Regional evaluation of forages in Indonesia: Aceh, Kalimantan, North Sulawesi and North Sumatra

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Introduction

The Forages for Smallholders Project (FSP) was able to make use of the results of species evaluations of the Forage Seeds Project (1992 – 1994). Several species were identified which had shown broad adaptation to environmental conditions in Kalimantan. These species were offered to farmers for evaluation on-farm in the Forages for Smallholders Project. Regional evaluation was continued at some sites of the Forage Seeds Project in Kalimantan, adding new species which had shown promise in other countries. New regional evaluation sites were established in areas where the FSP intended to work with farmers. These were tailored to the needs expressed by farmers and therefore did not include all species at every site. New regional evaluation sites were established in Aceh, North Sumatra, North Sulawesi and East Kalimantan. We would like to thank all of our local collaborators who provided data for this paper.

Site description

Table 1. Physical characteristics of sites for regional evaluations.

Site	Alt. (m)	Annual rainfall (mm)	Wet season	No. of wet months (>100mm)	Soil characteristics			Dominant farming system
					pH[1] (% Al sat)	Texture (drainage)[2]	Fertility[3]	
Gorontalo, North Sulawesi	18	1290	Nov-Jun	5 – 7	6.8	grey-brown fine sandy loam (seasonally flooded)	moderate (low S)	moderately intensive upland agriculture, mostly under coconuts
Loa Janan, East Kalimantan	<100	2020	Nov-Jun	7 – 11	4.8 (35% Al)	red loam (well drained)	moderate	degraded *Imperata cylindrica* grassland, extensive upland agriculture
Makroman, East Kalimantan	<100	2040	Nov-Jun	7 – 11	4.6 (65% Al)	yellow-brown silty loam (well drained)	moderate (low P)	mixture (50:50) of extensive upland (*Imperata* grassland) and rainfed lowland rice
Sepaku, East Kalimantan	<100	2400	Nov-Jun	7 – 11	4.8 (64% Al)	yellow-brown silty loam (well drained)	infertile (low P)	extensive upland agriculture (*Imperata* grassland), livestock production and home gardens around houses
Kanamit, Central Kalimantan	<20	2750	Nov-Jun	8 – 11	4.3 (82% Al)	organic black loam (poorly drained, seasonally flooded)	infertile (low P, S, Mn)	low-lying, seasonally flooded acid sulphate peat areas, lowland rice
Marenu, North Sumatra	300	2330	Oct-Apr	7 – 10	4.7 (82% Al)	brown, fine sandy loam (well drained)	infertile (low P, Mg)	natural grasslands, sheep production transmigration area in otherwise extensive uplands
Saree, Aceh	500	1580	Oct- Apr	4 – 8	5.1 (5% Al)	brown, silty loam (moderate drainage)	fertile	intensive upland, vegetable production and home gardens
Blang Ubo-ubo, Aceh	700	>1550	Oct- Apr	4 – 8	5.6	brown loam (well drained)	moderate	natural grassland, managed communal grazing in mountainous upland

[1] soil pH measured in 1:5 H_2O (% Al saturation in brackets).
[2] drainage (poorly drained, moderate drainage, well drained, seasonally flooded).
[3] major soil fertility deficiencies or problems (eg. low P).

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The selected sites represent a range of upland agro-ecosystems (Table 1). These range from relatively fertile soils in Saree, Aceh to extremely infertile soils in Marenu, North Sumatra (Table 2). All sites apart from Gorontalo are relatively humid with average annual rainfall ranging from 1290 to 2750 mm (Fig 1). 1997 was an unusually dry year which tested the ability of species to withstand dry conditions.

Aceh has vast areas of degraded natural grasslands in mountainous areas which traditionally have been used for communal grazing. Two evaluation sites were established; one in an area of intensive upland cropping (Saree) where farmers fatten cattle bred on the communal grazing areas and the second site (Blang Ubo-ubo) in a communal grazing area in the mountains. The latter is managed by a group of farmers. In Saree, forages are intended mainly for cut & carry. Those in Blang Ubo-ubo are for both cut & carry (supplementary feeding) near the cattle shed and for improvement of communally managed grazing areas.

South Tapanuli in North Sumatra is an area of extensive upland agriculture which has traditionally been used for grazing of cattle and buffaloes. The evaluation site is located in a transmigration area which has only recently been established. The transmigration area is based on sheep production. Farmers were given 20 sheep and 2 rams to start breeding sheep. Forages are needed mainly for cut and carry but there may also be some potential for improvement of grazing areas.

