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BIOCHAR USE AS SOIL AMENDMENT ON DRY LAND BY FARMERS IN DISTRICT OF BLITAR, INDONESIA

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Jangkung Handoyo Mulyo[2,3]
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Abstract

Dry land in Indonesia is larger than its wetland, with yield problem and low fertility. Therefore it is necessary to find innovation to manage it. Biochar as soil amendment is an innovation that could help farmers in dry land to increase its productivity.This research aimed to describe the response and participation of farmers on biochar production and application as soil amendment on dry land management. This research is used survey and experimental method.:Location of the research is Blitar district, Indonesia which has a vast of dry land. The method of determining on location and sample was undertaken purposively, and descriptively on analytical method.

The results showed that farmers are able and willing to produce biochar independently and applying biochar on dry land owned as sustainable soil amendment. Utilization of biochar as a soil amendment on dryland management in Blitar, Indonesia has been received by farmers as an innovation that could help farmers overcome the problems of low productivity of dry land and can improve fertilizer efficiency. The positive response and active participation of farmers increase in the application of biochar on dry land and farming of various commodities in annual

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cropping patterns and utilization of their yards. Socialization and assistance needed for the use of biochar is more intensive and sustainable for farmers to produce and utilize biochar, so innovations and technologies that have been found to be beneficial to the welfare of farmers, solve environmental problems and create a multiplier effect on the productivity of dryland farming.

Keywords : biochar, amendment, dry land.

Introduction

Total dry land in Indonesia is 123.1 million hectares and 13.3 million hectares of it are spreading in East Java , Bali , NTT and NTB . At the moment, farming, especially food crops can not just depend on the wetland area of 8.1 million hectares and tends to decrease each year due to conversion and change to other commodities of non- food crops, as well as Policy Spatial Plan (PSP) of regencies / cities throughout Indonesia . On the other hand , the trend of national food needs continue to get increased, so that is still necessary to have policies ensure the expansion of production with an area of 1.3 million hectares , or 8.7 million hectares until 2050. To support these goals, it is necessary to conduct important steps and positioned through the optimization of dryland (Haryono , 2013).

Efforts to improve the productivity of dry land are able to do with approach of optimization and expansion. The approach includes the optimization of the dry land which have been completely conducted in order to become more productive and sustainable through intensification with the support of innovation. The approach also contains extending the area expansion. The new farm with the dry land potential scale of priorities is determined in advance . Therefore, the above approach should be supported by science , innovation and cooperation networks (Haryono , 2013).

Java is an island with the most populated situation , heading issues of land management for sustainable agriculture , which is now is more complex because it should be the highest producer of food commodity to compensate of high population, also facing problems of overuse the land for non-agricultural purposes. To overcome these problems ,dry land and less fertile land management is important, as well as managing marginal land. Therefore, it needs appropriate technological innovation, in the sense of being accepted and implemented by farmers, and sufficient raw material available in farmers' land. These conditions can be a solution to the problems of land management and productivity of sustainable agriculture , and will not damage the environment. One of technological innovations that meets these criteria is the production and application of biochar on dry land.

