Appendix 5

FORAGE TREE ADOPTION AND USE IN ASIA

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ABSTRACT
Fieldwork was conducted in Asia to examine potentials for fodder-especially tree legume--adoption among smallholder farmers with mixed crop and livestock systems. Analysis of traditional systems in Bali suggested that farmers were likely to grow trees for fodder if agriculture was intensive; cattle were penned and fed by cut-and-carry; agroforestry was an integral part of local systems; shade-intolerant annual crops were not relied upon as the major agricultural output; and trees were superior to other sources in providing fodder in the dry season. Work with farmers at sites in which forages are being introduced and tested suggested the above and other factors of importance in the adoption of trees and other forages. Farmers perceived legume tree fodders positively in terms of animal health and weight gain; but were less happy about competition with crops, the (perceived) need to mix tree fodder with other sources, insect pests, and slow regrowth. The adoption of new trees also competed with the adoption or use of new grasses, natural grasses (almost universally viewed as healthy mixtures), and crop residues. Farmers did not appear to consider the difficulty of tree establishment as a constraint to adoption.

INTRODUCTION
Small holder farmers in Asia vary widely in terms of their mixes of annual and perennial crops, trees, and livestock. Farmers with irrigated lowland rice may have few or no trees and a draft animal at most. Many migrant farmers who settle in forest lands and employ slash-and-burn agriculture to produce rice or maize initially plant few trees and have minimal numbers of livestock. In more intensive upland systems, some farmers produce high value crops and have no animals. Other systems feature mixes of crops and livestock.

Those farmers with livestock employ feeding strategies ranging from herding and tethering animals to exploit natural vegetation to intensive systems characterized by penned animals, cut-and-carry feeding, and planted forages. In between these poles, other feeding systems combine cut-and-carry feeding of both planted and natural vegetation with animal herding or tethering. Crop residues may also form a significant portion of livestock feed. Planted forages include grasses and legumes, with the latter including trees.

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A "Forages for Smallholders Project" (FSP) has worked with small farmers in various sites in Asia on the participatory testing of new forages and animal feeding systems. Farmers somewhat readily adopted some of the fast growing, high yielding grasses, but have been less quick to adopt legume fodder trees.

Fieldwork was conducted to examine under what conditions have farmers adopted and incorporated trees in their mixed systems. Three sites in Bali, Indonesia, were included to understand systems in which farmers have incorporated many trees and some grasses in their traditional intensive systems. Three FSP project sites--one each in Vietnam, Sumatra (Indonesia), and northern Mindanao (Philippines)--were visited to examine the actual or potential adoption of introduced forages, including trees, in what are more extensive land use systems.

METHODS

Ethnographic and participatory evaluation proceedures were used to understand mixed agricultural systems, farmers' animal feeding systems, and farmers' perceptions regarding the forages utilized.

A small team of researchers from the Faculty of Animal Husbandry at Udanaya University (Denpasar, Bali, Indonesia), the Environmental Bamboo Foundation, and CIAT visited Besakih and Petang in the uplands north of Denpasar and sites on the island of Nusa Penida to the south of Bali. These sites featured traditional mixed agroforestry and livestock systems ranging in intensity from fully penned animals in Besakih to cut-and-carry combined with tethering in Peteng and Nusah Penida. Farmers were asked about their wet and dry season fodder use and to evaluate the forages used according to their own criteria. Eighteen to twenty-five farmers were individually interviewed at each site. Field observations were recorded.

FSP sites were visited in central Vietnam (Xuan Loc near Hue), northern Sumatra (Marenu), and northern Mindanao (Malitbog). At each site, a small group of researchers collaborating with the FSP project visited both forage adoptors and non-adoptors to discuss forage use and evaluations.
The proportion of fodders used by each interviewed group aggregated the individual forage uses across the sample. Most farmers had similar numbers of livestock at each site. Where a few informants had larger herds, care was taken to determine if their forage use proportions were similar to those of their neighbors and to correct the aggregate use as necessary.

In terms of participatory forage evaluations, farmers evaluated forages using matrices presenting each respondent's species x each respondent's evaluation criteria and by farmers' assignment of relative values (using beans or maize as counters). Individuals differed in terms of both forages used and evaluation criteria. Data was aggregated in two ways: by presenting relative values for those planting a particular forage and employing a given evaluation criteria; and by presenting the percentage of total "votes" received by a given species x evaluation criteria combination. The first method over-valued the less frequently encountered species x criteria combinations, ie, it ignored the negative "votes" of informants not using a particular forage and evaluation criteria combination. The second method undervalued the species x evaluation combinations held by the minority. Data aggregated from farmers' individual evaluations were, thus, presented to show both sets of values.

