The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. Its mandate is to help identify agricultural problems in developing countries and to commission collaborative research between Australia and developing country researchers in fields where Australia has a special research competence.

Where trade names are used this constitutes neither endorsement of nor discrimination against any product by the Centre.

ACIAR TECHNICAL REPORTS SERIES

This series of publications contains technical information resulting from ACIAR-supported programs, projects, and workshops (for which proceedings are not being published), reports on Centre-supported fact-finding studies, or reports on other useful topics resulting from ACIAR activities. Publications in the series are distributed internationally to a selected audience.

Lowry, J.B., Petheram, R.J., and Budi Tangendjaja, ed., 1992. Plants fed to village ruminants in Indonesia. Notes on 136 species, their composition, and significance in village farming systems. ACIAR Technical Reports No. 22, 60p.

ISBN 1 86320 071 1

Typeset and laid out by Arawang Information Bureau Pty Ltd, Canberra, Australia.

Printed by Goanna Print Pty Ltd, Canberra, Australia.

Plants Fed to Village Ruminants in Indonesia

Notes on 136 species, their composition, and significance in village farming systems

Editors: J. Brian Lowry, R. John Petheram, and Budi Tangendjaja

Principal contributors:

J. Brian Lowry	CSIRO Long Pocket Laboratories, Private Bag No. 3, Indooroopilly, Queensland 4068
R. John Petheram	Victorian College of Agriculture and Horticulture, Longerenong Campus, RMB 3000, Horsham, Victoria , Australia 3401
Budi Tangendjaja Tiolina Sitompul Supriati Kompiang Dadang Suherman Ashari Thahar Prapti Mahyuddin	Research Institute for Animal Production, P.O. Box 123, Bogor, Indonesia

Australian Centre for International Agricultural Research
Canberra 1992

Preface

FROM 1977 to 1986 a major bilateral project between Australia and Indonesia undertook to develop research on animal production in Indonesia. The Australian contribution took place through CSIRO, within which the project was administratively equivalent to a Division, and was funded through the Australian International Development Assistance Bureau (AIDAB). Initially, the project entailed setting up, under Australian leadership, a major new institute, Pusat Penelitian dan Pengembangan Ternak (P3T), with major Australian contributions in buildings, laboratory equipment and staff training. Australia took more of a support role following a restructuring of the Indonesian agricultural research organisations, when the P3T site at Ciawi outside Bogor became known as Balai Penelitian Ternak (BPT). The Australian component within BPT became known as the Project for Animal Research and Development (PARD), and took a progressively more advisory function.

This publication deals with data gathered at the Ciawi site over the years 1980–1984. After the initial stage of the project, which included the development of an excellent analytical laboratory, a program was implemented to study village farming systems. These studies brought an appreciation of the diversity of plants fed to village ruminants and of their relative nutritional importance.

One of the approved research projects within PARD was on the composition of plants used in feeding village livestock. A few results were published, but it became apparent that this was a large ongoing project. Even plant identification could take a long time. It was originally envisaged that the overall results would be published as an occasional paper by PARD, but the Australian presence at Ciawi was withdrawn before the date initially envisaged in a 1980 review, and at the end of 1985 PARD effectively ceased to exist.

The combined information on plant utilisation and composition for such a large number of species is unique, and of value not only in Indonesia but elsewhere in Asia and the tropical world. The authors are thus grateful to ACIAR for publishing the results as presented here.

Plants Fed to Village Ruminants in Indonesia

Summary

RUMINANT livestock in Indonesia – cattle, buffalo, goats and sheep – are fed almost exclusively on forages, by a combination of hand feeding and grazing subsystems. The plants fed to village ruminants come from the indigenous tropical flora, cosmopolitan weed species and the residues of major and many minor food crops. They include grasses, broadleaf herbs and a high proportion of woody plants. In this study 136 species, including most significant forage plants but excluding most major crop residues, were collected for analysis and identification from sites utilised for feeding. Ash, major minerals, nitrogen, fat, neutral detergent fibre, acid detergent fibre, cellulose and lignin were determined on all species. Some were also analysed for tannin and total phenols, sulfur, and sodium, and the water content in material being collected by the farmer. In vitro dry matter digestibilities were determined on a limited number.

In contrast to a common perception regarding feeds available in the villages, many species were of high quality in terms of proximate composition. A few stand out as being probably of high but unrecognised value. However almost all species had sodium levels inadequate for a high level of animal production. Water content varied widely and this factor may affect the efficiency of cut-and-carry feeding. Lignin: cellulose ratios were higher in the dicot and woody species, relative to the grasses and also to the non-graminaceous monocots. The results suggest several approaches to increasing animal production, in particular the use of salt supplementation as a first obvious step. There also exists scope for strategic feeding of specific classes of livestock within the range of village feeds available.

WITHIN Indonesia, and in particular in Java and Bali, are complex and productive agricultural systems, supporting some of the highest human population densities in the world (c. 10 persons/ha in the most fertile areas). Human population trends elsewhere in the tropics suggests that study of the densely populated systems in Java will have relevance to other areas. Agriculture in Indonesia is oriented toward food crops, but animal production is important within the systems overall (Thahar and Petheram 1983) for a variety of reasons (Knipscheer and Levine 1984). Large ruminants are widely kept, mainly for draught power, and account for the greater proportion (85%) of livestock units. However, the numbers of small ruminants (around 15 million) are higher than large ruminants (around 13 million) and they are often reared by people with little or no land. There may be postharvest grazing of cropped fields, or tethered stock, but much of the feed is cut and carried to the animals from fields under cultivation or wayside places. Surveys of village animal production have shown growth rates in general to be very low (Robinson 1977), while local breeds such as the Javanese Thin-tail sheep and Madura cattle have demonstrated high production under experimental conditions (Chaniago et al. 1984; Petheram et al. 1986). Thus it has usually been assumed that village feedstuffs are of low nutritional quality.

It is frequently claimed that one of the limitations on animal production in Indonesia is the lack of knowledge of feed composition. However, much of this interest in feed composition concerns nonruminant intensive animal production systems. In these, the balancing of nutrients and formulation of diets from least cost constituents provides a direct economic reward. A number of commodities available for intensive animal production are unique to Southeast Asia and certainly deserve rigorous research. For the rearing of ruminants under village conditions the relevance of feed composition is rather different. While one can hardly expect the ruminant rearer to select plants for feeding on the values for crude protein or fibre content, there are good reasons for studying and publishing such data.

The types of pasture that sustain grazing animal production in much of the world are virtually unknown in the more highly populated parts of Southeast Asia. Many of the species encountered in village forage surveys have never been analysed, or indeed properly

identified. The species are diverse and a number of important feed plants are 'unconventional' in terms of ruminant nutrition research. Many are collected from habitats such as semi- or even deep shade, steep banks, or aquatic areas where plants are likely to have very different composition from open pasture. Information on composition can indicate nutritional constraints in the existing system and possible ways of increasing production, reducing labour or increasing efficiency of utilising feed resources.

Unlike feed commodities traded in intensive animal production, a cash value cannot always be ascribed to wayside vegetation gathered by hand. The animal rearing enterprise is directed to providing family security as well as the monetary return from the finished animal. Gathering and transporting feed represents a significant investment of human labour, and knowledge of the relationship between the material gathered and its likely return in animal production is indeed of economic significance. Furthermore, cash sales of feed are very common in East Java and the feed market is increasing, with no control or guidance on relative value of feedstuffs.

To be of any value, composition information for a particular plant has to be linked with its abundance, distribution and growth stage. Together these indicate in practical terms the role it can play in a feeding system. This report attempts to combine both types of information.

Sources of Feed Information

The most systematic collections of feed information are the *Tables of Feed Composition* prepared by the International Network of Feed Information Centres (INFIC). However these are produced on a country-by-country basis. The publication for Australia (Leche 1982), which has been used as a model for this publication, itself contains little of relevance to the Asian tropics. Within Southeast Asia there are compilations for Malaysia (Devendra 1979) and Sri Lanka (Ibrahim, 1988). There are in existence *Indonesian Tables of Feed Composition* (Anon. 1983), but this publication is entirely based on data published in other countries and contains considerable confusion in nomenclature. Thus it equated the commercially dominant oil palm in Southeast Asia (*Elaeis guinensis*) with the Barbassu palm of tropical America (*Orbignya martiana*) which is not only botanically different but produces very different byproducts.

The most useful collection of information has been published by FAO (Bo Göhl 1975). Although having a strong emphasis on the semi-arid tropics and Africa, many of the species described occur in Southeast Asia. Its major disadvantage is that the only data relating to digestibility are the values for crude fibre, and these are of little value for ruminant nutrition. Information on some unconventional feedstuffs has been compiled by Devendra (1985).

Within Indonesia some village feed information was obtained by the Collaborative Research Support Program (CRSP) for Small Ruminants (van Eys et al. 1983).

Data have been published for only 32 species analysed at Ciawi (Lowry et al. 1983). A comparison between feeds in villages in West and East Java, with bulk sampling of forage loads and analysis for neutral detergent fibre (NDF) and minerals has been reported by Little et al. (1988, 1989).