Biochar or charcoal is a solid material formed from carbonization of biomass, which can be added to the soil with the aim to improve the functioning of the soil and reduce emissions of biomass that naturally decomposes to greenhouse gas (IBI, 2012). Widowati (2011) in her study found the low capacity of the buffer in the soil resulted in the loss of nutrients, which then performed a chemical fertilizer with increasing doses is an option. As a result of such action there is an imbalance of nutrients in the soil and damaging the environment. To overcome this problem, biochar application is needed, because it can increase the negative charge in the soil that can reduce soil nutrient leaching. Research Chan et al (2007) found that the provision of more than 50 tons of biochar per hectare can improve soil quality, including pH, cation exchange capacity (CEC), improve soil physical properties and field capacity. Deenik et al (2009) in his research concluded that biochar from organic materials are easily lost, increase respiration in the soil and make inorganic N is not easily changed; whereas biochar with high organic matter content is not appropriate for soil amendment in the short term. Other studies by Ying Ding et al (2010) found that biochar of bamboo charcoal can be used as an amendment to the retention of nutrients, especially in areas with high rainfall and mitigation of vertical transport of ammonium nitrogen. Widowati (2011, 2013) in her research states that there is interaction between biochar and fertilizer nitrogen uptake on the growth of corn plants. The combination of biochar and organic fertilizer with a dose of 15 tonnes per hectare and the combination of biochar and fertilizer 45 kg per hectare produces nitrogen uptake and growth of corn plants' best. Biochar can replace and reduce KCL fertilizer as maize production is 6.24 tons per hectare higher by 14% than without biochar; and a combination of the reduction of 75% KCL fertilizer dosage on application of biochar can increase corn production by 29%. Kumar (2012) in his study mentions that the organic material in the soil of degraded lands with simple technology is very low, to improve the productivity of the soil and stabilize yields required the addition of organic amendments. However, the main limitation of the addition of organic matter, especially in wet tropical conditions is rapid decomposition, necessitating the addition of organic materials that are repeated in every planting season, making it impractical and difficult to obtain sufficient sources of organic fertilizers. The results of some researches on the use of biochar, discovered that biochar's ability can improve soil properties, and carbon sequestration (Glaser et al., 2002; Lehman et al., 2003; Liang et al., 2006). Other researches on the benefits of biochar have been prooven that biochar can increase the harvest (Yamato et al., 2006 and Chan et al., 2008). Islami et al (2011) tested the hypothesis about the beneficial impact of biochar as an organic amendment in cassava-based crop systems found that the use of biochar will last longer as compared to conventional organic fertilizers such as manure and will encourage soil carbon sequestration. The beneficial impact of the use of biochar on soil properties have also been reported by many researchers such as improved properties of clams ground by Yamato et al (2006), soil physics by Chan et al (2008), and biological changes in the soil by Rondon et al (2007). Widowati and Asnah (2014) mentions in their research, the combination of biochar and fertilizer applications KCL 50 kg per hectare provide the highest agronomic results and effectiveness, namely the production of 7.02 tons per hectare, revenue of Rp19,305,000 per hectare, income of Rp 8,663,000 per hectare and RCR 1.8. Widowati et al (2010) in another study mentions that biochar application with or without NPK fertilizer, achieves a good effect on the availability of NPK in the soil, in addition to the combination of the application of biochar and organic fertilizers and NPK combinations produces biochar and vegetative growth of corn that are equally good.

Blitar regency has the characteristics of the land in the form of dry land area of 44, 939 hectares, larger than the rice field of 34,141 hectares (BPS, 2012), particularly in the south, namely Panggungrejo subdistrict, has dry land of 7,152 hectares which is the most extensive than other sub districts. Characteristics of dry land in the area is also classified as infertile so that in their production processes depends on the use of inorganic fertilizer (chemical fertilizer), it means it takes a lot of production costs, due to the availability of cost affects the ability of farmers in the supply of production factors needed in farming (Debertin, 1986 and Widodo, 1988). Therefore, farmers need a lot of inputs, especially fertilizers to achieve the success of farming. This would burden the farmers economically, but if they don't conduct it, then the production is not achieved as expected.

The use of biochar in the management of dry lands is intended to increase the productivity of land and fertilizer use efficiency in plants. However, common obstacles encountered in the application of biochar is a farmer custom that is not easily changed and needs concrete evidence to convince him. Therefore, this study was conducted to describe production and use of biochar as a soil amendment in the management of farmers' dryland in Blitar, Indonesia.

Material and Methods

This research was conducted in the village of Kalitengah, Panggungrejo district, Blitar, East Java, Indonesia, on the basis of survey methods and experimental (Sugiyono, 2009), with the following stages : a survey conducted on farmers who are members of farmers' group to measure the level of willingness to participate on dry land management with the use of biochar as a soil amendment. Based on the results of the survey, then it is conducted experiments and technical assistance in production of biochar from waste of rice husk and production equipment modifications from stove burners of waste biscuit tin, as well as its application on dry land.

