo
AMDP- IAE, CEAT	Development of Production Machinery for the Production of Organic Fertilizer	RSPangan/BC Geronimo
AMDP- IAE, CEAT	Design and development of mechanization technologies for Adlai and Peanut	J.D. De Ramos A.C. del Rosario
Other R&D Projects		
AMDP- IAE, CEAT	Design and development of a pneumatic dryer for agricultural by-products	VA Rodulfo, Jr.
AMDP- IAE, CEAT	Characterization of selected feedstocks (jatropha, oil palm, adlai)	MR Santiago
AMDP- IAE, CEAT	Design and Development of Mechanization Technology for *Jatropha* waste and by-products processing	MR Santiago
AMDP- IAE, CEAT	Optimization of the citronella oil extraction facility	VA Rodulfo, Jr. RS Pangan J.D. De Ramos
AMDP- IAE, CEAT	Socio-economic and mechanization profile of the corn production-processing system of the Calamba project site **(with R&D and Extension component)**	MVL Larona MC Bueno
AMDP- IAE, CEAT	Updating the level of mechanization collaborative activity with PHILMECH (Proposal Stage)	RC Amongo VA Rodulfo, Jr. MVL Larona A.C. del Rosario
Faculty-based Projects		
ABPROD-IAE, CEAT	Rice Hull/Corn Cob Furnace for Non-Power Applications	AR Elepaño EV Casas
PHRTC & ABPROD-IAE, CEAT	Mechanization of Heat Treatment of 'Carabao' Mango for Quarantine Disinfestation and Disease control	KF Yaptenco JD De Ramos

College/ Unit	Title of Project	Project Leader/In Charge
AMD-IAE, CEAT	Design and Installation of a Micro-Hydro Generator	RC Amongo AL Fajardo RLCatriz
AMD-IAE, CEAT	Anthropometric Survey of Farmers for Agricultural Machinery Design in the Calabarzon Areas	RC Amongo MC Petingco
LWRD-IAE, CEAT	Evaluation of the sustainability of a drip irrigation system and its potential in increasing the level of mechanization in a corn-based farm in Kay-Anlog, Calamba City	MG Villano AL Fajardo
Extension Projects/Activities		
AMDP- IAE, CEAT	Field Testing of Multicrop Pneumatic Planter (Modification of Fertilizer Applicator)	BC Geronimo JC Orozco
AMDP	Introduction of Corn Mechanization Technologies in Region 7	AC Del Rosario JD De Ramos MC Bueno
AMDP	Corn Production and Processing Mechanization Program in Region IV (Calamba City)	MCBueno
AMDP	High value crops and Corn Production and Processing Mechanization Program in Region IV Introduction of mechanization technologies for white corn production in Bondoc peninsula	BC Geronimo RS Pangan
AMDP	Pilot testing of the AMDP Corn Mill for Food and Feed Milling in Pilot Area	VA Rodulfo, Jr. MC Bueno
AMDP	Publication of the Philippine Journal of Agricultural & BioSystems Engineering (PJABE); Philippine Agricultural Mechanization Bulletin (PAMB); other extension materials (e.g. leaflets, posters in tarpaulin, etc)	RC Amongo JL Movillon EK Peralta RB Saludes AA delos Reyes MV Larona
Dean's Office/ AMDP	Publication of the CEAT Newsletter	RC Amongo MVL Larona Dept/Div Coordinators
AMDP	Promotion of AMDP developed agricultural mechanization technologies • Production of audio/visual presentation for AMDP • Publication of printed materials for information dissemination of agricultural mechanization (brochures, leaflets, posters, etc.)	MC Bueno BC Geronimo MR Santiago/MC Bueno MVL Larona/MR Santiago
AMDP	Conduct of symposiums/conference	MR Santiago MC Bueno MVL Larona
AMDP	Establishment of network/collaborative activity with local manufacturers	VA Rodulfo, Jr. MVL Larona MC Bueno
AMDP	Development of the AMDP Website (effective July 2010)	JD De Ramos MVL Larona
AMDP- IAE, CEAT/ w/ CA-FSTP	National Implementation of Farmer Scientist Training Program (FSTP) collaborative project with FSTP-College of Agriculture	J.D. De Ramos A.C. del Rosario