Animal experiments in Indonesia often quote feed analyses, but the feed itself is usually described as 'roadside grass' (rumput lapangan) as though it was a distinct botanical entity. In fact this may range from herbage gathered under a rubber plantation to that from fallowing rice fields, and may contain any combination of grasses, ferns, forbs or shrubs.

A recent major ACIAR project on introduction of forages also provided information on the composition and quality within Indonesia of lines that already have some recognition as forages (Blair et al. 1985).

Scope of Report

This report presents original information on 136 species of plants positively associated with the feeding of village ruminants, mostly in West Java. It does not include major crop residues such as rice straw which have been the subject of considerable study, but does include those used in ways that have not been properly documented. We believe it includes most other species making a significant contribution. As the area is humid with a poorly defined dry season, the data do not in most cases provide a comparison of the wet- and dry-season feed quality for a particular species. However the season and growth stage recorded here provide an indication of when the plant is likely to be available in highly seasonal areas. Tree leaves are an important dry-season supplement in the more seasonal areas, but results on the leaves sampled elsewhere should be applicable.

Initially it was believed that phosphorus would be the limiting mineral nutrient and all samples were analysed for phosphorus, calcium and magnesium. Later, with an awareness of the importance of sodium and sulfur, these elements were also included. Ash, ether extract and nitrogen were analysed as in traditional proximate analysis. Fibre was analysed

according to the van Soest detergent system for neutral detergent fibre, acid detergent fibre, cellulose and lignin (van Soest and Goering 1970). Various functions are available to predict metabolisable energy on the basis of fibre composition (Melo 1990; Minson 1982). These are not discussed here. Phenolics were considered potentially important because of their high level in particular tropical plants, and were measured both as 'total phenols' and as true tannin by a protein precipitation method.

Collecting and Analysing Samples

Collection

All samples were collected from areas where grazing or cut-and-carry feeding was in progress. In some cases a sample of a particular species was extracted from the mixture present in an actual load. More usually, it was necessary to cut the sample separately at the site, taking care to obtain the material as cut by the farmer. This might vary from slicing a compact sward close to the ground to uprooting a whole plant.

Processing

The sample of about 500 g was taken to the laboratory as rapidly as possible, freeze-dried, and ground to pass a 1-mm screen. The ground samples were stored at -10°C. Care was taken to avoid exposing fresh plant material in plastic bags to the sun or a warm environment, as autolytic changes could occur very rapidly. Where it was not possible to bring material quickly to the laboratory, the sample was allowed to dry in a current of air at ambient temperature.

Samples were stored, not only for immediate analysis, but as a reference collection for future research.

Identification

For identification, and as a check against future queries, a specimen of each plant collected was mounted and deposited in the herbarium maintained as part of the Farming Systems Program. The National Herbarium in Bogor was not enthusiastic about receiving scores of voucher specimens from P3T. In order to get fertile material for the herbarium specimen it was often necessary to make repeated visits to the collection site. Plant determinations were carried out by Mrs Dorothy Wheeler (grasses), Dr A.J.H. Kostermans, and staff of the Herbarium Bogoriense.

Analyses

Most dry-matter values were calculated on the freeze-dried material and are therefore marginally higher than those obtained by oven-drying.

Ash and ether extract were determined by the standard methods of the Association of Official Analytical Chemists (AOAC) methods. Nitrogen was determined by the Kjeldahl method. Results are quoted as crude protein, N × 6.25. Elements were determined following perchloric-nitric acid digestion. Calcium and magnesium were determined by atomic absorption spectrometry, sodium by flame photometry and sulfur and phosphorus by spectrophotometric methods.

Gross energy was determined by combustion in a Gallenkamp ballistic calorimeter, calibrated with benzoic acid as a standard.

Neutral detergent fibre (NDF), acid detergent fibre (ADF), cellulose and lignin were determined by the van Soest procedure (Goering and van Soest 1970).

Total phenols were measured as the molybdic acid complexes by the Folin-Cioccalteau method as described by Ribereau-Gayon (1972), using a tannic acid standard. Tannins were measured by the pepsin precipitation method of Hagerman and Butler (1978) also with a tannic acid standard. Condensed tannins were measured using the vanillin method with a catechin standard (Broadhurst and Jones 1978).

Soluble sugars were analysed by high performance liquid chromatography with a refractive index detector.

As analyses were carried out over an extended period it is worth noting that the laboratory maintained internal checks by being part of a network through which samples for proximate analysis were distributed and the results later circulated.

Background Notes

For most of the 136 species identified and analysed in this study there have been no previous data published. Only 22 were recognised as pasture plants, in terms of having been sown purposefully for forage elsewhere. In Indonesia most of these occur as volunteer plants, of which the most valuable in terms of quality and abundance is probably *Centrosema pubescens*. Of the woody plants, five species have recognised forage value. There are also 19 crop species, most of which would be regarded as minor crops but which can assume considerable local importance. Otherwise, the majority of plants in this study, 88 species, are wayside plants from a variety of habitats. They include weeds of cultivation, shrubs and herbs of disturbed sites, and

plantation or forest ground cover. Of particular note are the high proportion of plants characteristic of, and largely limited to, shady habitats (33 species). In addition, a substantial proportion of feed collected consists of non-shade plants growing in shaded sites. There is also a high proportion of woody plants (50 species). This reflects the significance of both 'mixed-garden' farms and the forest fringe in the upland villages as sources of feed.

As might be expected there was a wide range in composition. Almost all consisted of green leaf material, for which the lipid, protein and fibre content were broadly within the expected ranges. However there were more unusual feeds such as the starchy pith of the sago palms, or the peelings from cassava stems. Specific aspects are discussed in following sections. Overall, it would seem that there are a number of species that should have high feeding value, and the role of these should be examined more closely.

Features of Composition

Nitrogen

In Indonesia protein is the limiting nutrient, in terms of price, for intensive animal production. The situation is less clear for ruminants. Nitrogen is obviously deficient for animals on a rice-straw diet or unsupplemented mature grass. However a large number of the species collected in this study had nitrogen levels sufficient to sustain ruminant growth, and some were quite high. Apart from possible problems of nitrogen availability with high-tannin plants (Lowry 1990), it would seem that nitrogen is not limiting for animals fed a mixed diet except where there is a marked dry season.

Fibre

The functions for relating fibre analyses to digestible or metabolisable energy may be found elsewhere (e.g. Minson 1982). These can make use of the lignin values for indicating the release of energy from cellulose. Lignin is usually regarded as the main constraint on the digestibility of cellulose. However the results here indicate nothing of other constraints, such as cellulose crystallinity or highly-branched hemicelluloses.

Grasses tend to have a lower ratio of lignin to cellulose than pasture legumes. This has previously been evident for only a limited range of pasture species and is not usually regarded as a general rule. These results show that this difference has a strong biological basis, holding true over a very wide range of species, and with non-graminaceous monocots showing the same features as grasses (Table 1).

The decline in feed quality with maturity of tropical grasses is well known and is reflected in some of the high NDF values here.

Phosphorus and calcium

Overall, the results do not suggest animals would be likely to suffer acute phosphorus deficiency. This contrasts with results in the American tropics (McDowell et al. 1983). However the calcium: phosphorus ratio varies widely and may be a matter of concern with some diets. Some plants (e.g. kapok, *Ceiba pentandra*) appear to accumulate calcium to remarkable levels.

Sodium

Sodium is an unusual element in that, while it appears to have no role in plant metabolism (and thus there is no sodium requirement for healthy plant growth), it is an essential element in mammalian metabolism. Furthermore, most herbivores have efficient mechanisms for conserving sodium, so that virtually no sodium is required for maintenance. Deficiency is only manifest in pregnant, growing or lactating animals (Denton 1970).

There are few ways in which sodium can be immobilised in nature. Thus in the humid tropics, high rainfall, high temperature increasing solubilisation

Table 1 Comparison of cell wall data for different plant groups

Plant group	NDF-ADF	Lignin/cellulose	Lignin/NDF
Grasses (41 spp.)	29	0.14 ± 0.04	0.06 ± 0.02
Other monocots (5)		0.23 ± 0.09	0.13 ± 0.06
Herb. legumes (21)		0.32 ± 0.12	0.17 ± 0.06
Other herbs (23)	6	0.33 ± 0.14	0.19 ± 0.08
Tree legumes (21)	9	0.73 ± 0.30	0.31 ± 0.09
Other woody plants (29)	7	0.47 ± 0.22	0.23 ± 0.09

NDF: neutral detergent fibre
ADF: acid detergent fibre

generally, and high rates of biological turnover, all ensure that sodium is removed from the system. This is reflected in the results here, where the great majority of plant species had sodium levels below 0.1%. This confirms other results from Indonesia (Little et al. 1988). Direct responses to salt supplementation have been obtained with leucaena (Yates 1983). The response under village conditions is likely to be encouraging (Panggabean and Little 1987). In all probability this is the simplest and least costly method available for increasing animal production. Increased liveweight gain can occur *without* increased feed consumption because supplementation of sodium-deficient animals increases feed utilisation efficiency.

