INVESTIGATION AND RECORDING OF LIVESTOCK WASTE FOR THE CREATION OF BIOGAS PLANT

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Abstract

In this paper, the research focuses on the recording of livestock waste and the investigation of the views of cattle, sheep and goat farmers of the Municipality of Amyntaio (Region of Western Macedonia in Greece) regarding renewable energy sources and more specifically biogas plants which can contribute to waste management. In order to achieve the research goal, a quantitative survey was carried out on a sample of 38 livestock farmers, which showed that the farmers are not negative towards the prospect of creating a biogas plant in their area, but they do not have sufficient knowledge about it, thus requiring training in the area.

Keywords: livestock waste, biogas, renewable energy sources

Introduction

Biogas is a renewable source of energy, which is becoming more and more popular today, at a time when the shift towards Renewable Energy Sources is more intense than ever, due to the energy and environmental crisis that shape modern reality **([1], [2], [3]).** The research which is going to be presented below is a quantitative, descriptive research, which aims to investigate the positions and opinions of the farmers of the Municipality of Amyntaio (Region of Western Macedonia in Greece) regarding waste management through biogas production. For this reason, the bibliographic review was used as well as the method of quantitative research with a questionnaire and descriptive, statistical analysis.

Energy consumption is one of the primary pillars supporting today's global economic development model. Undoubtedly, modern societies use large amounts of energy to transport people and goods, to light and heat homes, and to operate industrial plants. The increase in energy demand is directly linked to the continuous rise in living standards **([4], [5]).**

Biomass production from livestock in the Municipality of Amyntaio

The Animal husbandry (Livestock) in the Municipality of Amyntaio is an important factor in the local economy and for this reason it is proved to be particularly strong. Cattle and a significant number of sheep and goats are raised in the Municipality **[6].** The aim is to create awareness and formulate policy on sustainable development that concerns the treatment of wastes such as animal waste, crop residues.

Recording potential of livestock biomass

As far as the recording potential of livestock biomass in the Municipality of Amyntaio is concerned, the data on the quantities of goats, sheep and cattle were obtained after a request to the Ministry of Rural Development and Food (Table 1).

Table 1. Total recording livestock potential in the Municipality of Amyntaio

Goats and sheep	**Cattle**	**Average organic load (for goats and sheep)**	**Average organic load (for cattle)**	**Dry material from Goats and sheep**	**Dry material from Cattle**
Number	Number	kg/d	kg/d	kg/d	kg/d
58,065	2,588	174,195.00	90,580.00	69,678.00	9,058.00
Annual organic load (for goats and sheep)				63,581,175.00	kg/y
				63,581.18	tn/y
Annual organic load (for cattle)				33,061,700.00	kg/y
				33,061.70	tn/y
Biogas Production from goats and sheep x60 m^3/tn FRM (fresh raw material)				3,814,870.80	m^3/y
Biogas Production from cattle x20 m^3/tn FRM (fresh raw material)				661,234.00	m^3/y
Biogas Production (Total)				4.476.104,80	m^3/y

Methodology

The research is developed with the method of quantitative research using a questionnaire and carrying out a statistical analysis. To conduct the research, an original questionnaire was used, which was distributed to a sample of 38 livestock farmers in the Municipality of Amyntaio. The majority of livestock farmers were aged from 40 until 60 and secondary school graduates. Research results extracted from participant responses were analyzed by descriptive statistical analysis and visualized through the use of bar charts and pie charts.

Results

Most survey participants, in terms of age, were between 40 and 60 years old, as shown in the following Figure 1:

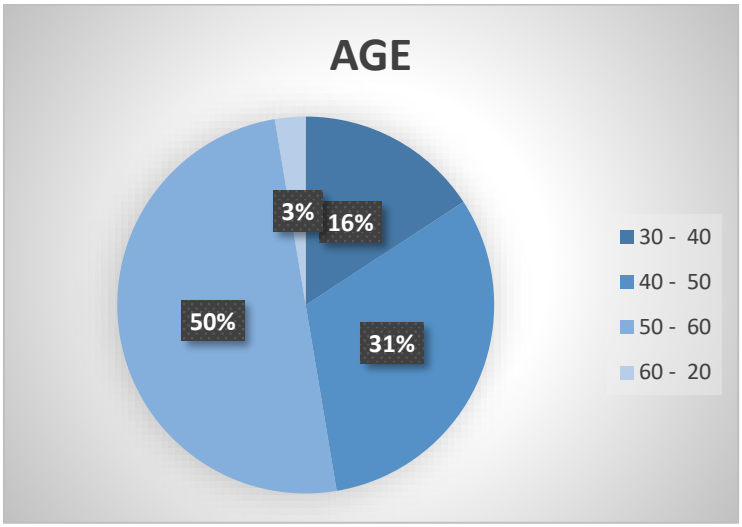

Figure 1: Age

In terms of educational level, most participants have completed the secondary education, while several have completed only the primary education and a few have completed the high education, as shown in the Figure 2. Moreover, 37 of the 38 participants were residents of the survey area.

