International Proceedings of Chemical,

Biological & Environmental Engineering

Food and Environmental Sciences II

Volume 92

Edited by
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Food and Environmental Sciences II

Selected, peer reviewed papers from the
2016 2nd International Conference on Food and Environmental Sciences
(ICFES 2016)
February 24-25, 2016, Ho Chi Minh, Vietnam

Edited by

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International Association of Computer Science & Information Technology Press
Singapore Office
#07-42, BLK 708
Jurong West
Street 71, Singapore
E-mail: pub@iacsit.org, press@iacsit.org
Web: http://www.iacsitp.com

Volume 92 of
International Proceedings of Chemical, Biological & Environmental Engineering
ISSN 2010-4618

ISBN 978-981-09-8660-5

Full text available online at http://www.ipcbee.com

***Distributed** worldwide by*

International Association of Computer Science & Information Technology Press
Singapore Office
#07-42, BLK 708
Jurong West
Street 71, Singapore
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And in the Hong Kong by
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Table of Contents

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International Proceedings of Chemical, Biological and Environmental Engineering, Vol. 92 (2016)
DOI: 10.7763/IPCBEE. 2016. V92. 7

Napier grass performance under agroforestry systems of upland area on Tuntang watershed, Indonesia

Adriani Darmawati Syaiful Anwar, Endang Dwi Purbajanti

ABSTRACT. The success of forage cultivation effort extremely depends on several factors, such as kinds of forage, climate, water, and soil fertility. A research on napier grass in agroforestry system conducted to find out soil fertility, growth, production, and quality of forage in agroforestry system in headwaters of Tuntang watershed. This research used factorial plan 2 x 2 which was repeated five times. The first factor was agroforestry system (AFS-1 and AFS-2) and the second factor was defoliation in wet and dry season. Parameter observed were height of plants, forage production, dry matter content, crude protein, and crude fibre. Height of plant in AFS-1 was higher (85.1 cm) than AFS-2 system (71.5 cm). Season had an affect on plants growth which was shown by height of plant that was lower during dry season (66.8 cm) than during wet season (89.8 cm). AFS-1 system had a better forage yield than AFS-2. Dry matter of forage varied between agroforestry system and season. The growth, forage yield, crude protein and fibre contents during wet season in the upland area of Tuntang watershed are better than during dry season. The best dry matter content is in AFS-2 during dry season and the highest crude protein content of napier grass lies in AFS-1 during wet season.

Keywords : Agroforestry, napier grass, crude protein, crude fiber

1.Introduction

Livestock have an important role in Indonesia since they produce meat and milk, are considered as wealth sources, and create job demand. Forage contributes a big portion of the total of dairy cattle production cost in Indonesia because more than 70% of livestock ration consists of forage. In addition to be the source of ruminant feed, forage can also be used for conservation of land resources. Napier grass (*Pennisetum purpureum*) is one of superior grasses which prevents the soil from erosion and increases the soil fertility, especially in upland area. In Central Java, Indonesia, napier grass has a high production and quality, produces many clumps of saplings, and has strong roots and fexible stem that livestock like.

In Indonesia, especially in Central Java, livestock maintenance generally includes in farming activities. The forage is fulfilled by farming land and compost heap owned by farmers. In the research location which is the upland area of Tuntang watershed, raising activity includes in agroforestry farming system. Farmers grow napier grass along with other plants in their own land. Agriculture is widely accepted as one of the sectors at most risk from climate changes challenges. Due to impacts of increased temperatures, reduced rainfall and increased frequency of variation in extreme events especially in tropics [1]. The sustainability of cropping systems needs nutrient replacement and soil fertility. Plants have potential outcomes and amount of nutrient which are moved

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from different soil. Therefore, the amount of nutrient applied must be based on the nutrient needs of the plant. The intensification and diversification of cropping systems affect the nutrient needs, cycles, and its distribution in the soil profile, which effect on the nutrient needs and the dynamics in the crop rotation. The nutrient management requires nutrient needs that fit the needs of plants. If this corelation is not well managed, the harvest will be vanished and the quality of the environment will lose the nutrient and, therefore, the nutrient use efficiency will also be dissapeared and it will increase the degradation potential of air, water, and soil quality [2].

