

Farmer's Adoption of Sorghum Farming in Marginal Land as Alternative Food Source in Bantul Regency Yogyakarta Province

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Based on the condition of limited of land for agricultural activities to fulfill the food needs especially in Bantul Regency Yogyakarta Province, it is needed an innovation that can support the various agricultural activities. The innovation will be more focused on using of marginal land for sorghum cultivation to improve the productivity of land. So far, villagers have been utilizing home garden for various farming production in micro scale for the domestic needs. In addition to home garden, land resources are also available surrounding the village such as land along river bank and sandy land in coastal area can be utilized for agricultural production in Bantul Regency. The aims of this research are (1) To determine the adoption technology in sorghum farming by farmers in marginal areas, Bantul Regency (2) To determine the diffusion technology in sorghum farming by farmers in marginal areas, Bantul Regency and also (3) to identify various problem and to find problem solving faced by farmers. This research operationally was conducted by survey method. Sampling technique was done by purposive sampling by choosing the farmers who have been experiencing in sorghum cultivation sorghum in Bantul Regency. The research result showed that the adoption's farmer cultivation of sorghum in marginal land up to 75,21%, process diffusion to transfer innovation using agent of change/extension officers, farmer group, and group leader and the last is the problem solving for sorghum cultivation there is availability land can be used marginal land such as land along river bank, sandy land in coastal area, and home garden; water availability can be solve with sorghum cultivation because it's needs less water and sandy land to cultivation of sorghum; choice red varieties

sorghum to avoid attract birds; underdeveloped market can be arranged by a cooperation with food industries; processing of product could create the value added; and giving skill to women farmer to make several product domestic for flour sorghum.

Keywords: Sorghum, Marginal Land, Adoption Innovation, Bantul Regency



I. INTRODUCTION

A. Research Background

Effect green revolution policies greatly have been impacting on the food availability from time to time in many part of Indonesia. The green revolution initially was considered as the best solution to improve national food security. However, many facts currently show the bad impacts for the existence of the food security and safety. Not only about the existence and availability of food, but also the green revolution practices have a bad influence on life condition as a place of ecological ecosystems. The diversity of food has significantly decreased as an impact of the green revolution policy. Misguided conceptions about food production system should be corrected properly as a responsibility for the next generation that will have in revitalizing of food diversity. Food security situation, however, has critical consequence to the country's resilience. When food security is unstable it will threaten country's stability any time.

Identifying and fathoming the food problems is not easy and simple matter. In the New Order period in Indonesia, the farming practices for improving the food intensification and extension have been extensively done. Intensification of farming has been done by employing the five's way cultivation (*panca usaha tani*) with mainly can be seen in the forms of application of fertilizer and seed subsidies, while the extension has been done for expansion the increasing of rice crops productivity. However, the significant production increase from the policies has been unstable and far from the expectation.

The food problems cannot be solve only done by concerning on one aspect of agricultural production, but it is needed the cooperative system among stakeholders to solve the problems of food production and distribution. Food problems often are also associated with the size of population that is too large in case of Indonesia. The huge population size has been causing the big burden for overcoming the food demand along the time.

Population size and the stability of food availability commonly have been use as a reason to import food. However, this strategy is not proper for giving the incentive for national producers. Some strategies should be introduced for decreasing the demand of food imports. To reduce food import by the government to some

extent could be solved by searching and developing various alternative food sources that can be use as staple food of local people for example kind of local produces wheat namely sorghum. As mentioned by Subejo (2013), many places in Indonesia have a tropical climate that meaning that it cannot be used to produce white wheat as has been produced by foreign countries. The latest official data reveals that Indonesian imports of wheat flour have exceeded 7 million tons yearly, totaling about 25 trillion IDR (US\$ 2.52 billion).

The impacts and dependency on import wheat have been significant in Indonesia. Many kinds of foods were made from imported wheat that has been use as daily consumption patterns of society. It is needed proper strategy to solve the problems. Wheat plants cannot grow well in tropical climate such as Indonesian area, to solve this problem there are several alternatives of solution to reintroduced and develop of kind of traditional wheat namely *chantel* (sorghum) as a local food materials in several proper places of marginal areas especially in Yogyakarta Province. Recently sorghum has been developed in the Yogyakarta Province including in Bantul and Gunungkidul Regency. The reintroduction of sorghum in rural community is expected to help the increasing of food diversity and for fulfilling the consumption needs of local people.