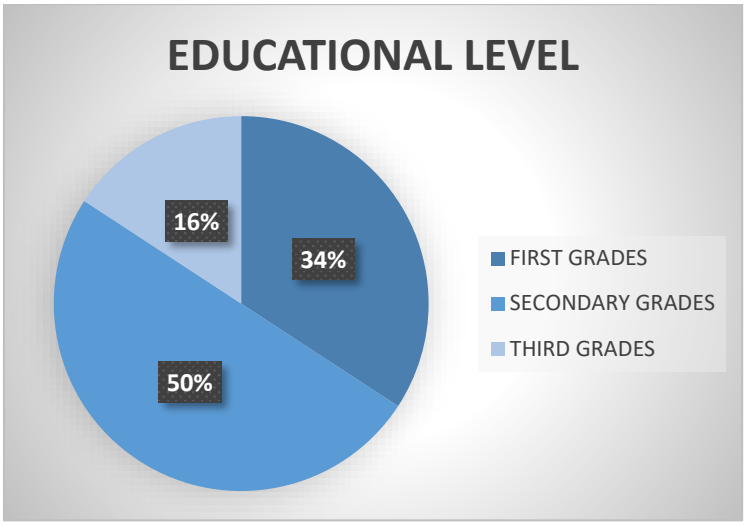

Figure 2: Educational Level

After completing their biographical information, participants were asked to respond to targeted questions, which were answered on a Likert scale. The scale was five-point, allowing responses from **1 (Nothing), 2 (Little bit), 3 (Moderately), 4 (Well), 5 (Very Well).**

There were 12 questions to the participants and their answers are presented in the below diagrams such as:

a) Is the cost of electricity a large financial expense for the operation of your unit? (Diagram 1)
b) In the livestock unit you operate, do you use any form of Renewable Energy Sources (RES) for the production of electricity (wind turbines, photovoltaics, etc.) to meet the needs of electricity? (Diagram 2).
c) Do you know the financial benefits of using Renewable Energy Sources? (Diagram 3)
d) Do you have any problems with waste management? (Diagram 4)
e) Have you attended any informational activity on livestock waste management? (Diagram 5)
f) Would you participate in a waste management training program? (Diagram 6)
g) Do you know the economic benefits of a biogas plant? (Diagram 7)
h) Do you think that a biogas plant would be efficient? (Diagram 8)
i) Would you invest in a biogas plant? (Diagram 9)
j) Have you considered installing a biogas plant in order to treat the plant's waste? (Diagram 10)
k) Do you know how a biogas plant works? (Diagram 11)
l) Could you work with other livestock farmers or a livestock cooperative to set up a biogas plant in your area? (Diagram 12)

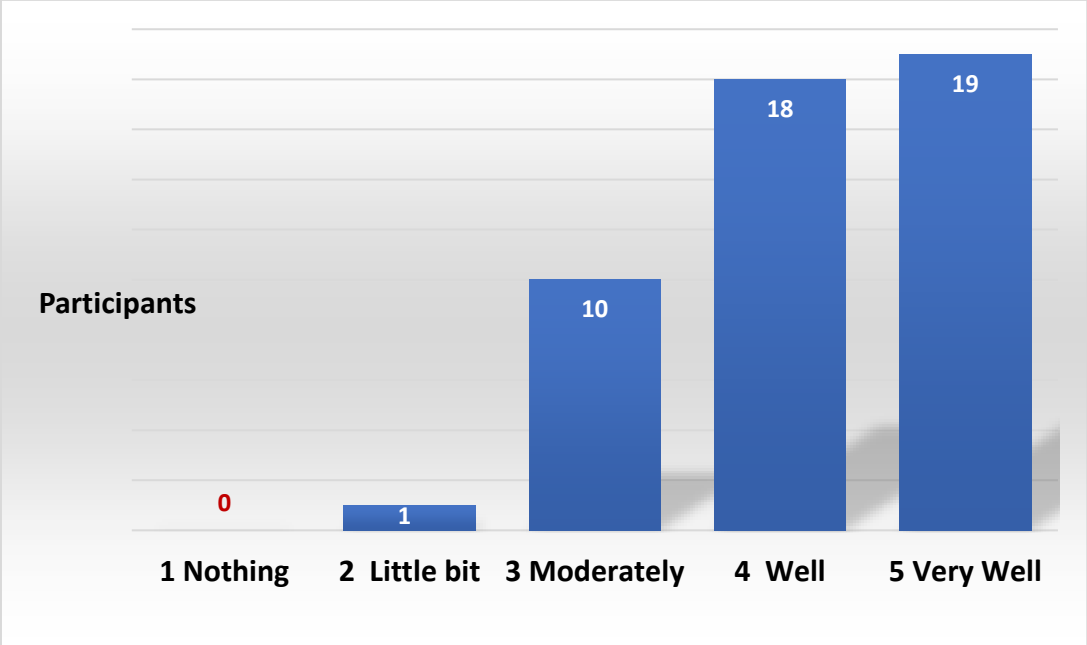

Diagram 1: Unit power cost

As it is seen from the Diagram 1, the majority of respondents consider the cost of electricity extremely important for their unit, having great concern for the reason that it causes an increase in the costs of the manufactured product they have. And quite a large percentage is afraid of a domino stoppage of payments which can be caused by the inability to repay electricity bills.