The data generated in this study includes qualitative and quantitative data (Dawson, 2002; and Fidel, 1993) obtained directly from the primary data source that is from farmers as dryland's manager. The sampling is using purposive (Sugiyono, 2008), with a total sample of 155 people in the early stages and 391 people at a later stage. The difference is due to the number of samples of this research, from the introduction of new technologies until the research finished, so that the sample collected is based on the awareness and willingness of farmers. Data were analyzed using descriptive methods (Whitney, 1960 and Neuman, 1997), that is a collection of facts through the proper interpretation, aimed at studying the problems in society, including relationships, activities, attitudes and opinions as well as the processes that occur in relation to the certain phenomenon and symptoms in the society. Descriptive method also aims to describe or give an overview of the research object through the data or samples that have been collected and compiled for the general conclusions (Sugiyono, 2008; 2009).

Results and Discussion

a. Characteristics of land in the research site

Most of the land in Blitar, East Java Province, Indonesia has the characteristics of dry land, particularly in the south, precisely in the District of Panggungrejo which is used as research site. The location of the Panggungrejo is close to the ocean of Indonesia so it has land characteristic of relatively less fertile than the region in the north nearby an active volcano Kelud. Farmers in the research sites depend solely on rainwater for irrigation during the growing season, and always use inorganic fertilizers in farming. Utilization of inorganic fertilizers in the long run would cost farmers in financing the farm as well as having unfavorable effects on the soil. However, if it is not conducted, then the production achieved is low.

Blitar regency is located at an average altitude of 167 meters above sea level, with a flat to hilly topography. However, the southern region is a coastal site, bumpy ground to rocky mountains with a slope of 15% - 40%. In climatology, Blitar obtains the average of rainfall for four months with a maximum temperature of 30 C and minimum of 18 C. The potential of Blitar southern region as well as a producer of mining / quarrying class B and C, others are iron sand, trass, bentonite, kaolin , feldspar, zeolite, ballclay, sandstone, limestone, andesite and pyrophilyte (BPS Blitar, 2015). Given this reality, the management of farmland in the research sites is heading challenges that requires handling by the innovation of technologies that can be adopted by farmers. Therefore, the use of biochar as a soil amendment in south Blitar of farmers' dryland is a requirement that must be met.

b. Biochar production techniques

Biochar can be produced on a factory, laboratory or farmer's scale. Biochar production of factory's scale using high-tech and expensive, however, the resulting product is also a high quality and large number production. Production at laboratory's scale using simple technology to high-tech, but the resulting production adapted to the purpose of research that will eventually make a recommendation. One of the recommended based on the results of research and engineering experiments are simple biochar production technology to farmers. Various methods of production of biochar that can be done by farmers, such as, using the drums by the holes and cover (Figure 1 a, b), using a wire netting at the center (Figure 1 c), using a stove and a container with principles such as frying (Figure 1 d) and using the stove from tin cans biscuit by the chimney and the hole (Figure 1 e). In this study, the latter method (Figure 1 e) are used. Application of the method has several advantages : the creation of installation (stove burners) is very simple and can be done by the farmers themselves, in good condition (not raining) can burn the chaff with a capacity of up to 1 ton, the combustion process takes place slowly but the result is good (good quality of charcoal/ biochar , not easy to ash), the installation is easily to move so that the production process can be done anywhere, means farmers can do while doing other work (does not have to wait until finished).