The matrix method also suffered in that values assigned to a cell could not be less than zero, eliminating relative degrees of negative evaluations. Farmers were then simply asked to name both positive or "good" and negative or "bad" characteristics associated with each forage source.

FINDINGS

Traditional intensive crop/livestock/agroforestry in Bali. Nineteen farmers were interviewd in Besakih. The volcanic slopes used by the Besakih farmers extend from some 1000 to 1500 meters above sea level, providing a cool climate and relatively rich soils suited to agroforestry and root crops. Farm size was a mean 0.95 ha, skewed by three extended families. Mean farm size was 0.6 ha for the 16 families (range 0.2-1.0 ha); while the remaining three families had 2.0-4.0 ha. Coffee and sweet potato were the most important crops followed by cassava, citrus, banana, cloves, coconut, and some maize. *Albizia* sp was grown for timber for the local wood carving industry.

Modal number of cattle was two (range 2-6 for the 16 families, 7-20 for the three extended families). Cattle were penned and not grazed or tethered. All feed was provided by cut-and-carry. Farmers relied upon on-farm feed resources ranging from natural grasses or weeds to planted grasses (*Pennisetum purpureum*), trees (*Calliandra calothyrsus, Gliricidia sepium, Albizia saman*, and jackfriut), and crop residues (sweet potato vines, leaves, and tubers) (Table 1). [n.b., Farmers near a forested hilltop outside of the study area relied more on natural grasses from the common area and planted fewer trees.]

Farms were intensively cultivated, with small parcels separated by "live fences" comprised of a wide mix of trees and a few grasses. Fence row species included the trees *G sepium, C calothyrsus, A saman, Erythrina orientalis*, jackfruit, avocado, *salak* (a local fruit), and grasses *P purpureum* and King grass (*Pennisetum* hybrid). Farmers admitted that with all animals penned, the apparent live "fences" were not established as fences per se. More likely is that these were "linear fields" established for fodder (and some fruit and timber) and having the advantages of ease of harvest and, more importantly, the deflection of much of the above- and below-ground competition of the trees into adjacent pathways, roadsides, and terrace walls.

Individual farmers in Besakih evaluated the forages they each used, using criteria each saw as important. When data is aggregated to show entries reflecting the mean score for farmers planting a particular forage and using a given criteria (Table 2), *C calythyrsus, G sepium, P purpureum*, and sweet potato were judged as somewhat equal and superior to A saman, jackfruit, and local grasses. The most important criteria were yield, palatability, and weight gain. Calliandra scored high in terms of weight gain, yield, animal health, and fast growth. Although scoring high across most criteria, Gliricidia was especially valued for yield. *P purpureum* was valued for its high yield; and sweet potato (leaves and tubers) especially high for palatability, weight gain, and fast growth.
Only slightly different results emerged when the percentage of "votes" gained by each species x evaluation criteria was considered. The criteria of yield, palatability, and weight gain remained the most important; and the forages Calliandra, Paspalum, and sweet potato were still the highest rated. Gliricidia and local grasses followed in popularity. The "less important" evaluation criteria for Besakih farmers were animal health, ease of establishment, fast growth, dry season productivity, and availability of planting material.

Moving down slope, 18 farmers were interviewed in Petang. Farm size was a mean 0.6 ha. Cassava was the most important crop, followed by citrus, coffee, banana, cacao, cloves, peanut, coconut, ginger, papaya, and maize. As in Besakih, farmers in Peteng relied on their linear fields for tree fodders (*G* *sepium* throughout the year and *E orientalis* and jackfriut in the dry season) and *P purpureum*, as well as local grasses and crop residues--banana stalk, cassava leaf, and coconut fronds (Table 1).

Eighteen farmers were interviewed in Sakti on the small island of Nusa Penida off of the southern coast of Bali. Mean farm size was 2.0 ha (range 0.3-7.0 ha, mode 1.5 ha). The island receives less rainfall, has a drier dry season, and has poorer (limestone) soils than the Balinese uplands. Main crops were cassava, maize, coconut, banana, and beans.

Mean number of cattle was three head per family (range 1-5, mode, 2 head). Cattle were fed by tethering (largely on each farmers' own lands, often under coconut) and by cut-and-carry. Farmers relied on tree fodders, including *G sepium* throughout the year and *Ficus* sp in the dry season. Local grasses were abundant in the wet season (accounting for 25% of cut-and-carry fodder). Less so in the dry. Banana stalk was an important feed source throughout the year (Table 1).