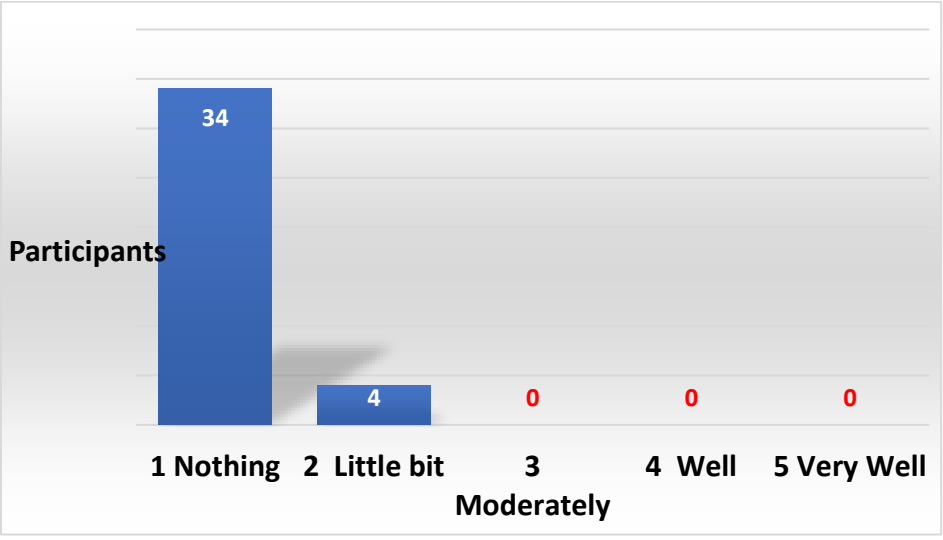

Diagram 2: Use of RES

As it can be shown from the Diagram 2, the strong majority of the sample did not use any form of RES in the activity unit, the four have installed Photovoltaics, the given

answers (not at all - a little) show that there is a lack of information about RES, but also a large scope for development and entrepreneurship in green energy in livestock units.

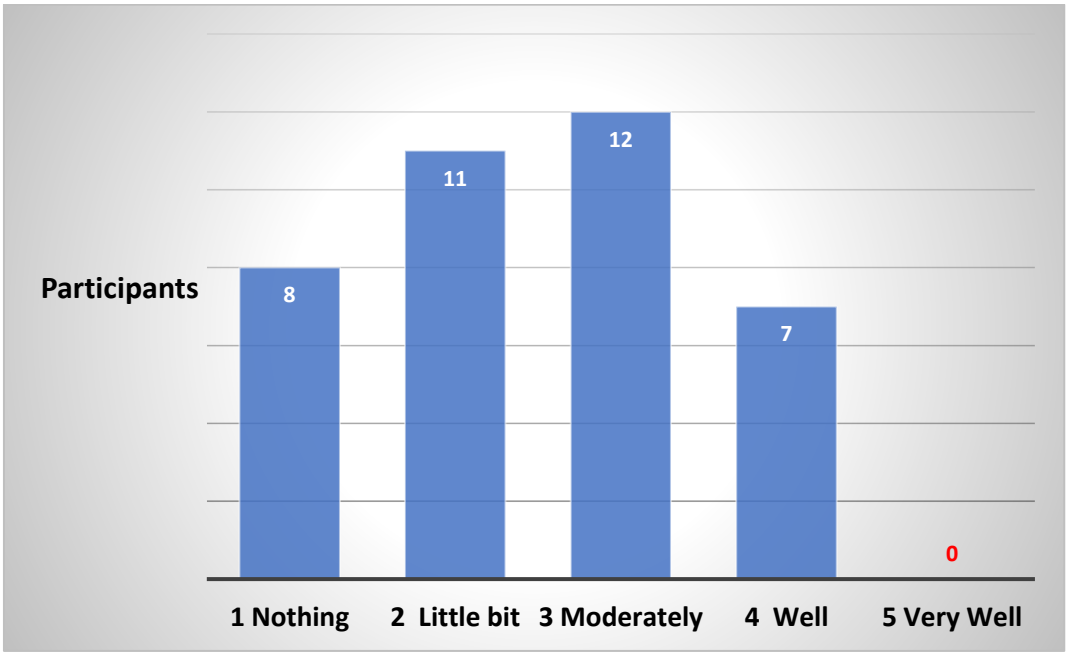

Diagram 3: Ability of knowledge for the benefits of using RES

In the Diagram 3, the answers were mixed, however, none of the participants chose option 5 (Very Well). This shows the lack of knowledge, maybe misinformation, but also the absence of information from the state on RES issues.

