

How Modern Machinery Replaces Laborers: A Comparative Study of Their Livelihood Before and After Implementation

Verline Gaudeene A. Dilla*, Reginald Ludwig G. Dalusong, Lesley Jane R. Elacion,
Franz Cedrick R. Mina, Roxzyleen Andreih C. Vasquez, Joseph A. Villarama
Central Luzon State University, Nueva Ecija, Philippines

*Corresponding Author Email: dillaverline0518@gmail.com

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Abstract. With modernization, the agricultural sector has increasingly adopted modern machinery, raising concerns about its impact on farm laborers, whose roles are being supplanted by these advanced technologies. This study examined the effects of mechanization on the livelihood of farmers in the Science City of Muñoz, Nueva Ecija, Philippines. Employing a phenomenological qualitative approach and convenience sampling, the research focused on five Filipino farmers who participated in in-depth, semi-structured interviews using a validated, researcher-developed interview guide. Data were analyzed using Colaizzi's 7-Step Method. The findings reveal that the prevalence of modern machines has significantly contributed to unemployment and financial hardship among farm laborers, posing challenges to their livelihoods. Additionally, the farmers highlighted the importance of education in the agricultural sector and the erosion of the "bayanihan spirit" (communal unity) due to the introduction of modern machinery. This study underscores the dual-edged nature of mechanization: while enhancing efficiency, it also inflicts substantial socio-economic costs on farm workers. Consequently, it calls for a deeper understanding and proactive measures to address the adverse effects on laborers affected by agricultural mechanization.

Keywords: Agriculture; Farm laborers; Mechanization; Modern machinery; Agricultural workers.

1.0 Introduction

The construction industry and the agricultural sector highly demanded a workforce—laborers were under the working class (with the hierarchical model as the basis); they were the ones in charge of manual labor, production, and the vital role of being the powerhouse of these industries. Employed agricultural workers were to work in crop fields, livestock, and food production facilities. Under the image of having an employer, these workers did not have any part in the possession of the equipment used, much less the land they worked on.

The nature of the workforce reflected the seasonal fluctuations in demand for agricultural labor. Moreover, working hours were long, especially when the planting and harvesting seasons commenced. However, these workloads decreased when off-peak seasons struck. Usually, the majority of employed agricultural workers' livelihoods in first- and third-world countries were based on the demand for them, primarily signed for contractual labor only. As per the report, 26.7%, or approximately 2 billion people, obtained their wages from having a livelihood connected with agriculture. In the Philippines, agriculture also suffered a significant decrease in employment that started with 24.5% (9.7 million) in October 2020, 24.6% (10.77 million) in October 2021, and 22.5% (10.60 million) in October 2022 (Baclig, 2022).

Because agricultural workers' minimum wages were typically low or nonexistent, they chose to maximize their potential and working hours to increase their earnings. However, farm laborers have not extended their shift hours to account for self-sufficiency in essential and significant food; one way is by introducing innovative technology and techniques (Mogato, 2018).

Data found that the 14.2 percent (5.7 million) recorded in October 2020 went for a dip in October 2021 with a 12.4 percent value of 5.4 million. It recently declined in October 2022 with an 11.8 percent decline; this led to 5.6 million losses of skilled workers in the field, fishing, forestry, and farming (Baclig, 2022). Even though the introduction of machinery was evidence of advancement and provided additional livelihood opportunities, it was also the reason for unemployment. Many were affected by the layoffs of agricultural agencies due to the advancement of machinery. In the Science City of Muñoz, the Philippine Rice Research Institute (PhilRice) and the Philippine-Sino Center for Agricultural Technology, government entities, and farms all over the town adopted modern machinery. Meeting the standard set by machines was unlikely for traditional farmers, as the capabilities of this equipment were of high precision for crop farming. Education was a significant factor, as adverse labor shortages affected agricultural production. The spontaneous spread of modern agricultural machinery indeed started taking over in the present time (Zheng et al., 2022; Zhou, 2022).

This study investigated and induced the performance of the laborers included in the decline of manual labor demands due to the prominence of modern machines. This focused specifically on their financial struggles before and after the widespread use of modern machines. Therefore, in line with the forgotten laborers, there was potentially extended assistance to the workers regarding financial and educational difficulties, as well as the further technological enhancement of the machines.

Knowledge and wisdom helped you garner information in your chosen careers and be your leverage for job opportunities. Education gave way to introducing the efficiency and stability that machines provided, leading to a cheaper and more profitable yield because of the long lifespan of these machines and their optimal maintenance for their development and profits. If education was present, the policies would be more effective by then. Based on the collected data, education became the harbinger of successful adoption, establishing a firm foothold that resulted in a bountiful yield (Paltasingh & Goyari, 2018). Furthermore, education was the core of knowledge; it also offered extracurricular activities involving farming and gardening (Bang, 2019). Similarly, farming was widespread in agricultural education as a further level of education for laborers who were interested or agricultural enthusiasts (Rice & Kitchel, 2018).

