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Effects of the Extensive Use of Mechanization on Farm Labor Use and Patterns in Rice and Corn Production Systems in the Philippines

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ABSTRACT

The study assessed the status of farm labor use and changing patterns as a result of extensive mechanization in the farm labor sector. It showed that the extensive use of mechanization, specifically for land preparation, planting, harvesting, threshing, and shelling, decreased the demand for manual labor in terms of man-day per hectare requirement. The study indicated significant reports on the changes in labor arrangements in farm operations from planting-harvesting arrangement to land preparation-harvesting arrangement, payment agreement (daily wage to informal contract), and mode of contracting labor (hired to family labor). The study also showed significant reports of labor shifting of farm workers from on-farm to off-farm activities. Three (3) policy recommendations were provided as a result of the study: (1) organization and recognition of landless farmworkers; (2) provision of training, upskilling, and employment opportunities; and (3) integration of the organized landless farm workers as human capital input needed in the establishment of Farm and Fisheries Clustering and Consolidation Program (F2C2) of the government.

Keywords: mechanization, farm labor, labor use, labor pattern, farm labor shifting, landless farm workers

INTRODUCTION

Over the years, rice and corn farms have become increasingly mechanized as influenced by the government's policy direction to increase productivity for food security and sufficiency.

Other contributing factors to mechanize are issues on low competitiveness due to the high production cost, increasing cost of farm labor due to its dwindling number and aging farm workers, climate change, need for irrigation, and the challenges of Association of the South East Asian Nations (ASEAN) integration. Enabling policy conditions

on food security and mechanization as well as prevailing conditions mentioned above have influenced the shift from most manual labor farm practices to mechanization in the rice and corn sector. The enactment of Republic Act 10601 or the “Agricultural and Fisheries Mechanization Law” and the Agricultural and Fisheries Modernization Act hastened the transition, in part with the budget allocation for mechanization. Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) (2019) indicated that budget for each banner program allocated specifically for agricultural equipment and facilities support, were 31.62% for rice and 43.98% for corn of the total budget for the respective national commodity program from 2011-2016.

Mechanization as a technological intervention has an indirect effect on crop yield. Unlike farm inputs, such as fertilizers, which have a pronounced effect on yields, mechanization leads to greater timeliness of operation, reduces crop losses, increases farming efficiency, increases overall productivity, increases cropping intensity and maximizes economies of scale that has the overall effect of a better farming enterprise.

Recently, there had been an observed shift of the labor force from agriculture to the industry and services sector in the country (**Figure 1**). The labor shift is a good indication of the country’s development towards industrialization. However, with the government program on the extensive distribution and utilization of mechanization, continued decline in the labor workforce in agriculture is observed. A significant factor contributing to the movement of labor was the difference in the daily basic wage of workers in each sector. In 2018, the minimum daily wage of an agricultural worker was only PhP306.28 as compared to the minimum daily wage of an industry and service (non-agricultural) worker that ranged from PhP317.00 to PhP400.00 (Philippine Statistics Authority, 2019). Other economic factors affecting the decline of

agricultural employment were the rapid growth and tightening of labor markets in the manufacturing (industry) sector (Philippine Statistics Authority, 2013-2020).

Other factors contributing to the decline in agricultural labor force, is the continued aging of farmers. Amongo et al. (2013) indicated that the average age of rice farmer was about 53 years old for four regions surveyed, (Region 5, Region 6, Region 8 and Region 4B), while the average age of corn farmers was 50 years old for the 3 regions (namely, Region 5, Region 6, and Region 8). Amongo et al., (2017) indicated that the average age of farmers in Masbate was 50 years old. Other studies in various sites of the Philippines (Amongo et al. (2013); SEARCA (2019)) noted the general observation that rice and corn farmers ranged from 50-60 years of age.

SEARCA (2019), revealed that for the regions surveyed, rice farmers-respondents perceived that there was insufficiency of labor for land preparation, planting, harvesting, and drying. Similarly, the study indicated that corn farmers-respondents perceived that there was also insufficiency of labor for land preparation, planting, harvesting, and drying. The results indicated insufficiency of labor was observed by more than a third of the rice and corn farmer-respondents for planting, harvesting and drying.

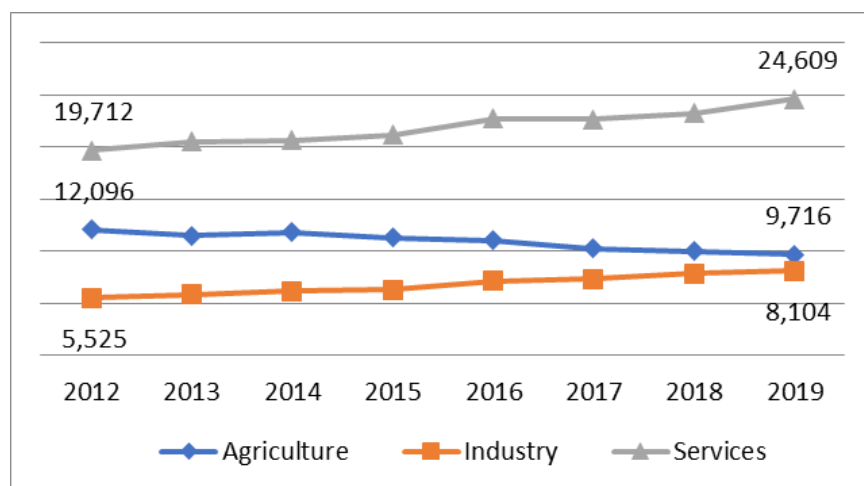


Figure 1. Number of Employed Persons by Major Industry Group (in thousands), Philippines, 2012-2019.