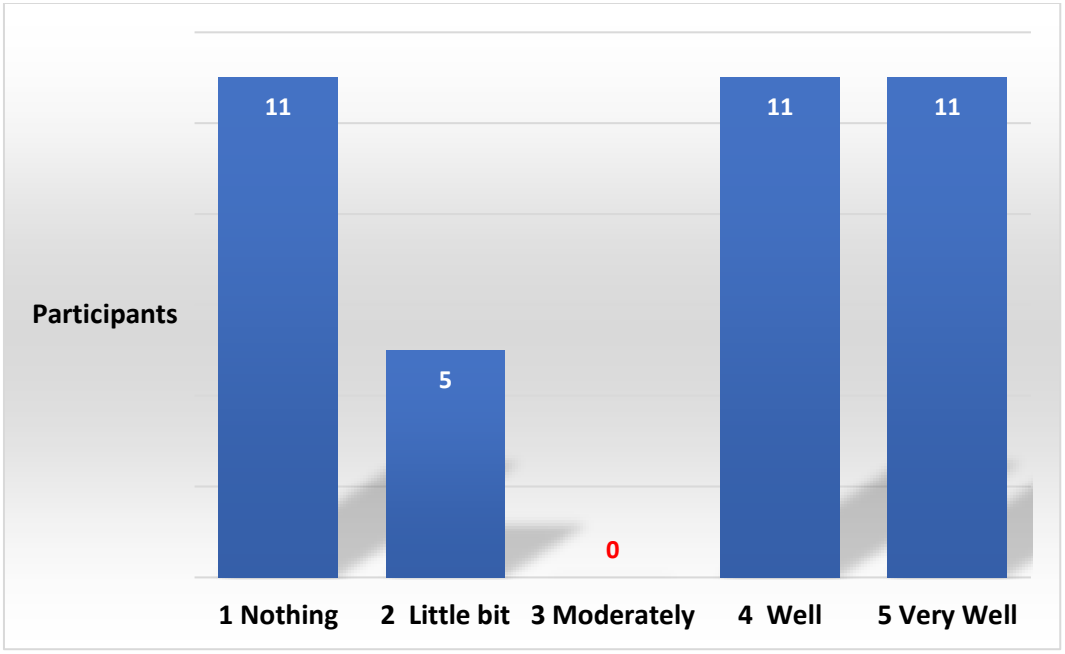

Diagram 4: Problems with the waste management

In the Diagram 4, the results showed a particular polarization between responses, with half of the sample stating that the participants face problems not at all to a little, with the other half reporting that they face problems a lot to very much, these responses are due to the fact that some farmers are also farmers i.e. cultivate the fields to produce their own food for their animals, with the result that livestock waste is used as fertilizer. The respondents, who answered that livestock waste is a problem for them, are the livestock farmers who do not cultivate fields in order to produce the food of their lives.

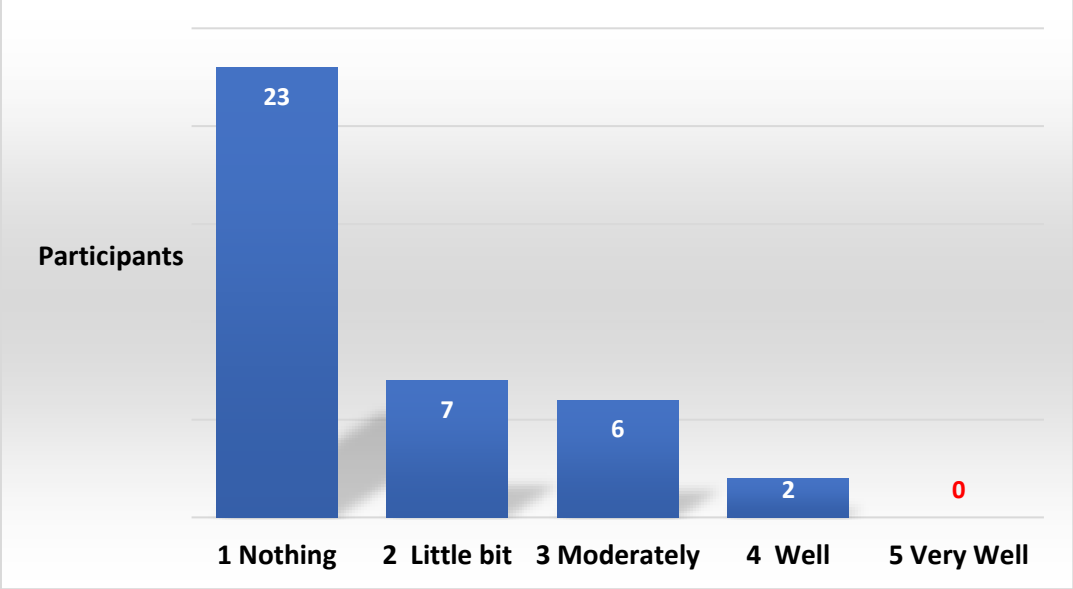

Diagram 5: Monitoring of informational action for waste management

The option “Nothing” received more responses, as shown in the Diagram 5. The question, however, recorded a big problem, that of insufficient information on the livestock waste management. In this way, there is a lot of scope for informational actions, seminars, workshops and other kinds of actions to inform livestock farmers about this issue.