Although farmers in Sakti agreed that *Sesbania* sp was superior to all other forages in terms of weight gain, palatability, and animal health, only one fourth of the farmers maintained the tree, which accounted for only 4% of feed in the wet season and 2% in the dry. Sesbania was not more widely adopted because of its short life span. On the other hand, although *Ficus* sp was viewed as providing poor quality fodder, it served as an "insurance" feed source in the dry season adopted by 50% of the farmers and providing 23% of dry season fodder.

Forage Project Cooperators, non-cooperators, adoptors, and non-adoptors in Sumatra, Vietnam, and northern Mindanao. The FSP site in Marenu, Sumatra, is a recently settled transmigration site. Farmers, both FSP project cooperators (n = 10) and non-cooperators (n = 8) reported having a mean of one ha; although some may have had more land and reported the "official" land holding for settlers. Cooperators had a mean 34 head of sheep; while non-cooperators had 19. Main income sources for cooperators were sheep, upland crops, and off-farm labour. Cooperators additionally claimed lowland rice and oil palm as main income sources. Cooperators complained of wild pigs, drought/lack of water, lack of capital, lack of job opportunities, and sheep theft as problems. Non-cooperators saw pigs, lack of capital, and drought/lack of water as problems. It appeared that non-cooperators had fewer sheep than cooperators, but were more successful in terms of off-farm employment and in the establishment of lowland rice paddies and oil palm plantations.

Sheep were fed by combined grazing on commons and cut-and-carry for mornings and evenings when animals were penned. Both cooperators and non-cooperators planted grasses and trees. Rates of adoption for several grasses were higher for cooperators, with non-cooperators relying more on King grass than cooperators. Half of the cooperators compared to none of the non-cooperators had sown *S guianensis*; and more cooperators had adopted and were using *G sepium* and *L leucocephala* compared to non-cooperators. Non-cooperators relied more upon local grasses than cooperators in the dry season (Table 4). Farmers' evaluations of fodder species were recorded in terms of positive and negative qualities of each (see below).

Ten FSP cooperators and 8 non-cooperators were interviewed in Xuan Loc near Hue in central Vietnam. Besides producing lowland rice and sugar cane, almost all farmers were tree planters. Most had fairly large numbers of fruit trees; a large proportion managed re-forestation areas under government contract; and a high proportion had family land similarly sown to plantation forests.

Comparing cooperators and non-cooperators, cooperators had more land (mean 2.4 ha vs 1.6 ha), but--for families having each enterprise--similar areas of lowland rice (0.2 ha), sugar cane (0.2 ha), areas under family forestry (1.3-1.4 ha) and numbers of cattle (4.0-4.4). Greater proportions of cooperators, however, had sugar cane, family forestry, and cattle (67% vs 50%). Although fewer non-cooperators had water buffalo, those having such animals had a higher number per family. More non-cooperators cared for government forest plots, but had smaller areas (7.5 ha) compared to those cooperators (9.7 ha) having such contracts (Table 5).

Farmers identified problems as lack of water for crops, lack of capital, low soil fertility, and lack of transport--followed by a lack of labour for grazing livestock and a lack of grazing land.

Cooperators were just becoming familiar with some of the grasses and fewer of the trees through testing (on small plots) as a part of FSP activities. The main evaluation criteria used by farmers were palatability, "quality", yield, weight gain, and animal health. If the evaluations of farmers using particular species and evaluation criteria are compared (without reference to the actual proportions of farmers actually using a given forage and/or evaluation criteria), native grasses were given highest marks due to high scores in terms quality, palatability, and yield. *P maximum* was also rated highly across criteria, and especially in terms of palatability. The trees *G sepium* and *L leucocephala*, although planted by 77% of the informants, scored low across criteria. Factoring in proportions of farmers planting a given forage and using particular evaluation criteria, native grasses, *P maximum*, and *S guianensis* (which all were testing or using) were given highest ratings (Table 6).

Ironically, farmers' tree planting practices appeared to work against the adoption of fodder trees. Most farmers planted a wide range of fruit trees in their home gardens and cared for forest plantations on both their own and on government lands. Introduced fodder trees had to compete with fruit trees in the home gardens and with commercial timber elsewhere. Because farmers perceived the potential for receiving high (and apparently low-risk) returns to forestry, the enterprise competed with livestock husbandry. Maturing forest plantations also resulted in less available natural fodder for either grazing or cut-and-carry. Some farmers had reduced their animal numbers; and the community as a whole may reduce cattle and buffalo numbers further to just the point where draft needs are met.