Source: Philippine Statistics Authority, 2013-2020

From the total number of employed persons in the Agriculture sector, about 51% were classified as Skilled Agricultural, Forestry and Fishery Workers (*tasks involving skills acquired through extensive experience and/or training*). Forty-nine percent (49%) were classified as agricultural, forestry, and fishery laborers under Elementary Occupations (*simple and routine tasks which require limited training or experience*).

In terms of occupational classifications, Elementary Occupations has the highest percentage (26.7%) of employed persons in 2019 (**Figure 2**). However, it also has the lowest average daily wage of Php260.36. On the contrary, those who were employed under Skilled Agricultural, Forestry and Fishery Workers have an average daily wage rate of Php417.01 (Philippine Statistics Authority, 2019). This indicates a good potential for agricultural laborers to pursue market-oriented farming or other agricultural-related activities (i.e machine operation).

The agriculture sector, through the government, should be able to implement strategies to strengthen its labor force, to be relevant, trained and skilled, competitive and more productive, given the changing labor situation patterns. Moreover, an in-depth study on the current labor use and patterns is thus needed to formulate policies and programs for a sustainable human resources development of the agricultural labor force.

OBJECTIVES

The study assessed the current status of farm labor use and patterns in the country as a result of extensive mechanization as input for policy on sustainable human resource development of farm labor. Specifically, the study aimed to:

1. Determine baseline information on the current use of labor for traditional and mechanized farms and farm operation cost;

2. Determine and describe farm operations where there are observed changes in labor utilization, relocation, rearrangement and overall utilization patterns;
3. Determine human resource development gaps and issues based on the survey, and identify opportunities to address the gaps; and
4. Recommend key policy interventions that will plug the gap in labor utilization, relocation and redistribution and establish a sustainable human resource development program for labor in the agricultural sector.

METHODOLOGY

Study Area

The regions of Cagayan Valley and Central Luzon; Western Visayas; and Northern Mindanao and SOCCSKSARGEN were purposely selected as representatives from Luzon, Visayas, and Mindanao, respectively. Each region was represented by one or two provinces with different stages in machine utilization for rice and corn. At least one of the selected provinces represented an advanced stage of mechanization (high machine utilization rate) for a specific commodity while the other province was

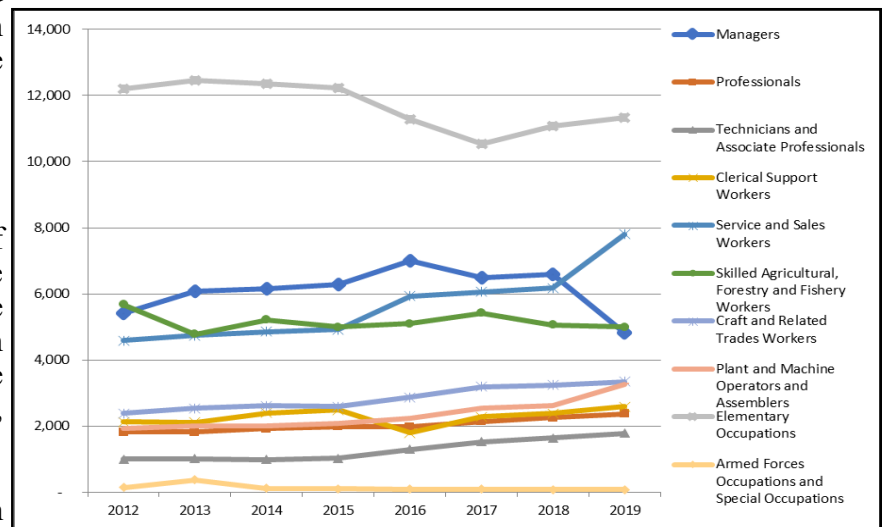


Figure 2. Number of Employed Persons by Major Occupation Group (in thousands) Philippines, 2012-2019.
Source: Philippine Statistics Authority, 2013-2020

Table 1. Number of respondents (farmers and landless farm workers), by region and by province, 2019-2020.

PROVINCE	RICE		CORN	
	Farmers	Landless Farm workers	Farmers	Landless Farm workers
Region II (Isabela)			31	31
Region III (Nueva Ecija)	31	31		
Region VI (Iloilo)	34	30	32	27
Region X (Bukidnon)			33	30
Region XII (South Cotabato)	31	30		
Total	96	91	96	88

either within the traditional farm practices or transitioning to mechanization utilization. Other criteria for the selection of areas are data on the regional and provincial volumes of rice and corn production, machinery distribution data by the Department of Agriculture through the Rice and Corn Mechanization Programs, accessibility of the survey site, and peace and order situations in the area.

Sampling Plan and Survey

The sampling design utilized non-probability sampling methods (e.g. purposive and convenience sampling). Using the criteria on selection of survey areas, a sample size of at least 30 primary respondents per category (i.e. farmers/farm owners and landless farm workers) for rice and corn farms and region was determined based on the Central Limit Theorem. Stratified purposive sampling design was used to identify the number of respondents at the municipal-level. Using data from the 2018 Registry System for Basic Sectors in Agriculture (RSBSA) (PCIC, 2019), cities and municipalities in each province was classified as having a low, medium, or high population of rice or corn farmers. Municipalities were further classified based on the Department of Agriculture Mechanization Program machinery distribution data from 2011 to 2016. Specific consideration was given to municipalities which received four-wheel tractors, mechanical transplanters, and combine harvesters. The number of respondents per province and classification is presented in Table 1.