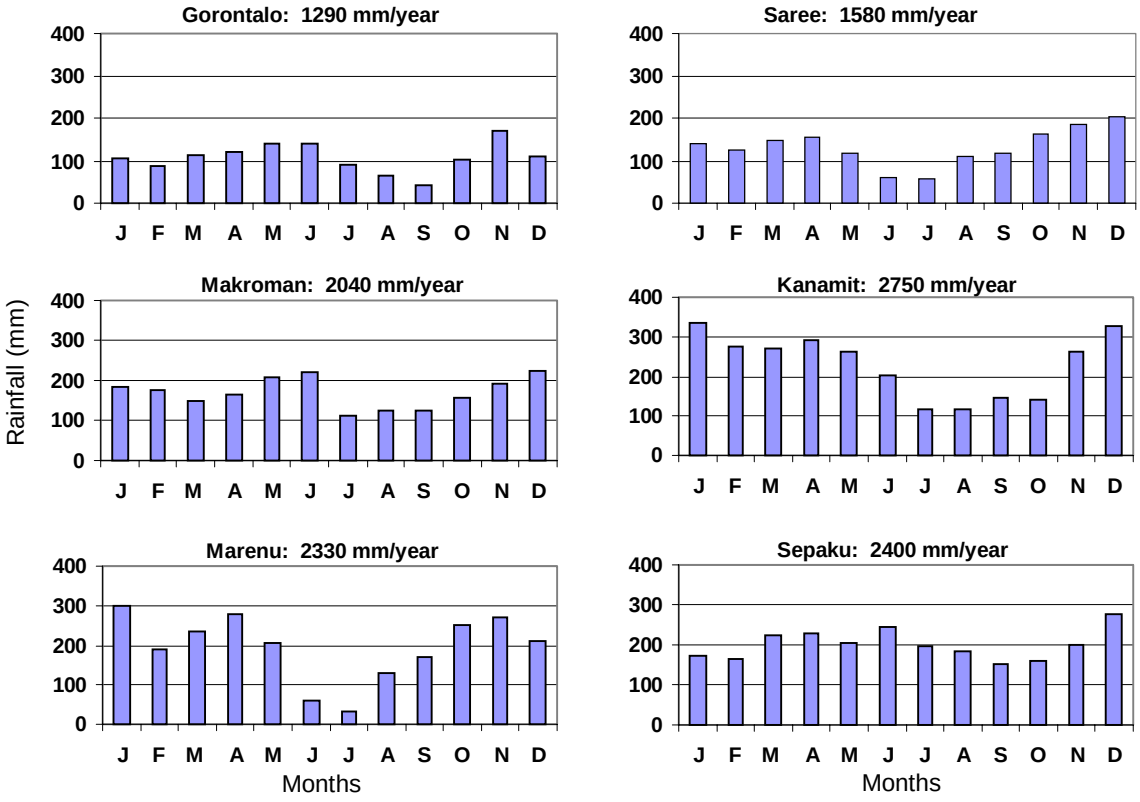

Fig. 1. Mean monthly rainfall (mm) at forage evaluation sites (10-year data).

Sepaku, Makroman and Loa Janan in East Kalimantan are located in *Imperata*-dominated upland areas, but represent a range of soil fertility and farming systems and thus the need for different types of forages. Farmers in Sepaku graze cattle on the poor-quality *Imperata* grasslands. Makroman has a mix of lowland and upland areas and farmers keep both cattle and goats. Farmers at Makroman are particularly interested in the use of legumes for weed control and soil fertility improvement in their upland cropping areas. Loa Janan was carried on from the Forage Seeds Project to complete a comprehensive evaluation.

Kanamit, Kuala Kapuas in Central Kalimantan is located in seasonally flooded lowland area of acid-sulphate peat soils This site was carried over from the Forage Seeds Project but new species were added which had shown potential in other countries.

Gorontalo in North Sulawesi is an area of moderately intensive upland agriculture, mainly under coconut plantations. Soils are moderately fertile but it is the site with the lowest rainfall and longest dry season. Farmers are interested in both grazing and cut & carry species.

Table 2. Soil analysis results at regional evaluation sites.