Figure 1a

Figure 1b

Figure 1c

Figure 1d

Figure 1 a, b, c, d simple installation of biochar production

Source:https://www.google.co.id/search?q=gambar+instalasi+biochar&biw=1366&bih=641&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwiPmIPnjtbOAhWHMo8KHZ3JCFsQsAQIGQ

Figure 1e : Simple installation of biochar production
Source : Asnah's research

This study uses observation procedures to participate, which means the process of biochar production by farmers are guided by technical assistance and guidance. Furthermore, biochar production process in this study are described in the flow chart presented in Figure 2

Start

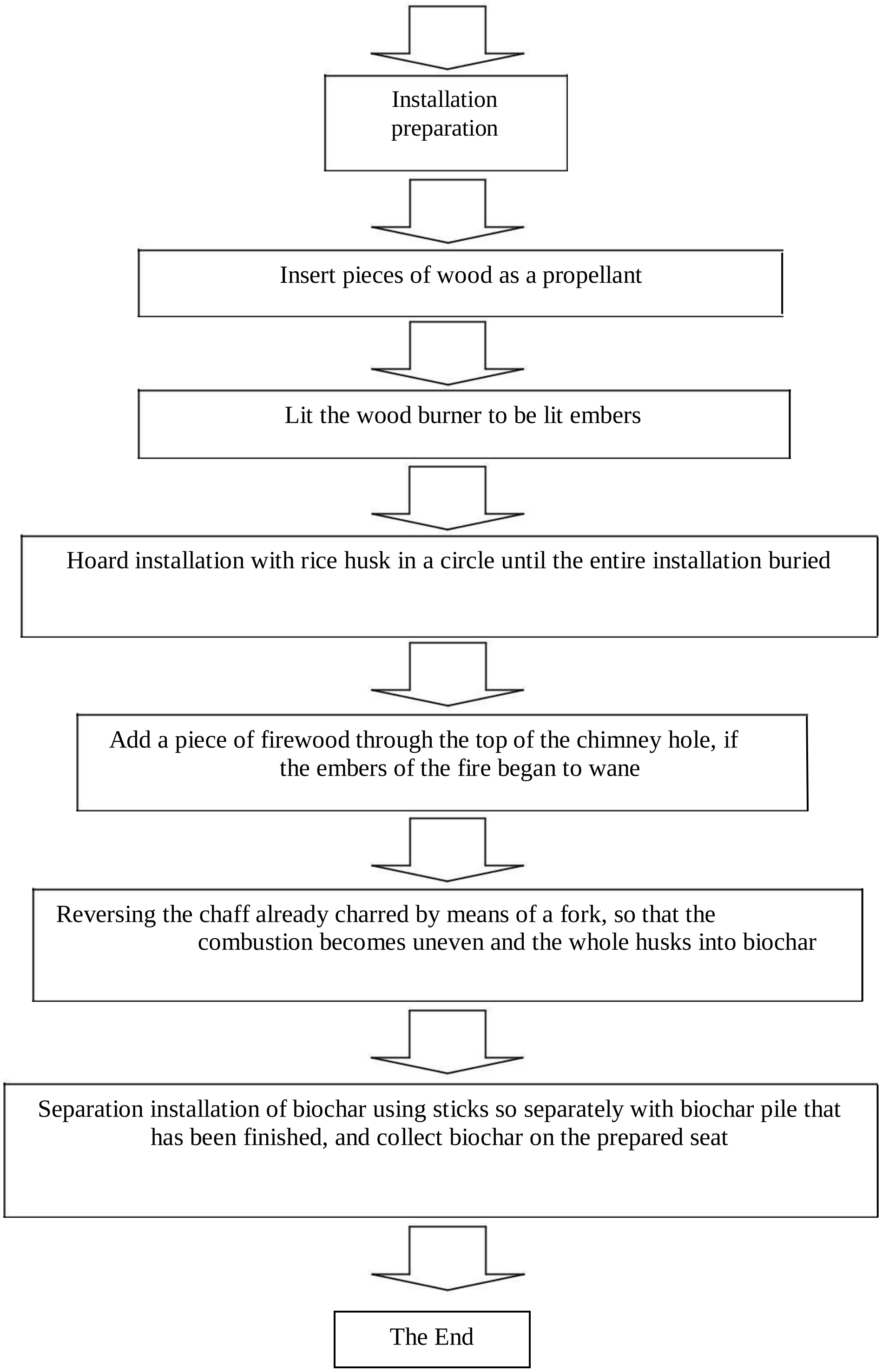

Figure 2: Simple biochar production process chart by the farmers

c. Farmer's response to biochar technology

Farmers who became samples of the research showed a positive response to technology biochar as a soil amendment. They realize that this is the technology that has been required and expected to help offset the costs of farming, especially fertilizers because the price of inorganic price is increasing every period of the growing season. Farmers are hoping the application of biochar technology will be able to improve the function of soil and increase fertilizer efficiency so that dry land productivity can be increased significantly. Farmers are also aware that the intensive use of inorganic fertilizers can only increase production shortly and have a negative impact on agricultural land in the long term. Therefore, they need innovation that can help overcome these problems. Technological innovation of biochar is very appropriate and answers the expectations of farmers with several advantages, such as: a simple technology, very adaptive to conditions of farmers, to do farmers in a sustainable manner, not costly because using raw materials available around the farmers that is using agricultural waste so it contributes the settlement of environmental problems.

Farmers' responses have been studied gradually in stages, beginning in the early stages with socialization and training of 155 farmers who belong to farmer groups. Next stage is technical support and training by giving an example of making biochar installation as well as biochar production. Furthermore about farmers' responses are presented in Table 1.

Table 1. The Response of Farmers to Adoption Technology of Biochar as an Amendment to Dry land.

Description	Farmers' Response			
	Initial Stage		Next Stage	
	Accept	Reject	Accept	Reject
Involved in the socialization (people)	155	0	391	0
Involved in training (people)	100	0	391	0
Involved in production (people)	85	70	293	98

Applied in the farming (people)	155	0	391	0
Plan to continue applied (people)	100	55	391	0

Source: Asnah, *et al* (2015) and research result (2016)