A sample of 371 respondents from a total population of 122,147 rice and corn farmers in the survey areas were interviewed by the team within a 3-month period. The total number of respondents for rice was 187 out of a population of 67,664 based on RSBSA 2013 data. For corn, there were 184 respondents out of 54,483 listed corn farmers. Based on these data, a confidence interval of 7.2% at 95% confidence level for both rice and corn surveys were derived based on

$$ss = \frac{Z^2 * p * (1 - p)}{c^2} \quad \text{Equation 1}$$

Equation 1 as follows:
where:

ss = sample size
p = 50% (default value for the response distribution)
Z = 1.96 (at 95% confidence level); and
c = confidence interval

Four (4) survey instruments were pre-tested and formulated for rice farmers, rice landless farm workers, corn farmers and corn landless farm workers to achieve the objectives of the study. Some limitations associated with the number of samples were the short time to conduct field survey activities and limited funds to conduct a large sample survey. In instances when respondents were unable to be at the designated survey location, the survey team would either travel to the location of the original respondent or find an immediate replacement with

the assistance of the Office of the Municipal Agriculturist staff. The project team conducted the survey from 2 December 2019 to 8 March 2020.

Percentage of Machine Utilization and Percentage of Respondents

The % machine utilization was computed using Equation 2 as follows:

$$\% \text{ Machine Utilization} = \frac{\sum (\text{percent utilization per operation})}{\text{total percent utilization}} \quad \text{Equation 2}$$

The percentage of respondents responses was computed using Equation 3:

$$\% \text{ Respondents} = \frac{\text{number of respondents (n)}}{\text{total number of samples (N)}} \times 100 \quad \text{Equation 3}$$

Classification of Major Occupations

The study used the International Standard Classification of Occupations 2008 (ISCO-08) (ILO, 2012) to classify the current skills, current work experiences, and potential future enterprises of the farm worker-respondents. The skill level in relation to educational attainment is divided into four groups. The first, and lowest ranked, have only reached primary education. The second group, skill level 2, are those who have reached the secondary level of education. The second group also included those who have had post-secondary but non-tertiary education. Skill level 3 includes individuals who have experience in, but not completed, tertiary education while skill level 4 are those who have received collegiate degrees or its equivalent (Table 2). ISCO classifies different occupational groups into four range scores. The first and lowest rank level includes those who have reached primary education. The fourth and highest rank are those who have collegiate degrees or its equivalent.

Definition of Terms

The farming method discussed in this paper referred to the predominant farm operation practices and/or machine utilization system. Moreover, the farm workers considered in this study, refer to “a natural person who renders service value as an employee or laborer in an agricultural enterprise or farm regardless of whether his compensation is paid on daily, weekly, monthly or *pakyaw* basis” as indicated in Section 4 No. 14 of the Republic Act 7607 (Magna Carta for Small Farmers). For the purpose of the recommended policies, farm workers are further defined as landless and whose contribution to the farm is purely work.

RESULTS AND DISCUSSION

Baseline information on the current use of labor for traditional and mechanized farms

Farming Methods and Machine Utilization in Rice Farms

Land preparation operations, namely plowing, rotavating, harrowing, and leveling, were done primarily with the use of machines in the three (3) rice surveyed areas, except for leveling in the province of South Cotabato, where animal-drawn planks were still commonly used. Planting was done through a mix of manual transplanting and broadcasting. The use of mechanical transplanters was not yet prevalent in all survey areas. Notable reasons for the low adoption of mechanical transplanters were the intensive-labor requirement in the preparation of seedbed and seedlings and the

Table 2. ISCO-08 classification of major occupation groups to skill level.

ISCO-08 MAJOR GROUPS	SKILL LEVEL
1 Managers	3 + 4
2 Professionals	4
3 Technicians and Associate Professionals	3
4 Clerical Support Workers	2
5 Services and Sales Workers	2
6 Skilled Agricultural, Forestry and Fishery Workers	2
7 Craft and Related Trades Workers	2
8 Plant and Machine Operators and Assemblers	2
<i>Source: ISCO-08, Vol 1 - ILO 2012)</i>	

lack of knowledgeable operators and nursery managers. The predominant method of harvesting in the survey areas was through combine harvester utilization. Most of the respondents sold their produce as fresh palay to traders or farmers' organizations. Drying of palay was only observed for farmers who retained some of their harvest for personal and household consumption.

Nueva Ecija had the highest percent (64%) utilization of machines (Table 3). Land preparation was fully mechanized from plowing to leveling, while most respondents already utilized combine harvesters for harvesting. Rotavating was done almost exclusively by four-wheel tractors and no animals were used for land preparation operations. There were two (2) respondents who were able to use mechanical transplanters during planting. No rental rates were specified for the mechanical transplanters at the time since they were owned by the respondent's organization. The respondents in Nueva Ecija favored manual transplanting due to higher reported yields as compared to broadcasting.

Similar to Nueva Ecija, almost all of the respondents in South Cotabato utilized combine harvesters for harvesting. None of the respondents practice mechanical transplanting. The preferred method of planting was through broadcasting due to a mix of lower cost and labor requirements, a lack of available labor for transplanting, and a high cost for transplanting.