Site	pH	Organic carbon	N	P[1]	S	K	Ca	Mg	Al	Na	CEC	Cu	Zn	Mn	Fe	B	Al sat.
	(1:5 H_2O)	(%)	NO_3	ppm		meq/100g									%		
Gorontalo, North Sulawesi	6.8	1.0	0.4	26	4	0.29	7.4	3.5	0	0.1	11.3	1.8	0.5	15	19	0.5	0
Loa Janan, East Kalimantan	4.8	2.4	7.0	58	32	0.51	2.7	1.6	2.6	-	7.4	0.8	0.7	9	-	0.7	35
Makroman, East Kalimantan	4.6	1.7	6.7	5	9	0.15	0.8	0.7	3.2	0.02	4.9	0.4	0.8	5	276	0.5	65
Sepaku II, East Kalimantan	4.8	1.2	0.5	5	6	0.14	0.8	0.4	2.4	0.02	3.8	0.3	0.2	3	113	0.3	64
Kanamit, Central Kalimantan	4.3	12.6	14	-	-	0.17	1.1	0.6	8.3	-	10.2	0.4	0.2	-	-	0.3	82
Marenu, North Sumatra	4.7	3.0	0.3	5	10	0.13	0.4	0.1	3.1	0.07	3.8	0.3	0.3	2	168	0.6	82
Saree, Aceh	5.1	2.2	19.8	40	8	0.38	6.5	1.8	0.4	0.07	9.1	2.0	2.5	14	169	0.7	5
Blang Ubo-ubo, Aceh	5.6	3.2	4.4	21	18	0.82	6.7	3.1	0	0.03	10.6	2.1	3.8	229	120	1.3	0
Concentration low, if	<5	<1.0	-	<5	<5	<0.1	<0.1	<0.2	-	-	-	<0.2	<0.2	<1	<1	<0.2	-

1 = P (BSES)

Methods

Forage varieties included in regional evaluations are shown in Table 3.

Small plots were established from either seed or vegetative planting material. Plot size ranged from 4 x 4 m plots to 10 x 10 m plots, depending on availability of land and resources. Plots were not fertilised. Weeding was restricted to the establishment period and occasional slashing or grazing. Performance of species, including yield, seed production, incidence of pests and diseases, was recorded periodically. Most sites were also used as demonstration sites for farmers and as a source of planting material for farmer evaluations.

Table 3. List of forages evaluated at regional sites in Indonesia.

Species	Sites							
	Gorontalo	Loa Janan	Makroman	Sepaku II	Kanamit	Marenu	Saree	Blang Ubo-ubo
Grasses								
Andropogon gayanus CIAT 621	✔	✔	-	-	✔	-	✔	✔
A. gayanus cv. Kent	✔	-	✔	✔	-	✔	-	-
Brachiaria brizantha CIAT 6387	-	-	-	✔	-	-	-	-
B. brizantha CIAT 6780	✔	✔	✔	✔	✔	✔	✔	✔
B. brizantha CIAT 16835	-	-	-	✔	-	✔	-	-
B. brizantha CIAT 26110	✔	-	✔	✔	-	-	✔	✔
B. brizantha ex. Sungai Putih	-	-	-	-	-	✔	-	-
B. decumbens cv. Basilisk	✔	✔	✔	✔	✔	-	✔	✔
B. humidicola CIAT 6133	✔	✔	✔	✔	✔	-	✔	✔
B. humidicola CIAT 6369	-	✔	✔	✔	✔	-	-	-
B. humidicola cv. Tully	✔	-	✔	✔	-	✔	✔	✔
Chloris gayana cv. Callide	-	✔	-	-	✔	-	-	-
Digitaria milanjiana cv. Jarra	-	✔	-	-	✔	✔	✔	-
D. swynnertonii CPI 59749	-	✔	-	-	✔	-	-	-
Panicum maximum T-58	-	-	-	-	-	✔	-	-
P. maximum CIAT 6299	-	-	✔	-	-	-	✔	✔
P. maximum cv. Makueni	-	✔	-	-	✔	-	-	-
P. maximum cv. Riversdale	-	✔	-	-	✔	-	-	-
Paspalum atratum BRA 9610	✔	✔	✔	✔	-	✔	✔	✔
P. atratum 'Pantaneira'	-	-	-	-	-	✔	-	-
P. conjugatum 'local'	-	-	-	-	✔	-	-	-
P. guenoarum BRA 3824	-	✔	-	✔	-	✔	-	-
P. malacophyllum CPI 27690	-	✔	-	-	✔	-	-	-
P. notatum cv. Competidor	✔	-	-	-	-	-	-	-
Pennisetum hybrid ('King' grass)	✔	-	✔	✔	✔	✔	-	-
Pennisetum hybrid cv. Mott (dwarf napier)	✔	-	✔	-	-	✔	-	-
P. purpureum 'local'	✔	-	-	-	✔	-	-	-
Setaria sphacelata var. *splendida*	✔	-	✔	✔	✔	✔	-	-
Stenotaphrum secundatum cv. Floratam	✔	-	-	-	-	-	-	-
Herbaceous legumes								
Aeschynomene americana cv. Glenn	-	✔	-	-	✔	-	-	-
A. americana cv. Lee	-	✔	-	-	✔	-	-	-
Arachis glabrata	✔	-	-	-	-	-	-	-
A. pintoi cv. Amarillo (CIAT17434)	✔	✔	-	-	✔	-	-	-
A. pintoi CIAT 18744	✔	-	-	-	-	-	-	-
A. pintoi CIAT 22160	✔	-	-	✔	-	-	✔	-
Cajanus cajan CIAT 18700	-	✔	-	-	✔	-	-	-
Calopogonium mucunoides 'local'	-	-	-	-	-	-	-	-
Centrosema acutifolium CIAT 5277	✔	✔	-	✔	✔	-	-	-
C. macrocarpum CIAT 25522	✔	-	-	✔	-	✔	-	-
C. macrocarpum CIAT 5452	-	✔	-	-	✔	-	-	-
C. macrocarpum CIAT 15014	-	✔	-	-	✔	-	-	-
C. macrocarpum CIAT 15047	-	✔	-	-	✔	-	-	-
C. pascuorum cv. Cavalcade	-	✔	-	-	✔	-	-	-
C. pubescens CIAT 15160	✔	✔	✔	✔	✔	✔	✔	✔
C. pubescens CIAT 438	-	✔	-	-	✔	-	-	-
C. schiedeanum cv. Belalto	-	✔	-	-	✔	-	-	-
Chamaecrista rotundifolia cv. Wynn	-	-	-	-	✔	-	-	-
D. heterophyllum CIAT 349	✔	✔	-	✔	-	✔	✔	-
D. ovalifolium CIAT 13089	-	✔	-	-	-	-	-	-
D. ovalifolium CIAT 13305	-	-	-	✔	-	-	-	-
D. velutinum CIAT 13220	-	✔	-	-	✔	-	-	-
Macroptilium gracile cv. Maldonado	-	✔	-	-	✔	-	-	-
Stylosanthes capitata CIAT 10280	-	✔	-	-	-	-	-	-
S. guianensis cv. Cook	-	✔	-	-	✔	-	-	-
S. guianensis cv. Graham	-	✔	-	-	✔	-	-	-
S. guianensis CIAT 184	✔	✔	✔	✔	✔	✔	✔	✔