Phenolics and tannins

Phenolic compounds are the most widespread and abundant class of secondary metabolites in plants, particularly woody plants. A few have distinct biological activity (oestrogenic isoflavones, gossypol) but most have low toxicity. However they can occur at very high levels, up to 40% of leaf dry weight in some species (Reed 1986). At high levels they may not only interfere with microbial and enzymatic processes in the digestive tract but also impose a nutritional burden through the requirements for their metabolism and excretion. If, as in some animals they are excreted as sulphate conjugates, there would be an increased sulfur requirement or an induced deficiency. Tannins are those phenolics that precipitate protein from aqueous solutions, and which thus have more direct effects on digestibility. The problem with measuring either total phenols or tannins is that the available methods require the use of a standard compound, such as tannic acid, and results must be given in 'tannic acid equivalents'. Tannic acid is relatively rare compared to the condensed tannins and there are numerous reasons why the compounds actually present may respond differently. Thus the values given are not absolute.

As expected, phenolic levels in the plant groups were in the sequence: woody plants > forbs > grasses. However a few grasses did have a significant phenolic content, and this has never been reported for temperate grasses. In some plants (e.g. *Calliandra callothyrsus*) the phenolics appeared to be all acting as tannin. In contrast *Acacia villosa* had a high phenolic content but almost no tanning activity. Thus earlier analyses that tend to equate tannins with phenolics would give very misleading results. The woody forages did not have the very high phenolic levels reported by Reed (1986) in the semi-arid tropics. Only one species, *Clidemia hirta*, contained appreciable levels of hydrolysable tannin. This is a common shrub in shady areas. Recent experiments have shown that the effects of the tannin can be overcome by supplementation with calcium hydroxide (T.B. Murdiati et al., pers. comm.).

Cut-and-carry feeding; water content

As noted earlier, most animal production is from grazing. The perception of the major contribution coming from cut-and-carry feeding arises from it being a highly visible human activity and an integral part of the rural scene. However, there is no denying the importance of cut-and-carry and the consequent role of the selection process. Farmers state that the major consideration is the relative ease of cutting and carrying, followed by their assessment of palatability. There is little selection as to plant part. Ground herbage tends to be cut very close to the ground and includes much stemmy and senescent material. Pens usually contain substantial amounts of feed residues. One reason for the apparent lack of selectivity may be that the residues accumulate with the animal manure and this is highly valued as fertiliser.

A further important aspect is the range in dry matter content of fresh plants, given that the water content of the load carried will represent wasted effort for the farmer. Dry matter content varies from about 10% for aquatic plants and succulent herbs such as Portulacca, through 10–20% for forbs and grasses, to 25–45% for tree leaves. There can thus be easily a twofold difference in dry-matter content of a load, depending on the mix of species. Forage loads range from 20 to 60 kg, and may be carried anything from 0.5 to 2.5 km. Other things being equal, there would thus be obvious advantages in collecting tree leaves. The work pattern could also be important, in that the longer the interval between cutting the load and carrying it home, the more water is lost by wilting.

Sedges

A feature of the vegetation of fallowing rice fields and other wet places is the high proportion of sedges (family: Cyperaceae). Although closely allied to the grasses their nutritional value has never been studied intensively as they are not important in other systems. They are commonly considered less palatable than grasses, and to contain more silica. Several species were collected in this study but unfortunately none was fully identified. Typical results are given in the entry for *Fimbristylis* sp. Feed evaluation of sedges is an important subject for future research.

Ferns and Allied Species

Six species come under this category and there are certainly other species in use that were not incorporated in this study. Some of these ferns form a significant part of the feed loads gathered in shady areas, and farmers appear to regard them as useful feed. This may be in part because the young fronds of some of these species are used as a vegetable. Despite the small number analysed it is evident that composition is very different from angiosperms, in particular in the low protein and high lignin content. Although the young frond is probably nutritious, it appears that nutritional value declines drastically as the frond reaches full size and while it remains green without any appearance of senescence. As only mature fronds are cut, it is likely that the feeding value is much less than the farmer believes, based doubtless on his use of young fronds. A number of ferns are teratogenic. Depending on the range of species used, this is something to be aware of in future research on reproductive losses in village ruminants.

Strategic and Supplementary Feeding

When there is a range of feed quality, animal production benefits can be maximised by using the highest quality feed for specific purposes such as early weaning, or supplementing the lactating female. This applies generally in animal production systems and has also been demonstrated in Indonesia. Leng (1985) has stressed that most ruminant production systems in Asia are based on low quality crop residues, and that improved production will depend on strategic supplementation of diets with selected high protein green forage species.

The results presented here provide some basis for advising the farmer on what plants to select as high-quality feeds. They indicate which plants currently used as ornamentals have most feeding benefit e.g. *Bauhinia variegata* and *Aralia javanica*. Some species that are currently used are so low in value that animal rearers could be advised to feed them only to certain classes of stock, or as drought or survival rations. Families that have no land at all but keep small ruminants could benefit from information on the relative value of certain tree and wayside species, which are the only available feedstuffs at certain times of the year.

Highlighted Species

Polytrias amaura is a ubiquitous species of roadsides, canal banks and fallow fields throughout Indonesia and Southeast Asia, yet there is no research reported on its value, growth habit, productivity or genetic variation. In addition, the following grasses, while not of particularly high quality, feature strongly in the feeding systems in terms of ubiquity and amount gathered: *Axonopus compressus, Ischaemum timorense,* and *Paspalum conjugatum*. None are highly regarded as pasture plants and there has been very little research done on them. However they are clearly tolerant of repeated cutting and of partial shade. They appear to warrant further evaluation. Also noteworthy (see list) are *Eleusine indica, Maesopsis emenii* and *Peronema canescens*. The swamp sago *Meteroxylon sagu*, although of localised importance, is very much undervalued and under-researched in the ASEAN region as a whole. It could undoubtedly play a major role in animal production.

Conclusion

These results show ruminant animal production utilising a range of plants much wider than previously reported in any single source. Given the biological diversity embodied in this range, the high primary productivity of the humid tropics, and the range in feed composition that can be dealt with in the ruminant tract, the fundamental outlook for animal production appears bright. There appear many opportunities to improve animal nutrition by a better understanding of the plant resources in the feeding system. A significant factor is the innovative ability of small-scale farmers. The challenge remains for local scientists and information services to devise ways for applying the information presented here to village ruminants, and thus ensure that this information reaches those who could benefit most – the small-scale ruminant rearers.

References

Anon. 1983. Indonesian tables of feed composition. Gadjah Madah University, Jogjakarta.

Blair, G.J., Ivory, D.A., and Evans, T.R. ed. 1985. Forages in Southeast Asian and South Pacific Agriculture. ACIAR Proceedings No. 12, Canberra, 202 p.

Bo Göhl. 1975. Tropical Feeds. FAO, Rome.

Broadhurst, R.B., and Jones, W.T. 1978. Analysis of condensed tannins using acidified vanillin. J. Sci. Food Agric., 29, 788–794.

Burkill, I.H. 1966. Dictionary of Economic Products of the Malay Peninsula. Ministry of Agriculture and Cooperatives, Kuala Lumpur.

Chaniago, T.D., Obst, J.M., Parakasi, A., and Winugroho, M. 1984. Growth of Indonesian sheep under village and 'improved' management systems. Ilmu dan Perternakan, 1, 231-237.

Craigmill, A.L., Eide, R.N., Shultz, T.A., and Hedrick, K. 1984. Toxicity of avocado (*Persea americana*) leaves: review and preliminary report. Vet. and Human Toxicol., 26, 381-383.

Denton, D. 1970. The Hunger for Salt. Springer-Verlag, Berlin.

Devendra, C. 1979. Malaysian feeding stuffs. Malaysian Agricultural Research and Development Institute, Serdang, Selangor, Malaysia. p. 145.

Devendra, C. 1985. Non-conventional feed resources in Asia and the Pacific. FAO, Bangkok. p. 140.

Goering, H.K., and Van Soest, P.J. 1970. Handbook 379, U.S. Dept of Agric.

Hagerman, A.E., and Butler, L.G. 1978. Protein precipitation method for the quantitative determination of tannins. J. Agric. Food Chem., 26(4), 809-12.

Harris, L.E., Haendler, L., Riviere, R., and Rechussat, L. 1980. International Feed Databank system: an introduction to the system with instructions for describing feeds and recording data. INFIC Publication 2.

Ibrahim, M.N.M. 1988. Feeding tables for ruminants in Sri Lanka. Veterinary Research Institute, Gannoruwa, Sri Lanka. p. 137.

Jones, R.J., and Lowry, J.B. 1984. Australian goats detoxify the goitrogen 3-hydroxy-4(IH)pyridone after rumen infusion from Indonesian goats. Experimentia, 40, 1435-1436.

Knipscheer, H., and Levine, J. 1984. The status of ruminants in Indonesia, with special reference to research needs. Small Ruminant Cooperative Research Program, Balai Penelitian Ternak/USAID, Bogor, Indonesia.

Leche, T.F. 1982. Composition of animal feedstuffs in Australia. Aust. Feed Inf. Centre, CSIRO, Prospect, NSW, Australia. 209 p.

Lee, D.W., and Lowry, J.B. 1975. Physical basis and ecological significance of iridescence in blue plants. Nature, 254, 50-51.

Leng, R.A. 1985. Determining the nutritive value of forage. In: Blair, G.J., Ivory, D.A., and Evans, T.R., ed., Forages in Southeast Asian and South Pacific Agriculture. ACIAR Proceedings No. 12, Canberra, 111-123.