Among the three provinces, Iloilo has the lowest machine utilization of 43% (Table 3). There was no predominant method of farming practiced by the farmer-respondents in Iloilo. This may be due to the different topographies and the availability of machines in the different areas. The most practiced (29%) farming method among the rice farmers in Nueva Ecija consisted of a four-wheel tractor-drawn rotavator, harrowing and leveling using a hand tractor, manual transplanting, and combine harvesting. On average, the operations of land preparation, planting, and harvesting required about 21.2 man-days and cost Php22,231.00 per hectare (Table 3).

In South Cotabato, with 44% machine utilization, 32% of the respondents practiced rotavating using a four-wheel tractor, harrowing by hand tractor, leveling by animal, broadcasting, and combine harvesting. These operations only required 5.6 man-days and Php10,369.00 per hectare to complete (Table 3). The low manpower and cost requirement is due to the method of planting by broadcasting.

Farming Methods and Machine Utilization in Corn Farms

Isabela had the highest percent utilization (41%) of farm machineries with reported use of four-wheel tractors, mechanical seeders and combine harvesters (Table 3). Although some farmers in Iloilo and Bukidnon also reported the use of four-wheel tractors and combine harvesters, most respondents still performed other operations manually.

Iloilo and Bukidnon had similar farming methods. Respondents from both provinces preferred the use of draft animals for land preparation because of the rolling and mountainous terrain of the corn farms of the farmer-respondents. Moreover, most farmer-respondents from Iloilo and Bukidnon owned draft animals (cows and carabaos). Planting in Iloilo and Bukidnon was primarily done manually as mechanical seeders were not yet available.

In Isabela, as combine harvesters became prevalent, fresh grains were sold immediately, thus there was no more need for drying at the farm level.

Four-wheel tractors and combine harvesters were also available in Bukidnon but only a few of farmer-respondents reported utilization (11%) (Table 3). Manual labor was still on high demand for harvesting-shelling in Iloilo and Bukidnon. In Bukidnon, manual drying was also preferred since it was much cheaper (Php3,223.00 per hectare) than using mechanical dryers (Php6,188.00 per hectare).

In Iloilo, with 4% machine utilization, the most practiced farming method (25%) consisted of plowing using draft animals, manual planting, manual harvesting-mechanical shelling, and manual drying. This required about 54.68 man-days and cost

Table 3. Summary of machine utilization and prevailing farming method for rice and corn production systems.

CROP	PROV- INCE	% MACHINE UTILIZATION	FARMING METHODS	% RESPONDENTS	MAN- DAYS/HA	COST (PHP/ha)
Rice	Iloilo	43%	mixed farming methods	no data	no data	no data
	Nueva Ecija	64%	Four-wheel Tractor (Rotavating) – Hand Tractor (Harrowing, Leveling) – Manual Transplanting – Combine Harvesting	29%	21.20	22,231.00
	South Cotabato	44%	Four-wheel Tractor (Rotavating) – Hand Tractor (Harrowing) – Man Animal (Leveling) - Broadcasting – Combine Harvesting	32%	5.60	10,639.00
	Iloilo	4%	Man-Animal (Plowing) – Manual (Planting) – Manual (Harvesting)-Mechanical (Shelling) – Manual (Solar Drying)	25%	54.68	16,522.00
	Isabela	41%	Four-wheel Tractor (Plowing) – Mechanical Seeder (Planting)- Combine Harvesting	29%	2.94	11,020.00
Corn	Bukidnon	11%	Man-animal (Plowing) - Man-animal (Furrowing) – Manual (Planting) – Manual (Harvesting)- Mechanical (Shelling) – Manual (Solar Drying)	30%	47.10	14,612.00

PhP16,522 per hectare. In Isabela, the most predominant farming method (29%) consisted of plowing with four-wheel tractors, planting using mechanical seeders, and combined harvesting-shelling which only required 2.94 man-days and amounted to PhP11,020 per hectare. Lastly, in Bukidnon, the most practiced farming method (30%) consisted of plowing and furrowing using draft animals, manual planting, manual harvesting, mechanical shelling, and manual drying. This required about 47.10 man-days and amounted to PhP14,612.00 per hectare (Table 3).

Man-Day per Hectare Requirement of Mechanized System and the Traditional System

Generally, use of farm machinery may be regarded as more expensive than manual labor. However, if farm machines would be utilized for major farm

operations such as land preparation, planting and harvesting, the study showed lesser man-machine days compared with the man-days in doing traditional methods (Table 4). Mechanized farming also allowed farmers to complete the operations in a timely manner and let them use time savings in other productive activities. On the other hand, the observed total 43.65 man-days difference between mechanized and traditional system for rice and 32.59 man-days for corn may be assumed to be the opportunity cost incurred by farm workers upon the introduction of four-wheel tractors and hand tractors, transplanters/mechanical seeders, and combine harvesters (Table 4).

Aside from harvesting, planting (especially transplanting) was also affected by the increased use of combine harvesters. Planting-harvesting labor groups were almost non-existent, while the

remaining labor for transplanting could be gradually replaced by the introduction of mechanical transplanters and the increasing utilization of direct seeding techniques, like broadcasting, which required significantly less manpower.

Combine harvesters did not only replace the labor for manual harvest in rice farms; thresher operators, laborers, and owners alike were also negatively affected. In many visited rice areas, threshers were left to rust under the heat of the sun, their engines and other salvageable parts removed.

A reduction in drying labor was also observed. During combine harvesting, the harvested fresh palay and corn grains are already bagged and ready for sale. Farmers usually opted to sell their produce right after harvest for ready cash-on-hand.

