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Socio-economic Assessing of Researcher's Perceptions and Farmer's Willingness to Adopt Silage Technology in Palestine-West Bank

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Abstract: In this paper the animal breeder in Palestine has many challenges including high feed prices, high-cost input, low-quality pasture, limited access to rangeland with high quality, and high cost of feed. In Tubas and Tulkarm areas, extensive irrigated agriculture is dominant. Large quantities of agricultural by-products are wasted. As one of the important interventions to decrease feeding costs, the study focused on silage technology adoption from the view of researchers and farmers. It meant using these agricultural by-products to make them beneficial and eatable for the animal. On the one hand, we removed these by-products from the environment and second, we fed to animals and ultimately, we reduced the input cost of animal feed. The main objective is to improve dissemination strategies and approaches that promote the adoption of silage technologies by identifying both researcher and farmer perceptions and constraints. A field `survey was conducted targeting 70 farmers (35 have knowledge and practice silage technology and 35 do not) from Tubas and Tulkarm areas. The binary logistic model was used for analysis in SPSS and Excel was used for data analysis. The main finding was that age and education play a very important role in the level of adoption, both have negative effects, and access to credit and land tenure may increase the chance of adoption. farming experience has a less negative impact on the level of adoption, while family size has also a negative impact, family size also affects the level of adoption. People in the targeted area try to diversify their income and educated people to leave their parents, either settle outside or come home at the weekend. The study recommended that being a member of a community-based organization increases your chance of access to new technology and increases your chance of adoption. Public awareness and approaches to CBO are crucial for the adoption of this technology. The size of the herd is important for adoption and cost analysis.

Keywords: Socio-economic, Perceptions, Adopt, Technology.

1 Introduction

The high cost of feeds is one of the major obstacles facing livestock farmers in Palestine. A huge number of livestock farmers quit farming as a result of this problem, especially knowing that 80% of feed is imported through Israel at high costs [21]. The annual import of animal feed reaches up to 350 million US $ (PCBS, 2020) and since all have to come through Israel, high risk is implied here by closing the border anytime.

However, many agricultural, agro-industrial, and fishery by-products have the potential as animal feeds. In Palestine, there are 1.5 million tons of annual animals and plant by-products that are not utilized properly and are largely wasted due to the inability of farmers to use them before they spoil (Table 1) [21]. Consequently, these by-products often become pollutants. Making use of these animals' and plants' by-products efficiently may contribute largely to reducing animal feed costs by making them available for small-scale farmers at a cheaper cost. Making silage out of these byproducts has become one of the potential options to maximize the efficient use of these by-products, where the availability of byproducts in Palestine will show in Table 1.

Table 1: Availability of by Products in the west bank information

Type	Notes	Total Quantity (tons)
Agricultural by Products	Fruit trees	560.220

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	Vegetable	310.520
	Field crops	135.450
Total		**1.006190**
Animal by-products	Poultry waste, eggshell, and slaughterhouse waste	600.464
Industrial by-products	Whey from cheese, citrus pulp, tahini, industrial biscuit, .. etc.	95.536
Total		**1.702190**

The best way to conserve plant nutrients and to use any agricultural by-product is silage making (a natural 'pickling' process). It is a technology that depends mainly on a fermentation process of sugar content in plants carried out by bacteria that produced Lactic acid in a sealed container ('silo') with no air and can be kept in this way for up to three years without deteriorating. Silage is very palatable to livestock and can be fed at any time.

Making silage from agricultural, agro-industrial, and fishery by-products is a proven system (FAO) that offers considerable potential to improve farm incomes and profits. It can yield continuity of quality feed availability even in times of drought, at a low cost. Small farmers easily make these feeds with simple technology. Different types of silage can be made by altering the formula (the choice and mix of by-products). In this way, the individual needs of different classes of livestock can be met.

The value of silages lies in their role as cost-effective supplements and as a means for preserving several high nutritional value agro-industrial by-products (e.g. tomato pulp, olive cake, etc.) that could be used in summer and as supplement feed. Silage technology is simple and does not require sophisticated equipment, is easy to handle, and transport, and can be made at the farm levels using family labor (Cornejo et al 2007).

In general, farmers tend to use silage to:

1. Improve the life and farmer's capital revenue,

2. Reduce farm running costs (mainly for animal feeding),

3. Introduce new technology in alternative feeding systems,

4. Improve the experience of the researchers and extension services staff.

Silage preparation from forage crops upon previous studies carried out by the researcher, the study found it highly recommended producing silage by combining more products: This will balance the nutritional component that animals may need according to their developmental stage:

1. Cultivation of different types of forage crops such as (sorghum, corn, barley, millet, and beet)

2. Forage crops should have been harvested, at the moisture content appropriate for the type of silo used.

3. The moisture content is 60-70 percent.

4. The green mass is cut into small pieces about 3 cm long.

Any new technology faces problems in the beginning, especially for farmers. To be successful, it is very important to take into consideration all factors affecting this technology. One of the criteria to test its success is the adoption level by farmers. The study is called 'Assessing Researchers' Perceptions and Farmers'

Fig. 1: Stage of silage making.

Willingness on Adoption of WLI technology aims to test the adoption level of silage technology among farmers and farmer's associations in Palestine as well as understand all factors affecting positively or negatively this technology. To improve its dissemination strategies and approaches that promote the adoption of proven water and land management technologies by identifying both researcher and farmer perceptions and constraints mainly focus on the Assessment of farmers' perceptions and exposure to the technology, assessment of researchers' perceptions of technology development and existing dissemination strategies (what is working, what is not and how to develop a good dissemination strategy), identify potential challenges and opportunities for adoption by farmers, and assess existing extension systems (private and public), identify good partners, and make recommendations for good practices that can accelerate and sustain the adoption process.