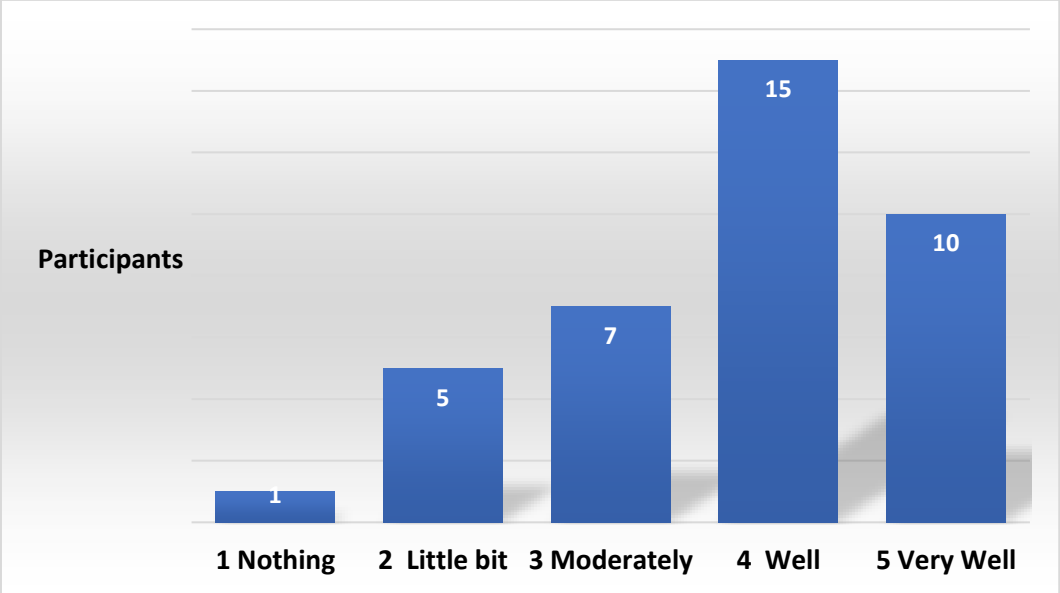

Diagram 6: Willingness to participate in the future

In the Diagram 6, only one of the participants was negative, while the largest group were those who supported the choice "Well", this result shows that the impressive will of livestock farmers and willingness to participate in informative events and entrepreneurship actions with the aim of developing the profession who are active.

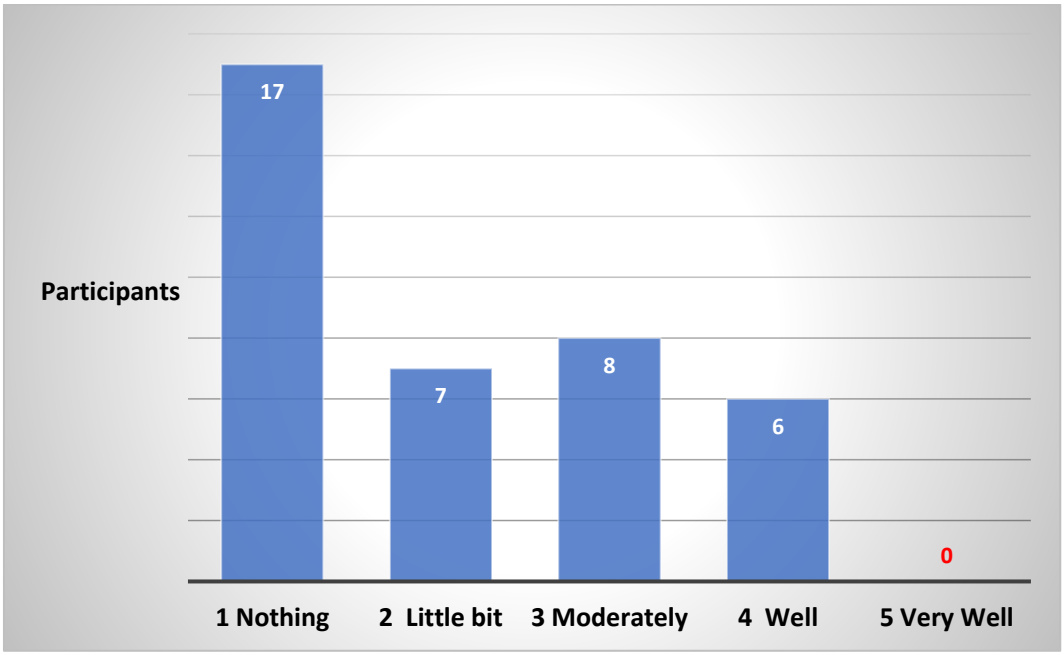

Diagram 7: Knowledge about the economic benefits of a biogas plant

In the Diagram 7, the participants ignore important information which would help them in order to reduce the costs of their businesses and grow them. Therefore, in this topic,

an update could be made on the benefits, mainly the financial ones for the creation of a biogas unit.