Farm work—a rigorous process that took months to harvest produce—was never menial work for laborers. One of the factors that contributed to agriculture's mechanization was education. The impact of education on the agriculture industry was undeniably the reason for laborers to broaden their horizons. Skills that benefited them long-term included handling production, marketing, and financial difficulties (Ninh, 2021). Agricultural laborers were characterized by their educational background once they entered the field of mechanization. College-level education encompassed agritourism, where agritourism related to farm visits. The information gathered is considered agricultural literacy (Brune et al., 2020).

Implementing different farming styles and machines improved the technologies that helped farming today. The agricultural sector significantly relied on technology, as it was used in food production and was much more efficient in reaching the needed quota. India has made remarkable progress in terms of agriculture. However, unlike neighboring countries, their horticultural and agricultural productivity could be higher (Kapur, 2018).

Mechanization reflected modernization and provided immediate changes in farming patterns, as not only did it increase production but also involved the financial improvement of a household (Lu, 2009) for primary farm owners in a world where technological advancement had a relevant role in upgrading every sector of the economy with machines. Hence, for both the private and public sectors and the participation of non-governmental organizations, there was no doubt that this increased the usage, popularity, and rapid development of mechanized equipment (Fuad & Flora, 2019).

Employers and field owners who used mechanized machinery to fulfill the heavy-duty farming process mostly looked for farmers with educational attainments and polished skills concerning technology. Education contributed to the inclusive growth of economic and agricultural output. (Wouterse & Badian, 2019). Different handling areas require specific proficiency, especially when the machinery has embedded data needed for total concentration. Laborers needed to input specific data, much more if the job required them to record the data after the machinery was used once it was done with farming.

As time passed, there was no doubt that every industry improved in efficacy. They implemented machines to reduce human labor. The agricultural industry, no less, did go with the revolution, and they implemented mechanization to lessen the manual labor of farmers. Farming after mechanization became increasingly reliant on machinery and technology. Tasks such as planting, harvesting, and tilling were often performed by machines, making farming more efficient and cost-effective, which attained sustainability in agricultural enhancement and food security. It was more desirable to have a set of strategies. More importantly, countries' conditions are derived from their policymaking (Emami et al., 2018). the assistance of technology. More importantly, countries' conditions are derived from their policymaking (Emami et al., 2018).

When traditional, manual, and animal farming fell behind, agricultural machinery helped these things flourish. It eventually boosted medium and low production outputs to achieve environmentally friendly and high-quality agricultural growth (Zhou et al., 2022; Peng et al., 2019). Farm machinery technology followed specific measures, such as cultivation and expanded opportunities to promote agricultural machinery (Chen & Zhang, 2021; Xu & Song, 2021). In the field, the application of machines had advantages such as 1) decreasing the use of agricultural tools and 2) saving the input labor cost. Although manipulating the field by utilizing machines, particularly combined tillage, removed traditional and manual operations like a) turning, b) harrowing, c) ridge raising, d) stubble planting, and e) base fertilizer application (He et al., 2018).

Unlike traditional practice, machines provided ease in farming, faster operations, and better results. The work was no longer tedious, especially in harvesting, as the combine harvester offers two-in-one operations (harvesting and threshing). Moreover, using machines also generated income as owners ventured into farm service provision enterprises. Mechanization had a wide variety of contributions to the agricultural sector. Not only did it enhance agricultural productivity and economic growth, but it also helped reduce labor costs. In addition, the land area doubled in size. Mechanization made farming activities more accessible, such as sowing, planting, fertilizing, and harvesting crops, as it did not involve strenuous and time-consuming labor, unlike before (Heritage Osofowora, 2022).

Back in the ancient period, agriculture and its traditional way were common for sustainability in livelihood. This supported the production of their food. The Philippines produced coconut, mangosteens, papayas, and bananas (Favre, 2019). It is known for its sandy beaches and vast fields (Alyosha, 2020), where the Filipino people still practice traditional farming methods (Healthy Options, 2019). In particular, the Ivatans in Bataan still dip their hands in muddy rice paddies to tend crops through 1) crop rotation, 2) fallowing, 3) water harvesting, and others (Healthy Options, 2019).

The colonization of the West in the country dominated various sectors, including the fields and farms—one of the largest industries (Blancaflor, 2018). Steam-powered machines' popularity changed the labor concept in agriculture. The acceptance of machines is justifiable, as stated; it gave multiple advantages to the country, particularly in its economy, even though it was part of a group of developing ones (Emami et al., 2018).