Future forage adoption will depend on the relative economic importance of lowland rice, sugar cane, forestry, and livestock. The importance of livestock will depend on needs for draft, the importance of farmyard manure, and the long-term investment advantages of cattle compared to forestry. A guess would be that cattle numbers would either stay the same or decrease. Livestock enterprises may, however, intensify in response to demand from Hue-possibly requiring higher quality feed produced on small on-farm areas.

A short period was spent in Maltibog in northern Mindanao in the Philippines. Small farmers have one or two head of cattle fed by tethering and cut-and-carry. Main crops are bananas, maize, and coconut. Although FSP cooperators were testing a range of new forages, many appeared to be interested in the possibility of receiving cattle via government dispersal programs (which traditionally required adoption of new forages as a pre-requisite). The high availability of banana stalk and open grazing lands meant that fodder resources were available, a factor working against new forage adoption. One community had a large area of mature *L leucocephala* trees, which was not being used as a major fodder source. On the other hand, dry-season fodder shortages and increasing demand for meat in the city of Cagayan de Oro may eventually lead to an increase in the genuine adoption of new forages for cattle-fattening enterprises.

An evaluation of forage species across sites. Farmers across sites were asked to name positive and negative characteristics associated with their different forage options (Table 7). The results were aggregated because of the substantial consensus across sites in the three countries (albeit, farmers at each site had a different suite of forages and, therefore did not evaluate all species).

The legume trees, *Calliandra* sp, *G sepium*, and *L leucocephala* were viewed positively in terms of yield, palatability, animal weight gain, and animal health. Negative characteristics included the need to mix leguminous tree fodder with other fodders, pests, and leaf fall in the dry season (*G sepium*). *Sesbania* sp fodder was considered of especially high value in Nusa Penida, but was not more widely planted because of its short life span. Although viewed as producing fodder of low nutrient value, *Ficus* sp and jackfruit were valued for their needed dry season productivity. Vietnamese farmers appeared to prefer to plant fruit rather than fodder trees in their home gardens. *Albizia* sp and jackfruit were valued for their timber as well as fodder.

Although farmers agreed that *Stylosanthes* spp was good in terms of animal health, nutrition, and weanlings, slow re-growth and itchiness (for farmers harvesting the fodder) were described as problems. Informants disagreed as to the palatability and drought tolerance of Stylosanthes.

Most of the planted grasses were found to be desirable in terms of fast growth, high yield, palatability, weight gain, and ease of harvest. Common complaints about the grasses included that old growth was not palatable and crop competition. Farmers sought grasses which were cutting tolerant, drought tolerant, adapted to low soil fertility, and were fast to re-grow.

Farmers across sites generally favoured their natural grass mixtures as being fast growing, good for animal health and weight gain, palatable, and, of course, available. In some areas, lowered production in the dry season was mentioned as a problem.

Sweet potato tubers and leaves were used for cattle fattening and "finishing" in some of the upland areas of Bali. Cassava leaf was commonly used as fodder in many areas, and was also viewed positively in terms of animal weight gain. Banana stalk was a significant fodder source at several of the sites. Among several positive characteristics was that it also provided water in the dry season.

DISCUSSION AND CONCLUSIONS

Recent studies range from pessimistic to hesitantly optimistic concerning the adoption of trees on farm, especially for fodder. Case studies in Nepal and India have shown that, in spite of increased tree planting for fuelwood and shifts from open grazing to stall feeding, farmers have relied heavily on crop residues and forage grasses to meet animal feed needs. Researchers concluded for these cases that "In contrast to the previous analysis of fuel, trees on farm do not appear to be a viable strategy for livestock feed (Warner *et al* 1999). Another review of forage husbandry in the tropics concluded that, "A wide and diverse range of trees and shrubs are used as fodder, but few are planted. When they are planted, it is seldom primarily to provide forage. Rather, forage is a by-product of fruit trees, live fences, and erosion-control strips, and makes the planting of these trees more attractive to farmers" (Bayer and Waters-Bayer 1998:139).

