Available herbage sustainability under soil and water conservation for development of small ruminants[1]

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ABSTRACT: Experiment was aimed to evaluate different model of composition of forage crops of alley cropping systems. It was conducted at the Village of Musuk, Boyolali District, Central Java Province, Indonesia from April to September 2009. The experimental site is located at 260 m above the sea level with daily average temperature and humidity, respectively, were 25.9^{o}C and 79%. A block randomized design with 5 treatments and 3 replications was used to arrange the experiment. Treatments consisted of M1: two rows of Gamal (*Gliricidia sepium*) (72 plants) sourrounded by 100 plants of *Pennisetum purpureum*; M2: 72 Gamals, 100 *P. purpureum*, 100 katuk (*Souporus androgynus*); M3: 79 Gamal (added-seven Gamals from west to east across the middle plot of land), 100 *P. purpureum*, and 100 katuk; M4: 79 Gamal (added-seven Gamals from north to south across the middle plot of land), 100 *P. purpureum*, and 100 katuk; M5: 85 Gamal (added-thirteen Gamals from west to east and north to south across the middle plot of land), 100 *P. purpureum*, and 100 katuk.
ANOVA was used to analysis data statistically and Duncan test was employed for further analysis. Experiment resulted that alley cropping model influenced the total herbage yield of Gamal, *P. purpureum*, and katuk (*S. androgynus*). The highest height of crops and dry matter yield were reached by the M4.

Key words: sustainability, herbages, alley cropping, small ruminant

INTRODUCTION

Potential of dry land in Indonesia is big enough, because of the dry land area 148 million (mill) hectares, including 102.8 mill ha of upland acid soils. From acid dry land is suitable for arable farming system only 55.8 mill ha, slope of land (less 15%) is directed to the development of food crops (19.5 mill ha) and land slope 15-30% for annual crop/plantation/pasture (36.3 mill ha). Upland acid soils are generally marginal. Many inputs are given instead impair the ability of dry land. Real damage is caused by erosion which seems so serious that may reduce the productivity of dry land (Rahim, 2003).

Preservation of soil moisture to be the most determining factor of success of dryland agriculture. Rainwater should be transformed first into the soil moisture, in order to be absorbed by plant roots. Effectiveness of this transformation is determined by soil texture and structure, types of clay minerals, soil organic matter content and effective into the ground (Notohadiprawiro, 1988). Reality in the field of land generally able to provide water for plants only 15-17 days since the last rain and ground water is available to reach the maximum (Rozari, 1983).

With increasingly greater erosion its deep slope, and the amount of erosion per unit area concentrated in 2.0-2.5 times more when the slope becomes steeper twice (Arsyad, 1989). Research results of Rachman *et al.* (1990) still showed high levels of erosion, total erosion that occurred during the three cropping seasons reached 25.86 - 105.5 tonnes/ha.

Alley cropping systems can demonstrate the contribution of: (a) maintain the nutrient cycle, (b) reduce nutrient leaching, (c) enhance soil microbial activity, (d) erosion control, (e) to improve soil fertility, (f) to maintain production levels or production of food crops and forage plants. Research

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results of Paningbatan *et al*. (1995) that conducted in the Philippines, alley cropping systems reduced soil erosion to less than 5 ton/ha/yr compared with traditional systems of soil erosion by 100-200 ton/ ha/yr.

Gliricidia sepium as elections have been tested as a hedge plant conservation, production and high quality of herbage, dry resistant and can live in all types of soil from 0 to 1200 m above sea level (Manurung, 1989). Gliricidia forage production was 18 months old and reached 9.06 kg/tree. In the dry season dry matter production of Gliricidia reached 0.99 tonnes/ha/month, whereas in the rainy season reached 1.48 tonnes/ha/month (Oakes dan Shov, 1962). When Gliricidia was harvested every three months reached 8,390 kg of forage or 5,156 kg of fresh leaves can be obtained from the fence around the area of one hectare of land (400 m). If gamal was planted on a land area of 1.32 m^2 planting is harvested every three months then reached 74,074 kg/year (Chadhokar, 1982). Gliricidia leaf contains crude protein 25-30%/ha/yr (Susetyo *et al.,* 1969).

Fresh Napier grass forage production reached 250 tonnes/ha/yr (Susetyo, 1981 dan Rukmana, 2005). The first cut was made after the Napier grass is more or less 50 days or when the grass reaches a height of 1 m (Susetyo, 1981). The next cut may be conducted every 40 and 60 days, respectively, for dry and rainy season (Rukmana, 2005).

Alley cropping is an alternative system of choice by introducing a variety of forage plants in a plot of land together consisting of a tree legume crops as a combined hedge shrub plants and cover crops. Expected area of operations the size of 10 x 10 m each farmer may apply this model even though in their yards. Alley cropping model with a base of modified crops Gliricidia and Napier grass need to be tested. Forage production of this mixtuire is expected high quality and guaranteed its sustainability and particularly liked the small ruminant dairy goats.