Researchers were also raising questions regarding the impact of agricultural machinery on agricultural production (Deng et al., 2020). Savings, quality, and efficiency were the two main aspects affected: the level of labor cost caused a significant decline in agricultural profitability (Li et al., 2017) as the price of agricultural machinery was much lower than labor cost (Tian et al., 2020). Thus, farmers who relied on agricultural machinery drastically reduced labor costs (Yao, 2009; Luo & Qui, 2021). In terms of quality and efficiency, agricultural machinery was able to perform actions that effectively improved the utilization rate of agricultural resources. Land leveling and land preparation reduced the need for weed and insect pest control (He et al., 2018; Nam et al., 2021). Other actions

were combined fertilization and sowing, which ensured accuracy and reduced the cost of seeds and fertilizer (Liu & Zhou, 2018).

As countries continued their pursuit of technology, the Philippines needed to catch up with the rising popularity of mechanized farming. Many industries, including agriculture, were beginning to recognize the importance of advanced intelligent systems, whether on farm or fruit classification technology. Ford Tractor was one of those companies that hopped on the advancement of technology in agriculture in the Philippines. They supplied rice planters throughout the country to serve as farmers' friends in maximizing their yield and, simultaneously, lessen the health risks of labor. A *rice planter* was a machine replanting rice seedlings in the paddy field. The farmer must load a mat-type rice nursery and maneuver the machine properly throughout the field as the machine automatically picks the rice and transplants it onto the soil (Food Tractor Philippines, 2023).

A revolutionary guide map was one of the Department of Agriculture's (DA) critical strategies as the national government and private sectors made advancements. The guide map gave the following services: 1) Identifying the recommended crops to be grown in each location in the country, 2) Determining the area of the shallow groundwater tables, 3) Saying the needed fertilizers to patch up the gaps of nutrients in a particular soil, and 4) Acknowledging the limitations of the specific community in terms of poverty (Mogato, 2018).

Aside from the advancement in the innovation of hybridization of rice seed, PhilRice launched mobile and desktop applications in the long run, which they were also using. Launched in 2013, Rice Crop Manager (RCM) efficiently reached out to agricultural laborers, particularly farmers all over the nation, recommending their needs to help in their yield of crops. Currently, RCM has made 1.46 million recommendations (Mogato, 2018). Another of their applications was the Leaf Color Computing (LCC) Application, which was used to check the nitrogen status of rice plants and replace the four-stripped handy "ruler" Leaf Color Chart (Philrice, 2021). PhilRice also developed an application that extended help for farm laborers to increase their value in the chain, called AgriDOC App. This application provides the following services: 1) Recording of expenses and activities, 2) Allowing the users to visit their farms on Google Maps, and 3) Reminding the users of farm-related tasks (Mogato, 2018).

Research studies have shown that manually classifying decreases yield. Factors such as fatigue and lack of training affected the sorting process of fruits. Inaccuracies were the major problem, with high variability following the list of dilemmas (Brosnan & Sun, 2002). Furthermore, manual processing consumes much time and is fragile to its surroundings (Bhargava & Bansal, 2018). As a result, research on machine learning algorithms arose using Random Forest to determine the crystalline coconut maturity level.

These factors highly impacted the laborers; one man must do the job, and the workers must team up. Farmers' responses led up to themes on the impacts of mechanization in their lives: 1) employment, 2) sufficiency of food, 3) education, particularly the youth, 4) income in terms of monthly, and 5) production processes in agriculture (Declaro-Ruedas et al., 2020). Farm laborers adapted coping strategies to the undesired impact of farm mechanization, including 1) minimization and budgeting in food expenses and 2) migrating season to look for alternative jobs as a source of income.

2.0 Methodology

2.1 Research Design

This phenomenological qualitative research design investigated the experiences of laborers affected by mechanization, particularly in the agriculture industry. This grasped common viewpoints and attributed labor experiences in traditional farming to mechanized farming. It discussed the underlying aspects of the unemployment of several farmers in different agencies and barangay in the Science City of Muñoz.

2.2 Research Locale

The study was conducted in two areas in the Science City of Muñoz, Nueva Ecija: a government entity, PhilSCAT, and a farm around Bantug. Science City of Muñoz is a 4th class municipality of Nueva Ecija with a total land area of 14,793 hectares and a present population of 102,823 as of December 2023. It is one of the five cities of the province.

2.3 Research Participants

This qualitative research used convenience sampling. Five (5) participants were from the Science City of Muñoz, Nueva Ecija, Philippines. The laborers came from different entities, making the results more effectively diverse. A code was assigned to each participant to maintain the participants' privacy and/or anonymity. The prepared guide questions were reviewed and validated by five (5) experts composed of statisticians and teachers.