In the early stage of socialization and training is only attended by 155 members of farmer group, but in the later stage, farmer group members involved are increased to 391 people. Increased trainees can not be separated from the role of farmer groups' head and the function of agricultural instructor who assisted farmers in the field by motivating and communicating to connect between researchers and farmers. Moreover, the awareness and knowledge of farmers have grown based on the experience and skills acquired during the training. There are some farmers seem to refuse biochar production, but in fact because they will produce in groups with other farmers who are in a farm and have adjacent land, and not because refusing biochar technology. Producing in groups according to the understanding of farmers is more practical and efficient in the implementation of process, place and transportation.

d. Participation of farmers in the application of biochar in the management of dryland

Participation in this research is the real action of farmers in applying biochar that has been produced and applied into dry land farming management. Based on the survey and the training and mentoring in two stages of farmers in farmer groups and the farmers' group as a whole, there is willing and accepting biochar as an innovative technology which will help in increasing the productivity of dry land and commodities that farmers cultivated. Farmers have been producing biochar in accordance with accepted production techniques while training. They utilize rice husks originating from rice mill waste and waste from poultry dung pads that surround the farmer's as a raw material. The process has the dual advantage in the form of biochar production to run smoothly because of raw material available and the completion of agricultural and livestock waste problem so it does not pollute the environment. In this case, applying the principle of the farm : back to the farm by the farmers and for the welfare of farmers.

Participation of farmers in the application of biochar toward management of dryland farming is realized in several commodities at the annual cropping patterns and utilization of their yards. Farmers cultivated commodities that are commonly grown on dry land. Farmers realized that awareness and knowledge are needed to maintain soil fertility and break the cycle of plant pests by growing different crops every season. The level of participation of farmers increased at an advanced stage due to the behavior of members of farmers affected by the behavior of the group in general, so what is the group's decision will have an impact on behavior change of the members. This case is called the method of oil droplets (oil flact method), it means when the first drop of oil only seems small but the longer it will expand. Table 2 presents the level of participation of farmers in the application of biochar on farms and dryland management.