Little, D.A., Kompiang, S., and Petheram, R.J. 1989. Mineral composition of Indonesian forages. Tropical Agriculture (Trinidad), 66, 32-37.

Little, D.A., Petheram, R.J., and Boer, M. 1988. Observations on the mineral content and nutritive value of diets fed to village ruminants in the Indonesian districts of Bogor (west Java) and Pamekasan (Madura, east Java). Tropical Agriculture (Trinidad), 65(3), 213-218.

Lowry, J.B. 1990. Toxic factors, problems and methods for alleviating these in farm animals. In: Devendra, C., ed., Shrubs and Tree Fodders for Farm Animals. IDRC, Ottawa, Canada, 76-88.

Lowry, J.B., Thahar, A., Sitompul, T., and Petheram, R.J. 1983. Composition of some village ruminant feedstuffs in west Java. Proc. 5th World Conf. Anim. Prod., Vol. 2. Japanese Zootechnical Society, Tokyo, 559-560.

McDowell, L.R., Conrad, J.H., Ellis, G.L., and Loosli, J.K. 1983. Minerals for grazing ruminants in tropical regions. USAID and Center for Tropical Agriculture, University of Florida, Gainesville, 86 p.

McLeod, M.N., and Minson, D.J. 1978. The accuracy of the pepsin-cellulase technique for estimating the dry matter digestibility in vivo of grasses and legumes. Anim. Feed Sci. and Technol., 3, 277-87.

Melo, I.M.P. 1990. Prediction of digestibility of feedstuffs using cell wall constituents and enzymatic solubilities. World Rev. Anim. Prod., 25(1), 83-88.

Minson, D.J. 1982. Effect of chemical composition on feed digestibility and metabolisable energy. Nutrition Abs. and Rev., 52(10), 592-612.

Murdiati, T.B., and Lowry, J.B. 1983. Toxicity of *Brachiaria decumbens*. Research Report, Project for Animal Research and Development/Balai Penelitian Ternak, Bogor, Indonesia, 56-57.

NAS (National Academy of Sciences) 1979. Tropical legumes: resources for the future. Advisory Committee on Technological Innovation, National Academy of Sciences, Washington, D.C.

Panggabean, T., and Little, D.A. 1987. Effect of supplementary sodium and selenium, and the provision of drinking water on the performance of young Javanese thin-tail rams fed roadside grass. Tropical Agriculture (Trinidad), 64(3), 209-211.

Petheram, R.J., Prawirodigdo, S., and Boer, M. 1983. Assessment of hand-fed forage diets in villages. Research Report, Project for Animal Research and Development/Balai Penelitian Ternak, Ciawi, Indonesia, 38-39.

Petheram, R.J., Prawirodigdo, S., and Prasetyo, H. 1986. Farm trials with Madura cattle: supplements for village diets. Networking paper 1, Farming Systems Support Project, Agency for International Development/University of Florida, Gainesville, U.S.A.

Reed, J.D. 1986. Relationships among soluble phenolics, insoluble procyanidins and fibre in East African browse species. J. Range Management, 39, 5-7.

Ribereau-Gayon, P. 1972. Plant Phenolics. Hafner, New York. p. 47.

Robinson, D.W. 1977. Livestock in Indonesia. Centre for Animal Research and Development, Centre Report No. 1, Ciawi, Indonesia.

Thahar, A., and Petheram, R.J. 1983. Ruminant feeding systems in West Java, Indonesia. Agric. Systems, 10, 87-97.

Van Eys, J.E., Mathius, I.W., Thomas, N., Rangkuti, M., and Johnson, W.L. 1983. Forage composition of sheep and goat diets in West Java. Small Ruminant C.R.S.P., Working Paper No. 24. Balai Penelitian Ternak, Bogor.

Van Soest, P.J., and Goering, H.K. 1970. Handbook No 379, U.S. Dept of Agriculture.

Van Soest, P.J., and Robertson, J.B. 1980. Systems of analysis for evaluating fibrous feeds. In: Pigden, W.J., Balch, C.C., and Graham, M., ed., Standardisation of analytical methodology for feeds. Ottawa, IDRC, 49-60.

Wina, E., Evans, A.J., and Lowry, J.B. 1986. Composition of the sago palms *Metroxylon sagu* and *Arenga pinnata*. J. Sci. Food and Agric., 37, 352-358.

Yates, N.G. 1983. The effect of a salt and trace element supplement on the growth of Javanese sheep offered *Leucaena leucocephala*. Tropical Animal Production, 50-52.

Yulvian, S., Hooper, P.T., and Stolz, D.R. 1986. Toxicity of *Ageratum conyzoides* (babadotan) fed to rats. First Indonesian Toxicology Conference, Bandung. Abstracts, 26-27.

Results

Results are presented in alphabetical order of scientific name, in the form:

Scientific name **Plant family**

Local and vernacular names; plant habit (tall tree, creeping herb etc.); distribution and habitat

Plant part analysed

Table of analytical data

Notes on significance and use in the forage system

Abbreviations used are as follows:

DM, dry matter content (%); Ash (%); P, phosphorus (%); Ca, calcium (%); Mg, magnesium (%); S, sulfur (%); Na, sodium (%); CP, crude protein (%); EE, ether extract (%); GE, gross energy (KCal/g); NDF, neutral detergent fibre (%); ADF, acid detergent fibre (%); Cel, cellulose (%); Lig, lignin (%); TP, total phenolics (%); T, tannins (%).

Where there were fewer than four replicate collections, the full set of analyses are presented. We consider this gives a better idea of the variation encountered than quoting means and ranges. Where possible description of the plant part analysed and its condition is given according to the INFIC system (Harris et al. 1980). Any additional results not in the tabulated line are given in the notes following. These consist principally of in vitro dry matter digestibility (IVDMD) by the pepsin-cellulase method, but also include 'condensed tannin' (CT) and total soluble sugars. Most values are rounded, not because of imprecision in the analyses, but to save space when the variation between samples was so great as to make the additional digit valueless.

Acacia auriculiformes A. Cunn. Mimosaceae

Acacia; tree, small, highly branched, to 10 m; Java, Southeast Asia, dry or infertile sites.

Leaves (phyllodes), mature

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.2	1.6	0.2	0.19	0.13	17	5	22	49	33	16	17	8.3	8.3
-	8	0.3	1.3	0.2	-	-	11	3	21	42	32	15	17	13	1.1

Tree originally indigenous in Torres Strait area, widely planted in Asia and acclaimed for potential in revegetation of leached, eroded sites, pulp or fuelwood; feeding value of rather leathery phyllodes generally regarded as nil, but *is used* as dry season feed for cattle in East Java and Madura. IVDMD 40%.

Acacia villosa Willd. Mimosaceae

Acacia, lamtoro merah, lamtoro cina (Indonesia); shrub or small tree, highly branched, to 4 m.; Java, Timor, locally abundant near former teak plantations.

Leaflets (from doubly pinnate leaves)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	3	0.4	0.7	0.1	-	-	28	4	23	20	12	7	5	13	-
-	4	0.3	0.6	0.2	-	0.01	22	6	-	23	-	-	-	12	6
-	4	0.2	0.6	0.1	-	0	26	5	-	28	19	9	9	13	-

Vernacular names from resemblance to leucaena; researchers must be able to distinguish these species. Currently incorporated in leaf meal from some areas. Species introduced as nurse tree in plantation forestry, almost unknown elsewhere. Contains high phenolic level with low tanning activity.

Aeschynomene americana Linn. Papilionaceae

Joint-vetch; herb, sub-shrub, slender, woody to 0.7 m; Java, Southeast Asia; sporadic near cultivation.

Leaves and terminal branchlets

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	5.9	0.2	1.2	0.4	-	0	21	42	19	36	25	19	501	1.6	0.8

Frequent around Bogor, perhaps due to introduction via Botanic Gardens. Palatable to ruminants.

Ageratum conyzoides Linn. Asteraceae

Barbadotan (Indonesia); rumput tahi ayani (Malaysia), herb, annual, to 0.5 m; Java, pantropical weed in less dry areas, fertile soils.

Aerial, vegetative (3)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
15	12	1.6	0.5	0.4	-	0.03	16	6	17	41	33	27	6	0.6	0
-	14	0.5	1.5	0.5	-	-	16	3	17	-	-	-	-	-	-

Abundant as post harvest weed, fed in large amounts. Causes liver damage when fed to rats (Yulvian et al. 1986).

Albizia chinensis Merr. Mimosaceae

Jaenjeng (Java); tree to 15 m, volunteer; Java.

Leaflets

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	4	0.4	0.5	0.4	-	0.03	40	4	22	56	31	14	17	0.7	-
-	4	0.2	0.7	0.3	-	0.02	32	5	-	50	28	12	15	5.2	2.2
-	4	0.1	0.6	0.4	-	0.03	26	5	-	50	26	13	13	4.1	1.0

Leaf rachis and rachillae

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	Tp	T
-	4	0.3	0.3	0.3	-	-	8	5	-	38	17	12	6	-	-
-	6	0.1	1.1	0.2	-	0.01	14	3	-	57	45	28	16	-	-

Appearance and uses similar to *A. falcataria* (also called *jaenjeng*) but tree smaller, volunteer seedlings appear more readily. May not be planted deliberately in villages. No record of distribution outside Java.