2 Study objectives

The theory of maximization of utility is generally used to explain the response of farmers to the adoption of new technology [12]. According to the theory, a new technology will be adopted by a farmer if the utility obtained from the new technology exceeds that of the former one. Following [2][16], it is assumed that a farmer's response to his situation is consistent with utility maximizing. The utility a farmer obtains from the technology is represented by Uijwith j = (0,1) indicating the adoption or non-adoption of the technology and I = (1, 2, …n) indexing the farmer's characteristics. Although these characteristics are not all observed, a linear relationship is assumed for the farmer between the utility derived from the technology and a vector of observed farmer's socio-economic, characteristics and can then be represented as the following objectives:

1- Study the level of adoption of silage-making in arid areas

2- Study the impact of a set of variables including constraints that affect the rate of adoption

3- Analyze the data and disseminate it to extension agents to try to improve the level of adoption

4- Introduce simple technology with extension agent's involvement to marginal farmers from an underdeveloped area of Palestine, in order to supplement additional feed and improve the nutrition of their livestock during the dry season by using a local resource-based silage as fodder for livestock maintenance during the dry season.

3 Study area

This study occurred in three sites that have been targeted and located in Tammun in Tubas and Tulkarm. A study located in the Eastern Slopes (part of the West Bank represents the largest proportion of the rangeland area in the region, accounting for 91% of the total pasture lands. Inhabitants of the area depend on a combination of subsistence agricultural production, field crops, forage cultivation, livestock, and off-farm income. The grazing capacity of the Eastern Slopes is severely limited, providing only 15% of the feed required (during winter and spring seasons only). The benchmark site of Tammun covers approximately 25.8 km2 and has an average rainfall that ranges from 213 mm in the east to 370 mm in the west. Of this area, 24.1% is used for rainfed and irrigated agriculture while 74.9% is rangeland. More than 90 % depend on livestock for their living. Recently, farmers and investors focused more on irrigated agriculture in this area as water became available through an underground well located in Tubas. As it is located in a hot area, early production with good prices is expected. Good source of income in this area for farmers and investors. With more plantations, more agricultural byproducts will be available. that later be used as silage. The Tulkarm area 4 is located in the western part of Palestine with an average rainfall of around 500 mm annually. It is considered one of the most irrigated agriculture regions in Palestine, constituting 30 % of total intensive irrigated agriculture. It is cultivated mainly with forage and vegetables with large quantities of agriculture by-products.

4 Methodologies

4.1 Data Collection

A questionnaire was designed and distributed to farmers with interviews face to face.

The study population was farmers and farmer's associations who adopted the technology and farmers who did not (or even did not hear about the technology). A group of 48 was interviewed. Data was collected including several socio-economic, environmental, and institutional factors: Age, level of education, farming experience, access to credit, etc.). Data was analyzed using SPSS software.

4.2. Variable selection and hypothesis

The description of the following dependent and explanatory variables and hypotheses are given in Table 2.

4.2.1 Dependent variable

For farmers' adoption analysis, adoption is usually defined in terms of a binary variable (adoption /no adoption). ADOP refers to the dependent variable (Y_i) which is defined as a binary variable with a value of 1 for those farmers who have adopted silage technology and 0 for those who did not. Likert analysis: for Likert analysis, we used a scale from 1 -6 as follows:

Strongly agree 6

agree 5

neutral   4

not agree   3

Strongly reject 2

not sure 1

4.2.2 Explanatory Variables and Hypotheses

The adoption of new technology is a process that is influenced by a set of interrelated biophysical ,socioeconomic, and institutional factors [2,13]. The potential explanatory variables for Silage technology as presented in Table 1- include a wide range of households, farming, institutional, and agroecological factors that are hypothesized to influence farmers' adoption.

Table 2: Description of the variables specified in the binary logistic model.

Acronym	Description	Type of measure	Expected Sign
Dependent variables			
ADOP	Whether a farmer has adopted or not	Dummy (1 if yes, 0 if no)	
Explanatory variables			
AGE	Household head's age	Years (1, 2, 3, 4)	-
EDUC	Educational background of the household head	1, 2, 3, 4, 5	+
FSIZ	Household in number of people	Numbers	+
FEXP	Household head's farming experience	Years	+
LABE	Labor force size	Active labor force numbers	+
TENUR	Status of land ownership	1, fully owned; 2, rented; 3, shared	?
OFFA	Farmer has any off-farm activity	Dummy (1 if yes, 0 if no)	?
INCO	Level of family income	1,2,3,4,5,6,7	+
CRED	Obtained credit	Dummy (1 if yes, 0 if no)	+
CBOS	Member to CBO's	Dummy (1 if yes, 0 if no)	+
VLIVST	Importance of livestock in the farming system	Dummy (1 if yes, 0 if no)	+
CONT	Contact with research, extension	Dummy (1 if yes, 0 if no)	+
KNT	Knowledge of the new technology	Dummy (1 if yes, 0 if no)	+
ATTI	Attitudes of farmer toward X-WLI technology	Dummy (1, feels that will have positive effects, 0 if negative)	+

While selecting the variables to be included in the model, an attempt has been made to include the most important factors influencing adoption decisions in subsistence farming. Of the variables included in the model, positive

relationships were expected in the case of farm size, timely availability of credit, extension service, technical training, family size, off-farm income, education level, and affiliation to farmers' groups.

4.2.3 Farmer Variables and Hypotheses

The human capital of the farmer is assumed to have a significant bearing on the decision-making regarding the adoption of new technologies. Most adoption studies have attempted to measure human capital through the farmer's age and their education or years of experience growing the crop [10][11][7].

