OPTIMIZATION MODEL FOOD SECURITY ON VOLCANIC SLOPES OF MERAPI BASED ENVIRONMENT

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Food security is a global issue. FAO studies show 925 million people worldwide hunger. Population growth, land conversion, reduction of investment and low agricultural technology led to agricultural production is not optimal and inhibition of food security. The purpose of the study was to determine the long-term food security optimization model-based environment, while specifically determine the suitability of food security and agricultural land. Food security in question is the level of food sufficiency. Environmental base in research focused on the physical and socio-economic variables. Physical variables include the shape of the land, land use, slope, soil and climate. Socioeconomic variables include production (rice, maize and potatoes), resident. Physical and socio-economic variables obtained from secondary data (CBS, BIG and BMKG) and primary (interviews and surveys). The location determined by purposive sampling research on volcanic slopes of Merapi. The research sample is based on land units of the overlay form of land, land use and slope. Analysis of basic physical research analysed with GIS and survey the field while the social economy through quantitative analysis of food adequacy calculation. The analysis showed that the suitability of land on the slopes of Merapi volcanic included in the category suitable (S1, S2 and S3) and the level of food sufficiency in the category of surplus unless the District Mlati and Depok. This is because the two districts located on the outskirts of Yogyakarta city with a high population and a low amount of agricultural land. However, food security in all regions is optimized by minimizing the bias is still a limiting factor that increases food security by increasing the number of production.

Keywords: Food Security, Adequacy of Food, Land Suitability

INTRODUCTION

Food is a basic need or the basic human needs for survival which in 1945 explained that the state must run food sovereignty (the people's right to food), and seek fulfillment of food for the population. The

obligation in question is to guarantee the availability, affordability and compliance with food consumption sufficient, safe, high quality and nutritionally balanced. However, based on research results Food Agriculture Organization (FAO) are the latest world population of 925 million people suffer from hunger. Food is a problem that must be addressed because of food to determine the sustainability of a nation.

Fulfillment food sufficiency can be done with agricultural development in the area of the volcanic slopes. Agricultural development influenced by the choice of commodities and enterprise system in accordance with the characteristics of the natural resources. The development of natural resources, especially land resources for agriculture optimally be done with the steps (a) determining the nature and characteristics of the land; (b) determine the suitability of land and (c) assessing the suitability of land for development of various agricultural commodities. In addition to these measures that support the government's policy towards agricultural productivity is also needed, especially in land-use changes, the provision of agricultural inputs, especially fertilizer and seeds that can increase agricultural production. Thus the food needs can be met in volcanic slopes.

The agricultural sector is the economic base of the population in rural areas. Similarly on the slopes of Merapi volcanic agricultural sector is the dominant sector, with agriculture as the foundation for the people and also has a great contribution to development in Sleman. Agriculture in Sleman an agricultural base should have been able to meet the company needed food. But the rise of land use changes that occur causing land degradation and demage to the environment which in turn will have an impact on agricultural production does not meet food needs of the population.

1. How is food security of agricultural land on the slopes of Merapi volcanic?
2. How is the suitability of land for farming on the slopes of Merapi volcanic?
3. How does the optimization model based food security environment in volcanic slopes of Merapi?

Theoritical Framework

Land characteristic is state land that can be measured and predicted. Land characteristic only shows the general condition of the land but has yet to show its quality to support a particular land use. Land quality is derived from the characteristics of the land or the ability of the land to meet specific requirements. The quality of land is the land properties that affect the suitability of land where land quality itself is

specific, which means the level of influence on land use will vary. In addition to the level of land suitability of land quality will also affect the production and costs of production or a combination of all three. Land suitability classification framework according to FAO (1976) can be divided into the tiers of the Order, Class, Subclass and Unit.