Table 2. Participation of farmers in the application of biochar on dry land farming

Comodity of farming	Farmers' participation			
	First Stage		Next Stage	
	Accepted	Rejected	Accepted	Rejected
Corn (people)	155	0	391	0
Peanut (people)	79	76	391	0
Soybean(people)	6	149	391	0
Paddy Gogo (people)	5	150	391	0
Chilly (people)	15	140	391	0
Melon/watermelon/cucumber(people)	0	0	391	0

Source: Asnah *et al* (2015) and research result (2016).

Conclusion

Utilization of biochar as a soil amendment on dry land management in Blitar, Indonesia has been accepted by farmers as an innovation that could help farmers to overcome the problems of dry land low productivity and also can increase fertilizer efficiency. The positive response and active participation of farmers increase in the application of biochar on dry land and farming of various commodities in annual cropping patterns and utilization of their yards.

The strategy is needed to be conducted as the implications for the receipt of biochar innovation by farmers is to carry out more intensive of socialization and mentoring toward o a wider farmers' perspective in the production and use of biochar. Thus, the innovation and technology that have been found, should be useful for the welfare of farmers, and can help to solve the environmental problems and create a multiplier effect on productivity of dryland farming.

Reference

- Asnah, Asnah, Masyhuri, Masyhuri, Jangkung Handoyo Mulyo dan Slamet Hartono. 2015. Pemahaman dan Partisipasi Petani Dalam Adopsi Teknologi Biochar Di Lahan Kering Blitar Selatan. Prosiding Seminar Nasional Kristalisasi Paradigma Agribisnis dalam Pembangunan Ekonomi dan Pendidikan Tinggi. IPB International Convention Center. Bogor 18 April 2015. 127-134.
- BPS. 2012. Kabupaten Blitar Dalam Angka. Badan Pusat Statistik Kabupaten. Blitar.
- BPS. 2015. Statistik Kabupaten Blitar. Badan Pusat Statistik Kabupaten. Blitar
- Chan, K.Y., L. Van Zwieten, I. Meszaros, A. Downie and S. Joseph.2007. Agronomic Values of Green Waste Biochar as a Soil Amendment. Australian Journal of Soil Research. 45: 629-634.
- Chan, K.Y., Van Zwieten, B.L., Meszaros, I., Downie, D. and Joseph, S. 2008. Using Poultry Litter biochars as soil amendments. Australian journal of soil research 46: 437-444.
- Dawson, Cathariene, Practical Research Methods A User Friendly Guide To Mastering Research (UK, How to Book Ltd, 2002), p. 14-23
- Debertin, D.L. 1986. Agricultural Production Economics. MacMillan Publishing Company. United States of America.
- Deenik, Jonathan, L., A.T. McClellan and G. Uehara. 2009. Biochar Volatile Matter Content Effects on Plant Growth and Nitrogen Transformations in a Tropical Soil. Salt Lake City. UT.Western Nutrient Management Conference. 8: 26-31.
- Fidel, Raya, Qualitative Methods in Information Retrieval Research (Summer, Library and Information Science Research, 1993), 15 (3) : 219
- Glaser, B., Lehmann J. and Zech W. 2002. Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal: A review. Biology and Fertility of Soils 35:219-230.
- https://www.google.co.id/search?q=gambar+instalasi+biochar&biw=1366&bih=641&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwiPmIPnjtbOAhWHMo8KHZ3JCFsQsAQIGQ
- Haryono. 2013. Intensifikasi Pengelolaan Lahan Sub Optimal dalam Rangka Mendukung Kemandirian Pangan Nasional. Prosiding Lahan Sub Optimal. Palembang 2013. 1-4