Farmers in the highlands of Nicaragua (in an area somewhat similar to the sites visited in Bali), on the other hand, used *Leucaena* spp and *G sepium* as fodder sources, and maintained naturally occuring *Guazuma ulmifolia* and *Acacia pennatula* trees because of their dry-season forage productivity (Nicola Maria Keilbach, personal communication, cited in Bayer and Waters-Bayer 1998). A collection of studies from South Asia and Eastern Africa indicated, in general, that the (albeit few) observed shifts to more intensive on-farm tree planting was occuring in regions undergoing agricultural intensification, and that this intensification has taken place in the more arable and productive areas with relatively higher rainfall (Arnold and Dewees, eds 1997).

For the areas visited in this study, several factors would appear to affect decisions regarding forage and tree forage adoption by smallholder farmers with mixed crop and livestock systems. Tree adoption was encountered where a combination of relatively high populations over a fixed land area had led to agricultural intensification. In Bali, such intensification featured high to exclusive reliance upon cut-and-carry feeding for penned animals; and a high reliance upon on-farm planted forages. In these cases, off-farm commons or open access areas supplying grazing land or fodder for cut-and-carry were not available. Indeed, in Besakih every plant--trees, crops, weeds--was privately owned. Fodder tree adoption also appeared more likely where farmers were already agroforesters growing a range of trees for a variety of purposes. Agroforestry itself also appeared more likely where systems were not largely reliant upon shade intolerant annual crops such as upland rice or maize. Finally, fodder trees were likely to be adopted where a marked dry season significantly decreased the relative availability of fodder from non-tree compared to tree sources.

The presence of adequate fodder sources in the form of open grasslands, grasslands under coconut, crop residues (e.g, banana stalk in Indonesia and the Philippines), and the growing of field crops for animal feed (some of the sweet potato in Besakih) would tend to decrease adoption of fodder trees. Livestock serve as a "bank account" for many small farm systems. Family forestry (in Vietnam) served the same purpose and was viewed as a better long-term investment, thus "competing" with livestock as an enterprise.

Farmers in project areas may also genuinely adopt new forages as they shift from herding and grazing to increased stall feeding (e.g., sheep in Marenu) or spuriously in the hope of receiving animals through cattle distribution programs (eg, Malitbog). These factors are synthesized in a farmers' decision tree (Figure 1).

Implications for the Forages for Smallholders Project. The FSP is correct in offering farmers at selected sites menus of forage grasses, legumes, and trees; and in facilitating farmer-participatory research in the testing of the introduced materials. The fieldwork reported on here provides several other suggestions:

1. Selection of project sites needs to carefully examine existing forage resources and the possibly changing relative profitability of livestock over other on- or off-farm enterprises. There may be little opportunity for intensification where livestock simply take advantage of available native forages or where other enterprises such as forestry would “compete” with livestock.

2. Areas undergoing intensification--eg, where land is becoming less available and penned animals are replacing grazing--would be likely for the adoption of new forages. “Linear fields”

such as those encountered in Bali may be appropriate for mixes of trees and grasses where open fields are not available.

3. Farmers in areas with more available land and natural forage resources may still be interested in new grasses and possibly trees if there are clear advantages in terms of dry season productivity. Farmers were willing to plant or use fodder trees producing inferior feed as long as dry season production was assured when needed. The *El Nino* related drought appears to have generated interest in Kalimantan when the new forage species provided the only green to be seen (Werner Stur, personal communication).

4. Farmers expressed a range of perceptions regarding the suitability of legume forages. In general, although good for weight gain and animal health, farmers also thought that legumes needed to be mixed with other foods, that animals refused to eat more than small amounts, and that fertility-related problems could arise. If not already doing so, the project may need to work with farmers willing to experiment with feeding regimes to determine the soundness of such perceptions. Farmers at one FSP site are apparently now more interested in *G sepium* after recently finding that their goats would, contrary to previous belief, consume loppings from the tree (Werner Stur, personal communication).

5. Further research is needed on the gender and age distribution of labour for cut-and-carry systems. Although male informants generally claimed to contribute equal shares of labour as women, observations give the impression that women contribute more for cut-and-carry and that children provide more for grazing and tethering. Women may have less involvement in fodder or tree planting decisions; and the opportunity costs of children's labour may be low. Both factors could reduce new forage adoption.

6. Crop residues were a major animal feed source in the areas visited. The FSP may want to integrate crop residues within any on-farm research.

7. Where natural forages are plentiful, the FSP may want to work with farmers to address the resource use/access issues associated with such forages in order for farmers to beneficially improve management of the resource. Communities may be able to work together on enriched natural pastures, for example.