Changes in farm labor utilization

Decreased demand for manual labor of farm workers

Rice farm workers reported that the operations mostly affected by mechanization were manual harvesting and threshing. After the introduction of combine harvesters, 60% to 90% of the respondents in each province indicated that demand for farm worker labor during harvest was reduced while 68% to 94% reported a decline in demand for threshing labor. Labor during land preparation was also reduced as reported by 33% of the farm worker respondents in Iloilo (**Table 5**). The values indicated a

higher adoption of the use of combine harvesters as compared to four-wheel drive tractors. Although the utilization of four-wheel tractors in rice farms were increasing, the leveling and finishing operations were still mostly done using carabaos and hand tractors. There was almost no change in the demand for labor for fertilizer application, pesticide application, insecticide application, weeding, and herbicide application.

The majority of the farm workers in all provinces indicated that the demand for labor in rice farms decreased with the onset of mechanization. The

Table 4. Percent decrease in man-machine day vs. man-day per hectare requirement for selected farm operations in rice and corn, 2020.

FARM OPERATION	RICE		CORN	
	Man-machine day	Man-day	Man-machine day	Man-day
	Mechanized	Traditional	Mechanized	Traditional
Land preparation	1.63	5.09	1.13	6.45
Planting	7.0	22.47	0.61	7.18
Harvesting	2.5	27.22	1.71	22.40
TOTAL	11.13	54.78	3.44	36.03
% Decrease in man-machine-day requirement	(79.68)		(90.44)	

Table 5. Percentage of farm workers who reported decreased demand for farm labor.

CROP/FARM OPERATION	% RESPONDENTS		
	Rice	Iloilo	Nueva Ecija
Land Preparation	33.3	6.5	20.7
Planting	8.0	59.1	20.7
Manual Harvesting	72.0	90.0	60.0
Threshing	68.4	93.8	80.0
Corn	Iloilo	Isabela	Bukidnon
Land Preparation	20.0	61.5	30.0
Planting	8.0	59.3	11.5
Manual Harvesting	8.7	50.0	16.7
Shelling	25.0	66.7	-

decrease in demand implied less time spent for work in rice fields and thus, reduced income. It is notable that three (3) respondents in Nueva Ecija indicated an increase in the demand for farm labor. This is due to the combination of an increase in cropping intensity due to mechanization, area planted, and demand for machine operators. In South Cotabato, no respondent felt a significant increase in work in rice farms.

For corn production, 50% to 67% of respondents from Isabela reported a decrease in the demand for labor in major farm operations, mainly because of the utilization of four-wheel tractors, mechanical seeders and combine harvesters (Table 5). On the contrary, about half of respondents in Iloilo and Bukidnon reported that the overall demand for labor actually remained the same. This can be attributed to the fact that despite of zero-tillage operation in upland areas, there was also report on expansion of planted corn farms which resulted to a relatively low reduction in the demand for labor.

Farmer's perception on the availability of farm labor

Farmer-respondents were asked on the availability of labor in their areas in terms of their perception if it is abundant, enough or sufficient, or insufficient. Many answered that there were still sufficient labor for every farm operation, however, there were also reports of labor insufficiency. Insufficiency of farm labor meant that farmers had experienced difficulties in contracting or getting labor especially during peak seasons of land preparation, planting, and manual harvesting, while abundant or enough labor in the farm meant that farmer-respondents perceived that farm labor was readily available when needed.

In the province of Iloilo, farmer-respondents reported that labor for major operations in rice farming ranged from sufficient to abundant which means there was no difficulty in contracting farm labor. However, one out of four rice farmers in the province indicated that available labor for planting, manual harvesting, and drying was becoming insufficient.

In Nueva Ecija, labor for land preparation was perceived to be sufficient by farmer-respondents. This may be attributed to the availability of hand tractors and four-wheel tractors in the province. In fact, none of the rice farmer-respondents in the province utilized carabaos for any of their land preparation operations. However, labor for manual harvesting and threshing was insufficient for half of the respondents (Table 6).

The rice farmer-respondents from South Cotabato indicated that labor for manual harvesting and threshing was widely unavailable. There were also reports of insufficiency in labor for land preparation, planting, and drying operations (Table 6).

For corn production, many farmers answered that there was still sufficient labor for farm operations. However, there were also reports of insufficiencies. In the provinces of Iloilo and Bukidnon, labor for planting and harvesting were perceived to be

Table 6. Percentage of farm workers who reported insufficiency in labor, 2019-2020.

OPERATION	% RESPONDENTS		
	Iloilo	Nueva Ecija	South Cotabato
Rice			
Land Preparation	17.6	-	36.7
Planting	26.5	41.9	23.3
Manual Harvesting	26.1	50.0	65.0
Threshing	10.0	50.0	47.4
Corn			
Land Preparation	27.6	22.6	14.3
Planting	32.3	25.8	29.0
Manual Harvesting	62.5	40.0	53.5
Shelling	18.8	40.0	11.5

insufficient due to the expansion of planted farms as shown in Table 6.

With the decreased demand of farm labor in Isabela due to the availability of combine harvesters, many farm workers shifted from rural to urban areas to seek employment. As a result, farmers perceive that labor was insufficient especially during peak seasons of harvesting and shelling.

Changes in farm labor arrangements

Planting-harvesting arrangement to land preparation-harvesting arrangement

Many farmers did indicate that planting-harvesting (*tanim-ani*) labor groups were becoming scarce. This is due to the mechanization of harvesting operations which limited the work available to planting-harvesting labor groups. To compensate for the loss of work during harvest season, these groups have increased their wage requests or demanded higher wage rate for pulling of seedlings and transplanting. With the increase in the number of custom hiring service providers, the planting-harvesting labor arrangement has become land preparation-harvesting arrangement for mechanized operations.