The existence of agricultural land suitability analysis can help determine a method of optimizing agricultural production to achieve food security, both physically and socially. Food Security is meant here is the achievement of food security which can be determined by knowing the ratio between food availability and food needs

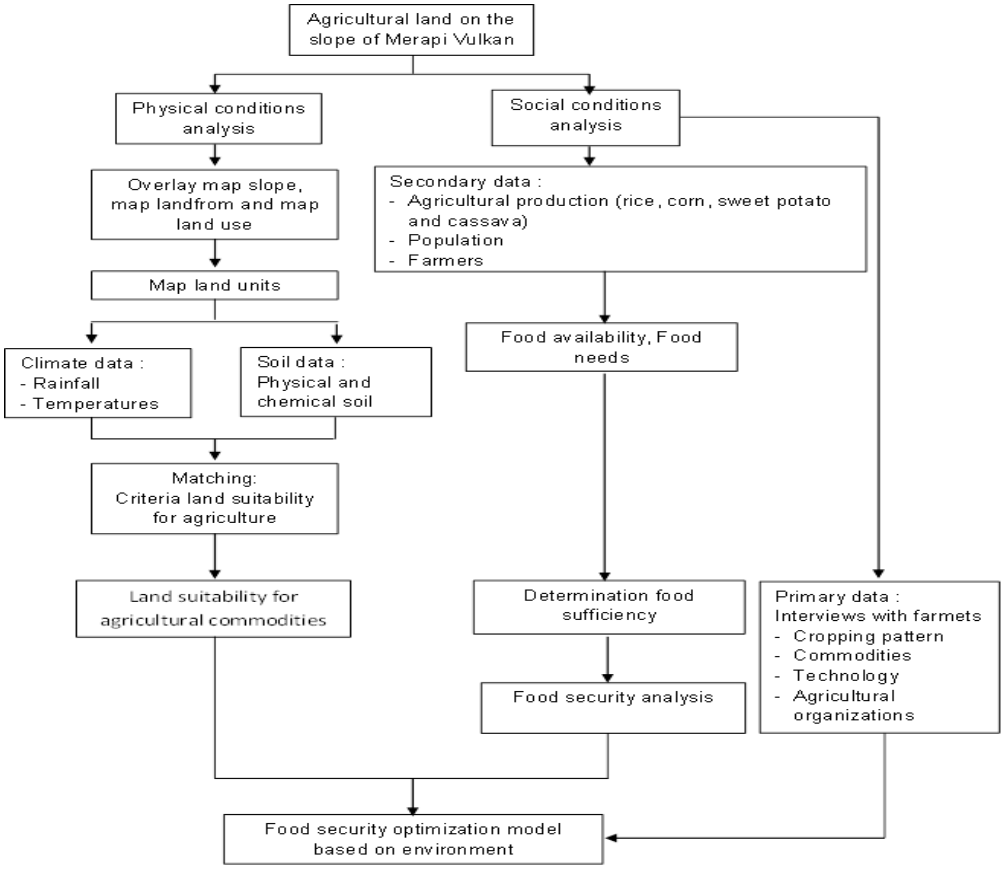

Figure 1. Flowchart of Research

Materials And Methods

The choice of location research done by purposive sampling is a slopes of Merapi Vulkan. Volcanic landform has a tendency towards the agricultural sector due to the type of arable land due to the pyroclastic material results volcanic activity.

The data used in this study are primary data and secondary data. Primary data collected is (1) a landforms maps and land use maps which can be obtained from the image interpretation; (2) Soil data: organic material, drainage, texture, soil depth, KTK, base saturation, pH and salinity which can be obtained from observations and measurements in the field; and (3) slope. Secondary data used in the analysis of land suitability includes images, Indonesia topographic map, climate data includes data of rainfall and temperature data obtained from the rain station. Secondary data required for analysis of food security is agricultural production data and population data can be obtained from the Badan Pusat Statistik.

Sampling was carried out based on different land units. This is caused by the same unit of land have the same formation and properties that can be used to generalize land units.