8. Finally, and to repeat several points above, farmers did not appear to be worried about the establishment costs in terms of time to productivity and care of seedlings associated with trees. Competition with crops, longevity, recuperation and regrowth after lopping, tree pests, and fodder suitability were main concerns.

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Table 1. Farmers' fodder sources (%), wet and dry seasons, Bali

	Besakih			Peteng			Nusa Penida		
	% farmers	Wet Season	Dry Season	% farmers	Wet Season	Dry Season	% farmers	Wet Season	Dry Season
TREE FODDER		37	43		25	37		41	53
G sepium	78	11	10	100	12	14	100	32	28
C calothyrsus	100	20	19	28	2	3		-	-
A saman	33	2	7	22	1	1		-	-
E orientalis		-	-	50	4	6		-	-
Ficus sp		-	-		-	-	89	5	23
Sesbania sp		-	-		-	-	28	4	2
Jackfruit	61	4	7	83	6	13		-	-
PLANTED GRASSES									
P purpureum	94	19	15	100	21	13		-	-
LOCAL GRASSES	89	11	8	94	24	11	94	25	8
CROP RESIDUES		13	13		24	30		28	33
Sweet potato (tuber,	89	13	13		-	-		-	-
leaf)		-	-	61	6	8	63	6	6
Cassava		-	-	100	14	15	83	12	16
Banana stalk		-	-	56	4	7	56	1	10
Coconut fronds		-	-		-	-	50	9	1
Bean leaf									
TOTAL		80	79		94	91		94	94

Table 2. Species evalution*, Besakih, Bali

	% Plant	Yield	Palatability	Weight Gain	Animal Health	Dry Season	Establishment	Fast Growing	Planting Material	Tot	Rank
		Evaluation Criteria									
Use criteria (%)		78	78	72	50	22	22	17	5		
C calothyrsus	100	5	4	6	5	3	3	5	2	33	1
G sepium	78	5	4	4	4	3	4	4	4	32	1
A saman	33	3	3	2	2	2	3	3	3	21	5
Jackfruit	61	3	3	3	2	2	2	2	3	20	5
P purpureum	94	6	5	5	2	3	3	4	2	30	1
Local grasses	89	4	3	4	2	1	3	1	1	19	5
Sweet potato	89	4	7	7	4	2	1	6	2	33	1
TOTAL		30	29	31	21	16	19	25	17		
Relative Importance		1	1	1	5	7	5	4	7		

* Eighteen farmers each planted different species and used different evaluation criteria. Entries are mean scores for those planting a given species and using a given criteria. Relative scores for species are percent planting x total. Relative importance of criteria are percent using criteria x total.

Table 3. Species evalution*, Besakih, Bali

		Evaluation Criteria									
	% Plant	Yield	Palatability	Weight Gain	Animal Health	Dry Season	Establishment	Fast Growing	Planting Material	Tot	Rank
Use cri (%)		78	78	72	50	22	22	17	5		
C calothyrsus	100	5	5	5	3	1	1	1	<1	21	1
G sepium	78	4	3	3	2	<1	1	1	<1	15	4
A saman	33	1	1	<1	<1	<1	<1	<1	<1	3	7
Jackfruit	61	2	2	2	<1	<1	<1	<1	<1	7	6
P purpureum	94	6	5	5	1	1	1	1	<1	20	1
Local grasses	89	4	3	3	2	<1	1	<1	<1	14	4
Sweet potato	89	4	6	6	3	<1	<1	1	<1	21	1
TOTAL		26	25	24	11	3	5	5	2	100	
Relative Importance		1	1	1	4	7	5	5	8		

* Entries are percentage of all "votes" for each species x evaluation combination. Species rank and relative importance of criteria reflect respective sumes of rows or columns.

Table 4. Forage use, FSP cooperators & non-cooperators, wet and dry seasons, Marenu, Sumatra

	Cooperators			Non-cooperators		
	% farmers	WS	DS	% farmers	WS	DS
TREES		25	19		13	12
G sepium	90	10	7	38	4	3
A saman	50	6	5	50	4	4
L leucocephala	90	9	7	50	5	5
LEGUMES						
S guianensis	50	8	4	0	0	0
LOCAL GRASSES	80	12	17	63	19	32
PLANTED		45+	50		61	45
GRASSES	90	15	15	100	20	15
P atratum	100	16	12	75	11	8
P guenoarum	60	4	12	25	7	6
B humidicola	60	7	6	50	9	6
B decumbens	20	3	3	13	1	1
S sphacelata	10	<1	2	63	13	9
King grass						
TOTAL		91	90		93	80

