INNSPUB

International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 19, No. 2, p. 22-30, 2021

RESEARCH PAPER OPEN ACCESS

Farming technologies: assessment on the availability and extent of use of improved farming technologies by farmers in North-western Cagayan, Philippines

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Article published on August 26, 2021

Key words: Farming technologies, Availability, Cagayan, Level of adoption

Abstract

In the Philippines, a wide range of agricultural technologies were already introduced and some are being used successfully by several farmers. However, the adoption of some areas is still poor. Since the main livelihood of people in North-western Cagayan is farming, there is a need to assess the adoption rate of the farmers to new and improved farming technologies. This study obtained the Socio-economic Characteristics of the respondents. It also determined the different farming technologies available in the respondents' community, and their level of adoption. Furthermore, it also determined how receptive the respondents to new technologies. This study covered the six municipalities in the north-western part of Cagayan, Philippines namely: Sta. Praxedes, Claveria, Sanchez Mira, Pamplona, Abulug, and Ballesteros. The findings show that most of the respondents are male with a mean age of 47. Majority of them are married with a household size of 5, high school graduates, tilling an average of 2 hectares with an average farm experience of 19 years, and own the land they are cultivating with an average annual income of Php57, 000. Most of the technologies they are using are products introduced in the market 10 to 20 years ago. While new and improved technologies are still not in use however most of them are aware of their existence. Thus, the level of adoption of farm technology of the respondents is high but the availability of products in the community is limited since new and improved technology is still not that accessible to them.

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Introduction

During the past years, the world population significantly grows and is continuously growing. It is expected to increase by 33 percent in the coming decades, that is, almost 10 billion by 2050 up from 7.6 billion as of 2017 (Clercq *et al.,* 2018). According to the Global Harvest Initiative (GHI), almost all the growth in population occurs in the less developed parts of the world where agricultural productivity is relatively low, such as Africa and Asia. In the study made by the DuPont Advisory Committee on Agricultural Innovation and Productivity for the 21st Century, it is stated that this population boom will be accompanied by increased strains on our food supply and resources. UN Food and Agriculture Organization initiated the increase of global food production to feed the inflating population. By dramatically increasing production yields, conserving food by substantially reducing postharvest losses and food wastage, giving farmers access to real-time information and services in the field, and improving the nutritional content of foods will address the growing global hunger and malnutrition.

Development in the Agriculture industry and policies has been improved to increase food production (Rehman, *et al*., 2016). New or modern technology in the agricultural sector can substantially improve agricultural production and sustainability. For example, modern irrigation practices, crop management products, fertilizers, postharvest loss solutions, improved seeds, mobile technology, urban gardening and farming, vertical farming, seawater farming, hydroponics, as well as access to information and extension services.

Scientific and technological advancements have already benefited farmers in the industrialized world by driving agriculture production (International Fund for Agricultural Development (IFAD), 2011). However, smallholder farmers who are responsible for 80 percent of the food in the developing world have yet to see similar gains. There is an increasing need of adopting new enhanced technologies in developing countries to accelerate diversification and intensification of agriculture. The need is induced by several factors of which growing population pressure is the most prominent (Norton *et al.,* 2006). The adoption of improved agricultural technologies for staple crop production has become a critical avenue of increasing the productivity of smallholder agriculture in developing countries, thereby fostering economic growth and improving well-being for millions of poor households. Yet some of these countries are still lacking information about various agricultural technologies used by farmers (Mignouna, 2011).

In the Philippines, a wide range of agricultural technologies were already introduced and some are being used successfully by several farmers. However, the adoption of some areas is still poor. Since the main livelihood of people in North-western Cagayan is farming, aside from fishing, there is a need to assess the adoption rate of the farmers to new and improved farming technologies.

This study determined the Socio-economic Characteristics of the Respondents in terms of their age, sex, marital status, household size, educational attainment, farm size, farm experience, land ownership, and annual income. This aims to establish the profile of the farmers in the area of study.