Analysis of land suitability for agriculture, there are several provisions (1) Requirements to grow crops that are used determine land suitability classes (2) Determination of land suitability classes for agricultural crops is done by the method of matching the method of determining the suitability of land based on matching between the characteristics of the land / land quality the prerequisites to grow crops farmland. (3) Class of land suitability determined on the basis that there is a limiting factor on the characteristics of the land/land quality.

Analysis of food security in the study visits of food sufficiency. Food security in a region can be determined by knowing the ratio between food availability with food needs.

Availability of Food

- Rice

$$\text{Net P} = (P \times (1- (B + Pk + T))) \times C \quad (1)$$

Description:

P = rice production
B = the value of seeds (0.0088)
Pk = Feed (0.02)
T = wasted (0,054)
C = coefficient of paddy into rice (0.632) (United Nations, 2004)

- Corn, Cassava, Sweet Potatoes

$$\text{M net} = P \times (1- (B + Pk + T)) \quad (2)$$
$$\text{C net} = P \times (1- (B + Pk + T)) \quad (3)$$
$$\text{SPnet} = P \times (1- (B + Pk + T)) \quad (4)$$

Description:

B = the value of the seeds (Corn (0009), cassava (0), sweet potato (0))

Pk = Feed (Corn (0.06), Cassava and Sweet Potato (0.02))

T = wasted (Corn (0.05), cassava (0.0213) and sweet potato (0.1))

$$Tnet = 1/3 \times (Cnet + SPnet) \quad (5)$$

Description :

Tnet : net production of cassava and sweet potatoes

Cnet : net production of cassava

Spnet : net production of sweet potato

$$Pfood = rnet + Mnet + tnet \quad (6)$$

Description:

Pfood : Food production cereals

Rnet : net production of rice

Mnet : net production of maize

Tnet : net production of cassava and sweet potatoes

- Food Cereals Availability

$$F = \frac{P_{food}}{t_{pop} x\ 365} \quad (7)$$

Description :

F : Food cereals availability

Pfood : Food production cereals

tpop : Midyear population

➢ Ratio Availability of Food

$$I_{AV} = \frac{F}{C_{normatif}} \quad (8)$$

Description:

I_{AV} : Food availability ratio

Cnormatif : Consumption normative (300 gram)

F : The availability of food cereals

Table 1 Classification Ratio Availability of Food

Ratio of Food Availability	Classification
R < 0,90	Prone to Food
0,90 ≤ r ≤ 1,14	Enough Food
R > 1,14	Surplus Food

Source: Badan Ketahatan Pangan, 2014

RESULTS AND DISCUSSION

Food Security

Food security in Sleman almost all fall into the category of food surplus but two sub-districts Mlati and Depok. Both districts are included in the category of food insecurity. This is in accordance with the spatial plan Sleman Regency stating that Distric of Mlati and Depok is an agglomeration region (urban development in certain areas) Jogja. This region is also a center of education, trade and services. In addition the District Mlati and Depok also passed by the State which is an economic path that connects between provinces. Mlati and Depok subdistrict also passed the roundabout which is a primary arterial road that make it into the second fastest growing districts namely of agricultural land into industry, trade and services.

