

The readiness of farmer communities in biogas development (A case study: Wiyurejo Village, Malang Regency Indonesia)

D Dinanti, D F Erlina and C Meidiana

Department of Urban and Regional Planning, Faculty of Engineering, Universitas
Brawijaya, Malang, Indonesia

dede_planoinc@yahoo.com

Abstract. Wiyurejo Village has the potential for biogas development with $\pm 75\%$ of breeders wanting to build biogas but do not have enough vacant land. Biogas is a renewable energy source which requires the involvement of the community and public awareness in its implementation. The purpose of this research is to know the readiness of breeders for the development of biogas with limited land availability for the development of biodigester in Wiyurejo Village, Malang Regency, Indonesia. Based on the analysis, the value of the stage of readiness of farmers community in Wiyurejo Village is 2.20, which means that from nine stages of community readiness, the stage of community readiness of Wiyurejo Village is in stage three, namely vague awareness. Vague awareness means most people feel that there is a local concern, but there is no motivation to do anything about it (Plested, Edwards, & Jumper-Thurman, 2006). The value of the dimension that gives the lowest contribution and is below the average value of the community readiness is community knowledge on the issue.

1. Introduction

The Government of Indonesia has a target to increase the share of renewable energy in which 10.81% of final energy consumption comes from biomass, including its derivatives (biogas) by 2020. Biogas is an alternative energy that can replace fuel oil or natural gas. Biogas energy can be obtained from household waste, livestock waste, organic waste from market and industry.

Therefore, some regulations concerning renewable energy development have been approved to achieve the target, especially in rural areas. Utilization of biogas tends to increase in Indonesia because it offers many social, economic and environmental benefits [1].

Renewable energy development is promoted as a promising method to solve the problem of rural energy supply and to improve the lives of rural households as it can reach remote areas far from the city gas network. The Government of Indonesia realizes that many benefits can be achieved from the utilization of alternative energy. Reducing greenhouse gas emissions, reducing fossil fuel dependence, and strengthening energy security are the advantages of alternative energy [2]–[5]. Specifically, the objectives of biogas development are to increase public awareness about green energy, reduce greenhouse gas (GHG) emissions, promote sustainable village development, accelerate environmentally friendly agriculture, increase rural household savings, and improve rural energy equity and rural life quality [Lidija, 2012]

One of the potentials for biogas development in Malang Regency is located in Wiyurejo Village, Pujon Subdistrict. Currently, there are 1,077 farmers in Wiyurejo Village, according to its 2013 Village



Profile, but there are only 20 farmers who have built biogas reactors from a total of 1,077 active farmers in Wiyurejo Village. This means that the potential for biogas development in Wiyurejo Village is very big.

According to the Head of SAE Cooperative, there are several obstacles in the development of biogas in Pujon Subdistrict, including in Wiyurejo Village, namely limited land availability for biogas development. Even according to the head of breeder group of Kalangan Hamlet, currently almost 75% of breeders want to build biogas but do not have enough vacant land. Thien Thu et al (2012) outlines some reason why farmers do not have biogas, and one of them is caused by land insufficiency [6]. As a result of this land problem, there are only a small number of people who volunteers to develop biogas. In addition, there are many breeders who do not know about biogas development technology, so they are not ready to find the solution on land problems.

Various theories state that the awareness and participation of the villagers are the key to the success of village development. Community involvement is an important element to consider when discussing biogas development [7]. Meanwhile, people mostly rely on village head to raise awareness among villagers on the importance of development efforts as a way to improve social conditions and increase the participation of villagers in development [8]. Thus, readiness is the basic foundation for a community or government in making a follow up on the activities to be done in the future.

Therefore, if one wants to develop biogas, then one must know the condition of the society and the readiness of the society in running a business and also in developing a region, including biogas development. Local community readiness is important in a development effort as it will make changes that will occur from the development of biogas. If the community is ready, there is a potential that the region will have a positive impact so that later biogas can prosper the community by encouraging the empowerment of the community to be able to participate actively to get the maximum benefit by managing resources.

2. Literature Review

2.1. Stage of Readiness

Readiness means the whole condition of a person or an individual that makes him ready to respond in some way to a situation and condition. Readiness is the overall condition of an individual to respond to or practice an activity which contains mentality, skills and attitude that must be possessed and prepared during a particular activity. In starting any kind of job, readiness is very important because by having readiness, any job will be resolved and can be done smoothly with good results.