(continued next page)

Table 3 (cont.) List of forages evaluated at regional sites in Indonesia.

Species	Sites							
	Gorontalo	Loa Janan	Makroman	Sepaku II	Kanamit	Marenu	Saree	Blang Ubo-ubo
S. hamata cv. Verano	-	✔	-	-	✔	-	✔	✔
S. scabra cv. Seca	-	-	-	-	-	-	-	-
S. scabra cv. Siran	-	-	-	-	-	✔	✔	✔
Tree legumes								
Calliandra calothyrsus ex. Indonesia (CPI 115690)	✔	✔	✔	-	-	✔	-	✔
Codariocalyx gyroides CIAT 3001	-	✔	-	-	✔	-	-	-
Cratylia argentea CIAT 18516	-	✔	-	-	✔	✔	-	-
Desmodium cinerea ex. MBRLC (CPI 46562)	✔	-	✔	-	-	✔	✔	✔
Flemingia macrophylla CIAT 17403	✔	✔	✔	-	✔	✔	-	-
Gliricidia sepium 'Retalhuleu'	✔	-	✔	✔	-	✔	✔	✔
G. sepium 'Monterrico'	✔	-	✔	✔	-	✔	✔	✔
G. sepium 'Belen Rivas'	✔	-	✔	✔	-	✔	✔	✔
G. sepium 'local'	✔	-	-	-	-	-	✔	✔
Leucaena collinsii QF 152/88	-	-	-	-	-	✔	-	-
L. leucocephala K636	✔	-	✔	✔	-	✔	✔	✔
L. leucocephala 'local'	✔	-	-	-	-	-	✔	-
Sesbania grandiflora 'local'	-	-	✔	-	-	-	-	-

Results

Several forage are broadly adapted across the wide range of soil fertility and rainfall conditions (Table 4).

The most broadly adapted forages were *Andropogon gayanus*, *Brachiaria brizantha*, *Brachiaria humidicola*, *Stylosanthes guianensis* CIAT 184, *Centrosema pubescens* CIAT 15160 and the tree legume *Gliricidia sepium*. Particular accessions have been identified within these species which are vigorous, persistent and produce seed at all locations.

There were also some other species which were adapted to particular environments (Table 4).

Detailed data on performance of species included in regional evaluations are presented in the Appendix.