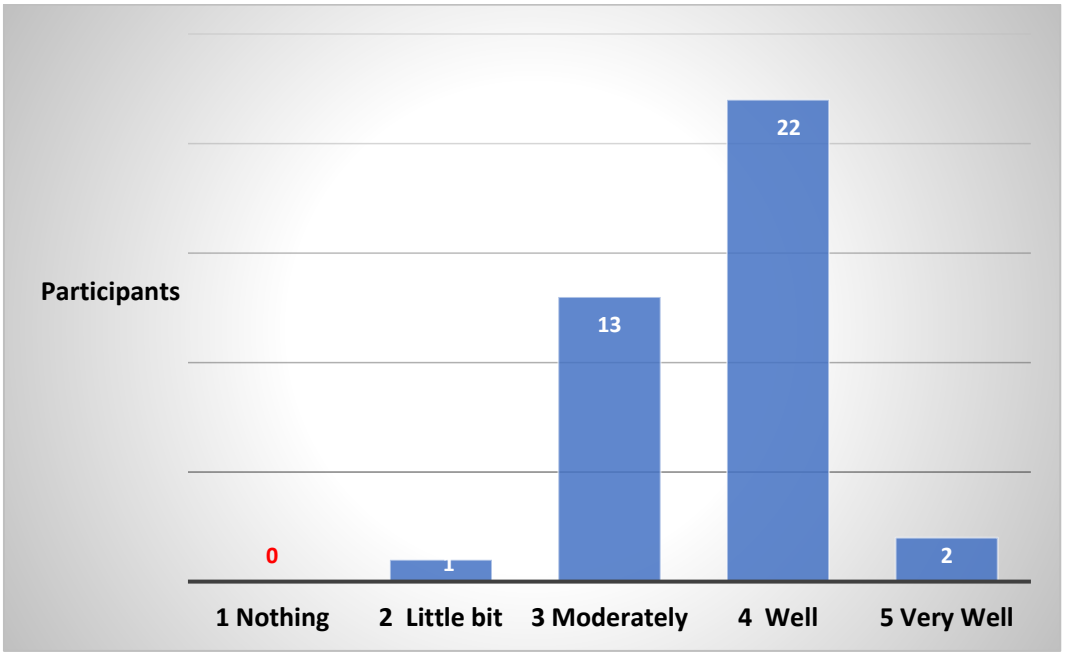

Diagram 8: Biogas plant efficiency

In the Diagram 8, most likely, the research participants consider that a biogas plant would be effective because it will manage their livestock waste. In addition, the biogas which will result from waste management will help the businesses to reduce some basic costs (eg energy costs).

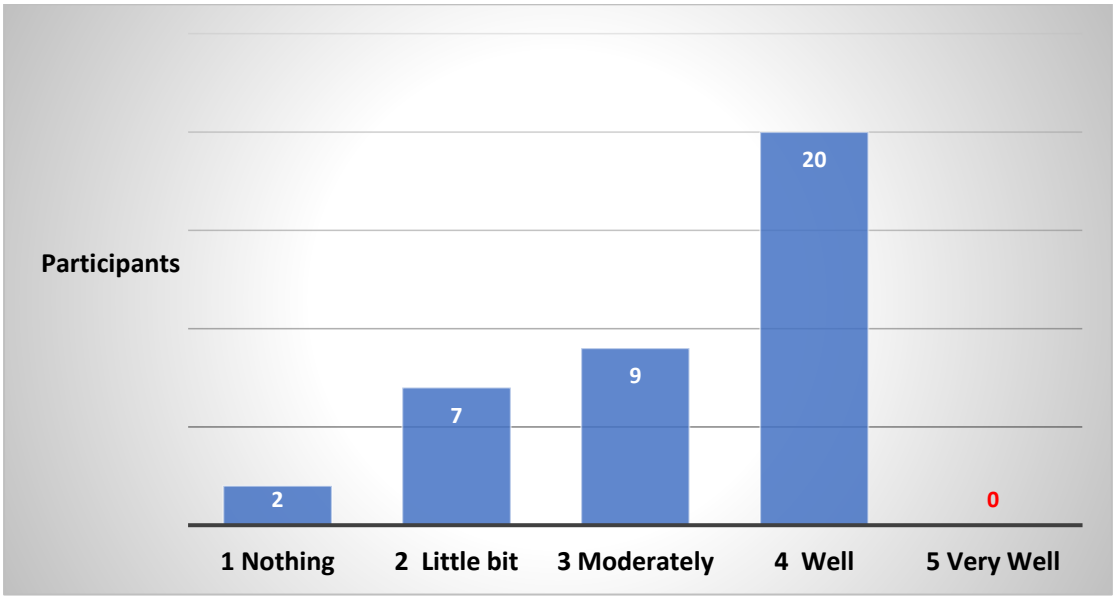

Diagram 9: Investment in a biogas plant

In the Diagram 9, the results confirm the positive attitude of the livestock farmers in the area of the Municipality of Amyntaio towards both the waste management of their units and the reduction of the energy footprint of their businesses. In this way, breeders realize the financial benefit they will have even if this is done in the long term.