The availability and extent of use of different farming technologies was also determined to assess the level of adoption of the farmers. Their perception on the advantages and disadvantages of using these improved technologies is equally important to know since this will be their basis on their reception for new farming technologies. This will further provide information for possible intervention and for improving future extension projects.

Materials and methods

Study Area

This study covered the six municipalities in the north-western part of Cagayan, Philippines namely: Sta. Praxedes, Claveria, Sanchez Mira, Pamplona, Abulug, and Ballesteros wherein one of the main sources of livelihood is farming.

Respondents and sampling procedure

Farmers from the six municipalities were purposively chosen to compose the respondents.

Research Instrument

Primary data were obtained using a questionnaire that served as the main tool for data collection. This was administered to the farmer-respondents. Direct observations and interviews were also done to supplement the data that were gathered in the survey area. This study used the questionnaire which is based on the research instrument of the study "Comparison on Technology Adoption of Potato farmers in Taiwan and the Northern Luzon, Philippines" by Normalyn Y. Tibao. The questionnaire was designed to obtain personal information from the farmers as well as their level of adoption of new farming technologies.

Statistical analysis

Collected data were analyzed using descriptive statistics. Weighted means, frequencies, and percentage distributions were used to determine the profile and the extent of use of farming technologies of the farmers.

Results and discussions

Socio-economic characteristics of the respondents

The socio-economic characteristics of the respondents considered were the following: age, sex, marital status, household size, educational attainment, farm size, farm experience, farm ownership, and their annual income.

The respondents were grouped into five age categories as shown in Table 1.0. Out of 785 respondents, 39% of the respondents fall within the interval 30–45 years old, which is the same percentage as those who fall between 46 and 61 years old. There are 13% of the total respondents whose age is 62 and above, who are already considered a senior citizen and should be retiring from tedious works.

The respondents' mean age is 47 years old. Table 1.0 also shows that 90% of the respondents are male. This could be due to the nature of works in the farm that requires strength and vigor that a male can handle more than that of a female. Most of the farmers are married with a mean household size of 5. Almost half of them (48%) are high school graduates while there are some pursued and graduated from colleges and few were able to attend elementary and high school only. It can also be seen in the table that 90% of the respondents have a farm size ranging from 0 to 4 hectares, though the computed mean farm size is 2 hectares. This implies that most of the respondents are mainly farmers with small landholdings.

As shown in table 1.0, 36% of the farmers had 15 – 29 years of farming experience, subsequently 41% had farming experience between 1 to 14 years and then 18% do farming for a range of 30 – 44 years. Few of these respondents even had a farming experience of 45 up to 74 years. The mean farming experience of the respondents falls to 19 years which indicates that most of them were doing farming for a long period. Out of the 785 respondents, 483 or 62% of them owned the farm they are tilling while the remaining 38% are just tenants. Their annual income ranges from as low as Php10, 000 to 1 million pesos, but the majority of the respondents earned below Php50, 000 yearly.

The computed mean annual income of the respondents is approximately Php57, 000, which can be regarded as very low considering that the mean household size is 5.

Respondents' reason for farming

There are four identified reasons why the respondents do farming. 76% of them do farming since it is the main source of income.

It is their family's livelihood. This can be attested by the fact that the main livelihood of people in North-western Cagayan is farming aside from fishing. 19% revealed that they do farming to earn extra income. While 4% said that they do farming to produce products for family consumption while the remaining 1% do it for leisure.

Application of technologies in the farmers' farming practices

Fig. 1 shows the percentage distribution of the respondents based on whether they apply

technologies in their farming practices. 84% of them responded that they do apply technologies while there are still 16% who preferred the traditional way (no use of farming technologies) of farming. This means that majority of the farmers are aware and have access to different farming technologies.

Table 1. Frequency and Percentage Distribution of Respondents by Socio-economic Characteristics (N = 785).