Conclusions

Environmental adaptation is only one part of successful forage technology. The next step is to find out how these forages fit into farming systems, and how they can be utilized to provide maximum benefits to smallholder farmers and the environment. This can best be achieved through farmer evaluation of forages. The broadly adapted forage species identified through regional evaluation form the basis for farmer testing. To make these forages widely available to farmers outside FSP sites, large-scale seed multiplication is needed.

Table 4. Broadly adapted forages in Indonesia.

	Site							
	Saree	Ubo-ubo	Gorontalo	L. Janan	Makroman	Sepaku	Marenu	Kanamit
Soil fertility[1]	H	M	M	M	M	L	L	L
Grasses								
Andropogon gayanus	4	-	-	3	3	4	3	4
Brachiaria brizantha CIAT 6780	4	-	4	4	4	4	3	4
Brachiaria brizantha CIAT 26110	4	3	4	-	3	4	-	-
Brachiaria decumbens	4	4	3	3	3	3	-	3
Brachiaria humidicola	4	4	3	4	3	4	-	3
Panicum maximum	4	4	2	4	2	-	1	2
Paspalum atratum	4	4	4	4	4	4	4	4
Pennisetum spp.	4	3	3	2	3	2	1	2
Legumes								
Arachis pintoi	3	-	4	1	-	1	-	1
Centrosema macrocarpum	-	-	1	4	-	2	4	3
Centrosema pubescens CIAT 15160	3	3	4	4	4	3	3	3
Desmodium heterophyllum	3	-	4	2	-	3	-	-
Stylosanthes guianensis CIAT 184	4	4	4	4	4	4	2	4
Tree legumes								
Calliandra calothyrsus	-	3	2	1	1	-	1	-
Flemingia macrophylla	-	-	4	4	-	-	4	4
Desmodium cinerea (prev. *D. rensonii)*	4	4	2	1	-	-	1	-
Gliricidia sepium	4	4	4	4	-	2	4	-
Leucaena leucocephala	4	4	1	-	-	1	1	-

[1] Soil fertility: H = high, M = moderate, L = low.
[2] Overall performance: 4 = excellent, 3 = good, 2 = moderate, 1 = poor, - == not evaluated at this site.

Appendices

Appendix 1. Performance of forage species at Gorontalo, North Sulawesi.

	Establishment success[1]	Yield Potential[2]	Persistence[2]	Seed Production[2]	Pests/ Diseases[3]
Grasses					
Andropogon gayanus cv. Kent	0	-	-	-	-
Brachiaria brizantha CIAT 6780	3	2	2	1	0
B. brizantha CIAT 26110	3	3	3	1	0
B. decumbens cv. Basilisk	2	2	3	1	0
B. humidicola CIAT 6133	0	-	-	-	-
B. humidicola cv. Tully	3	3	3	1	0
Panicum maximum CIAT 6299	2	2	2	1	0
Paspalum atratum CIAT 9160	4	4	4	1	0
P. notatum cv. Competidor	3	2	3	1	0
Pennisetum hybrid 'King' grass	4	3	3	1	0
Pennisetum purpureum cv. Mott	3	2	3	1	0
P. purpureum 'local'	3	3	3	1	0
Setaria sphacelata var. s*plendida*	0	-	-	-	-
Stenotaphrum secundatum cv. Floratam	2	2	4	1	0
Legumes					
Arachis glabrata	1	1	2	1	1
A, pintoi cv. Amarillo	1	1	2	1	1
A. pintoi CIAT 18744	0	-	-	-	-
A. pintoi CIAT 22160	4	3	4	1	0
Centrosema acutifolium	1	1	2	1	1
C. macrocarpum CIAT 25522	1	1	2	1	1
C. pubescens CIAT 15160	4	3	3	2	1
Desmodium heterophyllum CIAT 349	3	1	3	1	1
Macroptilium gracile cv. Maldonado	0	-	-	-	-
Stylosanthes guianensis CIAT 184	4	4	4	3	1
Trees and shrubs					
Calliandra calothyrsus	1	2	2	1	1
Desmodium cinerea CIAT 46562 (*D. rensonii)*	2	1	2	2	1
Flemingia macrophylla CIAT 17403	4	3	2	3	1
Gliricidia sepium 'Belen Rivas'	3	3	2	1	1
G. sepium 'Monterrico'	3	3	2	1	1
G. sepium 'Retalhuleu'	3	3	2	1	1
Leucaena leucocephala K636	3	2	3	3	2

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.

Appendix 2. Performance of forage species at Loa Janan, East Kalimantan.