The success of forage cultivation efforts extremely depends on several factors, such as the kinds of forage, climate condition, water, and soil fertility. Soil is an important element in the forage growth since it functions as a place for growing, a place for crops to obtain nutrient substance, and a source of water for crops. Whenever a shortage of nutrient element happends, roots, stem, and leaves growth of crops will be disturbed that can cause crops to be stunted. The napier grass quality is always related to livestock needs. The calculation system of forage needs in the stadia of livestock growth, type of plants, and forage quality have been greatly carried out. Many research on napier grass have been conducted, however, the napier grass production and nutrition value in agroforestry system in the upland area are still interesting to be examined carefully. The aim of the research is to find out the soil fertility,and the forage growth, production, and quality in the agroforestry system in the upland area of Tuntang watershed.

2. Material and Method

The research was done in Getasan region which becomes the upland area of Tuntang watershed. The elevation of the research location is 600-1,000 m undersea. The whole region of Tuntang watershed is located in the position of 110 ° 18' 26" - 110 ° 51' 01" Longitude East and between 6 ° 45' 31" - 7 ° 26' 55" Southern Latitude, with 156789.50 Ha wide. In upland area, there are many kinds of agroforestry systems. The research was conducted from May through December 2012. Getasan Subdistrict has cool climate with rainfall that adequately makes the soil fertile. Such climate includes in B2 type with its characteristic that has 7-9 wet months in succession and 3-4 dry months. To take the biophysical sample of agroforestry, the sample location is made by making plot sized 100 x 50 m2. The data collected are agroforestry includes diversity of cropping in agroforestry, by making the sample plot in each system sized 100 x 50 m2, to calculate the tree sample with 20 x 20 m2 plot.

The research was started by conducting an early survey to all location of the upland area of Tuntang watershed and recording the agroforestry system done by the local community. The survey found that the napier grass cultivating applied for forage was done in the agroforestry system, namely silvopasture (AFS-1) and agrosilvopasture (AFS-2). The napier grass observation was begun by cutting them as high as 10 cm from the soil surface in July (dry season period). The napier grass were, then, left to grow for 45 days without fertilization. During that period, the plants height were observed. On the 45th day, they were cropped to know the fresh production, dry matter (DM), crude protein (CP) content, and crude fibre (CF) content. Defoliation treatment during wet season was started in October by cutting

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the napier grass as high as 10 cm from the soil surface. The napier grass were, again, left to grow without fertilization. Afterwards, the same treatment was applied to the crops as in dry season which was observing their height. On the 45th day, those napier grass were harvested to know their fresh production, dry matter (DM), crude protein (CP) content, and crude fibre (CF) content. Briefly, the research design used was 2 x 2 factorial with 5 times repetitions. The first factor was agroforestry system (AFS-1 and AFS-2). While the second factor was defoliation (forage crops) during dry season (45 days) and wet season (45 days). The parameter observed were crops height, forage production, dry matter (DM), crude protein (CP), and crude fibre (CF). The napier grass sample was taken with 2,5 x 2,5 m2 plot. From such plot, a clump was taken. This sample was then measured its wet weight. The content of crude protein was measured by Kjeldahl method, while the content of crude fibre was measured by dissolving it using strong acid. The crude protein content was measured based on the nitrogen content which was measured using Kjeldahl method, with the calculation as follows. Crude protein content = N x 6,25.

All data collected was then tested on ANOVA (analysed of varians) based and to determine the difference among treatments, Duncan's Multiple Range Test (DMRT) [3].

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3. Result and Discussion

3.1. Result

There were two kinds of agroforestry system applied in Getasan Subdistrict namely silvopasture (AFS-1: *Albizzia falcataria*, Napier grass, cow) and agrosilvopasture (AFS-2: *Albizzia falcataria*, Corn (*Zea mays*), Cabbage, Napier grass, cow). The sloping soil condition forces the local people to plant crops by utilizing land as useful as possible to prevent from erosion. Most people in Getasan Subdistrict possess livestock such as dairy cattle and or *Etawa* goat, therefore, to fulfill the needs of their cattle food, they use the land to plant the forage which is grass.