B. Research Problems

Based on the above description, the background problem of the research is:

1. How an adoption technology in sorghum farming has been done by farmers in marginal areas, Bantul Regency.
2. How diffusion technology in sorghum farming has been done by farmers in marginal areas, Bantul Regency.
3. What the problems and solving problems in sorghum farming by farmers in marginal areas, Bantul Regency.

C. Research Aims

Based on the research problems, the purposes of this research are:

1. To determine the adoption technology in sorghum farming by farmers in marginal areas, Bantul Regency

2. To determine the diffusion technology in sorghum farming by farmers in marginal areas, Bantul Regency.
3. To identify the problem and solving problems in sorghum farming by farmers in marginal areas, Bantul Regency.

II. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

A. Literature Review

The Adoption and Diffusion Theory

Ray's (1998) discovered that adoption is a decision to make full use of an innovation as the best course of action available. An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption. Leeuwis and Van den Ban (2004) stated that adoption studies indicated that adoption of innovations is not something that happens overnight, but rather it is final step in a sequence of stage. Mardikanto (2010) mentioned that adoption in fact can be interpreted as an admission process innovation and or behavior changes, and includes: knowledge (cognitive), attitude (affective), and skill (psychomotoric) on the self person to give innovation room of transfer through community facilitator's beneficiaries. The adoption process is to achieve information, skills, technology and the other innovation from key persons or facilitators to community in needed.

Ray's (1998) stated there are the perceived attributes of innovations which are basic to extension are as follows:

1. Relative advantage. The degree to which an innovation is perceived as better than the idea it supersedes. The relative advantage may have a number of dimensions. For examples, if a new technology or practice gives more yield or income; or saves time, labor and cost; or has less risk than the existing one; it has more relative advantage.
2. Compatibility. The degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of the potential adopters. Compatibility has at least two dimensions namely situational compatibility and cultural compatibility.

3. Complexity. The degree to which an innovation is perceived as difficult to understand and use. An innovation should, as far as possible, be less complex for farmers to understand and use.
4. Trialability. The degree to which an innovation may be experimented on a limited basis. Adoption of new seeds and fertilizers are more, compared to new farm machinery, simply because seeds and fertilizers may be purchased in small units and tried, whereas, purchase of a farm machinery, requires large investment and cannot be tried in parts.
5. Observability. The degree to which the results of an innovation are visible. The visible impact of an innovation facilitates its diffusion in the social system.

Rogers (1962) cit Valera (1987) discovered that the process of adoption of innovations, in connection with agricultural extension, usually comprises five successive steps or stages: awareness, interest, evaluation, first trial, and either repeated use (adoption) or rejection.

The diffusion of an innovation refers to the total process by which the innovation spreads out among farmers until a large number of farmers have adopted it. It is not how a particular farmer moves step by step towards adoption, but how an innovation becomes adopted by more and more farmers. Rogers and Shoemaker (1971) cit Valera (1987) have pointed out the crucial element in the diffusion of new ideas: the innovation, which is communication through certain channels, over time, among the members of a social system. Melkote (1995:75) cit Harun and Ardianto (2011) stated that theory of diffusion of innovations have the chain on the communication effect, where the ability of media messages and opinion leaders in creating knowledge of new ideas and convince the target to adopt reforms that have been introduced. Through that ways are expected level adoption of innovation farmer's is high.

Sorghum Farming Cultivation

Sorghum is one of alternative of local food can be used as the substitution food for wheat. While wheat cannot be grown in tropical areas, so the strategy for reducing import of wheat must be founded from kind of substitution food crops. Sorghum is a type of cereal crops. But lately it has been a rare cultivated by local

farmers due to they are commonly do not have a good technology and marketing prospect, therefore most of local farmers choose the other farming commodities that will be more promising and profitable.

In the fact, sorghum cultivation has many advantages as compared to other farming commodities, sorghum can be used as materials of bread or cake, sorghum can be cultivated and handled easily, it also can be growth in dry and marginal areas, and many other advantages that sorghum has. Suwito (2007) discovers that sorghum has a high content of carbohydrate that approximately 60% -65% and protein about 2% -3%.