	Establishment success[1]	Yield Potential[2]	Persistence[2]	Seed Production[2]	Pests/ Diseases[3]
Grasses					
Andropogon gayanus CIAT 621	4	3	3	1	0
Brachiaria brizantha CIAT 6780	4	4	4	1	0
B. decumbens cv. Basilisk	4	3	4	1	0
B. humidicola CIAT 6369	4	4	4	1	0
Digitaria milanjiana cv. Jarra	2	1	1	1	0
Panicum maximum cv. Makueni	1	1	1	-	-
P. maximum cv. Riversdale	3	4	2	1	0
Paspalum atratum BRA 9610	3	4	3	1	0
Legumes					
Aeschynomene americana cv. Glenn	3	1	1	1	0
A. americana cv. Lee	3	1	1	1	0
Arachis pintoi cv. Amarillo	3	-	-	-	-
Cajanus cajan CIAT 18700	1	-	-	-	-
Centrosema acutifolium CIAT 5277	2	2	2	1	0
C. macrocarpum CIAT 15047&15014&5452	2	3	3	1	1
C. pascuorum cv. Cavalcade	3	?	?	?	?
C. pubescens CIAT 15160/438?	4	4	4	3	0
C. schiedeanum cv. Belalto	3	2	2	1	0
Desmodium heterophyllum CIAT 349	3	?			
D. ovalifolium CIAT 13089	2	?			
Macroptilium gracile cv. Maldonado	3	?			
Stylosanthes capitata CIAT 10280	1	-	-	-	-
S. guianensis cv. Cook	3	2	2	1	1
S. guianensis cv. Graham	3	?			
S. guianensis CIAT 184	4	4	3	2	0
S. guianensis SSD-12	2	?			
S. hamata cv. Verano	2	-	-	-	-
Trees and shrubs					
Calliandra calothyrsus	2	?			
Codariocalyx gyroides CIAT 3001	3	?			
Flemingia macrophylla CIAT 17403	4	4	3	2	0

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.

Appendix 3. Performance of forage species at Makroman, East Kalimantan.

	Establishment success [1]	Yield Potential [2]	Persistence [2]	Seed Production [2]	Pests/ Diseases [3]
Grasses					
Andropogon gayanus cv. Kent	3	3	2	1	0
Brachiaria brizantha CIAT 6780	4	4	3	1	0
B. decumbens cv. Basilisk	3	3	3	1	0
B. humidicola CIAT 6369	4	3	3	1	0
B. humidicola cv. Tully	4	3	4	1	0
B. humidicola CIAT 6133	3	3	4	1	0
Paspalum atratum BRA 9610	4	4	3	1	0
P. guenoarum	?			1	0
Pennisetum hybrid 'King' grass	2	3	2	1	0
Setaria sphacelata cv. Splendida	3	3	2	1	0
Panicum maximum CIAT 629	2	2	3	1	0
Pennisetum purpureum cv. Mott	2	2	3	1	0
Legumes					
Arachis pintoi CIAT 22160	-	-	-	-	-
Centrosema pubescens CIAT 15160	4	2	3	1	0
C. acutifolium CIAT 5277	3	1	3	1	0
C. macrocarpum CIAT 25522	2	1	3	1	0
Stylosanthes guianensis CIAT 184	3	2	3	1	0
Trees and shrubs					
Calliandra calothyrsus	1	-	-	-	0
Desmodium cinerea CIAT 46562	3	-	-	-	0
Gliricidia sepium 'Belen Rivas'	3	-	-	-	1
G. sepium 'Monterrico'	3	-	-	-	1
G. sepium 'Retalhuleu'	4	-	-	-	1
Leucaena leucocephala K636	3	-	-	-	1
Sesbania grandiflora 'local'	2	-	-	-	1

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.

Appendix 4. Performance of forage species at Sepaku II, East Kalimantan.