Table 5. Production assets, Xuan Loc, Vietnam

	Participants (n=10)			Non-participants (n=8)		
	% sample	Mean	Range	% Sample	Mean	Range
Farm size (ha)	100	2.4	0.3 - 8.0	100	1.6	0.3 - 3.4
Paddy area (ha)	83	0.2	0.1 - 0.3	88	0.2	0.1 - 0.2
Sugar cane (ha)	89	0.2	0.1 - 0.3	57	0.2	0.1 - 1.0
Family forestry (ha)	83	1.4	0.1 - 5.0	29	1.3	0.5 - 2.0
Contract forestry (ha)	27	9.7	6.0-20.0	50	7.5	6.0-10.0
Fruit trees (units)	100	104	23-290	86	140	29-280
Cattle (animals)	67	4.4	1-10	50	4.0	1-10
Buffalo (animals)	44	1.7	1-3	25	4.0	3-4

Table 6. Fodder assessment (n=13), Xuan Loc

		CRITERIA								
	% farmers	Palatability	Quality	Yield	Weight Gain	Animal Health	Total	Rank	Corrected Total	Corrected Rank
% used criteria	-	100	85	77	70	38				
S guianensis	100	2	3	3	3	3	14	4	14	1
P maximum	70	6	4	4	4	2	20	2	14	1
B ruziziensis	31	3	7	3	2	2	17	3	5	6
Native grasses	46	7	8	7	4	3	29	1	13	1
G sepium	77	2	2	2	2	1	9	5	7	5
L leucocephala	77	2	2	2	1	3	10	5	8	4
TOTAL		22	26	21	16	14				
Relative importance		2	1	2	4	4				
Corrected total		22	22	16	11	5				
Relative importance		1	1	3	4	5				

* Entries are relative mean scores for those planting a given species and using a given criteria. Ranking of species and relative importance of criteria were calculated from sums of rows and columns, respectively. Corrected totals and ranking reflect proportion of those using the species and criteria.

Table 7. Farmers' evaluations of fodder species

SPECIES	EVALUATIONS	
Calliandra spp	Good:	Weight gain, yield, palatable, animal health
	Bad:	Root competition, must mix w/other fodders, reduces animal fertility
G sepium	Good:	High yield, weight gain, animal health, milk production, palatable, prevents diarrhea, easy to grow, easy to harvest, cutting tolerant, long life
	Bad:	Not palatable if fed to much, must mix, lowers cattle fertility, leaf fall in DS, pests, slow regrowth, pests
Albizia sp	Good:	Commercial wood, weight gain, palatable, fast growing , drought tolerant
	Bad:	Difficult to harvest, diarrhea, not palatable, slow regrowth, excess leads to hair loss
L leucocephala	Good:	Palatable, high milk production, easy to harvest, drought tolerant, cutting tolerant, quick regrowth
	Bad:	Pests, must mix, excess causes ewes to bleed
Sesbania sp	Good:	Animal health, weight gain
	Bad:	Short life
Ficus sp	Good:	Produces in DS, long life
	Bad:	Low nutritive value, low yield, one harvest per year, not for animal health, shade competition
Jackfruit	Good:	Available in dry season/drought resistant, timber, prevent diarrhea
	Bad:	Low nutrient value, constipation
Erythrina sp	Good:	Weight gain, palatable, animal health
	Bad:	Low yield, diarrhea
Stylosanthes sp	Good:	Nutrition, animal health, good for weanlings, palatable, drought tolerant
	Bad:	Old growth not palatable (OGNP), itchy, not drought tolerant, slow regrowth, not palatable
P purpureum	Good:	Weight gain, fast growing, perennial, yield, palatable, easy to harvest, available
	Bad:	OGNP, must mix, no contribution to animal health, needs fertilizer
P atratum	Good:	Quick regrowth, cutting tolerant, drought tolerant, high leaf yield, easy to harvest, palatable, all parts consumed

	Bad:	Sharp edged, OGNP
P guenoarum	Good:	Fast regrowth, cutting tolerant, yield, easy to harvest, palatable, weight gain, produces in DS
	Bad:	Not drought tolerant, OGNP, rots if cut too low
P humidicola	Good:	Drought tolerant, quick regrowth, cutting tolerant, palatable, easy to maintain
	Bad:	Less leaf production, OGNP, crop competition, cannot plant other crops on same land after
King grass	Good:	Quick regrowth, palatable, drought tolerant
	Bad:	Short life
Setaria sp	Good:	Natural mixtures for animal health, fast growing, weight gain, palatable, available
	Bad:	Low productivity in dry season
Local grasses	Good:	Fattening & animal "finishing"
	Bad:	Diarrhea
Sweet potato	Good:	Palatable, weight gain
	Bad:	Not palatable 3 days after harvest, bloat
Cassava leaf	Good:	Animal health, provides water in DS, palatable, easy to harvest, increases milk production in DS
	Bad:	Diarrhea if fed in excess