- IBI. 2012. What is Biochar? International Biochar Initiative (IBI). www.biocharinternational.org. January 10, 2014
- Islami, T., Guritno, B., Basuki, N. and Suryanto, A. 2011. Biochar for sustaining productivity of cassava based cropping system in the degraded lands of East Java, Indonesia. Journal of Tropical Agriculture 49: 40-46.
- Kumar, B., Mohan. 2012. Mining waste contaminated Lands: an uphill battle for improving crop productivity. Proceedings The international conference on environmental, socio economics, and health impacts of artisanal and small scale mining. Edited by E. Handayanto, B.D. Krisnayani and Suhartini. The international research centre for management of degraded and mining lands (IRC-MEDMIND). University of Barawijaya, Indonesia. Malang, Februari 7-8, 2012. Page 3-13.
- Lehmann, J., da Silva, Jr., J.P., Steiner, C., Nehls, T., Zech, W. and Glaser, B. 2003. Nutrient availability and leaching in an archeological Anthrosol and a Ferralsol of The Central Amazon basin: fertilizer, manure and charcoal amendments. Plant soil 249:343-357.
- Liang, B., Lehmann, J., Kinyangi, D., Grossman, J., O'Neill, B., Skjemstad, J.O., Thies, J., Luizao, F.J., Peterson, J. and Neves, E.G. 2006. Black Carbon increases cation exchange capacity in soils. Soil science society of America journal 70: 1719-1730.
- Neuman, W. Lawrence, Social Research Methods : Qualitative and Quantitative Approaches (Needham Heights, MA Allyn and Bacon, 1997), p. 14
- Rondon, M.A., Lehmann, J., Ramires, J. and Hurtado, M. 2007. Biological nitrogen fixation by common beans (Phaseolus vulgaris L.) increases with biochar additions. Biology and Fertility of Soils 43: 699-708.
- Sugiyono. 2008. Metode Penelitian Kuantitatif, Kualitatif, dan R & D. Alfabeta. Bandung.
- Sugiyono. 2009. Metode Penelitian Bisnis pendekatan Kuantitatif, Kualitatif dan R & D. Alfabeta. Bandung.
- Whitney, F.L., 1960. The Elements of Research. Asian Eds. Osaka : overseas book co.
- Widodo, Sri. 1988. Production Efficiency of Rice Farmers in Java Indonesia. Gadjah Mada University Press. Yogyakarta. P. 17.

- Widowati, W.H. Utomo, B. Guritno dan Loekito, A.S. 2010. Ketersediaan Hara NPK dengan Biochar pada Pertumbuhan Vegetatif Tanaman Jagung.Jurnal Ilmu-ilmu Hayati.Desember 2010.22 : 58-68
- Widowati.2011. Optimasi Biochar dan Pupuk Nitrogen Terhadap Serapan Nitrogen dan Pertumbuhan Tanaman Jagung. Prosiding Seminar dan Kongres Nasional X Himpunan Ilmu Tanah Indonesia.Tanah untuk Kehidupan yang Berkualitas. Desember 2011. UNS. Surakarta
- Widowati. 2013. Aplikasi Biochar dan Dosis Pupuk Kalium Pada Pertumbuhan dan Hasil Jagung. Berkala Ilmiah Agroteknologi Plumula. 2(2): 127-137.
- Widowati and Asnah. 2014. Biochar Can Enhance Potassium Fertilization Efficiency and Economic Feasibility of Maize Cultivation. Journal of Agriculture Science.Februari 2014. 6(2):24-32
- Yamato, M., Okimori, Y., Wibowo, I.F., Anshori, S. and Ogawa, M. 2006. Effects of The application of charred bark of Acacia mangium on the yield of maize, cowpea and peanut, and soil chemical properties in south Sumatera, Indonesia. Journal of soil science and plant nutrition 52: 489-495.
- Ying, Ding, Yu Xue-Liu, Wei Xiang-Wu, De Zhi Shi, Min Yang, Zhe Ke Zhang. 2010. Evaluation of Biochar Effect on Nitrogen Retention and Leaching in Multi Layered Soil Columns.Journal of Water Air Soil Pollut. USA. 213: 47-55.