Changes in mode of farm labor payment

There was a shift in farm mode of labor payment from *arawan* (daily) to *pakyaw* (informal contract to complete the operation) basis, especially for labor intensive farm operations, such as planting and harvesting. For 'arawan' or daily wage, payment per day is made individually to farm workers who worked on specific operations, while 'pakyawan' is an informal contract payment for a group of farm workers for completing a specific farm operation regardless of the number of persons involved. Usually, farmers made this contract to "farm agents", who have contacts with a group of farmer workers.

Hired labor to family labor

In corn production, some closely-knit farmer-groups in Bukidnon preferred the practice of *bayanihan* (a spirit of unity and cooperation among Filipinos)

system using family labor and other kins rather than using hired labor to manage production cost.

Maintainers

Many of the former daily hired farm workers became maintainers. Maintainers are farm-workers hired by farmer-land owners regularly to tend and/or manage the farm. Payments to maintainers were usually in the form of a percentage of harvest (ranging from 10-15%). Farmer-land owners paid hired labor and/or pay custom services for farm operations such as land preparation, planting and harvesting. Other farm operations such as crop care, fertilizer/herbicide/pesticide applications, weeding and cultivation were performed by the maintainer as part of his job. Some maintainers were able to manage more than one farm.

Labor shifting

Farm labor remained to be the main source of income of most farm worker-respondents. Fifty-seven (57%) of the total rice farm worker-respondents and 39% of the total corn farm worker-respondents relied on farm labor for their annual income. However, with the introduction and proliferation of farm machineries, many farm workers shifted to other available jobs or employment.

Changes in type of work in the farm

The decreased demand for manual labor had resulted to a significant reduction in the number of working days of farm workers. In order to compensate loss of income, many farm workers have opted to shift from major farm operations to minor farm activities or types of farm work, such as crop care (i.e. fertilizer application, weeding) and/or to engage in other farm activities (i.e. livestock raising, other crop production).

On-farm to off-farm employment

Due to the decreased demand for farm labor, other respondents shifted from on-farm jobs to off-farm livelihood opportunities. Some farm-workers were employed as barangay officials and volunteer workers, security guards and utility personnel.

Others even ventured into personal businesses (e.g. tricycle driving, eatery business, barbeque or roasted pork business).

Moreover, off-farm employment became the main alternative of farm workers to look for other jobs. Unfortunately, with the limited available work in the rural area, many farm workers opted to work to the high labor demand of the industry and services sectors (e.g. construction works). Male farm workers became employed in the construction and manufacturing industry, while female farm workers were hired as mall sales ladies and food vendors.

Human Resources Development Gaps, Issues, and Opportunities

Human Resource Development Gaps

No formal organized groups for farm workers

Groups, associations, and cooperatives are limited for farmers/farm owners only. There are no recognized organizations of farm workers. Farm workers only form an informal group and have a leader who will look for available farm jobs for the sake of the entire group.

Lack of assistance and recognition from the government.

Generally, most of government agricultural subsidies and programs are directed towards farmers' groups or associations. Farm workers also need assistance and recognition from the government.

Limited or no training or seminars available for farm workers

Although many of the respondents were interested in learning new skills so that they could earn more, programs provided by the government are almost targeted to farmer/farm owners and farmers' organizations. Moreover, training or seminars for landless farm workers are limited.

Training and certifications for machine operation

Many farm workers are experienced in the operation of farm machines. However, not all of them were trained nor certified to become machine operators. Most custom hiring service providers and machine operators interviewed indicated that the knowledge and skills on machine operations were acquired through observation, informal hands-on lesson from employer, and years of experience of machine operators.

Lack of access to social protection/security

Many farmers and farm workers do not have savings, pensions, or investments mainly due to unviable financial conditions – low income, high cost of inputs, informal loans with higher interests, and that current supply chain structure favors traders/millers. Furthermore, farm workers have to work well past the age of retirement due to the lack of social security or pension and other sources of income.

No employer-employee relationship between farmers and farm workers.

This situation limits the amount of work available to farm-workers. In many cases, farm workers relied on agents, who had the direct contact to farmers for the kind of work needed in their farms.

Human Resource Development Issues

No job stability

Farm laborers are still not ensured of having continuous work for the season. The loss of even one day of farm work will have a significant impact on the procurement of their daily needs and those of their families. Hence, many farm workers decided to abandon working in farms and opted to look for job opportunities elsewhere.

Uncompetitive/inconsistent wage rates

The wages of farm workers are up to the discretion of the farmer. Many farm workers clamored for higher wage rates. Cost for meals and snacks are sometimes deducted from the wages of the worker.

Farmers also deduct the cost of losses due to bad weather in the wages of farm workers.

4Ps had an indirect effect on the labor assignment of farm workers

There were observations by farmers-respondents and even municipal government officers that the “Pantawid Pamilyang Pilipino Program” or 4Ps program may have some indirect effects on some farm workers’ motivation to work in the farm.

Safety and health risks

Farm workers and farmers alike are constantly exposed to health hazards from chemicals during herbicide, and pesticide/insecticide applications. Machine operators are also exposed to risk of injuries from using the machineries. The Universal Health Care Act (Republic Act 11223) somehow addresses the issue but in-field safety may still be inadequate. Not all farmers and farm workers are registered to/have access to PhilHealth.

Opportunities for farm-workers, and key skills and competencies for farm mechanization

For farm workers to adapt to the challenges of the continued agricultural mechanization, new skills and competencies are needed for them to provide the needed labor force for the continuing and increasing utilization of agricultural machineries and other agricultural-related activities.