Albizia falcataria Backer — Mimosaceae

Jaenjeng (Java); tree, large, rapidly growing, open spreading crown; Java, indigenous to Moluccas, widespread in wet tropics

Leaflets (Mean and SD; n = 5)

Dm	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	Tp	T
-	5.6	0.2	0.8	0.30	-	0.02	23	5	20	35	29	18	10	5.6	2.2
-	1.2	0.1	0.4	0.05	-	-	2	1	1	3	6	3	5	-	-

Increasingly important plantation forestry species for rapid growth for pulp and sawlog production. Potentially large leafmeal resource. Already incorporated in village farming systems of much of Java. Leaves valued for feeding sheep and goats and often harvested by climbing tree to 10 m to lop lower branches. Poles and timber very commonly used in house construction, despite softness, vulnerability to termites, and hence short life.

Alocasia macrorhiza Schott. — Araceae

Sente (Indonesia), elephant ear, cunjevoi (Aust.); herb, perennial, erect to 2 m, with thick prostrate rhizome; Java, Asia, Australia in wet areas, wild or cultivated

Leaf lamina

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
16	11.2	9.3	2.9	9.2	-	0.12	18.5	6.9	18.2	25	25	20	5	0.6	0

Petiole

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
12	9	0.6	0.7	0.3	-	- 0.4	5.0	1.0	14.7	19	10	8	2	0.4	0.1

Leaves sometimes cooked for monogastric animals or fed directly to fish. Fresh juice notoriously caustic or irritant. Starchy rhizome used as emergency food after rigorous preparation.

Amaranthus viridus Linn. — Amaranthaceae

Bayam (Southeast Asia); wild amaranth; herb, annual, to 0.4 m; Java, weed of cultivated land.

Whole aerial part, early flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	15	0.5	1.4	0.9	-	-	19	30.3	17	41	21	17	4	2	1
-	21	0.6	3.0	0.5	-	0.04	25	3.4	16	28	22	19	3	1	0.2

Very commonly fed to ruminants, and rabbits. Also used as vegetable. May contain nitrates but unlikely to be fed at levels to cause nitrate/nitrite toxicity.

Antidesma hunii Spreng. Euphorbiaceae

Huni (Sundanese); Buni (Java); tree to 10 m; Java, Southeast Asia; forest and village.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
20	14	0.2	1.7	-	0.15	0.04	15	6	17	31	27	17	7	2	1

Occurs wild as rapidly growing pioneer species but in Java also cultivated for fruit. Leaves valued for feed for village ruminants.

Apluda muticum Poaceae

Kolonjono (E. Java); grass, stolons ascending and trailing, to 2 m; Java, S. Sulawesi.

Leafy aerial part above leafless stolon, vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
46	7	0.1	0.2	0.2	13	0.04	4	2	18	75	51	41	6	-	-
-	10	0.4	0.3	0.4	-	0.01	9	3	-	65	41	32	4	-	-

A long-stemmed grass that scrambles through and over scrubby vegetation in the wet tropics and also in dry savannah grassland. Used occasionally in W. Java but frequently in E. Java and Philippines. Quality low because of high stem:leaf ratio.

Aralia javanica Araliaceae

Daun kedongdong (Indonesia); celery tree (Aust.); shrub to 2 m; Java, Southeast Asia; in villages cult., ornamental.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
17	14	0.3	2.9	-	0.2	0.05	15	5	17	33	28	23	5	-	-
17	15	0.3	2.9	-	0.2	0.07	17	5	17	31	27	21	5	-	-

Frequent in hedgerows. Leaves highly polymorphic. Young leaves used in lalap (salad). Highly palatable to rabbits.

Arenga pinnata Merr. Arecoideae

Aren (Java); sugar palm (S.E. Asia); palm, single stemmed, to 20 m; Java, Southeast Asia, agricultural land and forest margins.

Stem pith, mature plant

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	4.5	0.2	0.1	0.3	-	0	5	0.8	-	32	14	13	10	-	-

Whole pith occasionally fed to livestock. Locally may be used extensively especially for ducks (west coast of Java). Main use for sago extraction, and leaf fronds for roofing (atap in Java). The main constituent of sago pith is starch. For detailed composition see Wina et al. (1986).

Artocarpus heterophyllus Moraceae

Nangka (Indonesia, S.E. Asia), Jak (India), Jackfruit; tree, large, to 20 m.; Java, Southeast Asia, in and near villages.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	12.1	0.1	2	0.3	0.2	0.05	17	3	17	30	30	22	5	2.5	1
32	12.4	0.4	1.2	0.2	0.2	0.15	13	4	18	33	32	21	6	2.0	0

Leaves highly palatable to goats but no obvious reason apparent from composition although lignin is relatively low. Village rearers consider its leaves the best of any tree for ruminant feed. IVDMD 54%. Raw fruit is cooked as vegetable and sweet ripe fruit is eaten raw. Timber used in building and for ploughs.

Axonopus compressus Poaceae

Jukut pahit (W. Java), Carpet Grass (Australia); grass, rhizomatous, creeping, forming dense turf; Java; pantropical in wet climates.

Leaf, mature vegetative and flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.2	0.5	0.3	-	0.03	11	3	18	69	41	33	4	0.5	0
-	10	0.3	0.6	0.3	-	0.09	9	3	-	66	37	28	5	-	-
-	12	0.4	0.3	0.3	-	-	11	2	18	-	-	-	-	-	-

Well known tropical ground cover grass. Major component of ruminant feed in villages where forage cut from shady areas. Productivity under repeated cutting not known, but few grasses survive shade and cutting as well as this species. Often occurs with *Paspalum conjugatum*, and the two species have the same name in parts of Java. IVDMD 50%.

Bauhinia purpurea Linn. Caesalpiniaceae

Tapak kuda (from cloven-hoof leaf shape), orchid tree; small tree; leaves large, bilobed; widespread in tropics.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
30	9	0.3	1.6	0.4	-	0.02	25	5	19	45	32	25	7	1.1	0

Common decorative tree. Worth considering as feed resource because of abundance around villages (cf *Aralia javanica*), rapid growth and regeneration after cutting, high leaf to stem ratio, apparent freedom from pests and high palatability (to rabbits at least). A good forage reserve.

Blechnum orientale Linn. Pteridophyta

Paku lipan (Indonesia); herb (fern), tufted, perennial, to 1.5 m; Java, Southeast Asia, Australia; in damp shaded places.

Frond

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13.6	0	0.5	0.3	-	0.02	5	1.5	-	45	47	22	17	11	8
-	11.2	0.04	0.5	-	0.12	0	9	3.1	17	45	40	27	7	4	2

Robust fern with once-pinnate fronds. Frequent in loads in some villages. Animals undoubtedly reject fibrous stipe, so composition of part eaten probably better than above.

Boreria alata Rubiaceae

Bulu lutung (Sund.); herb, annual, prostrate to 0.2 m; Java, widespread on disturbed sites.

Aerial, vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	18	-	-	-	-	-	10	2.2	-	48	44	30	10	-	-
-	15	0.2	1.7	0.4	-	0.01	12	4.0	-	34	26	19	5	1.5	2
-	17	0.3	1.4	-	0.5	0	20	4.5	17	30	27	20	4	-	-

Found in forage loads but probably not collected deliberately. A number of medicinal uses recorded (Burkill 1966).

Brachiaria decumbens Poaceae

Brachiaria (Indonesia); signal grass; grass, perennial, robust, creeping, culms to 0.5 m; Java, Sumatra; planted and occasionally naturalised.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.3	0.4	0.3	-	0	3	1	18	71	43	31	6	-	-
-	9	0.2	0.4	0.3	-	-	5	2	17	73	41	32	4	0.6	0
-	10	0.1	0.5	0.3	-	0	10	2	17	65	37	29	4	-	-

Vigorous grass widely planted in wet tropics. Used on some projects in Indonesia. Potentially valuable but still under question because of sporadic hepatotoxicity. Possibly mycotoxin in litter (Murdiati and Lowry 1983).

Brachiaria distachya Stapf Poaceae

Annual brachiaria; grass, annual, low, creeping; Java, wet tropics; volunteer annual.

Aerial leafy part, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
16	11	0.2	0.6	-	-	0.09	20	3	16	60	23	27	3	0.8	0.2
17	12	0.3	0.2	0.6	-	0.06	13	3	15	62	37	31	4	-	0

Annual brachiaria appears palatable and of high quality but does not occur in large quantity. A much smaller plant than *B. decumbens*.

Brachiaria mutica Stapf Poaceae

Rumput melela (Java); para grass; grass, vigorous with creeping stolons and culms to 2 m; Java, tropics, on flooded soil.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.2	0.5	0.2	-	0.1	8	3	17	70	40	34	4	0.1	0

Large grass on edge of water or seasonally flooded areas. Major feed of buffalo in South Kalimantan swampland, rarely seen in closely cultivated areas. Regarded as good feed. Composition is highly dependent on sampling method, as upper leafy portion may be attached to long coarse stem.

Brachiaria paspalioides Poaceae

Annual brachiaria; grass, annual, low, creeping; Java, wet tropics, volunteer annual.