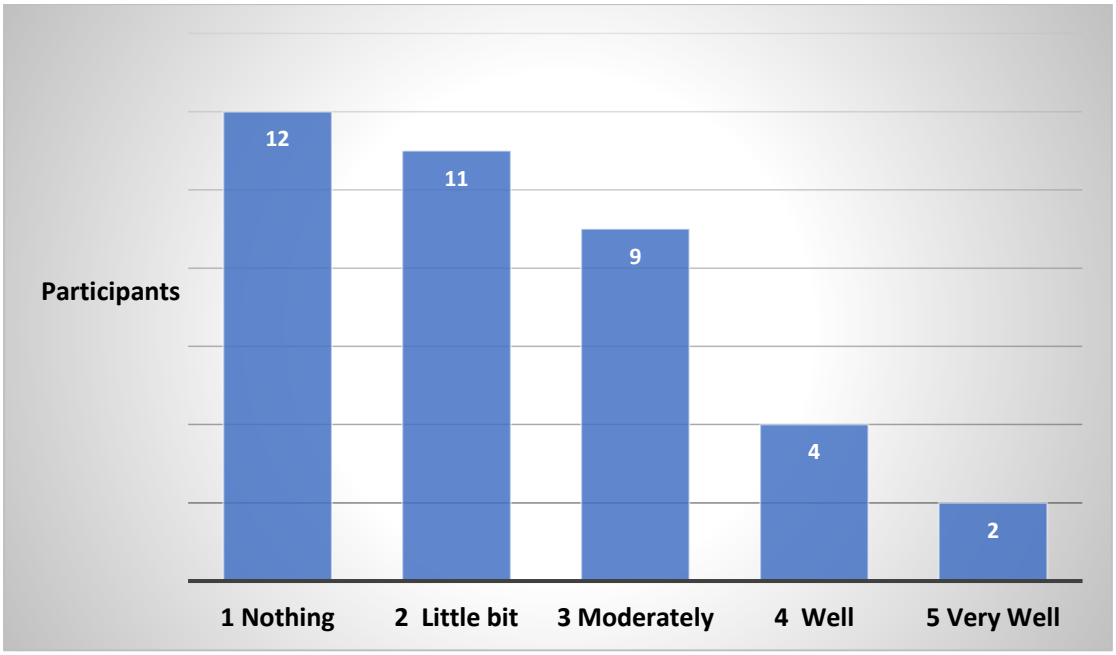

Diagram 10: Possibility of installing a biogas plant in the employment unit

In the Diagram 10, the thought of installing a gas plant to process their livestock waste is almost non-existent (only 8 out of 38 answered positively). In essence, no experts in biogas units, waste management and financial tools have approached the farmers in the area to guide them in such an investment.

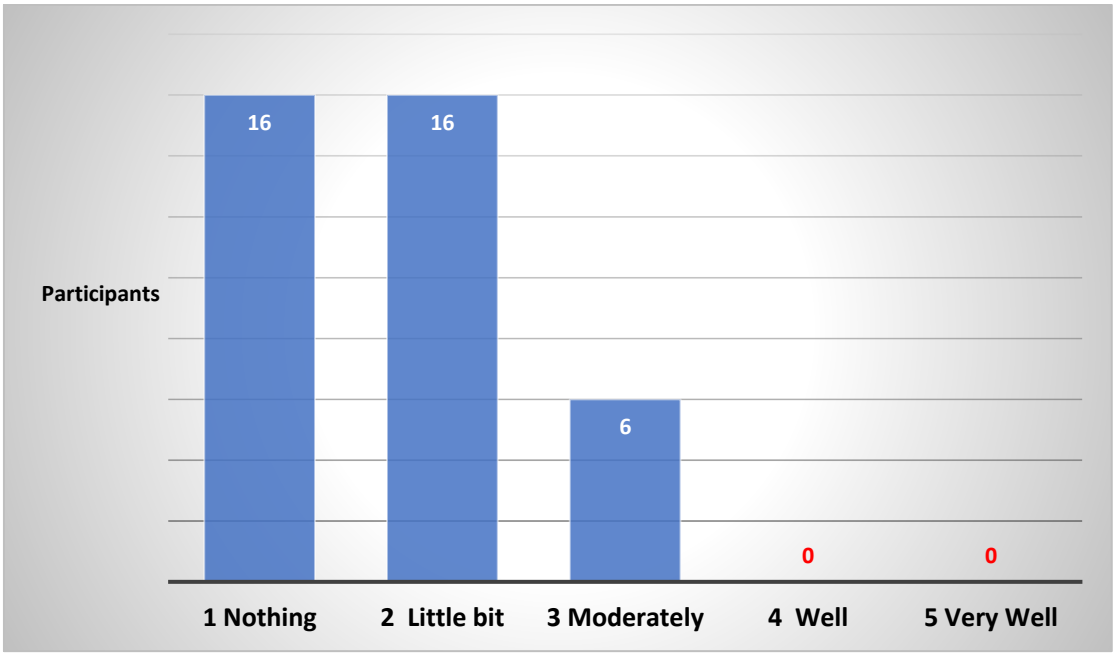

Diagram 11: Ability of knowledge of biogas plant operation

In the Diagram 11, the responses of the participants were expected. This happens because the educational level of the area's livestock farmers is low and also there is no thought of installing a biogas plant which will properly manage their livestock waste.