Socio-economic Characteristics	Frequency	Percentage	Mean
Age			
78 – 93	6	1	
62 – 77	93	12	
46 – 61	308	39	47
30 – 45	309	39	
14 – 29	69	9	
Sex	706	90	
Male	79	10	
Female			
	111	14	
Marital Status	648	83	
Single	1	.01	
Married	25	3	
Separated			
Widowed			
	10	1	
Household Size	109	14	
10 – 12	473	60	5
7 – 9	193	25	
4 – 6			
1 – 3			
	91	12	
Educational Attainment	108	14	
Elementary Level	102	13	
Elementary Graduate	379	48	
High School Level	59	7	
High School Graduate	45	6	
College Level			
College Graduate			
	4	0.3	
Farm Size (hectare)	6	0.7	
15 – 20	70	9	2
10 – 14	705	90	
5 – 9			
0 – 4			
	4	.01	
Farm Experience (year)	36	5	
60 – 74	143	18	
45 – 59	284	36	19
30 – 44	318	41	
15 – 29			
1 – 14			
Land Ownership	483	62	
Owner	302	38	
Tenant			
Annual Income (in Thousand Php)			
Above 200	19	3	57
150 – 200	10	1	
100 – 150	33	4	
50 – 100	150	19	
< 50	573	73	

Availability and extent of use on the different farming technologies of the farmers

Table 3.0 shows the different farming technologies that are usually present in a community like North-western Cagayan. These technologies were divided according to the following categories: for land preparation, for crop care and maintenance operation, for planting practices, for seed source, for harvesting practices, for storage practices during and before marketing, and grading practices. The table further shows the percentage distribution of the respondents on their extent of use or their level of adoption on the different technologies identified. For the different technologies used for land preparation,

majority of the respondents are using it except for the subsoiler which most of the respondents are not even aware of its existence. This is maybe because the subsoiler is not yet available in the community.

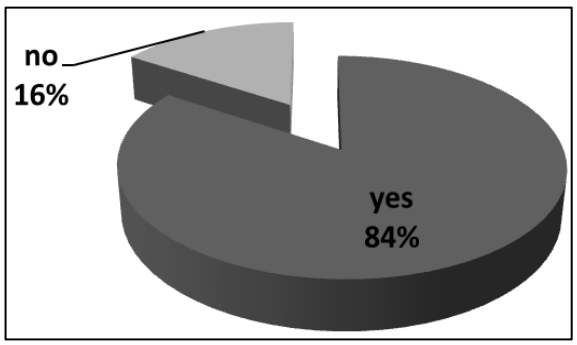

Fig. 1. Percentage Distribution of Respondents based on whether they Apply Technologies in their Farming Practices.

For the crop care and maintenance operation, the respondents are mostly using the irrigation pumps, herbicides, insecticides, and the different cleaning tools by hand but most of them are unaware of the weed twister and weed puller. Though about the same percentage are aware of the existence of these two tools, very few had tried using and using it. Table 3.0 also shows the three identified technologies commonly used in planting. 24% of the respondents are not aware of the corn planter, this is maybe because some of the respondents are purely on rice planting that is why the corn planter is not necessarily important thus no knowledge about it. The mechanical rice transplanted on the other hand is also not that familiar to them, this is because the use of this machine is not yet evident in the community. This can be explained by 68% of the respondents who are still practicing manual transplanting. The majority of the farmers are now using hybrid seeds, though many are still using inbred. It is also shown that they are aware of these kinds of seeds. Combine harvester is now widely used for harvesting, followed by the rice thresher and scythe respectively. Though there are still technologies that the farmers are not knowledgeable of their existence, like mechanical picker, stripper, and root crop uprooted. This is maybe because these tools are not the need of these farmers.

Table 2. Frequency and Percentage Distribution of Respondents by their Reasons for Farming (N = 785).

Reasons for Farming	Frequency	Percentage
➢ Farming is the main source of income	598	76
(family's livelihood)	147	19
➢ To earn extra income	34	4
➢ Crop raised is for family consumption	6	1
➢ For leisure		

Bag storage is still the most commonly used way for storage followed by the use of a warehouse. Some use cold storage and silos, others are aware but do not use these kinds of storage. Few of the respondents use machine grader.