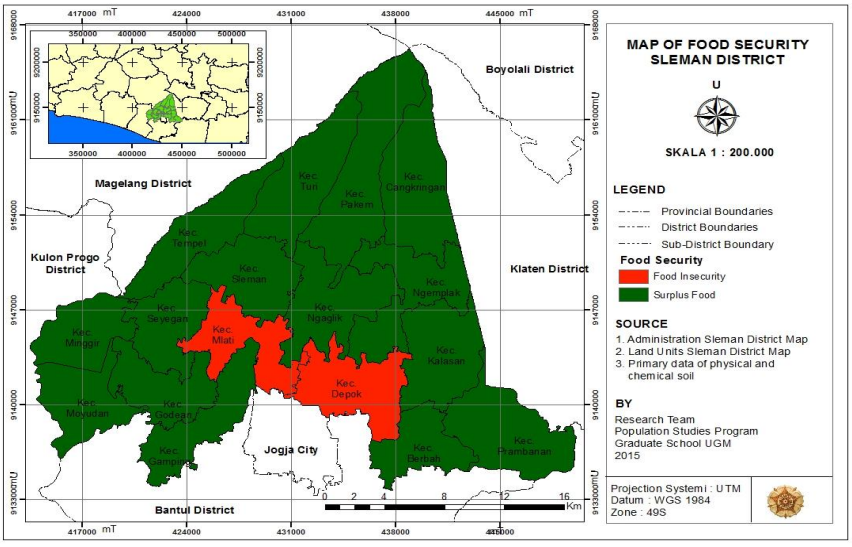

Figure 1 Map of Food Security in Sleman District

Apart from the two sub-districts, all districts in Sleman fall into the category of food surplus. This is supported by the climatological conditions that exist in Sleman. Sleman regency entered in wet tropical climates where in one month is the most rainy days 25 days with an average rainfall of 34.62 mm/day. Air pressure in Sleman is 1012.5 to 1017.3 mb, humidity 55% - 96.7% and the air temperature of 21.5°C - 31.8°C. Besides supported by a food surplus climatological conditions that occur in the bulk of the sub-district in Sleman also because the majority of soil types in Sleman Regency is the type of soil regosol spread over 49 262 ha (85.69%) of the area of Sleman. Regosol land is a

kind of undeveloped land but not an alluvial material or sludge flood. Regosol land has gray and brown. Soil structure of single grained (granular). Regosol soil derived from volcanic material. Have low organic matter content so that nutrient for plants not yet available. Therefore to increase the organic matter content needs to be done fertilizing and watering. Soil pH between 5 to 7 and soil permeability levels fast to very fast. Regosol type of soil is suitable for agricultural land, so most districts in Sleman region had a surplus of food. While food security for farmers calculations show that all the sub-districts of Sleman experienced a food surplus.

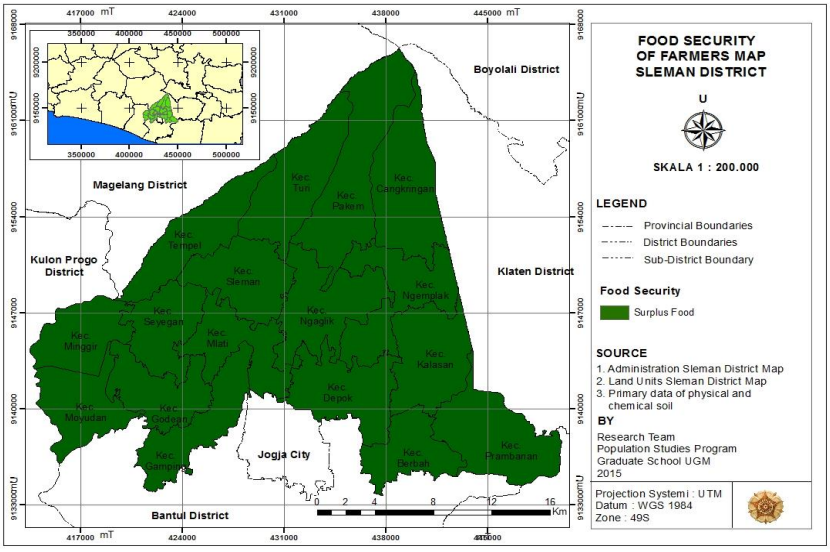

Figure 2 Food Security of Farmers Map in Sleman District

Land Suitability From Agriculture

For the rice crop in Sleman, comparison area at land suitability class S1 (fits) with the land suitability class S2 (corresponding) is almost the same, namely to S1 at 53.52% while for S2 at 41.03%. Meanwhile, for half the District of Paste and slightly subdistrict of Turi, there is a region with a land suitability category S3 (corresponding marginal) amounted to 3.93% of the total area.