To achieve the success of efforts to develop and expand food crops of sorghum must be accompanied by a package of technologies that include unit activities from planting to processing. Therefore we need the guidance and counseling about the benefits and technology cultivation (Irian Jaya Agricultural Information Institute, 1990).

As explained by Suwito (2007), a few things to be noted in the cultivation of sorghum is about the time of cultivation, how to cultivate the land, the soil and climatic conditions are suitable for sorghum crops, crop rotation, how to choose a good seed, the right time for planting, spacing and how to plant, maintain, and the last is harvest and post-harvest to give the crops that have high quality and quantity.

B. Conceptual Framework

Conceptual framework is collect ideas or opinions and thinking framework of the study in the form of schemes. On the topic of farmer's adoption and diffusion of sorghum cultivation will be explain about sorghum cultivation and adoption and diffusion of sorghum, and then the writer will be to identify problems of farmers about cultivation of sorghum and the other problem what their have. And at the end, writer will propose the solution and policies for solving problems of farmers to improve the adoption process. Conceptual ideas for this framework can simply be shown on Figure 1. as follows:



Sorghum Cultivation

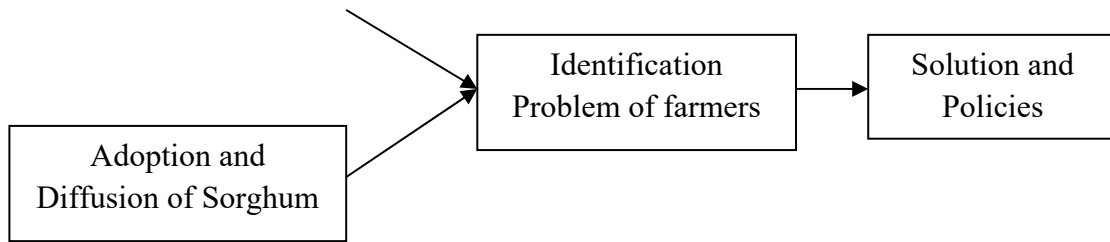


Figure 1. Conceptual Framework of Adoption's Farmer and Policies

III. RESEARCH METHODE

This study is based on survey research by using the research approach of descriptive analysis. According to Creswell (2012) in the design of the survey, the researchers describe a quantitative (numbers), behaviors, or opinions of a population by examining a sample of the population. Location of household sample were selected based on purposive method by considering the area that has sorghum farming in Yogyakarta namely Bantul Regency. Household Samples was selected by using purposive method namely farmers who have experience in cultivating sorghum crop. The total household sample was 30 samples that have been interviewed by using the structured questionnaire.

IV. RESULT AND DISCUSSION

The increasing of food needs continuously has been alarming to many parties continuously produce the food and to work hard in increasing the food production in order to fulfill the needs of community. Even though wheat has been used as food materials for various processed food in Indonesia and becomes the favorite food for the community such as noodle, bread, cereal, and etc, it has caused the huge dependency on wheat import of Indonesia. Public demand on wheat processed food is so high that has been causing huge import flour wheat and wheat from abroad. However we should concern that wheat crop is not suitable in Indonesian climate. In fact many areas of Indonesia have kind of local wheat in the form of local cereal varieties that can be used for substitute of wheat and can play important role as an alternative of new consumption pattern.

Sorghum or locally called as *chantel* as a local commodities actually has been known for a long time ago by the people of Yogyakarta Province, especially in Bantul and Gunung Kidul Regency. Unfortunately, for several decade sorghum crop has been quite rare and only few farmers grow the sorghum crop. Lack of cultivation technology, lack of processing technology and under develop of market system of sorghum have brought about the less incentive for growing sorghum among rural farmers. In fact, if sorghum developed properly with a high commitment and supports that will generate the high productivity and finally it will to some extent substitute the needs of flour wheat imports.

The aims this research that is to determine farmer's adoption technology in sorghum farming by farmers in marginal areas, Bantul Regency, to know the diffusion technology in sorghum farming by farmers in marginal areas, Bantul Regency and to identify the problem and solving problems in sorghum farming by farmers in marginal areas, Bantul regency.