AGE is the variable measuring the age in years of the household's head. Young members of a household have a higher willingness to apply new knowledge [16]. Thus, it is hypothesized that older people will be less likely to adopt Silage However, it is also found by [3] that adoption increases with age for younger farmers as they gain experience and increase their stock of human capital but declines with age for those farmers closer to retirement.

EDUC Level of education of the farmer has been found to have a positive influence on adoption. Farmers with higher levels of education are more likely to adopt new technologies or practices in comparison with less educated farmers [15][17][2].

Farm SIZ measures the size of the family in the target. In the study area, larger family size is generally associated with that silage making generally needs a labor force. These families have large family sizes and based on that, we expect that FSIZ has a positive influence on the adoption of silage adoption.

LABE refers to the size of the active-labor force. This variable may also be associated with family size. Most farming families used to depend mainly on their members as farming workers. Labor constraints often affect silage-making. As silage-making requires labor in its process, thus, a positive influence on the adoption of silage-making is expected with the presence of a larger active-labor force.

OFFA refers to an off-farm income source. It measures whether or not the farmer has any off-farm activities (1 if yes, 0 if no). Empirical studies [1] reported negative relationships between off-farm income and the adoption of soil conservation measures. However, [13] noted that the role of off-farm income in the decision to adopt is unclear. Hence, it is not easy to expect the influence of OFFA.

In silage making we expect that more off-farm income by another member of the family may encourage the farmers to take the risk and adopt the technology as extra financial resources are available.

A higher level of family income (**INCO)** implies the ability to invest in technologies and to have the risk associated with their adoption. A positive relationship would be expected.

Silage making needs an initial input cost which is around 2000 USA dollars, families with a high income have likely more chance to invest this amount of money. other risks may apply also, like contamination with a fungus that releases a toxin. NARC on its turn issued a strict guideline to prepare silage. If by any means, the farmers did not stick to protocol, risk of contamination and the quality of silage may appear.

4.2.4 Perception Variables and Hypotheses

ATTI measures farmers' attitudes, defined as the degree of a farmer's positive or negative feelings towards silage. Farmers develop positive attitudes if they feel that this technology can serve their needs. in our case, silage is intended to decrease feed costs. ATTI should be positive toward the adoption.

4.2.5 Institutional Policy Variables and Hypotheses

Farmers who have frequent contact with extension activities and experts (CONT) are supposed to have easy access, and complete information about problems, profitability, and performances .Therefore, CONT is hypothesized to positively influence adoption.

Farmers with access to considerable financial resources were supposed to adopt innovations earlier. Accessibility of farmer's cash credit (CRED) can help rural households to increase their production. Silage needs an initial investment of about 20000 USA dollars. So, access to CRED with a low rate may affect silage adoption positively. [14][9][20] found that credit constraints may hamper adoption behavior.

4.2.6 Farming Variables and Hypotheses

FARM size: Farmers with large farms may use it efficiently to plant corn or other cash crops and use its byproduct as silage. More farm size, more plantations with more plant residue. So, we expect families with more farm size to positively affect the adoption of silage-making.

TENUR reflects the status of land ownership. In Palestine, there are three main types of land ownership, privately

owned rented, or shared. Land ownership is widely believed to encourage the adoption of new technologies [8]. In fact, it depends on the type of technology. People tend not to take any risk in investing in infrastructure in shared or rented land. Farmers who privately owned land are in favor of applying the technology. in our case, silage-making needs facilities and a compound. We expect that farmers with privately owned land to be more likely to adopt this technology.

4.2.7 Agroecological Location Variables and Hypotheses

VLIST measures the importance of livestock in a village. In the study area, farmers in Jenin and Tubas rely mainly on livestock to generate their family income as a source of cash income or through dairy products and partially in Tulkarm. It is hypothesized that VLIST will positively affect the adoption of the WLI project.

4.2.8 Technology-related Variables and Hypothesis

For a technology to be adopted, some criteria that are very important and related to the technology itself have a significant effect on the level of adoption.

5 Results and Discussion

5.1 Effect of Age on Adoption

The results obtained are presented in Fig 2. It clearly shows that elder farmers are less likely to adopt silage technology than younger ones. The age of a farmer decreases the probability of adoption as farmers get older. This is consistent with the theory of human capital; young members of a household have a greater chance of absorbing and applying new knowledge [16].
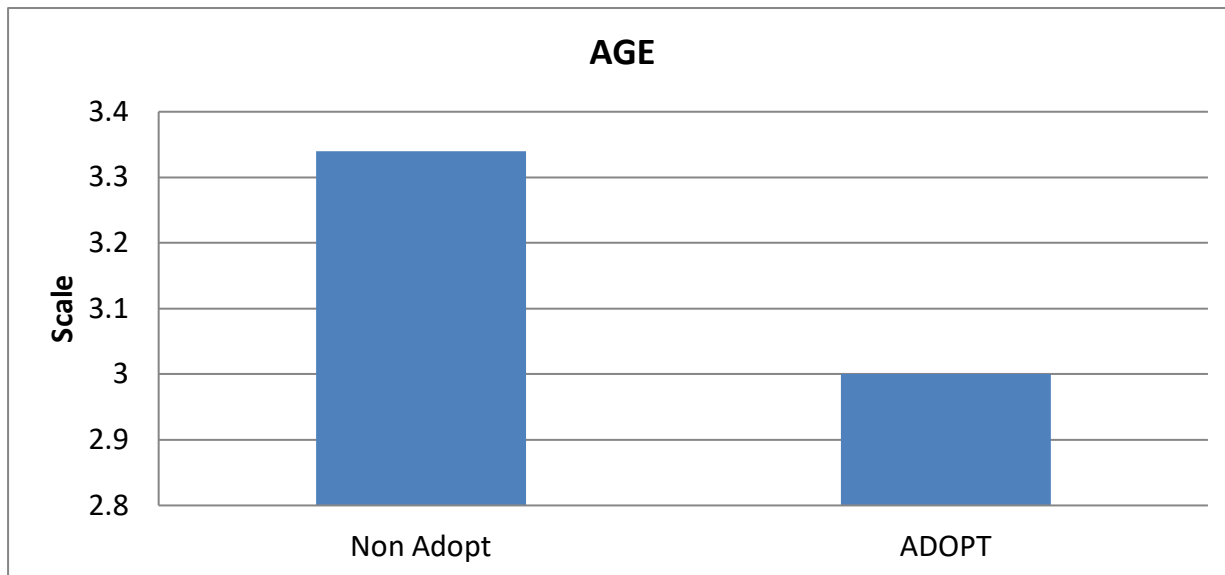