MATERIALS AND METHODS

Plant materials used were orders of materials Gliricidia cuttings, katuk and Napier. Experiment used an on farm land with the total land area of 1500 m^2 which was divided into three groups each covering 500 m^2. Each group was divided into 5 treatments on the land with an area of 100 m^2 (10x10m). Research sites for goat farmers grouped the village of Musuk, Boyolali district. There were 15 squares of land involving 15 farmers. Support materials was the initial soil analysis, anorganic and organic fertilizers, rooton used to stimulate plant growth.

The next matter was the chemical reagents needed for laboratory analysis to further test the forage quality of forage gliricidia, katuk and Napier grass, and a mixture of all three were prepared for proximate analysis test on a dry matter content, crude protein and crude fiber.

Research on the modified model of alley cropping was designed in a block randomized design consisting of five treatments and three replicate groups. Group was the land of the three groups of livestock farmers. treatment of five models that tested the modified Alley cropping was:

M1 : Composed of two rows of Gliricidia plants around the plots of land amounting to 72 plants were planted fields and section 100 clumps of Napier grass (*P. purpureum*)
M2 : Composed of a number of 72 plants of Gliricidia, clumps of Napier grass and 100 katuk plants.
M3 : Composed of: 79 plants of Gamal (added-seven Gamals from east to west across the middle plot of land), 100 of katuk and 100 clumps of Napier grass:
M4 : Composed of: 79 of Gamal (added-seven Gamals from north to south across the middle plot of land), 100 plants of katuk and 100 clumps of Napier grass
M5 : Composed of: 85 plants of gamal (added-thirteen Gamals from west to east and north to south across the middle plot of land), 100 plants katuk, and 100 clumps of Napier grass

The research began with the preparation of land, including land clearing of the old plants, land preparation and initial soil sampling. Afterwards was the preparation of planting materials of cuttings Gliricidia and the planting in each plot of land in accordance with the results of treatment randomization. After one month planting of cuttings Gliricidia was followed by planting of Napier grass, and katuk. Trimming on Gliricidia and Napier grass were conducted three months after the growth of Napier grass, which was intended to ensure a uniform growth.

Growth (plant height and leaf number) was observed after trimming. Production and forage quality evaluation were carried out two months after results of re-growth after trimming. The measured parameter was the fresh and dry matter production, crude protein and crude fiber content. Data were analyzed by analysis of variance procedure followed by Duncan's multiple range test to determine differences among the treatments in the level of 5% (Steel and Torrie, 1995).

RESULTS AND DISCUSSION

Plant Growth

Observation of plant height of modified alley cropping was attempted to show that the treatment effect on plant height of Gliricidia, Napier grass, and Katuk (Table 1). The highest plant height of Gliricidia was reached M5 and followed by M4, M3, M2, and M1. High density stimulates the elongation of plant cells in etiolation process, so that the plant would be higher.

Table 1. Plant height of crops of the modified alley cropping

Treatments	Gamal [1]	Napier grass	Katuk	Average
	....	cm	....	
M1	26,00	190,00	-	108,00
M2	28,33	175,00	71,00	91,44
M3	35,33	195,83	59,00	96,72
M4	35,67	166,67	72,67	91,67
M5	53,33	212,23	55,33	106,96
Average	35,72	187,95	60,80	

[1] Napier grass and plant height showed no particular pattern katuk because the M5, M4, M3, M2, and M1. Gliricidia shade plants that have different plant density was not completely closed, so had not affected the plants grow together.

Growth of Gamal and Katuk were slower than the Napier grass. In accordance with the nature of the legume crop that early growth was slow and after establish the growth rate increased rapidly (Table 1). Height of Gliricidia aged 4 months on average reached 35 cm, while the Katuk reached 60 cm. Gliricidia established after the age of one year after planting, whereas Katuk was ± 6 months after planting. Height of Katuk was two-fold compared to Gliricidia an average of , Napier grass height was 187.95 cm, because the grass has a bready reached the optimum vegetative growth.

Dry Weight Production

Table 2. Dry matter production of the modified alley cropping

Treatments	Gamal	Napier grass	Katuk	Total
	....	(kg/100 m^2)	....	
M1	20,16	90	10,0	120,16
M2	23,76	120	7,3	151,06
M3	35,55	100	9,2	144,75
M4	37,92	121	13,0	171,92
M5	52,70	68	14,3	135,00
Average	34,02	99,8	10,8	144,58

The highest total dry matter production was reached of the M4 at 171.92 kg/plot, while M2 reached 151.06 kg/plot. Production increased in the M4 because there were an additional 7-Gliricidia plants stretching from north to south, but when compared with M3 was also coupled with the 7-crops of Gliricidia production declined to 144.75 kg/plot because the plants in planting Gliricidia across from east to west. In M5 with the addition of 13 longitudinal and transverse of Gliricidia decreased production (135.00 kg/plot). The highest height of crops and dry matter yield were reached by the M4.

Competence nutrients and sunlight on the M5 allegedly more stringent than the M3 and M4 because the number of plant population was denser.

CONCLUSIONS

It can be concluded that alley cropping model influenced the total herbage yield of Gamal, *P. purpureum*, and katuk (*S. androgynus*). The highest height of crops and dry matter yield were reached by the M4.

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