2.4 Research Instrument

During two weeks involving semi-structured interviews with five (5) respondents, the study was guided by a set of 22 open-ended self-constructed guide questions. The instrument was fractionated into three components: 1) informed consent form and data privacy clause, 2) questions on the perspectives and experiences of respondents on how modernization of machinery affects their livelihood as laborers after its implementation, and 3) questions on challenges and opportunities on the outgoing presence of machinery in the agricultural sector.

2.5 Data Gathering and Analysis Procedure

The respondents were contacted for in-person meetings. During the initial meeting, informed consent forms were secured, while the research purpose was explained thoroughly to the participants. A set of researcher-made interview guide questions relating to the farmers' livelihood before and after mechanization was used for all five respondents in a one-on-one semi-structured interview. The respondents were well-informed and willingly agreed to have their interviews documented using audio recordings. The data gathered undergo the 7-step Colaizzi's Method to reach an in-depth understanding: 1) reading the transcript for familiarization, 2) collecting statements with relevance and a sense of the concept that the study investigates, 3) understanding the meanings of the collected statement, 4) bracketing extracted words into themes, 5) identifying the explanation and description of the structure of the phenomenon, 6) generating a report regarding the core of the concept this study investigates and its importance, and 7) proving the validity of the results by letting the participants give feedback.

2.6 Ethical Considerations

The Central Luzon State University (CLSU) Ethics Research Committee (ERC) reviewed and approved this research on March 14, 2023, with an ERC Code 2023-163.

3.0 Results and Discussion

Using a thematic analysis, the answers of the participants were coded and categorized, forming three major themes: (1) difficulty in sustaining livelihood, (2) education and its essential role, and loss of the sense of "*bayanihan* spirit" (communal unity).

Table 1. Themes

Themes	Exemplary Quotations
Difficulty in Sustaining Livelihood	Before, harvesting was done manually; now, machines do it, such as the combine harvester that they pertain to. Because of this, you can't engage anymore in agriculture work by means of hand and sweat, which would lessen your source of income in life.
Education and Its Important Role	Education has a huge role because if you have an enforced educational background, you can have a chance to be successful in life. However, what would [mechanization] contribute when you do not have money to buy machinery?
Loss of the of the Sense of " <i>bayanihan</i> spirit" (communal unity)	Solidarity was no longer eminent since people prioritized their lives, unlike before.

3.1 Difficulty in Sustaining Livelihood

Laborers had difficulty sustaining their livelihood after machines' popularity in the agricultural sector. Participants have acknowledged the unfavorable consequences the machines have brought to them in terms of employment and financial stability that contributes to their overall livelihood. Regardless of the ease the machines gave to physical labor, it also meant to replace the job itself of the laborers: hand tractor plows the field, reaper mows the rice, and thresher separates the rice grain from the straw.

"Before, harvest was done manually; now, machines do it, such as the combine harvester that they pertain to, and because of it, you cannot engage anymore in the agriculture work using hand and sweat. That would lessen your source of income in life."

Subjects could tell that despite the hard work and effort the agriculture industry demanded back then, more income was entering, favoring their life before. With farming being removed from their sources of income and them heavily relying on this, the introduction of machinery agriculture without compensation or plan for the affected laborers caused them to further susceptibility to poverty. One factor of this is the difficulty in meeting their daily needs, which they battled even before the machinery and has increased now after the implementation of machinery.

"The work on agriculture was more difficult back then, but there was more money. Today, life is easier, but the poor are left behind."

"Life was easier back then than it is now; back then, when you had karyada, you had money every day; now, with machinery, we have lost our karyada."

"Those without fields have been affected; they cannot mow, so what will they eat?"

On the other hand, two participants said their lives before and after the implementation felt the same due to market price inflation.

"Our lives were the same as before, but the expenses were minimal. Now, we can hardly save money due to inflation."

Based on the article by Nguyen (2022), food insecurity in the country is in a growth spurt as it only relies on imported food rather than its produce, considering the population to feed.

Due to the unemployment in the agricultural sector, subjects considered changing occupations, such as construction workers and tricycle drivers, as a substitute for their source of income. They have mentioned that their lives with these jobs are better than when in agriculture as they have assurance of money regularly coming in.

"I will choose life at present. Because when I work in construction, it pays daily. It pays higher than what you get in farming. Now, our lives are quite comfortable because of construction work."