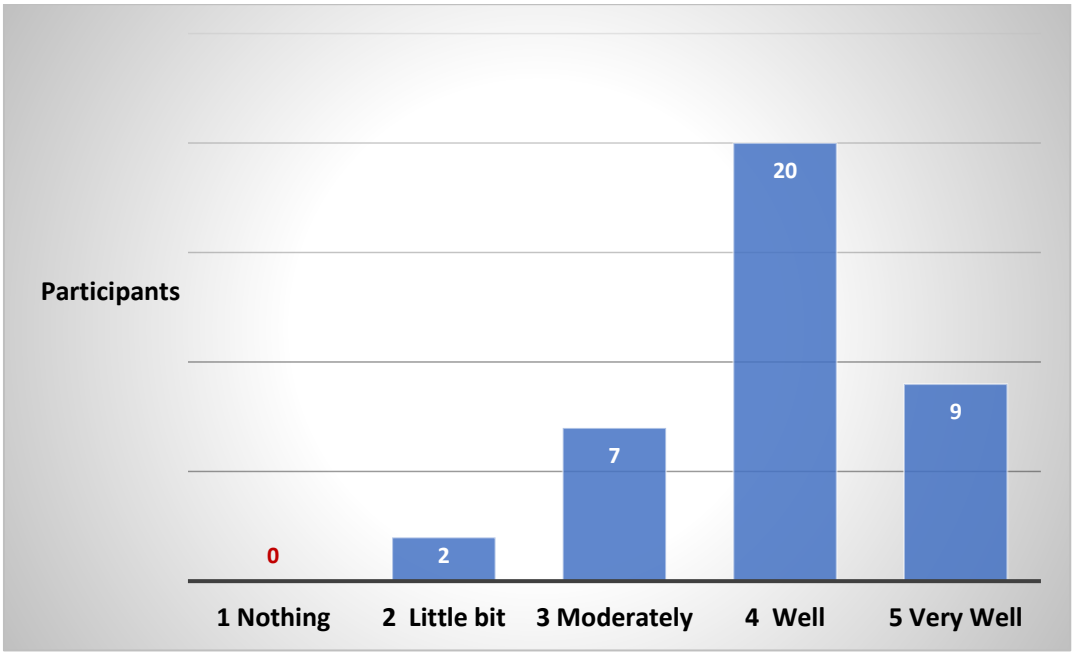

Diagram 72: Collaboration to create a biogas plant

As it can be observed from the answers to all the previous questions, the livestock farmers of the area are positive about the prospect of installing a biogas plant and there is the need for the creation of a breeders' cooperative emerges, as shown in the Diagram

12. This cooperative will manage the waste of livestock units on behalf of its members. Of course, in the past the cooperatives which were created, mainly among farmers, did not have the best results. Therefore, taking into account the example of agricultural cooperatives, perhaps the reason can be identified why the majority of the participating farmers answered positively (Well) but not definitely (Very Well).

Conclusions

To summarize, the investigation and recording of livestock waste was studied with the aim of creating a biogas unit. Initially, from the registration of the animals in the area of the Municipality of Amyntaio, it appears that there are the required livestock units with the animal potential to support the project of operating a biogas unit in the area from their waste. Moreover, from the calculations made, it is found that there will be a significant economic benefit since the quantities of livestock waste are very high.

Additionally, through the installation of the biogas unit, for which the majority of the participating breeders is agreed, the proper livestock waste management will be achieved. The result of proper waste management will be the reduction of the environmental footprint of the livestock units in the area. In this way, the main goal will be achieved, which based on the findings of the research is also the goal of the breeders, which is the care of the environment in the area of the Municipality of Amyntaio.

Finally, from the answers given by the breeders, it was found that they have not been informed about the installation and operation of a biogas plant and about the waste management of their livestock units. In addition, while the majority of livestock farmers are positive about the prospect of operating a biogas plant, on an individual or cooperative level, they are unaware of important tools (e.g. funding from European Union programs), strategies and policies which facilitate such ventures.

A typical example is that they ignore the policy of the European Union for the circular economy, which includes the reuse of waste for the production of new products. In this particular case, the reuse of livestock waste in the production of biogas is ignored, which will significantly help both in terms of energy sufficiency and saving resources.

Solutions for these problems can be found very easily and efficiently. The design and implementation of training seminars on the subject of biogas units as well as waste management could cover the information gap of the livestock farmers in the area. In

the context of the specific programs, modules could be included which would refer to the available financial tools for an investment in a biogas plant and to give good practices for the use tools.

For example, a presentation of existing biogas units could show the progress of the unit from the beginning (eg business plan) to the operation of the unit and mentioning all the tools used at each stage. In this way, the breeders of the area, will be informed about the issues previously mentioned, and will also understand, through the examples of the existing biogas units, that there is a good investment which can be carried out and help on many levels both their own the livestock units and as well as the Municipality of Amyntaio.

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