Fig. 2: Age of farmers and its effect of adoption: data were taken as the mean of age:

Scale: 1: 15-20, 2: 25-39, 3: 40-50, 4: above 50 years old

Source: Own elaboration from data set survey (2020)

5.1.1 Education Level

Education level. has a positive effect on the adoption of any technology, i.e., educated farmers are more likely to adopt the technology. But in our case, it is different as many of the targeted farmers are herders, either completed their primary school or maximum secondary school, and rarely university graduates. The result shown in Fig. 3 confirms this.

In fact, silage technology is not complicated and doesn't need that high level of education, so most farmers who adopt this technology either completed their primary or secondary education. Most of the targeted farmers have a secondary school education. Most of them are non-adopters. While farmers with less basic school or university degrees are in favor of adoption.
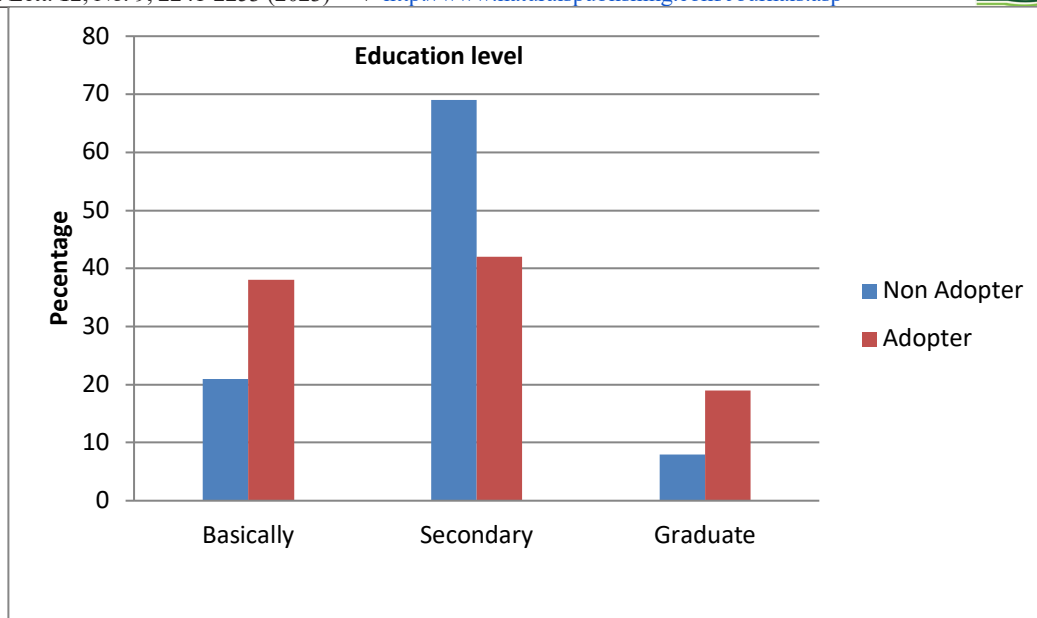
Fig. 3: Education level of targeted farmers

Source: Own elaboration from data set survey (2020)

5.1.2 Farming experience

Faring experience is supposed to have a positive effect on the adoption level, but in our case, the faring experience did not enhance the adoption level. This may be attributed to the fact that farmers with broad experience may have good management practices or may be not willing to take the risk with new technology. Simply saying they don't want to be changed. Changing farmer perception is a big problem in Palestine. It looks like they inherited this from their parents and grandparents, and they feel this is the way they wanted to run their life.

But if we look at adopters, we find that they have less faring experience. This may be reflected by the way that they are willing to explore new technology (Fig. 4)

5.1.3 Land Tenure

Three main types of land tuners are recorded for sample farmers, owned, rented, or shared. Results of sample data analysis presented in Fig. 5 indicate that 77 % of the non-adopter farmers own the land, while 64 % of adopter farmers are found to own the land. In addition to 16 % of adopted have shared land.
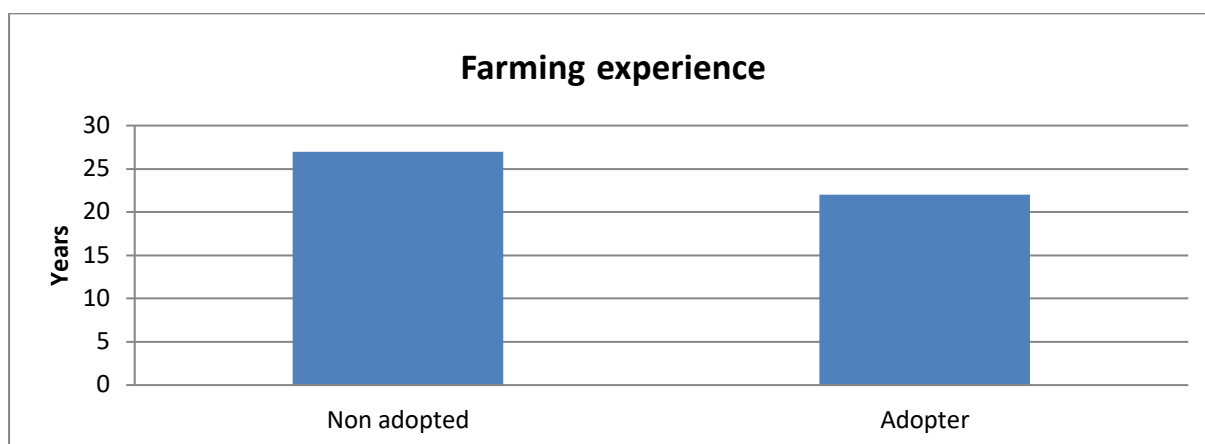