Most of them do not use and not even aware of their existence, because they usually leave the grading part/practice to those who buy their product.

Perceived advantages and disadvantages of the farming technologies

The perceived advantages and disadvantages of the identified farming technologies were classified into three namely (1) Usefulness, (2) Ease of Using, and (3) Effectiveness in terms of Production. These three classifications were usually considered when introducing new technology to farmers.

Usefulness of each technology according to respondents' experience

Table 4 shows the usefulness of the different technology use in farming technology practices as perceived by the respondents.

Technologies used for harvesting practices have the highest mean of 4.50 whereas the technologies used for grading practices have the lowest mean of 3.65.

Most of the practices were described as very useful except for weeding, storage, and grading practices with a descriptive value of much useful. Generally, the grand mean of 4.24 described as very useful means that the respondents consider the different technologies very useful in their farming practices.

Table 3. Percentage Distribution of Respondents by Extent of Use (or Level of Adoption) on the Different Farming Technologies.

Farming Technologies	Not Aware	Aware	Interested	Evaluated	Tried	Using	Rejected
Land Preparation							
• Grab Hoe	-	37	3	3	27	26	4
• Animal-drawn moldboard plow	-	34	3	3	23	34	3
• Animal-drawn spike-tooth plow	-	37	4	2	20	33	3
• Tractor drawn moldboard plow	-	40	4	1	6	48	1
• Tractor-drawn chisel plow	-	43	5	-	7	45	-
• Tractor-drawn spike-tooth harrow	-	43	5	1	8	44	-
• Tractor-drawn spring-tooth harrow	23	21	4	1	8	4234	1
• Rotary tiller	20	32	7	2	5	19	-
• Subsoiler	34	24	10	2	11		-
Crop Care and Maintenance Operation							
• Irrigation pumps	8	21	3	2	8	56	2
• Herbicides/ Insecticides	1	11	2	-	4	82	-
• Cleaning tools by hand	-	13	2	1	7	76	-
• Weed twister	30	26	13	4	9	18	-
• Weed puller	32	26	14	4	8	16	-
Planting Practices							
• Corn planter	24	41	7	4	10	13	1
• Mechanical rice transplanter	38	34	11	3	2	12	1
• Manual transplanting	-	20	2	1	8	68	-
Seed Source							
• Inbred seeds	-	23	2	2	20	52	2
• Hybrid seeds	-	18	2	1	7	72	-
Harvesting Practices							
• Combine Harvester	7	27	5	2	7	52	-
• Mechanical Picker	44	31	11	3	2	8	1
• Scythe	-	20	7	3	18	51	2
• Rice thresher	5	17	3	4	30	41	1
• Corn sheller	26	38	7	5	10	16	1
• Reaper	15	31	3	1	16	33	1
• Stripper	38	36	8	5	4	9	1
• Root crop uprooter	44	32	10	3	4	8	-
• Manual Picking	-	34	4	1	9	51	1
Storage practices during and before marketing							
	25	33	8	7	10	14	4
• Use of cold storage	-	38	2	3	16	38	3
• Warehouse	-	53	6	10	7	20	5
• Silos	-	33	2	4	17	43	2
• Bag storage							
Grading Practices							
• Machine grader	45	28	8	6	5	8	-

Table 4. Perception of the Respondents on the Usefulness of each Technology According to their Experience.

Farming Technology Practiced	Mean	Descriptive Value
Land preparation	4.46	Very Useful
Weeding	3.98	Much Useful
Planting	4.31	Very Useful
Seed source	4.37	Very Useful
Pests and disease control	4.38	Very Useful
Fertilizer application	4.34	Very Useful
Irrigation practices	4.28	Very Useful
Harvesting practices	4.50	Very Useful
Storage practices	4.11	Much Useful
Grading practices	3.65	Much Useful
Grand Mean	4.24	Very Useful

Ease of using each technology according to respondents' experience

It can be seen from Table 5 the perception of the respondents on the ease of using each technology.