Aerial leafy part, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
28	10	0.4	0.5	0.2	-	0	9	3	14	72	34	27	3	-	-

Slender annual brachiaria, inconspicuous but possibly frequent in feed in some localities. Disappears in dry season.

Brachiaria repens Poaceae

Torpedo grass; grass, creeping perennial. rhizome with torpedo-like swelling near tip; Java, naturalised in wet places (weed).

Aerial leaf part; mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
11	0.2	0.3	0.4	-	0.2	-	12	3	-	61	29	25	3	-	-
13	0.3	0.5	0.2	-	0.1	-	12	2	17	63	36	28	3	-	-

A perennial brachiaria very much smaller and less productive than *B. decumbens*, but seen rather often, and frequently seen in feed loads from swampy ground.

Bridelia monoica Euphorbiaceae

Kandri (Java); tree, small, to 8 m; Java, volunteer tree or shrub on fertile sites

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
35	11	0.3	2.7	0.6	0.6	0.05	20	7	19	30	28	18	8	-	-

Typical of a number of rapidly growing volunteer (bird-dispersed) shrubby Euphorbiaceae, leaves probably good feed.

Calliandra callothyrsus Mimosaceae

Kaliandra merah, kaliandra (Indonesia); bushy shrub or small tree to 6 m; Java, Central America; rare elsewhere in tropics.

Leaflets (mean & S.D.; n = 8)

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	5	0.3	0.8	0.2	-	-	24	5	23	34	26	15	10	9	9
-	0.7	0.1	0.4	0.02	-	-	4	2	3	8	4	2	3	3	4

Well known tree legume, originally introduced to Java as ornamental. Multiple uses discovered in Java and now being promoted throughout tropics. Despite high content of condensed tannin, fresh leaf material valuable feed for ruminants. Research continuing. Contains also non-tanning phenolics such as quercetin-3-rhamnoside.

Calopogonium mucunioides Desv. Papilionaceae

Calopo; herb, creeping or weakly climbing; Java, pantropical; annual pasture legume.

Aerial, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	7	0.2	0.9	-	-	0.01	20	6	19	42	32	24	7	0.5	0
-	8	0.1	1.4	-	0.2	0	15	4	-	49	37	29	7	0	0

Originally introduced as cover crop under rubber plantations, persists in high rainfall areas as annual volunteer, incorporated in cut feed, unpalatable by itself. IVDMD 63%.

Canna indica Liliaceae

Ganyong, canna lily; herb, perennial, to 2 m; Java, widespread in warm climates, mostly cultivated.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
16	14	0.4	1.0	0.5	-	0	13	5.6	16	44	20	17	2	5.2	1.4
14	15	0.2	0.7	0.4	-	0.1	16	5.4	17	37	21	19	2	4.8	-
-	15	0.4	1.1	0.4	-	0.3	15	4.3	-	50	26	22	3	6.5	0

IVDMD = 64%

Capparis sp. Capparidaceae

Herb, annual, creeping or erect to 0.25 m; Java, widespread, weed of disturbed sites.

Aerial, early flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	14	0.4	2.9	-	1.0	0.07	17	3	16	45	35	28	6.4	-	-

Carica papaya Caricaceae

Papaya, paw paw; giant herb, tree-like, with stout non-woody trunk; pantropical, cultivated for fruit.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
13	9	-	-	-	0.4	0.06	19	5.2	18	19	17	13	2	2.3	-

Familiar fruit plant around houses and villages and in commercial gardens. Low lignin content of leaf supports herbaceous nature. Leaves contain the alkaloid carpaine in addition to papain enzyme, but are included in feed loads.

Ceiba pentandra Gaertn Malvaceae

Kapok (Indonesia and throughout Asia); tree, large, to 40 m, deciduous; Java, Asia; villages, boundaries of cultivated fields, roadsides.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13	0.3	4.4	0.6	-	0.1	20	7	-	26	20	15	4	3	0
-	21	0.2	7.2	0.3	-	-	10	12	-	19				7.0	-
-	15	0.2	6.9	-	0.2	0	-	10	-	23	-	-	-	-	-
-	18	0.2	4.8	0.5	-	0.03	14	5	-	24	17	11	6.4	-	-

Results variable but remarkably high in ash, Ca, and ether extract. Extensively used as dry season feed in C.E. Java and W. Timor. Seed cake used locally as concentrate. Gossypol content low (Amlius Thalib unpubl.) but contains antinutrients.

Centrosema pubescens Benth. Papilionaceae

Centro, butterfly pea; herb, twining and strongly climbing; Java, Asia.

Aerial, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.2	0.9	0.2	0.2	0	20	3	19	47	28	20	7	-	-
28	7	0.2	1.0	0.2	0.2	0.11	22	4	-	42	32	25	7	-	-
27	8	0.3	1.2	0.3		0.02	22	5	18	44	32	22	8	-	-

Important tropical pasture legume; in Java rarely sown but common throughout in wayside vegetation, nowhere abundant. Forage sought after by ruminant rearers in W. Java.

Chrysopogon acicularis Trin. Poaceae

Rumput jarum (W. Java); suket dondomen; love grass; grass; tough creeping rhizomes and short leaf; Java, tropics; widespread on dry exposed sites.

Leaf only; mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.2	0.5	0.1	-	0	13	2	17	68	32	24	4	1.1	0.2
37	9	0.4	0.2	0.3	-	0	10	3	18	74	33	27	4	-	-

Leaf and stem; dry season, whole plant lifting from soil

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	17	0.1	0.7	0.1	-	0	4	1	16	68	40	24	5	-	-
-	15	0.2	0.4	0.2	-	0	4	1	-	68	48	32	7	-	-

Tough persistent grass; emergent seed heads notoriously tough to cut in lawns. Leaves appear slight but are one of last remaining feeds on heavily grazed fields. Persists longer into dry season than other common grasses.

Clidemia hirta D. Don — Melastomataceae

Harendong (Sund.); shrub to 2 m; Java, S.E. Asia; wet climate, shaded sites; abundant.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
32	10	0.2	1.6	0.24			9.5	1.6	-	30	27	20	6	21	20

Introduced tropical American species. Common on banks and slight shaded sites, used sparingly, contains high level of hydrolysable tannin, berries eaten by children.

Clitorea laurifolia Poir — Papilionaceae

Urek-Urekan; herb, subshrub, erect, 0.5 m.

Leaves and terminal branches, early flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
35	5	0.2	0.7	0.1	-	0	15	4	19	44	43	21	13	8.4	6
-	4	0.2	0.7	0.1	-	0	17	5	-	40	33	21	11	-	2
-	4	0.1	0.7		0.1	0	18	5	18	55	33	24	9	-	-

Common but nowhere abundant, on dry exposed banks. Because of habitat, probably a valuable species for ground cover and feed.

Colocasia esculentum Schott — Araceae

Talas (Indonesia), Cocoyam (Engl.), Taro (Polynesian), Gabi (Philippines); herb, perennial, erect to 1.5 m with starchy corm; Java, Asia, Pacific; cult. and wild in swamp places.

Aerial, leaf blade, wild variety

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13	0.4	1.0	0.2	-	-	19	6	19	34	22	17	5	1.7	0.2

Many varieties in cultivation for starchy corm or stem. As with virtually all Araceae, fresh leaves have strongly irritant properties. Used as feed after boiling. Note low DM and high CP.

Commelina nudiflora Linn. Commelinaceae

Brambangan (Java), Wandering Jew; herb, perennial, creeping; Java, widespread on wet sites.

Aerial vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	18						15	3	19	53	39	30	5	-	-
-	20	0.5	1	0.3	-	-	14	2	15	46	34	27	5	-	-
-	18	0.3	1.2	0.4	-	0	16	5	16	54	33	23	6	0.8	0.2

Mucilaginous leaves also eaten as a vegetable. This and related species frequently cut for feed but low dry matter content must make this unrewarding.

Crotalaria mucronata Papilionaceae

Giring-giring (Ind), rattlepod; herb or weakly woody shrub to 1 m; Java, pantropical.

Leaf and terminal shoots, early flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	5.3	0.2	1.3	0.3	-	0	15	4	18	28	17	15	2	1.4	0

Contains pyrrolizidine alkaloids and would probably be toxic if fed in quantity. Normally used in small amounts in mixed loads. Sometimes gathered for rabbits. Several other *Crotalaria* species have similar composition and occurrence.

Curculigo latifolia Dryand Hypoxidaceae

Lumbah padi, kelapa puyoh; herb, perennial, stemless, leaves erect to 1 m; Java, Southeast Asia, forests, forest margins and shaded occasionally as ornamental.

Aerial, leaf blade

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	11	0.3	1.7	0.3		-	11	5	18	48	42	35	6	4.4	-
24	9	0.2	1.3	-	0.2	0.01	13	5	-	49	37	32	5	2.5	0.2

Leaves cut for feed. Also noteworthy for taste-modifying properties of small white fruit.

Cyclosorus parathelypteris Pteridophyta

Paku; herb, terrestrial fern erect to 1 m; Java; Southeast Asia; shaded places.