The dominant limiting factor in the suitability of land for rice crops in Sleman is rooting medium (37.68%), followed by a factor of erosion (29.53 %). The limiting factor in the form of relatively more difficult rooting medium above because it is innate from nature, while the factors of erosion can be overcome or reduced by technical measures and vegetative in land conservation activities. Judging from the distribution

of both these limiting factors, both are spread almost evenly across districts in Sleman.

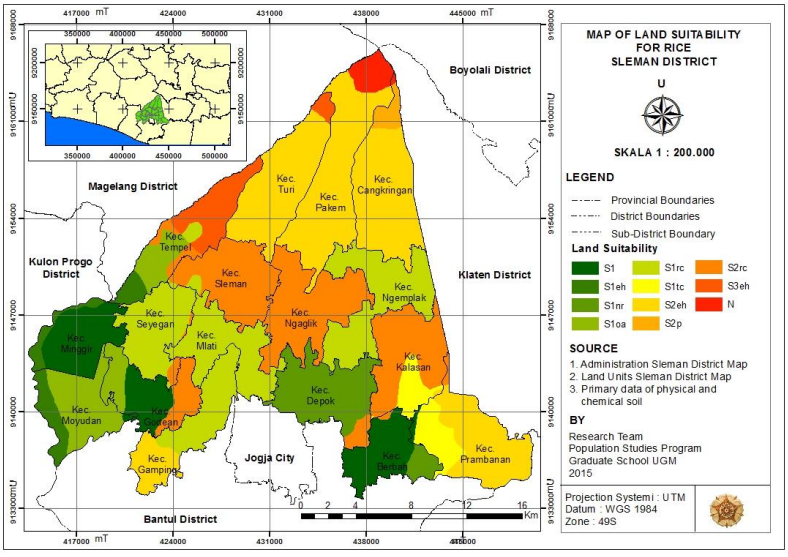

Figure 3 Map Of Land Suitability For Rice in Sleman District

For the corn crop in Sleman, suitability of land suitability class S2 (corresponding) is more dominant compared to the suitability of land suitability class S1 (very appropriate), namely (61.24% of the total area). For land suitability classes S1, the corn crop is in accordance developed in Depok, Berbah, Ngemplak, Minggir, Moyudan, and Godean. For other sub-district, the distribution of land suitability class S1 contained in partial Prambanan, Kalasan, Ngaglik, Seyegan, and Tempel sub-district.

The dominant limiting factor in the suitability of land for corn crops in Sleman is water availability (59.72%), while the other limiting factor is not so dominant. The limiting factors such as the availability of water requiring treatment in the form of engineering technologies such as the manufacture of irrigation channels, wells, pumping water from the river, as well as the handling of non- technology such as crop rotation. See the spread of limiting factors such as availability of water, it can be seen that the limiting factors such as the availability of water is spread evenly in most sub-districts in the district of Sleman.