As explained by Nakamura (2018), technological unemployment has been nothing new since the advancement of technology and the introduction of machinery. Machinery made people's lives easy. However, they also made their lives difficult, especially the ones in the working class. The findings created awareness of the machines' negative impact on their lives. This is supported by Magbitang et al. (2022), who found that technological innovations such as the mechanized reaper have caused unemployment and migration among farmers. This led the farm workers to engage in alternative livelihood endeavors like poultry and livestock production. Agriculture no longer provides much income despite countless efforts poured into farming. Alternative jobs have become the savior of many modern farmers, who can no longer support their families with farming.

Borah et al. (2024) obtained results that showed the barriers faced by the farmers in Assam, India, to adopting Climate Smart Adaptive Livelihood Technology (CSALT). The most significant problem appeared to be the limited skills regarding using CSALT, which is matched by the farmers' lack of awareness about CSALT in general. The insufficiency of the farmers' resources to invest in the said technology was also identified as an important barrier.

3.2 Education and Its Important Role

Laborers acknowledge the significance of education in finding jobs and operating agricultural machinery. Education is essential to everyone. It helps us reach our highest potential while getting or exploring new ideas. It helps us obtain skills, techniques, information, and knowledge that can aid us in our growth and development, impersonally and personally (Team et al., 2022).

"Education has a huge role because if you have an enforced educational background, you can have a chance to be successful in life. However, what would [mechanization] contribute when you do not have money to buy machinery?"

Education has a vital role in the livelihood of laborers, improving how they can utilize the tools and information they have to be efficient in producing their produce. However, while education is extremely vital-formal education is not available for everyone, so everyone should try to make knowledge readily available.

According to a study conducted in Vietnam by Ninh (2021) on the economic role of education in agriculture, education gives farmers the tools to acquire and apply knowledge to develop marketing, financing, and production solutions. Most of the participants responded that education can help them secure better opportunities for their jobs. In a study set in Nepal by Pudasaini (1983), education in agriculture is more effective for productivity in a modern environment than in a traditional one. This study highlighted the great relevance of education in agriculture, which is in line with Ninh (2021), who found that education helps in the output of rice farming households as it provides them with better management of large farms. Furthermore, this implies that policies aiming to provide quality education to rural people will effectively enhance their income and trigger long-term economic and agricultural growth.

Mbanasor et al. (2024) highlighted that educated farmers are more likely to comprehend new information, including modern improved technologies, which makes them better equipped. This is after they found a significant result regarding the crucial importance of formal education in farmers' decision-making process regarding Climate Smart Agriculture (CSA) methods. They explained that education asserts wider channels to the farmers, including, most importantly, the media, thereby expanding the foundation of their knowledge.

3.3 Loss of the Sense of "bayanihan spirit" (communal unity)

The reduction of manual labor happened when machines replaced them. The sense of "Bayanihan" dissipates with the lack of laborers. The subjects were in harmony with their responses regarding the "Bayanihan" since, without interactions, the unity and cooperation to achieve their goal of harvest, which was once in full swing back then, became absent.

"Solidarity was no longer imminent since people prioritize their own life, unlike before."

Ever since the introduction of machinery into the agricultural sector, laborers have tried to redeem themselves and battle with machines' capabilities. However, as time goes by, machines' competency and efficiency increase, leaving the laborers behind. Hence, the sense of "Bayanihan" was lost. Laborers now only prioritize their families as they think of alternative ways to stay afloat and have their daily necessities met.

According to Medrano et al. (2015), the introduction of machines to help with the labor involved in farming eventually intervened with the farmers' tradition as the "bayanihan" was on the brink of extinction.

The machines helped lessen the laborers' workload as they no longer had to do manual labor. Nevertheless, despite this approach and the efficiency of the machines, it is indisputable that machines significantly impacted the livelihood of laborers and affected the "Bayanihan."

The sense of the farmers' solidarity is slowly dissipating, as stated by Medrano et al. 2015 in which machines did almost everything that farmers could do. This made each farmer far more competitive with the others, further losing camaraderie and solidarity among farmers and their families. Farmers were left with dust as the machines started to take over manual and technical labor.

According to Rodulfo et al. (2021), farmers were met with insufficient farm labor as machines took over. They had experienced difficulties in securing any farming contract, especially during peak season for land preparation, planting, and even harvesting. In their results, it was stated that farm respondents of this study that labor ranged from sufficient to abundant. However, some respondents expressed that securing availability for farm labor, such as land preparation, planting, and manual harvesting, became problematic as machines were used.

With that, work became a struggle as they were left to compromise and fend for themselves, making them look for alternative jobs outside of the range of farming.

Moreover, their chance to farm came infrequently, leading to the loss of "Bayanihan," as they considered themselves first before others. Unity slowly perished as farmers went on their own and took the remaining labor tasks as their own since this was the basis for their wages. They lamented that they had no choice but to think only of themselves and their family, as it was the only way to provide their daily necessities.