Aerial, frond without stipe

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	12	0	0.6	0.3	-	0.02	11	2	-	48	47	20	26	4.8	2.0

Cynodon dactylon Pevs. Poaceae

Grintingan (Java), Bermuda grass, couch grass; grass, narrow leafed, creeping, forming dense swards; Java, wet tropics.

Aerial leafy part, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	12	0.3	0.9	0.2	-	0	14	3	17	65	34	24	4	-	-

Well known tropical pasture and turf grass. Doubtfully planted for this purpose in Java but widely naturalised, usually dominant in very small discrete patches.

Cynodon plectostachyus Poaceae

African star grass; grass, narrow leafed, vigorous, creeping and ascending; Java, wet tropics.

Aerial leafy part, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	9	0.4	5	0.2	-	0.03	14	3	15	68	31	25	4	1.1	0.7
-	10	0.3	0.7	0.1	-	0.06	10	3	16	74	39	30	4	-	-

Well known pasture grass. Introduced to Java. Mainly found around government research stations. Highly productive pasture under high levels of N and moisture. Has larger inflorescence than *C. dactylon*.

Cyrtococeus accrescens Poaceae

Rumput telor ikan; grass, broad leafed, creeping stolon and short erect stem; Java, shady places.

Leafy stem, early flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	11	0.3	0.3	0.2	-	0	13	5	17	58	34	27	5	-	-

Forms open sward in shady places, height variable. Frequently used. Response to cutting and productivity worth knowing in view of unusually shady habitat, for grasses.

Desmodium heterophyllum DC Papilionaceae

Heuhealangan (Sund.), hetero (Aust.); herbaceous trifoliate legume, creeping, usually overtopped by grasses; Java, pantropical in wetter climates.

Whole aerial part, early flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
21	12	0.2	1.8	0.6	-	0.09	13	4	-	52	37	25	10	3.9	1.7
20	8	0.2	0.5	0.3	-	0	14	5	--	21	40	29	9	3.4	2.6

One of the few pasture legumes that is found in wayside vegetation of roads, canals, and ricefield banks. Widespread but plant usually hidden in complete sward. Contribution probably via N fixation as well as feed value. Selection and evaluation of local lines should be carried out. Collection and sale of seed could be valuable village industry, because of high value placed on seed in N. Australia.

Desmodium triflorus DC. Papilionaceae

Rumput sisek pateh, rumput jarem (Java); herbaceous trifoliate legume, small, creeping or in dense mat; pantropical, in lawns and grassland, usually below sward.

Aerial part

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	12	0.2	1.6	0.3	-	0.04	18	4	-	50	35	23	8	-	-
-	6	0.1	1.5	-	0.2	0	15	4	-	50	36	25	10	-	_

This very small legume probably makes a useful contribution to close grazed pasture and to N fixation, but is usually too small and close to the ground to be used in hand cut feed.

Dicranopteris linearis Gleicheniaceae

Resams, paku andam; fern with dichotomous branching, creeping rhizome; Java, Asia. Locally dominant on infertile open sites.

Frond with pinnules, full sized, still green

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
38	6	-	0.3	0.2	-	0.03	6	4	-	39	29	18	11	-	-

Included in feed loads. Composition varies continuously from nutritious young fiddlehead to highly lignified virtually dead frond. Collection of sample as cut by farmers.

Drymaria cordata Willd. Caryophyllaceae

Chickweed; herb, creeping and densely branching, forming thick layer on wet ground; widespread weed in wet tropics (e.g. on tea plantations).

Aerial vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
13	10	0.5	1.6	0.4	-	0	22	4	18	44	30	24	6	1.0	0.3

This is one of a number of otherwise obscure species that gain significance because of large amount of wet habitat provided by the ramifying irrigation systems in Java.

Echinochloa colona Link Poaceae

Watuton (Java); grass, tufted, leaves to 0.5 m; Java, in damp places.

Leaf, mature, flowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
17	13	0.2	0.6	0.4	-	0	9	2.4	17	65	41	33	4	-	-

Locally abundant, particularly in fallow sawah, and along canals and dam edges.

Echinochloa stagnina Poaceae

Grass, robust leafy tops rising to 2 m from long stolons submerged in swamp or floating; pantropical.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.3	0.5	0.3	-	0.1	11	3	17	53	44	37	5	2.1	0

A major feed for buffalo in the swamps of South Kalimantan, where it forms dense stands in deeper water; often with dense para grass at the shallow edges.

Eleusine indica Gaertn Poaceae

Jukut jampang (Sund.), juket carulang; goose grass; grass, tufted, annual or ephemeral; pantropical; rapidly growing weed after cultivation.

Leaf (whole aerial part), preflowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
23	10	0.1	0.8	0.5	-	0.03	20	3	18	55	30	27	2	0.8	0.1
23	11	0.4	0.8	0.4	-	0.02	19	3	17	59	30	26	2	-	-

Whole aerial part, mature, postflowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.2	1	0.4	-	0.04	7	2	17	75	39	33	3	0.8	0
26	9	0.4	0.7	0.2	0.3	0.05	9	3	19	71	39	34	3	-	-

This species is a well known weed of cultivation in warmer climates. In Java probably seldom presents a problem because of the intensity of cultivation. Instead it would seem to be an excellent feed plant, with composition apparently the best of the local grasses when used before flowering. The possibility of managing this to increase quality of feed from harvested fields should be considered.

Enterolobium cyclocarpum Gris. Mimosaceae

Large tree, spreading crown, doubly pinnate leaves; Java, widespread; as roadside shade tree.

Leaflets

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
32	6	0.3	0.4	0.8	0.4	0	34	8	22	25	30	23	7	1	0.1

Whole leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	5	0.1	0.6	-	0.2	0	21	4	-	46	28	18	10	-	-

Results included because the tree is already present in Indonesia and is being promoted (NAS 1979), and is said to provide good forage. We have no records of feed applications in Indonesia. Easily confused with the much more common raintree (*Samanea saman*).

Equisetum debile Lycopodiaceae

Horsetail; herb, stems erect, much branched, scale leaves, from creeping rhizome; Java, close to water, somewhat shaded localities.

Aerial part

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
14	26	0.3	0.8	-	0.9	0.07	13	3	13	47	44	30	2	-	-
14	25	0.4	1	-	0.9	0	15	2		46	44	32	2	-	-

Plant cut along with other canal-side herbage. Feed application of interest because this is a highly primitive plant not previously known in this context and is also recorded as poisonous. Note extremely high ash content. Plant said to accumulate silica.

Eryngium foetidum Linn Umbelliferae

Katumbar londa (Java); herb, stemless rosette of thorny leaves, spiked flower stem; tropical, in open (high-light) environments.

Leaves

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
20	8	0.2	1	0.4	-	0.4	15	5	-	31	27	22	4	-	-

Plant used as flavouring herb because of pungent smell. Occasionally fed to rabbits.

Erythrina subumbrans Merr. Papilionaceae

Dadap (Indonesia), lucky bean; tree, medium sized, with trifoliate leaf; Java, tropics; roadside, field borders, villages.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	9	0.3	1.8	0.3	0.11	0.01	21	4	20	45	42	31	10	2.2	0
-	10	0.2	2.7	0.2	-	-	19	5	-	43	42	28	14	-	-

Branches frequently lopped for feed. Tree grows readily from cuttings (rarely sets seed, perhaps through lack of natural pollinator) and grows readily after cutting. Seeds known to contain alkaloids. Leaves used as worm remedy for ruminants in some areas of Java.

Euchlaena mexicana Schrad Poaceae

Mexican grass, teosinte; grass, tall, tufted; leaves to 1.5 m; Java, planted to consolidate slopes.

Leaf, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.3	0.3	0.1	-	-	11	2	15	64	42	34	4	2.6	0
-	9	0.2	0.4	0.3	-	0.08	14	3	-	64	34	28	2	-	-

A robust grass, occasionally planted on eroded tea estates. Productive but not capable of establishing itself. Said to be of low digestibility. IVDMD 50.8%

Eupatorium inuifolium Compositae

Tall herb (2 m); Java, ? ; locally abundant on waste ground, grassland, rubber estates.

Aerial leaf part, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
23	10	0.2	2.1	0.6	1.7	0	17	13	-	32	27	21	5	-	-
-	11	0.2	1.7		0.3	0	21	13	-	70	30	23	6	-	-

Unlike *E. odoratum* this species appears to be palatable and locally may be a major feed. Habitat more restricted.

Eupatorium odoratum Linn. (syn *Chromalaena odoratum*) Compositae

Herb, erect, to 1 m; Java, pantropical, weed of waste ground and open places.

Aerial, leafy part

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	8	0.2	1.0	0.6	0.5	0	18	8	-	35	28	21	6	5	0
-	9	0.2	1.6	-	0.3	0	19	8	20	26	21	16	5	-	-

Well-known weed, leaves foetid when crushed. Standing plants totally avoided by livestock but commonly included in cut-and-carry loads. Possibly toxic, and inclusion in loads of forage is likely to reduce feed intake, due to strong odour and taste.

Ficus septica Burm. Moraceae

Ara (general name for figs); tree, bushy, to 5 m, large glossy leaves; Java, Southeast Asia, frequent volunteer on uncultivated ground.