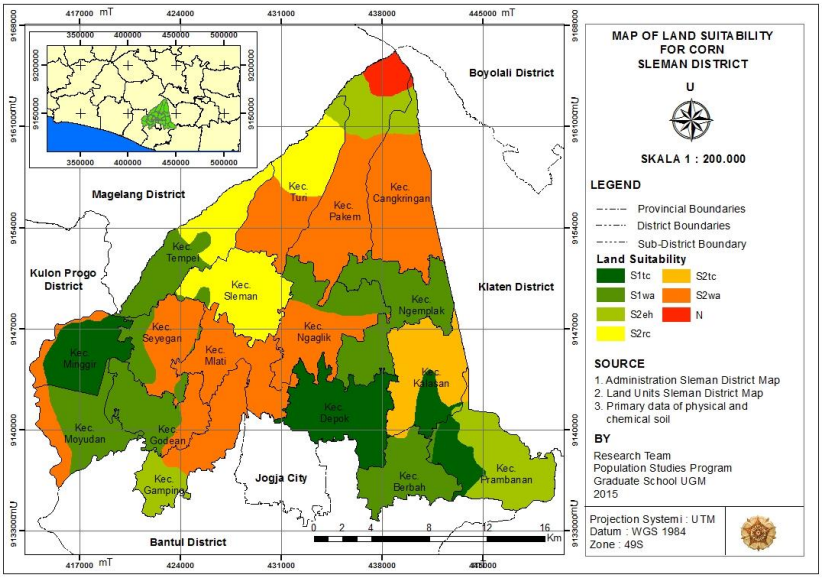

Figure 4 Map Of Land Suitability For Corn in Sleman District

For sweet potato crops in Sleman, suitability of land suitability class S2 (corresponding) is more dominant compared to the suitability of land suitability class S1 (very appropriate), namely (66.13 % of the total area). For land suitability classes S1, sweet potato is very suitable developed in Depok, Berbah, Seyegan. For other sub-districts, the distribution of S1 are in partial sub-district Minggir, Moyudan, Godean, Tempel, Kalasan, Ngaglik, and Ngemplak.

The dominant limiting factor in the suitability of land for sweet potato crops in Sleman is temperature (40.51%), followed by a factor of rooting medium (35.92%). Both of these factors are natural factors that are difficult to overcome, and costly to overcome. Therefore, other factors need to be considered when going to cultivate yams, for example by looking for sweet potato varieties that can tolerate conditions of temperature and rooting medium in Sleman. Judging from the distribution of both these limiting factors, both are spread almost evenly across districts in Sleman.

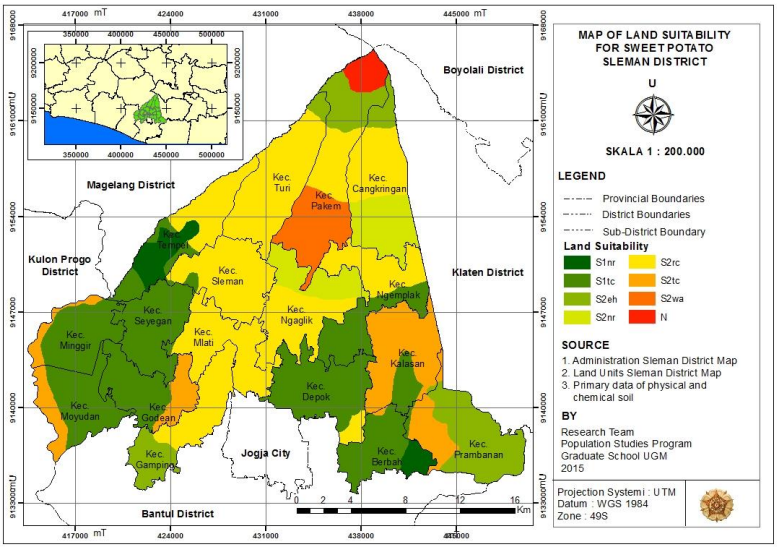

Figure 5 Map Of Land Suitability For Sweet Potato in Sleman District

For cassava plants in Sleman, comparison area at land suitability class S1 (fits) with the land suitability class S2 (corresponding) is almost the same, namely to S1 at 48.83% while for S2 at 49.93%. For land suitability S1, the rice crop is very developed in the district accordance Minggir, Moyudan, Seyegan, Godean, Depok, Berbah and Ngemplak. Sub-district of S1 to another distribution contained in partial sub-district Tempel, Ngaglik, Kalasan and Prambanan.