All the technologies under the different farming practices were considered easy to use with a grand mean of 3.91, except for the grading practices since most of them do not use any technology in grading their products.

Table 5. Perception of the Respondents on the Ease of Using each Technology According to their Experience.

Farming Technology Practiced	Mean	Descriptive Value
Land preparation	3.99	Easy
Weeding	3.69	Easy
Planting	3.96	Easy
Seed source	4.04	Easy
Pests and disease control	4.06	Easy
Fertilizer application	4.07	Easy
Irrigation practices	3.90	Easy
Harvesting practices	4.07	Easy
Storage practices	3.90	Easy
Grading practices	3.38	I don't care
Grand Mean	3.91	Easy

Table 6. Perception of the Respondents on the Effectiveness of each Technology in terms of Production (Cost-Based).

Farming Technology Practiced	Mean	Descriptive Value
Land preparation	3.82	Very Good (85%)
Weeding	3.39	Satisfactory (75%)
Planting	3.76	Very Good (85%)
Seed source	3.73	Very Good (85%)
Pests and disease control	3.73	Very Good (85%)
Fertilizer application	3.72	Very Good (85%)
Irrigation practices	3.72	Very Good (85%)
Harvesting practices	3.87	Very Good (85%)
Storage practices	3.53	Very Good (85%)
Grading practices	3.14	Very Good (85%)
Grand Mean	3.64	Very Good (85%)

Means of learning new technology

According to the farmer-respondents, they have learned to use new farming technologies from other farmers who have already tried using these technologies. While others learned from extension programs and activities of government agencies, NGOs, and other institutions. A few learned from advertisements, schools, and field demonstrations.

Effectiveness of each technology in terms of production (Cost-Based)

Table 6 shows the perceived effectiveness of each technology in terms of the production of the farmers. Except for the weeding, all the other practices were rated by the respondents as very good. This means that the respondents believe that the different technologies identified are at most 85% effective in terms of their expected production. This implies that they believe that using farming technologies is to their advantage when based on their production.

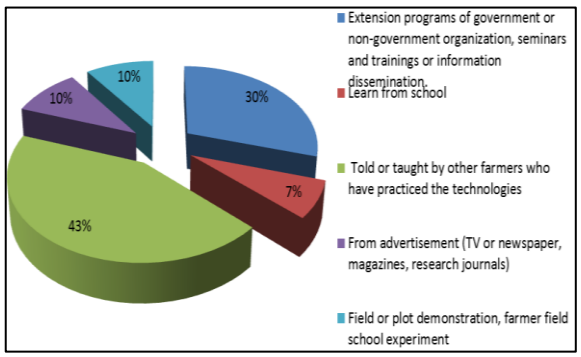

Fig. 2. Percentage Distribution of Respondents based on How Did They Learned to Adopt New Technologies.

Willingness to adopt new technologies

Fig. 3 shows the percentage distribution of the respondents on how receptive they are in adopting new farming technologies. 65% of the total respondents are willing to try and adopt new farming technologies. While the remaining 35% chose to stick to the practices and technologies they are currently using.

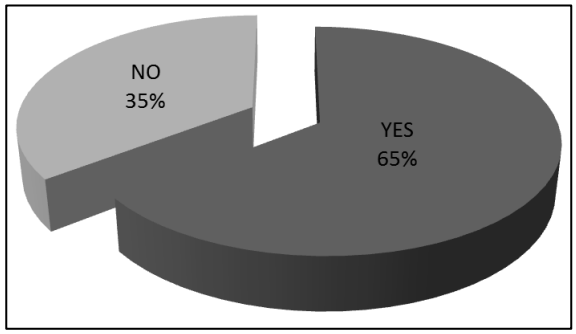

Fig. 3. Percentage Distribution of Respondents based on their Willingness to Adopt New Technologies.