3.1.1. Forage yield and nutritive value

The result of ANOVA forage yield presented that agroforestry system and season showed great influence, while the interaction between agroforestry system and season was not influential. From dry matter ANOVA result, it was found out that agroforestry system and season showed great influence, whereas the interaction between agroforestry system and season also gave great influence. Crude protein ANOVA result pointed out that agroforestry system and season showed great influence, while the interaction between agroforestry system and season also gave great influence. On the other hand, crude fibre ANOVA result indicated that agroforestry system and season showed great influence, however, the interaction between agroforestry system and season as not influential.

The plants height in AFS-1 system was higher (85.1 cm) than AFS-2 one (71.5 cm). Season influenced on the crops growth which was shown by the plants height that was lower during dry season (66.8 cm) than during wet season (89.8 cm). AFS-1 system had better forage yield than AFS-2. It happened because AFS-2

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planting on sloping land was done to reinforce the land itself. Besides, the number of crops in each experiment plot was only a few.

Forage dry matter varied between agroforestry system and season. During dry season, forage dry matter would be higher which happened both in silvopasture and agrosilvopasture systems. The lowest dry matter occured during wet season in AFS-1 system. It was presumed that the existence of shade in silvopasture system caused the vegetative period of crops longer, therefore it made the dry matter lower. Crude protein in AFS-1 system was lower than in AFS-2. The highest protein content in AFS-1 system occured during wet season (11.27 %), while the lowest protein content in AFS-2 happened during dry season (6.0 %). Crude fibre in AFS-2 system was higher than in AFS-1 system. The dry season caused crude fibre content higher than wet season.

3.2. Discussion

Napier grass in AFS-1 system had better forage quality when it was observed from its crops production and crude protein. The number of trees in AFS-2 were fewer since the land was used to plant crops. Napier grass were planted on the terrace sideline. Agroforestry system obviously influenced on the plants height, forage yield, and napier grass's forage crude fibre. The interaction between agroforestry system and season was not obviously influential. AFS-1 had higher plants height and forage yield than AFS-2. The Ques ungual agroforestry system offered great potential to improve soil fertility and biological health in the region related to traditional slash-and burn agriculture [4]. Plant height and forage yield in AFS-1 were also higher than AFS-2 during wet season compared to dry season. The more amount of rainfall provided more water for nutrient solution, transpiration, and plants body composer. Agroforestry system had bigger place and longer time to prevent water in the deeper soil layer than monoculture system, showing that agroforestry system increase the capacity of ground water retention because of deeper roots system[5]. Agroforestry system could increase the utilization of rainfall compared to annual plants [6]. The agroforestry combination of hedgerow in making use of ground water was more efficient than trees or plants, water absorption from trees reached into deeper soil layer and started more early after the irrigation than Sorghum, and plants could make use of top layer ground water better[7]. The crude fibre content in ASF-1 system was lower caused by lower stem leaves ratio as a consequence of higher N plants. The interaction between agroforestry system and season greatly influenced on forage dry matter and crude protein. Dry matter content of napier grass in AFS-2 system during dry season was not different from AFS-1 system. The best crude protein content of napier grass planted in AFS-1 system occured during wet season. It happened because during wet season plants obtained more water for vegetative growth (which was shown by the plants height and forage yield). the composition of chemical and nutritional value of forage varied depending on the composition of botany, phase of the growing season, fertilization, and growth condition. When the moisture content and protein content of plants (vegetation) are low, the crude fiber content will increase. Protein levels are mostly influenced by type of soil, amount and type of mineral fertilizers applied. The content of crude fibre is directly related to the amount

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of temperature and rainfall quantity where meadow grow. The content of crude fibre tends to increase with an increase in the supply of water to a patch of grass, it explains why crude fibre content in the first year is lower than the other years [8].

4. Conclusion

The conclusionof this research is that napier grass in agroforestry system of AFS-1 has better growth, production, and quality than AFS-2. Growth, forage yield, protein and crude fibre contents during wet season in upland area of Tuntang watershed are better than during dry season. The best dry matter content in AFS-1 occurs during dry season and the highest crude protein content in napier grass planted using AFS-1 system happens during wet season.

5.Acknowledgement

The authors would like to extend their gratitude to Directorate General Higher Education for supporting this research through the scheme of Operational Board of State University(BOPTN) for research.

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9 789810 986605

ISBN 978-981-09-8660-5

IPCBEE Vol. 92 2016

ISSN 2010-4618, *Full text available at http://www.ipcbee.com*

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