In terms of formal education, about 65% of rice farm worker-respondents and 64% of corn farm worker-respondents belonged to International Standards of Classification for Occupations (ISCO-08) skill level 2 since they have reached at least secondary education. With skill level 2, they were qualified to any job that falls under the major groups of Clerical Support Workers, Services and Sales Workers, Skilled Agricultural, Forestry and Fishery Workers, Craft and Related Trades Workers, and Plant and Machine Operators and Assemblers. Many respondents already had work experience in these categories (classified under skill level 2), however, many of them were still employed as agricultural and construction laborers even though

Table 7. Matching of ISCO-08 and PQF levels with TESDA National Certificate Qualifications.

ISCO-08 SKILL LEVEL	EDUCATION PROGRAM	PQF LEVEL	QUALIFICATIONS
	Early childhood education		**
SL 1	Primary education		
SL 2	Lower secondary education		
SL 2	Upper secondary education	Level 1 Level 2	NC I NC II
SL 2	Post-secondary non-tertiary education (6 months to 2 years)	Level 1 Level 2 Level 3 Level 4	NC I NC II NC III NC IV
SL 3	Short-cycle tertiary education (2 to 3 years)	Level 5	Diploma
SL 4	Bachelor level education or equivalent	Level 6	Baccalaureate Degree
SL 4	Master level education or equivalent	Level 7	Post-Baccalaureate Program
SL 4	Doctoral level education or equivalent	Level 8	Doctoral Degree and Post-Doctoral Programs

Basic Source of data: ILO (2012) and Philippines Qualifications Framework (pqf.gov.ph) - TESDA (2012)

both jobs were considered as elementary occupations and only required skill level 1.

Comparing the ISCO-08 skill levels with the Philippine Qualifications Framework (PQF) levels of Technical Education and Skills Development Authority (TESDA) (Table 7), it can be presumed that the majority of rice and corn farm worker-respondents who had reached secondary education (ISCO-08 skill level 2 and PQF level 2) were qualified to take TESDA NC I and NC II training courses (TESDA, 2012). This can be their entry-level step to Technical-Vocational education to attain higher competencies and improve their general employability.

TESDA offers a wide range of training courses for all sectors of the economy. However, with the recent COVID-19 pandemic, TESDA decided to confine its priority courses on agriculture, construction, and health-related courses. TESDA's agriculture related training courses that may be applicable for farm workers vary from production related skills to entrepreneurial development.

In line with the government's annual machinery distribution, certification of operators should be their next priority. Farm workers can enroll in any of the four machinery operation training courses being offered by TESDA. With this, farm workers would have the opportunity to learn new skills and earn higher income while supporting mechanization in rice farming. The four training courses for machine operation are the following:

1. Agricultural Machinery Operation NC II
2. Agricultural Machinery Servicing (4-Wheel Tractor) NC III
3. Rice Machinery Operation NC II
4. Drying and Milling Plant Servicing NC III

CONCLUSION

Hired farm workers provide significant labor force in the agricultural production system. They have long been the partners of farmers in crop production and postproduction activities. As such, they should be recognized as significant contributors to agricultural economic activities. The study presented the prevailing farming methods and machine utilization in rice and corn farms in the study areas. Despite differences in level % machine utilization in the study areas, general changes in overall labor utilization patterns were observed in the study areas as a result of mechanizing the farm.

The study showed that there had been changes in farm labor utilization in terms of manual labor and in man-day per hectare requirement, specifically for land preparation, planting, harvesting, and threshing/shelling. There were also reports of changes in labor arrangements in terms of farm operations, such as planting-harvesting arrangement to land preparation-harvesting arrangement, payment agreements (*arawan* to *pakyawan*), and mode of contracting labor (hired to family labor). The study also showed significant reports of labor shifting of farm workers from on-farm to off-farm jobs as a result of extensive use of mechanization.

Even with the continued and intensive program of the government to mechanize the agricultural sector, human capital inputs will still be needed to perform various types of farm works. With the continuing changes in farm labor use and patterns, farm workers should also be given the same support provided to farmers or farmer groups, as provided in the policy recommendations. It is also imperative that government agencies should capacitate the current pool of farm workers and provide them with the appropriate skills and competencies to thrive as agricultural mechanization expands.

RECOMMENDATIONS

The following policy recommendations were provided as a result of the study:

On the organization and recognition of landless farm workers

The landless farm workers shall be encouraged to organize into formal groups, and be recognized by the Department of Agriculture (DA) and/or Department of Labor and Employment (DOLE), as part of institutional support, to benefit from government subsidies and programs and guarantee their welfare.

As a strategy for this move, the organization and registration of landless farm workers could be facilitated by the Municipal/City Agriculture Offices, in coordination with the Barangay Local Government Units and the Provincial Agriculture Offices, using the Registry System for Basic Sectors in Agriculture data.

Provision of training, upskilling, and employment opportunities to the farm labor sector

Training and capacity building programs shall be made available for the agricultural labor sector including the landless farm workers.

Article III, Sec. 12 of the Agriculture and Fisheries Mechanization Law indicates the need for training of agricultural extension workers and agricultural engineers to serve as trainers for farmers and fisherfolks on agricultural mechanization technologies and practices. These training and scholarship programs should also be extended to farm workers.