2.2. Biogas

Biogas is a gas produced by anaerobic activity or fermentation of organic materials including human and animal waste, domestic waste (household), biodegradable waste or any biodegradable organic waste under anaerobic conditions. The main ingredients in biogas are methane and carbon dioxide. Biogas is a gas mixture of anaerobic fermentation process from cattle dung (cow). Cow dung can meet the need for waste used for biogas. Biogas is a process of producing bio gas from organic material with the help of bacteria. Biogas energy serves as replacement energy for fossil fuels, thereby reducing greenhouse gases in the atmosphere and other emissions [9].

2.3. Community

Community is part of society which consists of various characteristics. Community has a more limited capacity for self-sufficiency than society, but this limitation makes community has closer relationships and greater sympathy. There is often a misunderstanding between society and community. The two terms are often interpreted in the same way, but they are very different. Society is different from community. The definition of society is more general and broader, while the definition of local community is more limited and is also limited by the area of the region and the number of citizens. However, in terms of the activity of their relationship, community is tighter than society, and its unity

is also greater. In the aspect of society, this research is aimed at the villagers of Wiyurejo as a whole, while in the aspect of the community, it is aimed at breeders in Wiyurejo Village. This study aims to determine the stage of readiness in the development of biogas, so the target in this study is more specified at breeder community in Wiyurejo Village who are directly involved in the development of biogas.

Table 1. Stage of community readiness.

No.	Stage	Explanation
1	<i>No awareness</i>	There is no self-readiness in the community or leader to respond to certain thing based on understanding and reason and moral considerations which accompanied by freedom so that it can be consciously accounted for, such as an issue that is not generally recognized by the community or leader as a problem.
2	<i>Denial/resistance</i>	Member of community can minimally recognize a concern, but there is little confession that this will take place locally.
3	<i>Vague awareness</i>	Most of them feel that there is a local concern, but there is no motivation to do something on existing efforts/programs.
4	<i>Preplanning</i>	There is a clear recognition that something must be done, but the efforts are not focused or done in detail.
5	<i>Preparation</i>	A leader begins to actively plan, and the community supports the existing efforts or programs.
6	<i>Initiation</i>	There is adequate Information for justification (decision/ reason/ consideration) on the efforts/programs made.
7	<i>Stabilization</i>	There are activities/efforts made by the community supported by government or community decision maker for people interest.
8	<i>Confirmation/expansion</i>	The members of community feel comfortable with the efforts/programs, and they support expansion, namely an activity to increase/broaden the effort/program marked by creating new effort/innovation, expanding the facility, and improving economic activity.
9	<i>High level of community ownership</i>	Members of the community have detail knowledge on the cause, result, and consequence of an effort/program.

Source: Plested, Edwards, & Jumper-Thurman, 2006

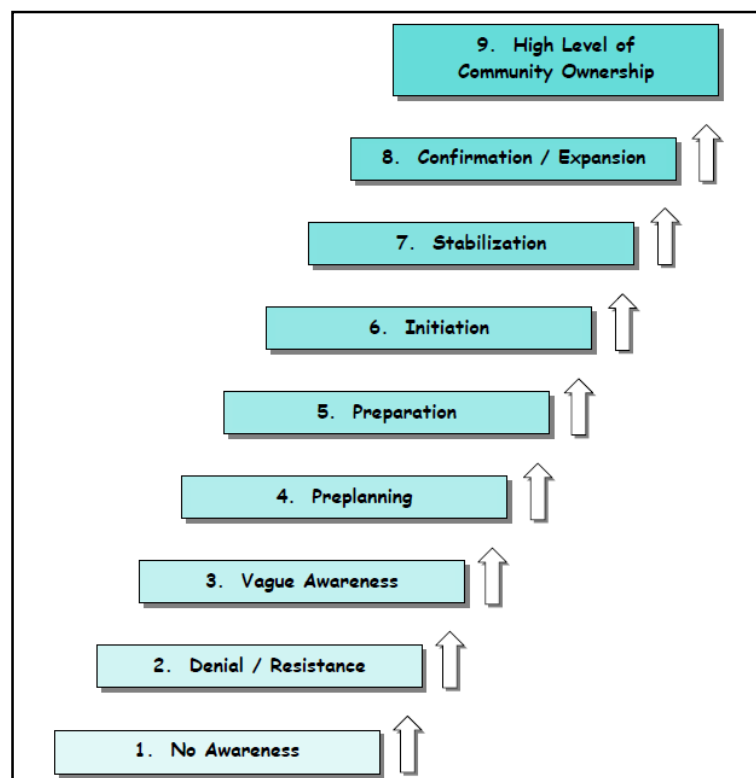


Figure 1. Stage of Community Readiness

3. Methods

3.1. Area of the Study

Wiyurejo village is about 28 km west of Malang City Indonesia with an area of 249.06 Ha which consists of 3 smaller areas called Dusun, namely Dusun Wiyu, Dusun Kalangan and Dusun Bagean. The number of breeders in Wiyurejo village is 1,077 farmers.