Birungi et al. (2024) found the significance of trust and commitment by the farmers of Uganda to each other regarding collective marketing. Their result showed the high level of trust in the integrity and goodwill of the farmers to help each other as being united and performing in large units gives incentives to the farmers. This suggested a strong sense of belonging, obligation, and interest in persevering in marketing the rice collectively.

4.0 Conclusion

Mechanization makes farming more efficient and accessible, yet it comes at a cost. It hurts the livelihood of the laborers, making them seek alternative jobs to sustain life. The results reveal how the themes affect each other. Nueva Ecija is one of the top rice producers in the Philippines. Farming is the sole source of livelihood for almost every household. Due to the rising popularity of mechanized farming, their income is now not the same as before, leading them to resort to a different job or a temporary source of income, usually referred to as a "*sideline*." This answers the questions focusing on the respondents' financial stability before and after implementing machinery and fulfills the determination of alternative sources of income. Now, education comes into play, as employers prefer adept employees. Even though experience counts as leverage, education is the main decision-maker for employers. However, as stated in the results, education is not available for everyone, as socioeconomic status hinders their right to study. Free education does not exactly mean accessible education, as schools are not present in secluded communities. Hence, this solely explains how education affects an individual's ability to adapt to agricultural sector mechanization. Machines are now their competitors, and educational attainment in job seeking is their dream crusher. They have no choice but to push back communal unity and prioritize themselves and their families first. In conclusion, the continuous advancement of technology and the unwavering implementation of mechanization push farmers to fall behind in the fast-paced environment, which certainly impacts their performances due to the discouragement they encounter.

5.0 Contributions of Authors

The authors confirm their contribution to the paper as follows:

Study conception and design: DILLA, Verline Gaudeene A., DALUSONG, Reginald Ludwig G., ELACION, Lesley Jane R., MINA, Franz Cedrick R., VASQUEZ, Roxzyleen Andreih C., VILLARAMA, Joseph A.

Data collection: DILLA, Verline Gaudeene A., DALUSONG, Reginald Ludwig G., ELACION, Lesley Jane R., MINA, Franz Cedrick R., VASQUEZ, Roxzyleen Andreih C., VILLARAMA, Joseph A.

Analysis and Interpretation of results: DILLA, Verline Gaudeene A., DALUSONG, Reginald Ludwig G., ELACION, Lesley Jane R., MINA, Franz Cedrick R., VASQUEZ, Roxzyleen Andreih C., VILLARAMA, Joseph A.

Draft manuscript preparation: DILLA, Verline Gaudeene A., VASQUEZ, Roxzyleen Andreih C., VILLARAMA, Joseph A.

Manuscript revision: DILLA, Verline Gaudeene A., VASQUEZ, Roxzyleen Andreih C., VILLARAMA, Joseph A.

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7.0 Conflict of Interests

The authors affirm that they do not have any competing interests.

8.0 References

- Alyosha. (2023, January 29). 20 things the Philippines is known and famous for. Hey Explorer.
- Bacig, C. E. (2022, December 8). PH farms getting empty: Agriculture job loss a worrying trend. PIDS - Philippine Institute for Development Studies.
- Bang, G. H. (2019). A new paradigm to general agricultural education in elementary school. *Journal of Korean Practical Arts Education*, 25(3), 43–59. <https://doi.org/10.29113/skpaer.2019.25.3.004>
- Bhargava, A., Bansal, A. (2018). Fruits and vegetables quality evaluation using computer vision: A review. *Journal of King Saud University - Computer and Information Sciences*, 33 (3), 243-257, <https://doi.org/10.1016/j.jksuci.2018.06.002>
- Birungi, P., Agea, J. G., Baiyana, I., Kyazze, F. B., Mulugo, L. W., & Ndaula, S. (2024). Smallholder farmers' trust and commitment influence collective marketing outcomes for the rice producer organizations in mid-western Uganda. *International Journal of Agricultural Extension*, 12(1), 51-70. <https://doi.org/10.33687/ijae.012.001.4816>