Fig. 4: Effect of farming experience on adoption

Source: Own elaboration from data set survey (2020)

As concluded by previous adoption studies in literature, the results reflect that land ownership is not major played in the level of adoption. We expect that land ownership enhances the adoption level. In our case, we have different results.

The number of Non adopted farmers who own land aerator than adopters. This may be explained that farmers have no difficulty getting plant residue in nearby other fields or the cost of bringing the residue is not that costly.
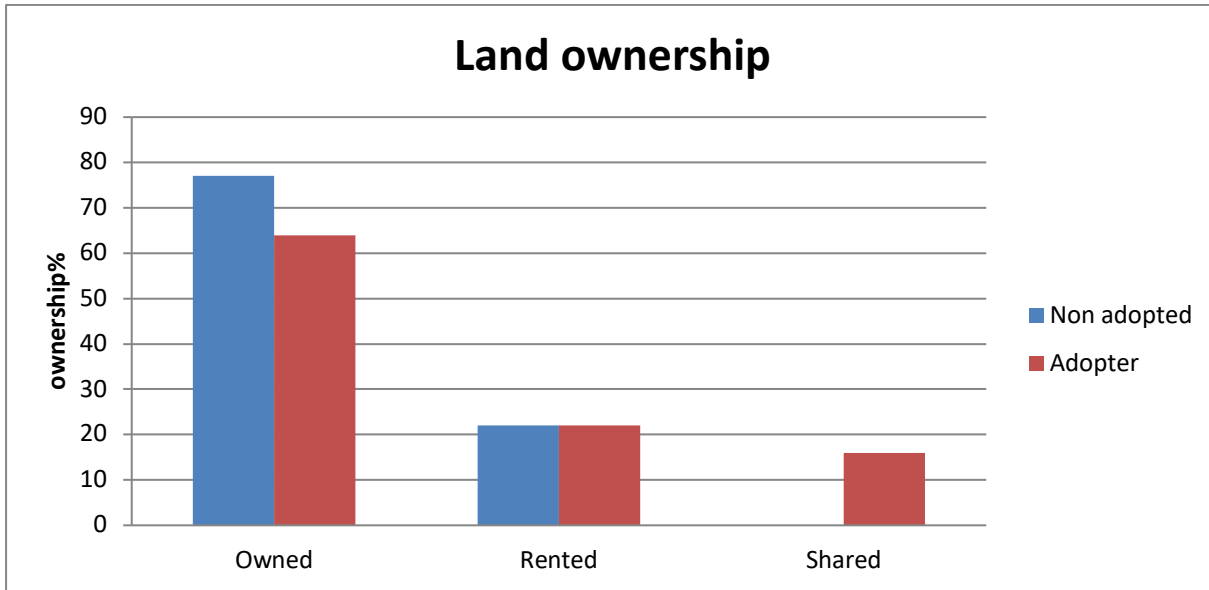
Land ownership

Fig. 5: Land ownership of farmers

Source: Own elaboration from data set survey (2020)

5.1.4 Work on the Farm

The results are presented in Fig 6. It shows that of adopters, 78 % are full-time, while for non-adopters about 64 % are full-time. This means people have less chance to work in another place.
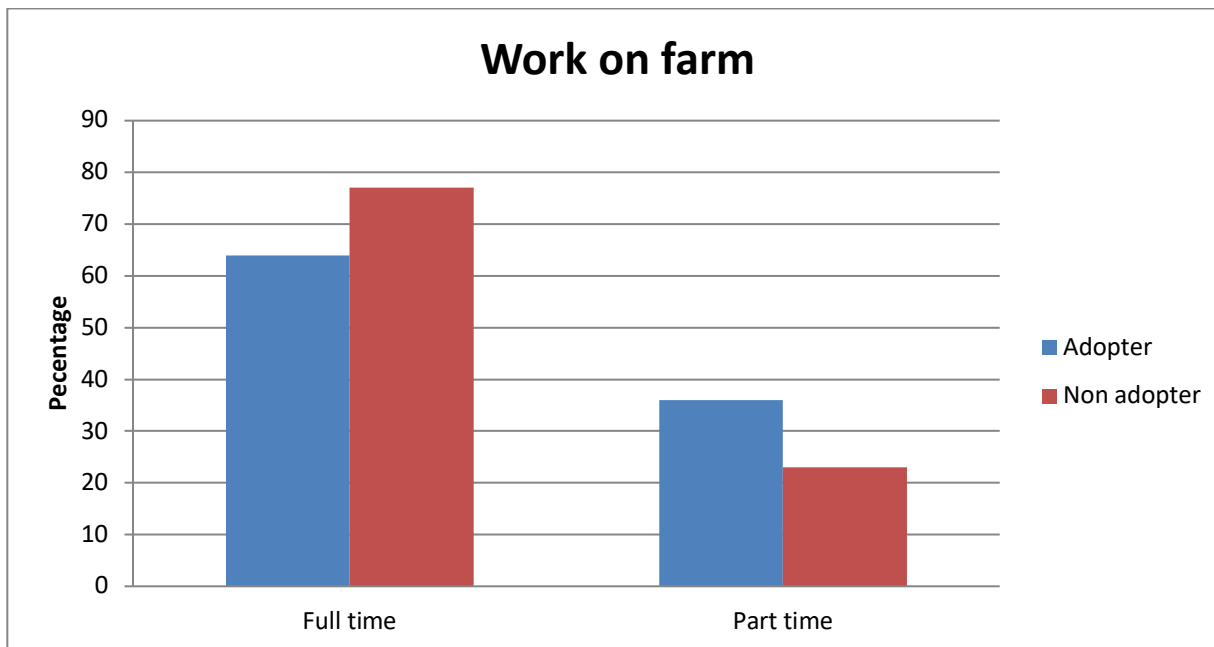
Work on farm