3.2. Data collection

Data were collected through questionnaires by collecting information from key persons who are deemed most aware of the condition of the community and existing issues regarding biogas development in Wiyurejo Village

3.3. Key respondents

There are 6 respondents in Wiyurejo Village who are given a questionnaire, namely those who are considered most aware of the community climate and issues about the development of biogas in Wiyurejo village. Key respondents provide community readiness assessment by answering the questionnaire that has been provided. In the Community Readiness Handbook, 4 to 6 speakers are needed as key respondents who are able to provide information in biogas development efforts [10].

Table 2. Key respondents in Wiyurejo Village

No.	Respondents
1	Mr. Mufid Farid, Head of Wiyurejo Village
2	Mr. Sugeng, Head of farmers group in Dusun Kalangan
3	Mr. Suwarno, Head of farmers group in Dusun Wiyu

No.	Respondents
4	Mr. Nur Rohmat, Head of farmers group in Dusun Bagean
5	Mr. Kayin, Head of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict
6	Mr. Yoko, Secretary of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict

3.4. Community Readiness Model

Stage of community readiness can be identified through a community readiness assessment based on six readiness dimensions or variables [10]. Readiness is used to determine the extent to which the community is ready to take action on an issue or a problem. To measure community readiness, there is a dimension of readiness which becomes the key factor to influence community readiness to take action on issue/problem. The readiness dimension consists of six dimensions, including: community efforts, community knowledge of efforts, leadership, community climate, community knowledge about issue, and resources related to the issue. The explanation of the readiness dimension is as follows:

1. Community Effort
Community efforts are used to find out to what extent the business, program or policy has been implemented to address the issue.
2. Community Knowledge about Effort
Knowledge is used to see to what extent the community knows about the local effort being undertaken, and whether the efforts are known by the whole community.
3. Leadership
Leadership is used to find out to what extent the leader has an influence on the community in supporting the issue.
4. Community Climate
Community climate can be seen from the attitude of the community to the effort as well as community contribution to the effort.
5. Community Knowledge about Issue
Community knowledge about issue is used to find out to what extent the community knows about the issue.
6. Resources Related To the Issue
Related resources are used to know to what extent local resources, people, time, money, space and others are available to support the business.

Scoring is a process or steps to assess community readiness based on the six dimensions or variables used [10]. Scores of dimensional measurements are as follows:

Dimension of Community Effort	: 2.84
Dimension of Community Knowledge About Effort	: 3.76
Dimension of Leadership	: 4.67
Dimension of Community Climate	: 3.32
Dimension of Community Knowledge About Issue	: 2.27
Dimension of Resource Related to the Issue	: 3.83
Amount	: 20.7

$$20.7: 6 (\text{number of dimensions}) = 3.4$$

After acquiring readiness value from the community, the ladder of community readiness is then determined. Based on the ladder of readiness, the community climate can be known so that appropriate handling can be given based on the stage of readiness. In addition, in the Community Handbook Manual there is also a strategy based on the ladder of community readiness to improve the readiness of Wiyurejo Village community in developing biogas. The assessment of readiness is based on key respondents using scores one to five. To simplify the scoring assessment, parameters based on the variables and the score are made. The use of likert scale in readiness scoring assessment is because likert scale is generally used to measure the attitude or response of a person to an object. Disclosure of attitude using Likert scale is

very popular among researchers. This is because in addition to being practical, a well-designed likert scale generally has a satisfactory reliability [11]. Likert scales use several questions to measure individual behavior by responding to 5 choices on each question: strongly agree, agree, does not answer, disagree, and strongly disagree [12]. However, in this study the measurement of value is adjusted to the variables and questions needed to determine the stage of readiness of breeders in Wiyurejo village in the development of biogas.