TESDA, DOLE, and DA-Agricultural Training Institute, with assistance from State Universities and Colleges, may provide the necessary formal training to individuals from the farm labor sector to retool them into machine operators or other agricultural related activities. Civil Society Organizations are also encouraged to participate in capacity development. Such agencies may also formulate and provide other training regulations that are appropriate for the agricultural labor sector. Such agencies should also utilize the *Tulong-Trabaho* Act (Republic Act 11230) to provide free access to Technical-Vocational Education and Training and

strengthen the qualifications of farm workers to meet the challenges of the emerging mechanized farming sector.

Integrating the organization, training and employment programs, social welfare aspects of farmer labor workers to the Farm and Fisheries Clustering and Consolidation (F2C2) Program

The bona-fide farmers and fishers indicated in the Department of Agriculture Administrative Order 27, dated Aug. 5, 2020 (DA, 2020) can include the organized farm workers as the human capital input needed in the establishment of F2C2 projects.

Farm workers could be part of the F2C2 projects on the establishment of the seedling nurseries to support the promotion of the government of mechanized transplanting. Maintainers can also be target groups for training on upskilling for crop production since they work directly for farm-land owners for income sharing. The study suggests that farm-land owners who were usually in the higher age-brackets may hire maintainers to manage their farm (this will address the aging farmer population). The maintainers could also be part of the organizational structure of the F2C2 projects.

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LITERATURE CITED

- AMONGO, R.M.C., LARONA, M.V.L., RODULFO, JR., V.A., DEL ROSARIO, A.C., DE RAMOS, J.D., CASTALONE, A.G.M., EUSEBIO, M.F.V., BORJA, A.A., AMONGO, J.M.C. (2013). Determination of the Agricultural Mechanization Level in the Production and Postproduction Systems of Rice and Corn in Selected Regions of the Philippines: Terminal Report. UPLB-PHilMech Project Unpublished Terminal Report.
- AMONGO, R.M.C., YAPTENCO, K.F., SALUDES, R.B., LARONA, M.V.L., PARAS, JR., F.O., DELOS REYES, R.B., CASTRO, M.Y., QUILLOY, E.P., DE RAMOS, J.D., PANGAN, R.S., RODULFO, JR., V.A., ESTRADA, M.D.G. & VALENCIA, R.C. (2017). Diffusion and Utilization of UPLB Corn Mechanization Technologies in Masbate Province. *Philippine Journal of Agricultural and Biosystems Engineering (PJABE)* Vol. XIII, 2017 Issue.
- DEPARTMENT OF AGRICULTURE. (2020). Administrative Order no. 27. Establishing The Farm And Fisheries Clustering And Consolidation Program (F2C2) Towards Greater Inclusive Agri-Business Development In The Country.
- INTERNATIONAL LABOUR ORGANIZATION. (2012). International Standard Classifications of Occupations: ISCO-08 Vol. 1. International Labour Office-Geneva. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf
- PHILIPPINE CROP INSURANCE CORP. (2019). Registry System for Basic Sectors in Agriculture (RSBSA) List of Farmers 2018. Retrieved from <https://pcic.gov.ph/rsbsa-list-of-farmers-2018/>
- PHILIPPINE STATISTICS AUTHORITY. (2013-2020). Agricultural Indicators System Population and Labor Force. Quezon City, Philippines.
- PHILIPPINE STATISTICS AUTHORITY. (2019). Trends in Agricultural Wage Rates 2016-2018. Quezon City, Philippines. Retrieved from https://psa.gov.ph/sites/default/files/Signed_Trends%20in%20AWRS%202016-2018%2029%20Oct%202019.pdf
- REPUBLIC OF THE PHILIPPINES. (1992). Republic Act no. 7607: An Act Providing A Magna Carta of Small Farmers. Official Gazette 4826. Metro Manila, Republic of the Philippines.
- REPUBLIC OF THE PHILIPPINES. (2013). Republic Act no 10601: An Act Promoting Agricultural and Fisheries Mechanization Development in the Country. Metro Manila, Republic of the Philippines
- REPUBLIC OF THE PHILIPPINES. (2018). Republic Act no. 11223: An Act Instituting Universal Health Care for All Filipinos, Prescribing Reforms in the Health Care System, and Appropriating Funds Therefor. Metro Manila, Republic of the Philippines
-

REPUBLIC OF THE PHILIPPINES. (2018).

Republic Act no. 11230: An Act Instituting a Philippine Labor Force Competencies Competitiveness Program and Free Access to Technical-Vocational Education and Training (TVET), and Appropriating Funds Therefor. Metro Manila, Republic of the Philippines.

SOUTHEAST ASIAN REGIONAL CENTER FOR GRADUATE STUDY AND RESEARCH IN AGRICULTURE (SEARCA). (2019).

(Contributing authors: Amongo, R.M.C., Del Rosario, A.C., Larona, M.V.L., Rodulfo, Jr. V.A., Duminding, R.S.DG., Salandanan, A.D., Bondoc, D.L., and De Padua, V.A.N.). Intensive Use of Mechanized Technology in the Agriculture Sector: An Evaluation of the Effects and Implications in Selected Commodity Value Chains. Ed: Landicho, N.M. Project Funded by the Department of Agriculture – Philippine Council for Agriculture and Fisheries (DA-PCAF).

TECHNICAL EDUCATION AND SKILLS

DEVELOPMENT [TESDA]. (2012). The Philippine Qualifications Framework. TESDA Policy Brief Issue 02. Retrieved from [https://www.tesda.gov.ph/uploads/File/policybrief2013/PB%20Philippine %20Qualification%20Framework.pdf](https://www.tesda.gov.ph/uploads/File/policybrief2013/PB%20Philippine%20Qualification%20Framework.pdf) ■