Fig. 6: Type of work on the farm

Source: Own elaboration from data set survey (2020)

5.1.5 Credit

Most farmers did not take any loan as indicated in the results presented in Fig.7: More than 96 % of adopters did not take credit. We do believe that credit may increase the chance for adoption, but farmers are afraid of not being able to pay back the money or afraid of increased interest or deal with the bank.
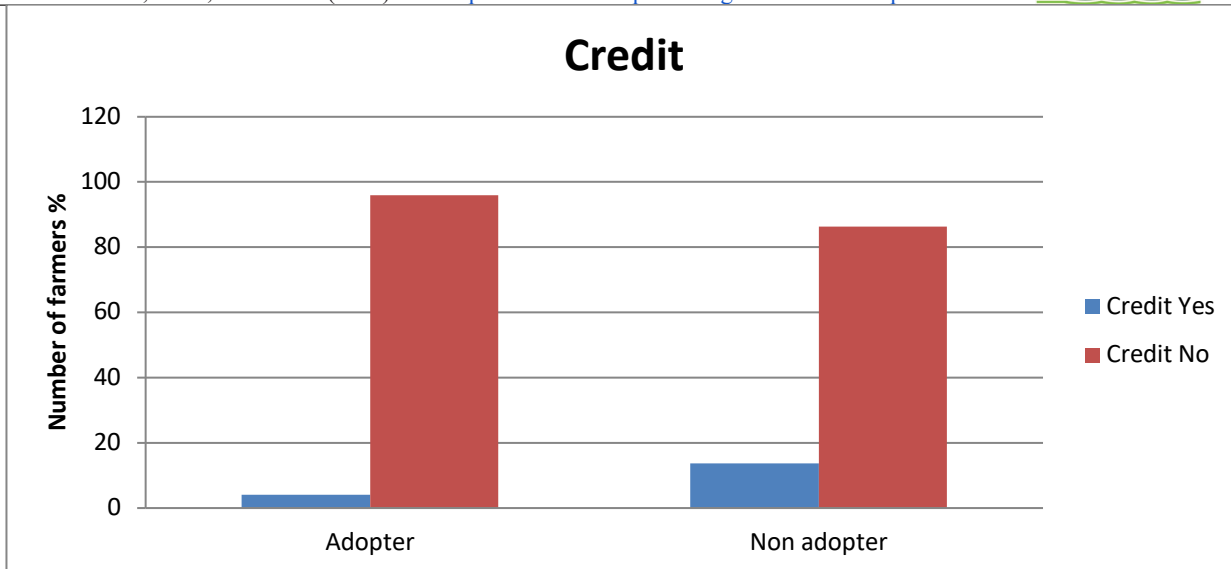
Credit

Fig. 7: Percentage of farmers taken credit

Source: Own elaboration from data set survey (2020)

5.1.6 Member with a community-based organization (CBO)

In Fig. 8, about 70 % of adopters are not members of CBO, and 30 % of non-adopters are not members. 52% of adopters are members and 48% of non-adopters are members of CBO. In general, most adopters (70 %) are not members of CBO. This reflects either that CBOs are less informed about this technology, or farmers are not convinced by the profitability of this technology.