	Establishment success[1]	Yield Potential[2]	Persistence[2]	Seed Production[2]	Pests/ Diseases[3]
Grasses					
Andropogon gayanus cv. Kent	4	4	4	1	0
Brachiaria brizantha CIAT 6780	4	4	4	1	0
B. decumbens cv. Basilisk	4	3	4	1	0
B. brizantha CIAT 2610	3	3	4	1	0
B. brizantha CIAT 6387	3	3	3	1	0
B. humidicola CIAT 6369	4	3	4	1	0
B. humidicola cv. Tully	3	3	4	1	0
B. humidicola CIAT 6133	4	3	4	1	0
Paspalum atratum BRA 9610	3	3	4	1	0
P. guenoarum BRA 3824	3	3	3	1	0
Pennisetum hybrid 'King' grass	3	2	3	1	0
Setaria sphacelata cv. Splendida	3	2	4	1	0
Panicum maximum CIAT 629	?	-	3	1	0
Pennisetum purpureum cv. Mott	-?	-	3	1	0
Legumes					
Arachis pintoi CIAT 22160	1	1	-	-	-
Centrosema pubescens CIAT 15160	3	2	3	2	0
C. acutifolium CIAT 5277	2	1	3	1	0
C. macrocarpum CIAT 25522	2	1	3	1	0
Desmodium heterophyllum CIAT 349	3	1	3	1	0
D. ovalifolium CIAT 13305	4	1	3	1	0
Stylosanthes guianensis CIAT 184	4	2	4	2	0
Trees and shrubs					
Desmodium cinerea CIAT 46562	-?	-	1	-	-
Flemingia macrophylla CIAT 7403	-?	-	1	-	-
Gliricidia sepium 'Belen Rivas'	3	-	-	-	0
G. sepium 'Monterrico'	3	-	-	-	0
G. sepium 'Retalhuleu'	3	-	-	-	0
Leucaena leucocephala K636	3	-	-	-	0

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.

Appendix 5. Performance of forage species at Kanamit, Central Kalimantan.

	Establishment success[1]	Yield Potential[2]	Persistence[2]	Seed Production[2]	Pests/ Diseases[3]
Grasses					
Andropogon gayanus CIAT 639	3	3	4	2	0
Brachiaria brizantha CIAT 6780	3	4	4	1	0
B. decumbens cv. Basilisk	3	3	4	1	0
B. humidicola CIAT 6133	3	3	3	1	0
B. humidicola CIAT 6369	3	3	4	1	0
Chloris gayana cv. Callide	2	2	1	-	-
Digitaria milanjiana CPI 41192	2	2	2	1	0
D. swynnertonii CPI 59749	4	3	4	2	0
Panicum maximum cv. Makueni	2	2	2	1	0
P. maximum cv. Riversdale	2	3	3	1	0
Paspalum conjugatum 'local'	3	2	3	1	0
P. malacophyllum CPI 27690	2	1	1	1	0
Pennisetum hybrid ('King' grass)	3	2	2	1	0
P. purpureum 'local'	3	3	3	1	0
Setaria sphacelata cv. Splendida	3	3	2	1	0
Legumes					
Aeschynomene americana cv. Glenn	4	1	1	1	0
A. americana cv. Lee	2	1	1	1	0
Arachis pintoi cv. Amarillo	2	1	1	1	0
Cajanus cajan CIAT 18700	1	-	-	-	-
Calopogonium mucunoides 'local'	2	2	3	1	0
Centrosema acutifolium CIAT 5277	3	3	3	1	0
C. macrocarpum CIAT 5452	3	3	3	1	0
C. macrocarpum CIAT 15014	3	3	3	1	0
C. macrocarpum CIAT 15047	3	3	3	1	0
C. pascuorum cv. Cavalcade	2	3	-	-	-
C. pubescens CIAT 438	3	3	3	1	0
C. pubescens CIAT 15160	3	3	4	1	0
C. schiedeanum cv. Belalto	2	2	2	1	0
Chamaecrista rotundifolia cv. Wynn	2	2	2	1	0
Desmodium velutinum CIAT 13220	1	-	-	-	-
Macroptilium gracile cv. Maldonado	2	3	2	-	-
Stylosanthes guianensis cv. Cook	2	1	1	1	0
S. guianensis cv. Graham	2	1	1	1	0
S. guianensis CIAT 184	4	3	4	2	0
S. hamata cv. Verano	2	1	2	1	0
Trees and shrubs					
Codariocalyx gyroides CIAT 3001	0	-	-	-	-
Cratylia argentea CIAT 18516	0	-	-	-	-
Flemingia macrophylla CIAT 17403	4	3	4	3	-

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.

Appendix 5. Performance of forage species at Marenu, North Sumatra.