- Blancaflor, S. (2018, October 1). 120 years after Philippine independence from Spain, Hispanic influence remains. NBC News. <https://www.nbcnews.com/news/asian-america/120-years-after-philippine-independence-spain-hispanic-influence-remains-n912916>
- Brosnan, T., Sun, D. W. (2002). Inspection and grading of agricultural and food products by computer vision systems—a review. *Computers and Electronics in Agriculture*, 36 (2-3), 193-213. [https://doi.org/10.1016/S0168-1699\(02\)00101-1](https://doi.org/10.1016/S0168-1699(02)00101-1)
- Brune, S., Knollenberg, W., Stevenson, K. T., Barbieri, C., & Schroeder-Moreno, M. (2020). The influence of agritourism experiences on consumer behavior toward local food. *Journal of Travel Research*, 60(6), 1318-1332. <https://doi.org/10.1177/0047287520938869>
- Borah, A., Gogoi, P. B., & Rahman, B. (2024). Perceived barriers to the adoption of Climate Smart Adaptive Livelihood Technology (CSALT) by the farmers in flood prone areas of Assam. *International Journal of Environment and Climate Change*, 14(2), 227-231. <https://doi.org/10.9734/IJECC/2024/v14i23940>
- Chen, S. S., & Zhang, X. Q. (2021). Agriculture green and high-quality development of Fujian province under new era. *Sci. Tech. Mana. Res.* 18, 96-104.
- Declaro-Ruedas, M. Y. A., Bais, L. S. (2020). Coping strategies of the farm laborers toward farm mechanization in Central, San Jose, Occidental Mindoro. *Journal of Asian Rural Studies*, 4(1), 109-118. <https://dx.doi.org/10.20956/jars.v4i1.2149>
- Deng, X., Yan., A., Xu, D., & Qi, Y. (2020). Land registration, adjustment experience, and agricultural machinery adoption: Empirical analysis from rural china. *Land*, 9(3), 89. <https://doi.org/10.3390/land9030089>
- Emami, M., Almassi, M., Bakhoda, H. (2018). Agricultural mechanization, a key to food security in developing countries: strategy formulating for Iran. *Agriculture & Food Security*, 7, 24. <https://doi.org/10.1186/s40066-018-0176-2>
- Favre, L. (2019). 10 Things to Know About the Philippines. USNews. <https://www.usnews.com/news/best-countries/articles/2019-06-20/10-things-to-know-about-the-philippines>
- Ford Tractor. (2023). Rice Transplanter in the Philippines: Ford Tractor. Ford Tractor Philippines. <https://fordtractor.ph/rice-transplanter-philippines/>
- Fuad, M. A. F., & Flora, U. M. A. (2019). Farm mechanization in Bangladesh: A review. *International Journal of Research in Business Studies and Management*, 6(9), 15-29. <https://doi.org/10.1016/j.jafr.2021.100225>
- He, J., Li, H. W., Chen, H. T., Lu, C. Y., and Wang, Q. J. (2018). Research progress of conservation tillage technology and machinery. *Transaction of the Chinese Society for Agricultural Machinery*, 49, 1-19.
- Healthy Options. (2019, June 8). Back to our roots: Traditional farming methods in the Philippines. <https://shop.healthyoptions.com.ph/blogs/articles/back-to-our-roots-traditional-farming-methods-in-the-philippines>
- Kapur, R. (2018). Usage of Technology in the Agricultural Sector. *Acta Scientific*, 2(6). <https://actascientific.com/ASAG/ASAG-02-0103.php>
- Li, T., Yu, W., Balenzentis, T., Zhu, J., & Ji, Y. (2017). Rural demographic change, rising wages, and the restructuring of Chinese agriculture. *China Agricultural Economic Review*, 9(4), 478-503.
- Liu, H. H., & Zhou, H. (2018). Analysis on farmers' selection behavior of mechanized-transplantation and its influencing factors: Based on the perspective of link cost and survey data of the main rice producing area in Jiangsu. *Journal of Hunan Agricultural University*, 44(1), 32-37. [https://doi.org/10.13331/j.cnki.jhau\(ss\).2018.01.005](https://doi.org/10.13331/j.cnki.jhau(ss).2018.01.005)
- Lu, F.-M. (2009). The role of agricultural mechanization in the modernization of Asian agriculture: Taiwan's experience. *Engineering in Agriculture, Environment, and Food*, 2(4), 124-131. <https://doi.org/10.11165/eaef.2.124>
- Luo, M. Z., & Qui, H. L. (2021). Agricultural machinery socialization service adoption, endowment difference and alleviation of rural economic relative poverty. *South China J. Econ*, 2, 34-51.
- Magbitang, T. D., Fulong, L. V., Sabaulan, J. S., & Ramos, B. A. (2022). Effect of the modern rice harvesting technology to the livelihood of the farm workers in select barangays of an independent city in Northern Luzon. *International Journal of Innovative Science and Research Technology*, 7(9), 901-904. <https://ijisrt.com/assets/upload/files/IJISRT22SEP409.pdf>