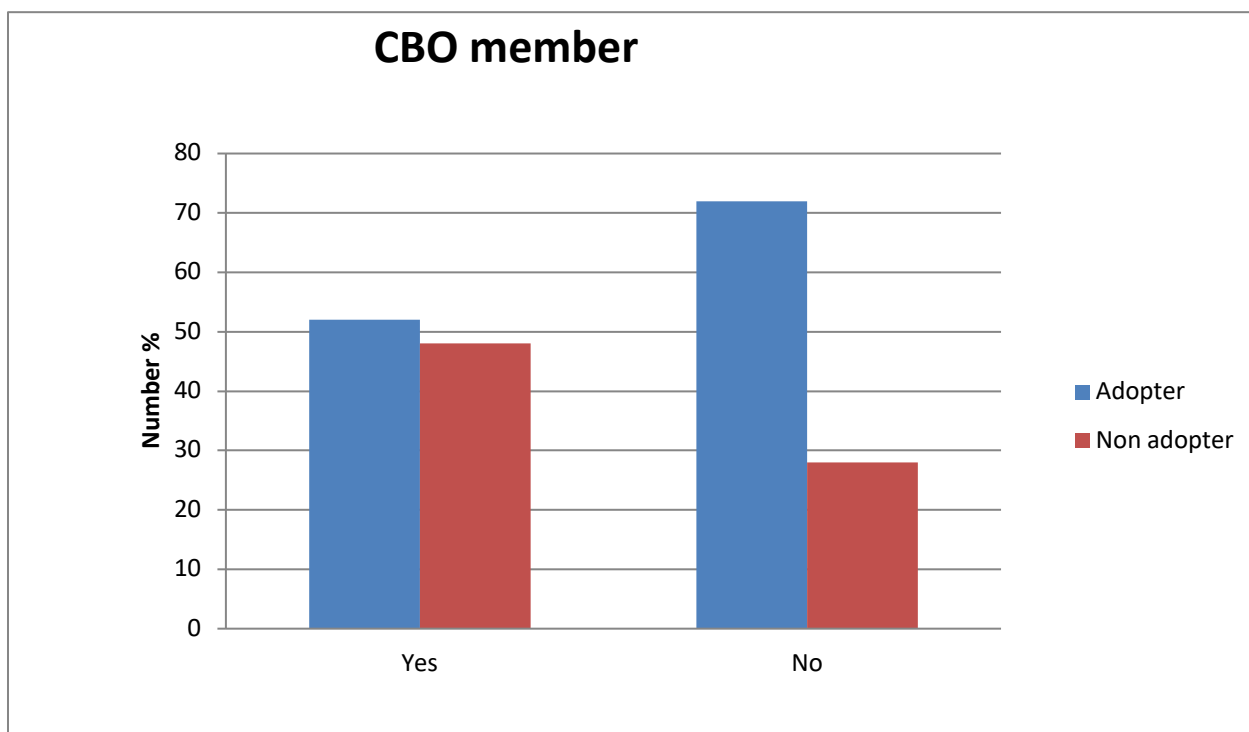We assume that CBO membership may enhance the adoption level.

CBO member

Fig. 8: Percentage of farmers members in CBO

Source: Own elaboration from data set survey (2020)

5.1.7 Descriptive statistics

Seventy farmers were interviewed, and data was collected, data was filtered and only 48 questionnaires were included in the analysis. The results are shown in Table 3

Table 3: Statistics of the explanatory variables used in the empirical logistic model

Variables	N	Min	Max	Mean	Std. Deviation
ADOP	48	0	1	.52	.505
AGE	48	2	4	3.21	.651
EDUC	48	1	3	1.81	.673
FEXP	48	5	45	24.44	8.832
FSIZ	48	2	13	7.50	2.306
TENUR	48	1	3	1.42	.679
OFFA	48	1	3	1.42	.679
LABE	48	1	8	3.50	1.750
INCO	48	1	8	3.21	1.821
CRED	48	1	2	1.92	.279
CBO	48	1	2	1.38	.489
KNT	48	1	2	1.27	.449
CONT	35	1	3	1.49	.562
ATT	35	1	1	1.00	.000
VLIVST	42	1	1	1.00	.000
Valid N	31				

5.1.7.1 Regression model – Binary Logistic Model (Logit)

The binary logistic model is used to estimate the probability of a binary response based on one or more predictor (or independent) variables (features). Logistic regression measures the relationship between the categorical dependent variable and one or more independent variables by estimating probabilities using a logic function.

Binary logistic regression is a popular statistical technique in which the probability of a dichotomous outcome (such as adoption or non-adoption) is related to a set of explanatory variables and has been widely applied in adoption studies. [2][5][6].

This is to be tested empirically by the following model (**Logit Model**): A binary logistic regression is to be used to regress the dependent variable, Y, of whether the farmer had adopted X_WLI technology: Prob (event) = Prob (Y,1 represents I the farmer adopted, and 0, otherwise)

Y = 1: Adopted, 0: otherwise

5.1.7.2 The Validity of the Model

A) Test of **Hosmer and Lemeshow**

Hosmer and Lemes show statistics are one of the most reliable tests of model fit for binary regression [16]. The results on the validity of the model are presented in Table 4.

The hypothesis (H0) is to test if there is no difference (Ha: difference) between the observed and predicted values.

If the p-value is less than 0.05: It is a poor fit for a binary logistic regression model.

If the p-value is more than 0.05: It is a strong fit for a binary logistic regression model.

The p-value was found to be 0.259 from the Hosmer and Lemeshow Goodness-of-Fit Test, which is computed from the Chi-square distribution with 8 d.f.

B) The overall percentage of correct predictions (**higher is better**)

5.2 Empirical results

A)   The coefficients (β), their magnitude, sign (+; -) and their significance (Sig.1,5 or 10% level)

B)   Exp. (β): Gives the exponential of the expected value of β raised to the value of the logistic regression coefficient, which is the predicted change in odds for a unit increase in the corresponding explanatory variable.

A)   The coefficients of the binary logistic regression model have been estimated by applying maximum likelihood methods using SPSS 20.0.

Table 4: Parameters estimates of the binary logistic regression model for factors influencing adoption of silage technology in Palestine. Variables in the Equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
AGE	-1.242	1.013	1.502	1	.220	.289
EDUC	-1.178	.819	2.070	1	.150	.308
FEXP	-.018	.060	.087	1	.768	.982
FSIZ	-.138	.204	.457	1	.499	.871
TENUR	1.112	.828	1.801	1	.180	3.039
LABE	.113	.238	.224	1	.636	1.119
INCO	.131	.291	.203	1	.652	1.146
CRED	2.062	1.949	1.119	1	.290	7.861
CBO	.655	1.050	.388	1	.533	1.924
CONT	.030	.954	.001	1	.975	1.030
Constant	.534	5.800	.008	1	.927	1.706

The results clearly show that the overall percentage of adoption among farmers is 71.4% which is acceptable and high. This means that the explanatory variable used could explain 71 % of the adoption of the selected variables there is a high potential for this technology to be disseminated in the near future.