4. Results

4.1. Issue related Land Availability for Biogas development

According to Enny Ariani, 2011 one of the success of biogas development is the land availability. Land availability becomes one of the important conditions in developing biogas. According to Thien Thu, et al which discusses some reasons farmers do not have biogas reactor caused by the insufficiency of land owned [6]. Land problems faced by farmers in the village Wiyurejo. Farmers who want to have biogas must undoing their intentions because they realize they do not have enough land to build a digester reactor.

Biogas development in Wiyurejo Village is still considered less, because form 807 farmers in Wiyurejo Village, only 20 biogas units were build. According to the Head of SAE Cooperative there are several obstacles in the development of biogas in Pujon Sub-district, including in Wiyurejo Village, which is limited land available for biogas development. From the survey results it is known that the land owned by farmers are still not sufficient to build bio digester installations that fit the standards, especially in Dusun Kalangan which has the most cows, all farmers do not have enough vacant land

The average vacant land owned by farmers in Wiyurejo Village is classified into 5 classes, which is 0-5 m², 6-10 m², 11-15 m², 16-20 m², 21-25 m². The Farmers mostly have 6-10 m² whereas the land needed to build the size of the reactor, the smallest, ie 4 m³ requires 13.75 m² of land (See Table 1).

As much as 59% of farmers still do not know that the land availability is one of the conditions that at the time of submission of biogas development proposal will also be seen the feasibility of the land owned. If the width of their land is still less than then the biogas cannot be built. This proves that the farmers in the village of Wiyurejo is not much to realize that the limitations of vacant land is also a problem

Table 3. Required Land for Biogas Installation

Reactor size (m ³)	Required Land (m ²)
4	13.75
6	18
8	26.25
10	36
12	49.5

Source: Biogas Household, 2015

4.2. Stage of Readiness

The calculation of community readiness in Wiyurejo Village is calculated from the sum of each variable value used, among others, community effort, community knowledge of effort, leadership, community climate, community knowledge about issue, and resources related to the issue. The stage of community readiness can be seen from the total value of the assessment of each variable. It is taken from the total average value that has been divided by the number of respondents in each variable. Then, the total sum is acquired and divided by the number of variables used, namely those six variables. From the average result, the value of the stages of readiness of farmers in Wiyurejo village in the development biogas is related to limited land availability

4.2.1. Community Effort. Community effort scores in Wiyurejo Village are at 1-3 [see table 4]. It's indicate that the effort of Wiyurejo farmers to finding solutions for limited land in the development of biogas is still low. The low level of awareness and understanding of farmers due to the lack of community in the village Wiyurejo. So far, the community is only a group of livestock and cooperative communities. Communities in the village of Wiyurejo so far are still very lacking in conducting joint activities so that cause a lack of means to exchange opinions and inputs for biogas development and business level because there has been no socialization and discussion together to find solutions to the land availability problem that occurred in Wiyurejo Village.

Tabel 4. Score of community effort.

Responden	Community awareness level of village efforts		Community understanding level		The duration of village community efforts / programs that have been running		Score Average
	Score	condition	Score	condition	Score	condition	
Head of Wiyurejo Village	3	Neutral	2	Do not understand	2	>1-2 year	2.3
Head of farmers group in Dusun Kalangan	2	Do not care	2	Do not understand	1	0-1 year	1.7
Head of farmers group in Dusun Wiyu	3	Neutral	2	Do not understand	4	>3-4 year	3.0
Head of farmers group in Dusun Bagean	2	Do not care	1	Very Unfamiliar	5	>4 year	2.7
Head of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	3	Neutral	1	Very Unfamiliar	1	0-1 year	1.7
Secretary of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	3	Neutral	1	Very Unfamiliar	1	0-1 year	1.7
Total Score							13.0
Average (Total Score/total interviewer)							2.17

4.2.2. Community Knowledge of Effort. The knowledge level of farmers score are 1-2 which means low [see table 5]. The farmers still do not understand the issue because the lack of information. Currently there is an effort by building biodigester under the house. But very few farmers are willing to do so, there are still many farmers who do not want to build biodigester under the house due to leakage. The lack of knowledge about alternatives in building biogas installations made farmers couldn't solved the problem.

Table 5. Score of community knowledge effort.