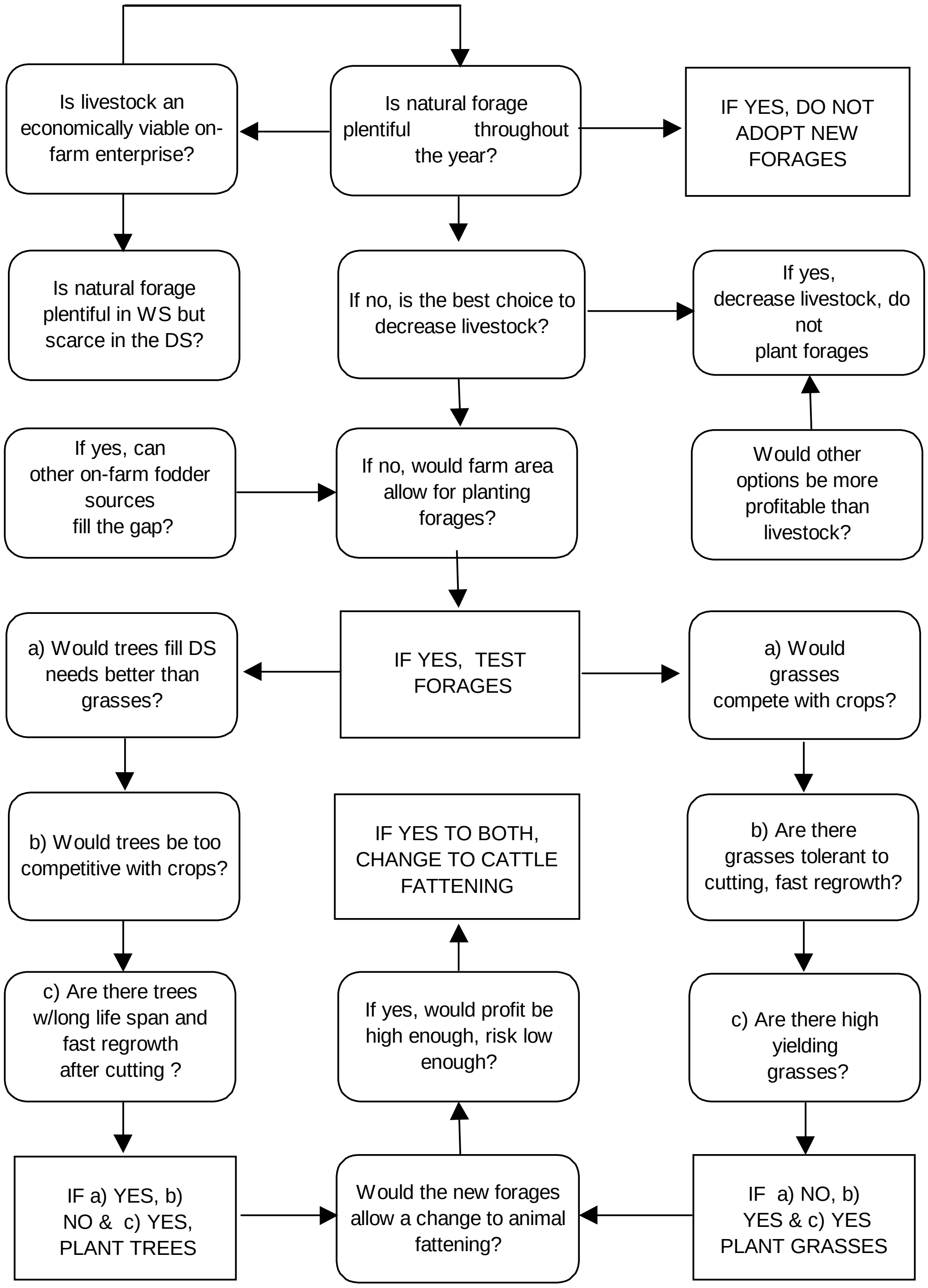

Figure 1. Farmer forage & tree adoption decision model