Table 4.1. Adoption's Technology of Sorghum Cultivation in Bantul Regency

Technology of Sorghum	Total People		Adoption's Percentage (%)	Recommendation Technology of Sorghum
	Yes	No		
1. Preparation				
- Preparation of planting materials	29	1	96,67%	The average farmer preparing seeds ready for planting.
- Preparation of land	29	1	96,67%	Performed with plowing one or two times, raked and leveled.
2. Cultivation				
- Setting the planting hole	26	4	86,67%	Conducted spacing 70cm x 20cm or 75cm x 25cm.
- Procedure planting	27	3	90,00%	Each planting hole 2 seed planted sorghum. Planting by using a drill
- Stitching	24	6	80,00%	Stitching to sort out the seed quality or not damaged at the time of planting.
3. Maintenance				
- Watering	24	6	80,00%	The ideal watering done in the morning and afternoon. Initial watering is done to stimulate the growth of shoots, then further watering is done if necessary mean when soil begins to dry.
- Fertilization	24	6	80,00%	Fertilizer used in the form of chemical fertilizer and compost. Urea: 200 kg/ha TSP : 100 kg/ha Kalium : 30 kg/ha
- Weeding	22	8	73,33%	Weeding is done old sorghum plants at 10-15 days after the planting. Weeding the two performed together at dewing.

- Moisturing/dewing	19	11	63,33%	Dewing done to strengthen the stem.
- Management of pest and disease	26	4	86,67%	Control can be done in a preventive and curative. Preventive done by simultaneously planting, seed varieties, and a protected environment. Curative done with pesticides, insecticides, and others.
4. Harvesting				
- In accordance with the level of maturity (times)	22	8	73,33%	Sorghum seeds were harvested when ripe, usually 45 days after the ovule is formed or about 4 months.
- Harvesting as recommended (way)	22	8	73,33%	Harvesting is done by cutting the stalk ranging from 7,5-15 cm below the seed piece using a sickle.
5. Post-Harvest				
- Threshing and Drying	21	9	70,00%	Threshing is done traditionally with wooden beater (<i>digepyok</i>) and the threshing machine (thresher). Drying is carried out in the blazing sun with the aim that the crops do not rot. Drying is done until the seed moisture content reaches 10-12%.
- Sorting	14	16	46,67%	Separation of the grain that contains the skin usually by " <i>ditapen</i> ".
- Processing to making flour.	16	14	53,33%	Processing into flour aims to gain added value the sorghum.
- As an animal feed	16	14	53,33%	Sorghum stems are used for animal feed.
Total	361	119	75,21%	

Source: Interview's Farmer (2013)

In short it can be explained that the sorghum crop cultivation has been done by farmers in Bantul Regency almost at the same when corn is cultivation. Base on the Table 4.1, it shows that a large part of farmers have cultivated sorghum following the recommended cultivation techniques. It is slightly different as compared to the other farmers who grow sorghum in wet land areas. Most of sample farmers in Bantul Regency have been using marginal land for sorghum cultivation such as sandy land in coastal areas and sandy land along the river banks. Farmers face the limitation of land availability. Fertile lands commonly have been used for the other profitable food commodities such as rice and corn.

The other important reason for sorghum cultivation is related to the cost, many farmers mentioned that cultivation of sorghum did not need a high cost. In addition, the environmental adaptability of sorghum is high, even in the worst condition for instance no watering sorghum will still be able to survive. Limited of water is not a problem for sorghum, because sorghum can be grown in dry land. But unfortunately, sorghum plants have failed harvest during the latest dry season because attacking of bird pests. Bird species like the white sorghum varieties,

farmers could introduce and changed to other varieties such as red sorghum for solving the problems.

Based on the research in Bantul Regency, it can be identified that farmers have been trying to grow sorghum along the river banks, however in some cases they did not succeed due to overload river water or incidence of flooding. For coping the problem, at the present time farmers have been trying to plant sorghum on the marginal sandy farming land of Pakualaman's land in coastal areas.

Another advantage of sorghum is the usage of sorghum stem for animal feed and the use of main stem or seed for replanting the new sorghum plots. However, farmers have still been facing in product marketing, there is no clear market system for sorghum that accommodate the sorghum products. Post-harvest processing skills by farmers to improve product valued added has been also still quite limited.