Responden	Community Knowledge		Community Knowledge Level		Advantages / Weaknesses of Village efforts		Score Average
	Score	condition	Score	condition	Score	condition	
Head of Wiyurejo Village	2	Do not Understand	3	Neutral	3	Neutral	2.7
Head of farmers group in Dusun Kalangan	2	Do not Understand	3	Neutral	3	Neutral	2.7
Head of farmers group in Dusun Wiyu	2	Do not Understand	4	Knowing	4	Helpful	3.3
Head of farmers group in Dusun Bagean	2	Do not Understand	3	Neutral	1	Very Unhelpfull	2.0
Head of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	1	Very Uninformed	1	Do not Know	1	Very Unhelpfull	1.0
Secretary of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	2	Do not Understand	1	Do not Know	2	Unhelpfull	1.7
Total Score							13.3
Average (Total Score/total interviewer)							2.2

4.2.3. Leadership. Leaders in Wiyurejo Village are still considered less active in assisting biogas development. This is indicated by an assessment of the influence of the leader, the level of involvement and support is 1-3 [see Table 6]. Currently some leaders of Wiyurejo Village have been aware of problems in the biogas development. However, until now the leaders and government are still lacking in helping farmers to settle the problem. The interview with the head of the livestock group stated that the head of the livestock group had tried to offer the farmers, but when the farmer rejected the offer from the head of the livestock group there was no follow-up to help the farmers to build biogas. There has been no initiative from leaders to try to invited the farmers for a discussion together to find a solution for the problems.

Table 6. Score of community leader effort.

Responden	The role of Community Leader		Involvement Level of Community Leader		Support of Community Leader		Score Average
	Score	condition	Score	condition	Score	condition	
Head of Wiyurejo Village	2	No effect	3	Neutral	2	Doesn't support	2.3
Head of farmers group in Dusun Kalangan	2	No effect	2	Not involve	3	Neutral	2.3
Head of farmers group in Dusun Wiyu	3	Neutral	3	Neutral	2	Doesn't support	2.7

Responden	The role of Community Leader		Involvement Level of Community Leader		Support of Community Leader		Score Average
	Score	condition	Score	condition	Score	condition	
Head of farmers group in Dusun Bagean	2	No effect	2	Not involve	2	Doesn't support	2.0
Head of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	2	No effect	3	Neutral	2	Doesn't support	2.3
Secretary of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	2	No effect	1	Never involve	2	Doesn't support	1.7
Total Score							13.3
Average (Total Score/total interviewer)							2.2

4.2.4. Community Climate. Community climate in the development of biogas is considered high [see table 7] even though the level of constraints is quite high. Community attitude not support for biogas development efforts related to land limitations. There has been no initiative from the community to help or motivate farmers to come together for solutions. Currently there are alternative solutions for building biodigester reactors under the house, but there are less experiences barriers make farmers unwilling to build biodigester reactors. Farmers find it difficult to care for livestock because they do not know where to move their animals temporarily and construction leak

Table 7. Score of community climate.

Responden	Community Contribution		Community Attitude		Level of Obstacles		Score Average
	Score	condition	Score	condition	Score	condition	
Head of Wiyurejo Village	3	Neutral	4	Good	1	Very High	2,7
Head of farmers group in Dusun Kalangan	3	Neutral	3	Neutral	2	High	2,7
Head of farmers group in Dusun Wiyu	3	Neutral	4	Good	2	High	3,0
Head of farmers group in Dusun Bagean	3	Neutral	3	Neutral	2	High	2,7
Head of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	3	Neutral	4	Good	1	Very High	2,7
Secretary of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	1	Very unsupported	1	Very Bad	2	High	1,3
Total Score							15.0
Average (Total Score/total interviewer)							2.5

4.2.5. Community Knowledge about Issue. Community Knowledge about issue in the development of biogas is considered low [see table 8]. Limited land has not become the community concentration in the development of biogas. According to respondents there is still no information availability or data collection for the development of biogas related to land limitations. Limitations of such data and information can make it difficult to assist land-ridden farmers to build biogas.

Table 8. Score of community knowledge about issues.

Responden	Information availability		Database availability		Level of community Knowledge regarding biogas development programs		Score Average
	Score	condition	Score	condition	Score	condition	
Head of Wiyurejo Village	1	None	1	Not Available	3	Neutral	1.7
Head of farmers group in Dusun Kalangan	1	None	1	Not Available	3	Neutral	1.7
Head of farmers group in Dusun Wiyu	3	Neutral	1	Not Available	2	Do not Know	2.0
Head of farmers group in Dusun Bagean	3	Neutral	1	Not Available	2	Do not Know	2.0
Head of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	3	Neutral	1	Not Available	2	Do not Know	2.0
Secretary of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	2	Not available	1	Not Available	1	Do not Know	1.3
					Total Score		10.7
					Average (Total Score/total interviewer)		1.78

4.2.6. Resources Related to Issue. Resources related to issue in biogas development is considered low [see table 9]. There is less socialization and training related to biogas development, especially for farmers who didn't have land. Farmers didn't get more information about issues related to the development of biogas and only information was about biogas development subsidy development for normal construction. If farmers want to build a reactor under the house, it will cost more when compared with normal construction. It will also make it difficult for farmers to spent more due to economic condition. Assistance in addition to cost biogas aside subsidy until now still not exist in the Village Wiyurejo.