- Medrano, J. C., Villanueva, K., & Tindown, D. J. (2015). Rice combine harvester: Its effects to the livelihood of rice-field tenants in a second class municipality. *Asia Pacific Journal of Multidisciplinary Research*, 4(4), 112-118. <https://www.apjmr.com/wp-content/uploads/2016/10/APJMR-2016.4.4.17.pdf>
- Mbanasor, J. A., Kalu, C. A., Okpokiri, C. I., Onwusiribe, C. N., Nto, P. O. O., Agwu, N. M., & Ndukwu, M. C. (2024). Climate smart agriculture practices by crop farmers: Evidence from South East Nigeria. *Smart Agricultural Technology*, 8, 2772-3755. <https://doi.org/10.1016/j.atech.2024.100494>
- Mogato, A. A. (2018, July 26). In the Philippines, technology is seeping into agriculture. Bworldonline. <https://www.bworldonline.com/special-reports/2018/07/26/175993/in-the-philippines-technology-is-seeping-into-agriculture/>
- Nakamura, H. & Zeira, J. (2018, June 26). Automation and unemployment: Help is on the way. <http://dx.doi.org/10.2139/ssrn.3202622>
- Nam, K., Suk, S. D., & Byeong-il, A. (2021). The empirical analysis of production cost reduction effects from the agricultural machinery rental policy. *Journal of Rural Development*, 44(2), 51-78. <https://doi.org/10.22004/agecon.330820>
- Ninh, L. K. (2021). Economic role of education in agriculture: Evidence from rural Vietnam. *Journal of Economics and Development*, 23(1), 47-58. <https://doi.org/10.1108/JED-05-2020-0052>
- Heritage Osofowora. (2022, November 11). Product spotlight - The importance of mechanization as a service. Crop2Cash. <https://www.crop2cash.com.ng/blog/product-spotlight-the-importance-of-mechanization-as-a-service/>
- Paltasingh, K. R., & Goyari, P. (2018). Impact of farmer education on farm productivity under varying technologies: case of paddy growers in India. *Agricultural and Food Economics*, 6(1), 1-19. <https://doi.org/10.1186/s40100-018-0101-9>
- Peng, J., Wu H, Song J, & Li M. (2019). Impact of agricultural mechanization level on farmers' cropping index in Hubei Province. *Zhongguo Shengtai Nongye Xuebao/Chinese Journal of Eco-Agriculture*, 27(3): 380-390. <https://doi.org/10.13930/j.cnki.cjea.180624>
- PHILRICE. (2021, January 12). Leaf color computing app | PRRI. Philippine Rice Research Institute. <https://www.philrice.gov.ph/leaf-color-computing-app/>
- Pudasaini, S. P. (1983). The effects of education in agriculture: Evidence from Nepal. *American Journal of Agricultural Economics*, 65, 509-515. <https://doi.org/10.2307/1240499>
- Rice, A. H., & Kitchel, T. (2018). Agriculture teachers' integrated belief systems and its influence on their pedagogical content knowledge. *Journal of Agricultural Education*, 59(1), 51-69. <https://doi:10.5032/jae.2018.01059>
- Rodulfo, V. A., Del Rosario, A. C., Larona, M. V. L., Salandanan, A. D., Bautista, M. G. O., & Querijero, N. J. V. B. (2021). Effects of the extensive use of mechanization on farm labor use and patterns in rice and corn production systems in the Philippines. *Philippine Journal of Agricultural and Biosystems Engineering*, 17(2), 41-42. <https://doi.org/10.48196/017.02.2021.03>
- Tian, X., Yi, F., & Yu, X. (2020). Rising cost of labor and transformations in grain production in China. *China Agricultural Economic Review*, 12(1), 158-172. <https://doi.org/10.1108/CAER-04-2018-0067>
- Wouterse, F., & Badiane, O. (2019). The role of health, experience and educational attainment in agricultural production: Evidence from smallholders in Burkina Faso. *Agricultural Economics*, 50(4), 421-434. <https://doi.org/10.1111/agec.12500>
- Xu, D., & Song, W. (2021). Research on the evaluation of green development of agriculture in the perspective of rural revitalization. *Study Explo*, 3, 130-136.
- Yao, J. L. (2009). Relationship of agriculture mechanization development and cost decrement of three main grain crops. *Journal of Agricultural Mechanization*, 31, 24-27.
- Zheng, H., Ma, W., Guo, Y., & Zhou X. (2022). Interactive relationship between non-farm employment and mechanization service expenditure in rural China. *China Agricultural Economic Review*, 14(1), 84-105. <https://doi.org/10.1108/CAER-10-2020-0251>
- Zhou X, Ma W. (2022). Agricultural mechanization and land productivity in China. *International Journal of Sustainable Development & World Ecology*, 29(6), 530-542. <https://doi.org/10.1080/13504509.2022.205163>