Table 4.2. shows the diffusion components and communication channels, time and social system cultivation of sorghum in Bantul Regency. Public information related to sorghum farmers has been mostly acquired by agent of change (field extension workers), farmer groups, and group leaders. Revitalization of sorghum in Bantul is a new thing that is being developed as an alternative to improve sorghum substitute food that always rises to meet the needs of the community.

In average, the farmers in Bantul Regency started cultivate sorghum since 2012. Involvement extension in the cultivation of sorghum is constantly needed to assist with aspects related to agricultural and particularly in providing market linkages and providing skills for the processing of sorghum to provide added value.

Table 4.2. Diffusion's Technology of Sorghum in Bantul Regency

Diffusion Component	The Answers
a. Communication Channel	
Agent of Change (extension).	Yes
Friend/Neighbor.	No
Mass Media.	No
Groups Farmer.	Yes
The others (Sales, Group leaders and so on).	Yes
b. Timing	
The first time get information.	2012
Beginning cultivation of sorghum.	2012
There is new information about sorghum.	No
c. Systems of Social	
Neighbor who cultivation of sorghum.	Yes

Suitable to sorghum cultivation (areas).	Yes
There is agent of change as monitoring sorghum cultivation.	Yes

Source: Interview's farmer (2013)

Table 4.3. The Problems of Farmer in Sorghum Cultivation in Bantul Regency

Identified Problems	Prospective Solutions
Availability of land	<ul style="list-style-type: none"> - Land along river bank. - Sandy land in coastal areas. - Home garden.
Water availability	<ul style="list-style-type: none"> - Sorghum is needs less water (dry land). - Useful sandy land to cultivation of sorghum.
Pest and disease of sorghum	<ul style="list-style-type: none"> - Choice red variety of sorghum to avoid birds.
Underdeveloped Market	<ul style="list-style-type: none"> - Development of sorghum can be arranged by a cooperation and partnership with food industries.
Price is cheap	<ul style="list-style-type: none"> - The harvest not only in sorghum seed, but also make a product like flour or kinds of food.
Processing of Sorghum	<ul style="list-style-type: none"> - Giving skill to women farmer to make some product domestic from flour of sorghum.

Source: Interview's farmer (2013)

The various problems on sorghum crop development have been faced by farmers. The problems that found among farmers in sorghum crop farming are displayed on Table 4.3. Crucial issues that need to be addressed for improving sorghum cultivation including the availability of land, water availability, pests and plant diseases of sorghum, underdeveloped market, lower price, and underdeveloped of sorghum processing. Those problems create less incentive on sorghum farming and sorghum farming becomes more marginalized and makes farmers are reluctant to plant sorghum seriously.

There is a need a model of cooperation and partnership between farmers, farmer groups, extension workers, local government, investors, food processing industries, and stakeholders to reconstructing the cultivation and handling system of sorghum. In the future sorghum farming will be not only get a high production rate but also has a higher market prospect. In addition, the future development should be directed that farmers do not only sale the sorghum products and seed but will be more advance trough the involvement of farming households in sorghum products processing for fulfilling household food diversification demands and also for selling in getting more income. The effort related to the development of sorghum cultivation

might be able to provide an alternative of food for community that in turn can support the food security at the community level or even national level.

V. CONCLUSIONS

Conclusions that can be taken from the research are:

1. Adoption level of the large part of farmers on the cultivation of sorghum has been in line with the technological cultivation recommendation because basically sorghum cultivation is not difficult for farmers and the cultivation has been practices under working together among farmer groups.
2. Diffusion technology of Sorghum cultivation in Bantul Regency has been done through agents of change (field extension workers), farmer groups, and group leaders.
3. Problems and solutions for the cultivation of sorghum is mainly related to the availability of land to utilize marginal land such as land along river banks, sandy land in coastal areas, and home garden because sorghum has a high adaptability, water availability with limited water conditions sorghum able to stay afloat life, the selection of red sorghum varieties to reduce the impact of bird attacks can reduce the incidence of crop failure, underdeveloped market could be solved by the arranged by a cooperation and partnership with food processing industries, a low price of sorghum can be solved by introduction of product processing such as making flour and flavor or various kinds of processed food, and promoting and training for women to improve processing skills to produce some domestic food product by using sorghum.

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