Table 9. Score of resources related to issue.

Responden	Level of need and intensity of training procurement (training) to the community		Community support to provide help		Intensity of external assistance		Score Average
	Score	condition	Score	condition	Score	condition	
Head of Wiyurejo Village	1	Not support at all	3	Neutral	3	Neutral	2.3
Head of farmers group in Dusun Kalangan	3	Neutral	3	Neutral	3	Neutral	3.0
Head of farmers group in Dusun Wiyu	3	Neutral	3	Neutral	3	Neutral	3.0
Head of farmers group in Dusun Bagean	2	Not suport	2	Not support	2	Not Satisfied	2.0
Head of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	2	Not support	2	Not support	2	Not Satisfied	2.0
Secretary of Biogas Development of SAE Milk Cooperative in Pujon Subdistrict	2	Not suport	1	Not support at all	2	Not Satisfied	1.7
Total Score							14.0
Average (Total Score/total interviewer)							2.3

The calculation results interpret the stage of readiness of Wiyurejo Village community. The total value of all variables is 13.22, if divided by the number of dimensions which is six, then the result is 2.20 [see table 10]. This value shows that, from nine existing stages, the stage of readiness of farmers in Wiyurejo village is in stage three (vague awareness) [see table 11]. Vague awareness means most people feel that there is a local concern, but there is no motivation to do anything about it [Plested, Edwards, & Jumper-Thurman, 2006]. The value of dimension that gives the lowest contribution and is below the average value of the community readiness is community knowledge about the issue. This could be the main cause why community readiness is still in the third stage.

Table 10. The calculation of combined variables in Wiyurejo Village.

No	Variables	Total
1	Community Efforts	2.17
2	Community Knowledge of Effort	2.20
3	Leadership	2.22
4	Community Climate	2.50
5	Community Knowledge about Issue	1.78
6	Resources Related to the Issue	2.30
Total		13.22
Average		2.20

Table 11. The value of the stages of community readiness.

No	Stage	Range
1	No awareness	1.00-1.44

No	Stage	Range
2	Denial/resistance	1.45-1.88
3	Vague awareness	1.89-2.33
4	Preplanning	2.34-2.77
5	Preparation	2.78-3.22
6	Initiation	3.22-3.66
7	Stabilization	3.67-4.11
8	Confirmation/expansion	4.12-4.55
9	High level of community ownership	4.56-5.00

Source: Plested, Edwards, & Jumper-Thurman, 2006

Community climate in Wiyurejo village shows the same thing with the assessment of the stage of readiness. 36% of farmers have known that the constraint to build biogas is lack of vacant land. It shows that there is local concern from the farmers. However, until now there is still no motivation from farmers to try to find a solution. Meanwhile, 87% of farmers have vacant land, but the width of their land is still less than the need for biogas development, so biogas development cannot be done. According to Mr. Sugeng, the head of farmer group in Dusun Kalangan, many farmers are actually interested in developing biogas, but they feel that their land is not wide enough, and there has not been any follow-up to help the farmers so that they can still build biogas.

At the stage of vague awareness, the goal is to increase community awareness about the problems of land limitations that can inhibit the development of biogas and explain the benefits of biogas for the life of farmers. When their awareness has increased, the next stage can be done, that is helping farmers to look for a solution to overcome the problem of land limitation.

Because 59% of farmers still do not know that the land is one of the conditions. This proves that the farmers in the village of Wiyurejo is not much to realize that the limitations of land owned is also a problem. Previously known that as many as 87% of farmers whose land is still not able to be built biogas due to empty land area that is not in accordance with needs. However, only 36% of farmers are aware that the problem is the lack of vacant land. There are still many Farmers who do not know that at the time of filing the development of biogas will also be seen the feasibility of the land owned, if still less then the biogas cannot be built. Lack of information in the development of biogas in the village Wiyurejo can be one reason there are still many farmers who do not know that land compliance to be a requirement for the construction of biogas reactor.

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