The dominant limiting factor in the suitability of land for rice crops in Sleman is rooting medium (48.48%), followed by the availability of water (28.80 %). The limiting factor in the form of relatively more difficult rooting medium above because it is innate from nature, whereas the availability of water can be handled by engineering technologies such as the manufacture of irrigation channels, wells, pumping water from the river, as well as the handling of non- technology such as crop rotation. See the spread of limiting factors such as availability of water, it can be seen that the limiting factors such as the availability of water is spread evenly in most of the districts in the District Sleman. Judging from distribution of both the limiting factor, both are spread almost evenly across districts in Sleman ,

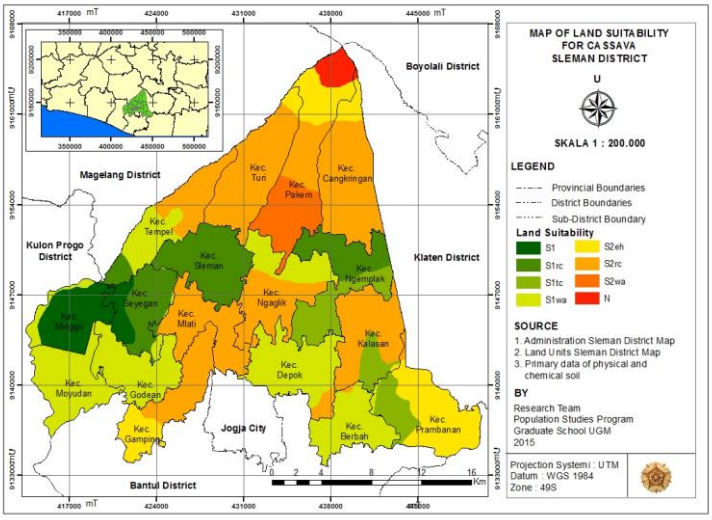

Figure 6 Map Of Land Suitability For Cassava in Sleman District

Optimization Model Food Security Environment Based

Optimization model based food security environment in Sleman there are various kinds. Some optimization model food security carried out by farmers is to conduct an integrated land management to maintain and improve soil fertility. Some land management tool made by farmers in Sleman is "Pemberaan", mulching and the use of organic fertilizers.

"Pemberaan" is the process emptying or rest of farmland during a specific time period. In the process of this fallow and grass weeds allowed to grow after harvest. This is done to reduce the degradation of the land where the land intensive treatment can lead to a decrease in soil fertility and reduction in agricultural output (production).

Figure 6 “Pemberaan” in Sub District Kalasan
Foto By Research Team (2015)

Mulching is provision of skin to cover the surface of the soil by using crop residues or grasses, such as rice straw. Mulching is done with

the aim of preventing the loss of water through evaporation process, reducing the occurrence of spark erosion due to rainwater, controlling the growth of weeds and help maintain soil structure. Aside land management is done with fallow and mulching also conducted an organic fertilizer.

(a) **(b)**

Figure 7 (a) Mulching (b) Organic Fertilizer in Sub District Tempel
Foto By Research Team (2015)

Optimization food security of farmers in Sleman can be done also with concurrent planting system. Concurrent cplanting pattern has several benefits which are able to break the life cycle of pests. In addition to cropping systems simultaneously it is able to facilitate the irrigation settings.

Increased agricultural production by farmers in Sleman also be done with the system "Legowo". "Legowo" comes from the Javanese language comes from the word "Lego" which means wide and "Dowo" meaning long. Benefits of rice cultivation system "Legowo" is increasing the number of rice crops, increasing the production of rice plants, improve grain quality, reduce disease and pest attacks, simplify maintenance and save the rice crop fertilizer. In the system "Legowo" there are also drawbacks including the need to employ and more time when the process of rice cultivation and seed requires more.

Figure 8 “Legowo” System in Sub District Berbah
Foto By Research Team (2015)

CONCLUSION

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Some optimization model food security carried out by farmers is to conduct an integrated land management to maintain and improve soil fertility. Some land management tool made by farmers in Sleman is "Pemberaan", mulching and the use of organic fertilizers. Optimization food security of farmers in Sleman can be done also with concurrent planting system and “Legowo” system.

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