Reasons on un/willingness to adopt new technologies of the respondents

From Fig. 3 where most of the respondents are willing to adopt new farming technologies and some are not willing because of different reasons shown in Table 7. There are four identified reasons why the respondents chose to adopt new technologies and are presented in the Table 8.

The most frequent reasons are the availability of trusted new technologies and its compatibility with their current farming practices.

On the other hand, the respondents who do not want to adopt new technologies say that this is because they lack the capital for new technology. Some say that it is complicated to use new technology that why they prepare not to adopt it, and a few others don't believe in the possible output that the new technology can give.

Table 7. Frequency and Percentage Distribution of the Respondents on their Reasons on Un/Willingness to Adopt New Technologies.

Willingness to Adopt New Technology	Reasons	Frequency	Percentage
Yes	Availability of new technologies and I trust, e.g. resistant varieties, chemicals to enhance growth and protection to plants.	291	33
	Availability of resources (e.g. capital, knowledge, ability, etc.)	159	18
	Compatible with my current farming practices	239	28
	Practiced by other farmers and I find it also easy, useful and compatible	185	21
No	Lack of Capital	206	44
	Complicated	150	32
	I don't believe it	110	24

Expected Results when Adopting a New Technology

Of the 785 respondents, 81% expect an increase in crop production if they will be using or adopting new technology/ies. Almost the same percentage (79%) of the respondents believes that new technologies will increase their income. Table 8.0 shows further that 67% of them expect the production of high-quality crops and 44% of the respondents think that these technologies may reduce their farming cost. Generally, farmers expect a positive outcome when they will be using new and improved technologies.

Obstacle in adopting new technology

Three possible obstacles were identified by the respondents that may hinder them from using new technologies in their farming.

The most common response is the lack of capital. According to them, they do not have enough budget to invest in a new technology so they prefer to stick to what they are currently practicing and using.

Table 8. Frequency and Percentage Distribution of the Respondents on their Expected Results when Adopting a New Technology.

Expected Result	Frequency	Percentage
Increase in crop production	431	55
Production of high-quality crops	356	45
Increase in income	418	53
Reduction in farming cost	235	30

Table 9. Frequency and percentage distribution of different obstacles in adopting technology as perceived by the respondents.

Obstacles	Frequency	Percentage
Availability of Useful & Trusted Technology	207	35
Lack of Knowledge	96	16
Lack of Capital	288	49

On the other hand, they are also afraid to use new technology since they are still uncertain if these technologies can be trusted. While the rest do not want to venture on new farming technologies since they lack the knowledge of the operations, maintenance, and overall usage of the products.

Table 10. Frequency and percentage distribution of the respondents on how soon they plan to adopt new farming technologies.

Plan to Adopt New Technology	How Soon?	Frequency	Percentage
Yes	In 6 months	248	45
	In 9 months	53	10
	In 12 months	117	21
No		132	24

Plan on adopting new technologies

Table 10 shows that 76% of those who are willing to adopt new technologies plan to adopt it after 6 months or that will be the next cropping season.

Some intend to do it after 9 months while the rest in 12 months. On the other hand, the remaining 24% do not intend to use in their farming practices new farming technologies soon.

Conclusions

The findings of the study show that most of the farmer-respondents are male with a mean age of 47. The majority of them are married with a household size of 5. A good number of them were high school graduates, tilling an average of 2 hectares with an average farm experience of 19 years. 68% of them own the land they are cultivating with an average annual income of Php57, 000. Most of the technologies they are using are products introduced in the market 10 to 20 years ago. While new and improved technologies are still not in use however most of them are aware of their existence. Thus, the level of adoption of farm technology of the respondents is high but the availability of products in the community is limited since new and improved technology is still not that accessible to them. The respondents believe that using these technologies is advantageous in terms of usefulness, ease of use, and cost-effectiveness. Most of the respondents are receptive and very willing to adopt new technology for as long as the product or technology being introduced is trusted, useful to their current situation, and economically friendly.

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