	Establishment success[1]	Yield Potential[2]	Persistence[2]	Seed Production[2]	Pests/ Diseases[3]
Grasses					
Andropogon gayanus cv. Kent	4	3	4	1	0
Brachiaria brizantha CIAT 6780	4	3	4	1	0
B. brizantha CIAT 16835	4	1	4	1	0
B. brizantha ex. Sungai Putih	4	2	4	1	0
B. humidicola cv. Tully	4	2	4	1	0
Digitaria milanjiana cv. Jarra	4	-	4	-	0
Panicum maximum T-58	4	1	2	3	0
Paspalum atratum BRA 9610	4	4	4	1	0
P. atratum cv. Pantaneira	4	4	4	1	0
P. guenoarum BRA 3824	4	4	4	1	1
Pennisetum hybrid ('King' grass)	4	1	2	1	2
P. purpureum cv. Mott	4	1	2	1	0
Setaria sphacelata var. *splendida*	4	1	3	2	0
Legumes					
Centrosema macrocarpum 25522	4	4	4	1	0
C. pubescens CIAT 15160	4	3	3	1	1
Desmodium heterophyllum CIAT 349	2	1	2	1	4
Stylosanthes guianensis CIAT 184	4	2	4	3	1
S. scabra cv. Siran	2	1	2	2	1
Trees and shrubs					
Calliandra calothyrsus CPI 115690	2	1	2	1	0
Cratylia argentea CIAT 18516	0	-	-	-	-
Desmodium cinerea CPI 46562	2	1	2	1	4
Flemingia macrophylla CIAT 17403	4	4	4	2	1
Gliricidia sepium 'Belen Rivas'	4	4	4	1	0
G. sepium 'Monterrico'	4	1	3	1	0
G. sepium 'Retalhuleu'	4	1	3	1	0
Leucaena collinsii QFI 152/88	4	1	3	1	0
L. leucocephala K636	4	3	4	1	0

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.

Appendix 6. Performance of forage species at SPK Saree, Aceh.

	Establishment success[1]	Yield Potential[2]	Persistence[2]	Seed Production[2]	Pests/ Diseases[3]
Grasses					
Andropogon gayanus CIAT 621	0	-	-	-	-
Brachiaria brizantha CIAT 26110	3	3	4	1	0
B. decumbens cv. Basilisk	3	4	4	1	0
B. humidicola CIAT 6133	3	3	4	1	0
B. humidicola cv. Tully	3	3	4	1	0
Panicum maximum CIAT 6299	4	4	4	2	0
Paspalum atratum BRA 9610	3	4	3	1	0
Legumes					
Arachis pintoi CIAT 22160	3	3	3	1	0
Centrosema pubescens CIAT 15160	3	3	3	2	0
Desmodium heterophyllum CIAT 349	3	3	3	1	0
Stylosanthes guianensis CIAT 184	3	3	3	3	0
S. hamata cv. Verano	3	3	3	3	0
S. scabra cv. Siran	2	3	3	2	0
Trees and shrubs					
Desmodium cinerea CPI 46562	4	4	4	3	0
Gliricidia sepium 'Belen Rivas'	4	4	4	-	0
G. sepium 'local'	2	2	3	-	0
G. sepium Monterrico'	4	4	4	-	0
G. sepium ,Retalhuleu'	4	4	4	-	0
Leucaena leucocephala K636	2	4	4	2	1
L. leucocephala 'local'	2	2	2	2	1

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.

Appendix 7. Performance of forage species at Blang Ubo-ubo, Saree, Aceh.

	Establishment success[1]	Yield Potential[2]	Persistence[2]	Seed Production[2]	Pests/ Diseases[3]
Grasses					
Andropogon gayanus CIAT 621	0	-	-	-	-
Brachiaria brizantha CIAT 26110	3	3	4	1	0
B. decumbens cv. Basilisk	3	4	4	1	0
B. humidicola CIAT 6133	1	3	4	1	0
B. humidicola cv. Tully	3	4	4	1	0
Panicum maximum CIAT 6299	4	4	4	2	0
Paspalum atratum BRA 9610	3	4	3	1	0
Legumes					
Centrosema 'mixture'	3	3	3	2	0
Stylosanthes guianensis CIAT 184	3	3	3	3	0
S. hamata cv. Verano	3	3	3	3	0
S. scabra cv. Siran	2	3	3	2	0
Trees and shrubs					
Calliandra calothyrsus	3	3	3	2	0
Desmodium cinerea CPI 46562	4	4	4	3	0
Gliricidia sepium 'Belen Rivas'	4	4	4	-	0
G. sepium 'local'	2	2	3	-	0
G. sepium 'Monterrico'	4	4	4	-	0
G. sepium 'Retalhuleu'	4	4	4	-	0
Leucaena leucocephala K636	2	4	4	2	0
L. leucocephala 'local'	2	2	2	2	1

[1] Establishment success: 0=did not emerge, 1=poor, 2= moderate, 3=good, 4=excellent.
[2] Yield potential, persistence and seed production: 1=poor, 2=moderate, 3=good, 4=excellent.
[3] Pests/Diseases: 0=none, 1=little impact, 2=moderate impact, 3=severe impact, 4=plants killed.