The results of the linear regression model showed that there are three factors that affect the adoption of silage among farmers. Age is a crucial factor affecting the level of adoption. Young farmers are willing to adopt new technology, while elderly farmers tend to use traditional feeding or are not interested in risking or investing in new technology. This may be attributed to a lack of experience or educational level as shown by Cleary, which has a negative impact as well. So, both of these two factors are correlated: age and educational level.

Land tenure also has a positive effect on adoption. People with privately owned land are more likely to adopt this technology, as the Silage needs infrastructure and machinery.

On the other hand, this type of technology needs more labor force, upon analysis of family.

Composition in the study, we found that most emails are going outside and searching for another source of income, while heads of family and females too, much of responsibility. It has a negative impact on the level of adoption.

It was also shown that the farming experience has a negative impact on the level of adoption. we found that less farming experience will have a positive impact on adoption. Farmers in this study have a minimum farming experience of 15-20 years. This could be explained as follows:

Many years of farming allowed farmers to follow a strict way of living and used to raise their sheep in this way. Never forget that they are old also. To change their mind is not as simple as it be. While young people are more open-minded and ready to try or use any new technology that maximizes their profit.

Meanwhile, other factors affect positively the level of adoption, and this is explainable. The most factor that affects positively the level of adoption is access to credit. As any technology needs initial l investment, in this technology we did a cost-benefit analysis (data not shown), we found that at least farmers should have a minimum of 50 heads of sheep to cover the initial input cost which reaches 20000 USA dollars.

5.3 Likert scale analysis

Criteria of adoption are usually extended to cover the characteristics of the technology being adopted. For the current technology, characteristics have included technology trialability, compatibility, benefits to the environment, complexity in implementation, and how skills and knowledge needs. Reducing risks in agricultural production, reducing costs, increasing profit, and affordability (not expensive) are included as characteristics of any technology that is taken into farmers' account when adoption decisions are being made.

Likert scales are a non-comparative scaling technique and only measure a single trait in nature. Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale.

Respondents of farmers to the questions of their opinions regarding technology characteristics reflect a positive general view on Silage.

The majority of farmers have agreed or strongly agreed that the technology is able for divisibility, compatibility, and communicability. Farmers also agreed or strongly agreed that ST is easy to implement and follow up, saves costs, and increases profits. Regarding risks associated with ST. According to farmers, ST is affordable technology and not complex, but it requires skills and knowledge. The results of the Likert scale are presented in Fig.9 below.
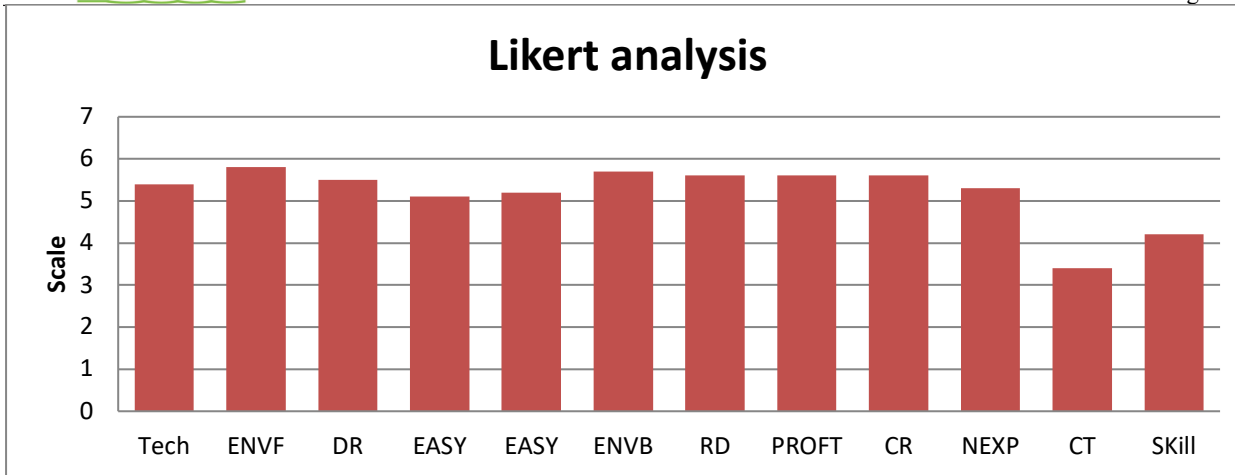
Fig. 9: Likert Scale Analysis

6 Conclusions

Smallholder crop-livestock farmers were motivated to make silage in environments where (a) seasonal lack of feed particularly in drought areas (that is, with more than dry months) caused great production losses (e.g. reduced milk production and death of cattle) and (b) organized and motivated farmers with market-oriented dairy production that existed or were emerging. Increased usage of silage-making technology using improved forages and feeds to overcome the dry season feed deficits in the dry tropics seemed possible by the application of appropriate technology transfer strategies. The involvement of extension agents is important for adoption.

7 Recommendations

For this technology to be adopted we recommend the following:

1   More access to credit

2   More involvement of extension agent throughout the whole process

3   Public awareness should be more

4   More scaled work and more approach with other farmers

5   WLI can explore additional plant production like alfalfa and other forage crops, thus farmers may have a greater incentive to adopt.

6   Working with farmer's associations than individual farmers in future

7   Having a central facility for making silage with the engagement of private sector

The main outputs are:

a.   Availability of simple technology to manufacture silages.

b.   Availability of cheap and available sources of feed for the benefit of poor farmers when range plants are not available.

c.   Improving the livestock sector and animal production sector in general.

d.   Improve the livelihood of poor farmers.

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Conflict of interest

The authors declare that there is no conflict regarding the publication of this paper.

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