Leaves

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
21	13	0.4	2.6	0.5	-	-	18	5	18	22	22	19	2	1.2	4

This is one of a number of fig species that are cut for feed. That most often used but not yet identified is a species with characteristically silver undersides to the leaves, found on the fringes of forest on the mountains. There are some hundreds of *Ficus* species in Java. It is likely that, in general, the leaves provide good feed, and are so recorded for India/Nepal. See also the closely related *Artocarpus* species.

Fimbristylis sp. Cyperaceae

Herb, tufted linear leaves; pantropical, wet places.

Leaf

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13	0.3	0.3	0.3	-	0.04	13	3	-	62	32	25	3	-	-
-	13	0.2	0.3	0.3	-	0.02	9	3	-	68	43	34	4	-	-

Sedges make up a substantial proportion of the vegetation on fallowing rice fields and other wet ground. Their nutritional quality is very poorly known in relation to their prominence in the feeding systems. Although closely allied to the grasses, they form a distinct group both ecologically (wet habitat) and in such features as the sharply silicified stem edges. They would feature more prominently in this account but for problems of identification.

Gliricidia sepium Steud. Papilionaceae

Gamal (Java), gliridsidia (Indonesia), madre de cacao, daun; small tree (to 15 m), once-pinnate leaves, flowers along stem; Central American to humid tropics, in Java mostly seen as living fence.

Leaflets

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	8	0.4	1.4	0.6	0.21	0.05	28	2	20	21	18	12	6	0.1	0
-	11	0.3	2.7	0.9	-	-	25	4	20	35	23	11	11	1.0	-
-	17	0.1	3.5	-	0.1	0	20	4	0	43	27	15	12	-	-

This small tree is possibly more productive than leucaena on acid soils in the wet tropics. Propagation through woody cuttings is a further advantage. Plants grown from seed likely to have higher dry season production. Found abundantly in Indonesia but at present scarcely utilised for feed due to apparent unpalatability when fresh. However it can be fed after wilting, has no apparent toxicity to ruminants, and is a highly valued feed in e.g. West Africa and Sri Lanka. Understanding and overcoming the low level of utilisation provides a major opportunity for increasing the feed supply to village ruminants in Indonesia. The leaf does however have growth depressing effects on growing broiler chickens (Tangendjaja and Lowry unpubl.). Contains coumarin, but volatiles giving rise to somewhat unpleasant smell have not yet been identified. A single flavonol (kaempferol-3-galactorhamnoside) occurs in substantial amounts (1-2%).

Gnetum gnemon Linn. Gnetaceae

Meninjau, menimping, gnetum; tree, erect-bushy to 15 m; Java, Southeast Asia (rare), village tree.

Leaves

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
26	20	0.2	1.4	0.2	-	0.03	20	7	17	37	34	23	11	1.5	0

Despite the appearance of a typical broadleaf tree, this species is a botanical oddity that is not a flowering plant but a gymnosperm, with nearest relatives the bizarre *Welwitschia* of the Kalahari desert and *Ephedra* of Arizona. Gnetum is unique to Southeast Asia, some species found wild as forest lianes but only this one cultivated. Only in Java are the human food uses developed so highly (the reported content of cyclopropenoid fatty acids in the seeds may some day give rise to concern). The plant is thus a common village tree and so a considerable amount of leaf material is fed incidentally. There are no known adverse factors. The young leaves are used as a vegetable, e.g. in sayur asem and lalap.

Hibiscus rosa-sinensis Linn. Malvaceae

Bunga sepatu (Indonesia), hibiscus; shrub; pantropical, abundant as hedge plant.

Leaves

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
24	13	0.3	3.4	0.5	-	0.4	16	7	17	21	15	10	5	2.1	0.3
-	9	0.2	2.2	0.5	-	0.6	19	6	18	27	12	10	2	1.5	0.4

The common ornamental hibiscus is extremely abundant around villages in S.E. Asia. Through cutting to control it as hedge, it is frequently included in feed loads, and appears to be palatable. Its use has been noted by Davendra (1979) and van Eys et al. (1983). In contrast to *H. tiliaceous* its use is much less seasonal. This is one of a number of hedge plants (cf. *Aralia javanica*) which are found in and around villages, and in Java add up to a considerable biomass. They usually have uses in addition to being ornamental (hibiscus is used for black pigment), are in close proximity to village ruminants, and are used incidentally for feed.

Hibiscus tiliaceous Linn. Malvaceae

Ware, waru laut, (Indonesia), sea hibiscus; tree; Indo-Pacific, largely coastal.

Leaves

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
32	10	0.2	2.1	-	0.4	0.1	13	5	19	48	40	30	10	-	-
-	9	0.2	2.1	0.6	0.6	0.01	13	6	-	47	39	28	10	-	-

This is a very characteristic tree of the Indo-Pacific seashore, becoming more conspicuous in the less rich floras of the drier or island areas, and the range of uses increasing. The leaves are an important dry-season feed for cattle in East Java. In the large felt-like leaves, growth habitat and feed applications it is very different from the common ornamental *Hibiscus*. A number of other large tree *Hibiscus* species occur but we do not know of any feed applications.

Homalanthus populifolius Graham Euphorbiaceae

Shrub, large membranous chordate leaves; Java, high rainfall areas, hills.

Leaves

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
22	6	0.2	1.3	0.3	-	0	17	8	19	21	20	18	2	-	-
25	9	0.3	1.7	-	0.3	0	18	6	17	20	20	16	2	-	-
30	8	0.2	1.3	-	0.2	0	16	7	-	25	24	20	3	-	-

Very common rapidly growing volunteer shrub. Not found in the drier, highly disturbed sites that *Melastoma* would colonise but in those that are at somewhat higher elevations, more wet or cloudy, or more fertile. At Ciawi appears readily on uncultivated slopes and sides of ravines. It is usually cut before maturity. Seed supply probably comes from forest margins. The leaves are large, delicate, and would have a high feeding value if no adverse constituents are present. Similar notes probably apply to a number of species of *Macaranga* (also Euphorbiaceae) which we have not collected but are highly visible in wayside shrubby vegetation.

Hyparrhenia rufa Poaceae

Grass, tufted, leaves to 0.6 m; Africa, Southeast Asia, open spaces, fertile sites.

Leaf (whole aerial part), preflowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.2	0.4	0.3	-	0.03	12	3	19	65	37	-	3	-	-
28	11	0.2	0.7	0.4	-	0.01	11	3	-	64	38	29	2	3.7	2.6

This species is known elsewhere as a useful dryland pasture species. At Ciawi it shows very rapid growth with arrival of the wet season, relative to accompanying vegetation.

Imperata cylindrica Beauv. Poaceae

Alang alang (Indonesia), lallang (Malaysia), numerous local names, blady grass; grass with underground rhizome and leaves to 1 m; pantropical; forms dense cover on burnt-over infertile ground.

Leaf, preflowering

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	7	0.2	0.7	0.2	-	0	9	2	18	76	36	32	3	2	2.5

This grass is notorious as an indicator of land misuse, the last stage from forest clearing and shifting cultivation. With repeated burning tends to form stable association intractable to cultivation. Nevertheless, valuable as a stabilising species on infertile hillsides. The appropriate use, and modification, of alang alang dominated land is a major problem for Indonesia. Used as a poor roofing thatch. Young shoots palatable to ruminants but plant rapidly becomes unpalatable. The composition given above is that of a vast resource. IVDMD 29%.

Indigofera spicata Papilionaceae

Tarum, creeping indigo; herb, legume, stems creeping or shortly erect, pinnate; Asia, Africa; locally abundant in Java.

Whole aerial part

DM	Ash	P	Ca	Mg	S	Na	CP	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	11	0.2	2.2	0.3	-	0.03	17	4	-	36	28	22	7	2.6	1.0
-	11	0.3	2.3	0.3	-	0	21	4	16	41	24	18	6	1.2	0.6

This species was regarded as a useful new legume in Australia until it was discovered that it contained a non-protein amino-acid, indospicine, which was liver damaging. It would be of major interest to thoroughly evaluate the indigenous form in Indonesia to see if the 'leucaena story' is repeated, i.e. if it was completely detoxified by rumen microorganisms in local animals. The plant however is much less abundant than leucaena so it may be that there is not enough substrate to give rise to and maintain specialised microorganisms.

Ipomea caraica Convolvulaceae

Railway creeper, morning glory; herb, vigorously climbing and twining, forms dense aggregations on banks and fences; pantropical, weed of open spaces and disturbed ground.

Aerial leafy plant

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
15	10	0.2	0.5	0.3	-	0.13	16	3	19	33	26	21	5	2.7	0
18	10	0.2	1.4	-	0.4	0.68	16	4	18	37	31	24	7	-	-

Well known tropical weed, that is frequently included in feed loads. High protein and low fibre values suggest it could be a valuable feed. However many Convolvulaceae contain lysergic acid derivatives, particularly in the seeds. This may be the cause of the drowsiness ('marbok') sometimes reported in livestock fed kang kong (*Ipomea reptans*). Closer examination is warranted.

Ipomea crassicaulis Convolvulaceae

Kangkung hutan (Indonesia); tall herb (2 m) with many erect unbranched stems arising from underground rhizomes; Java, Southeast Asia , thickets in wetter localities.

Aerial leafy plant

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	8	0.5	0.8	0.4		0.02	28	5	19	26	21	17	4	2.7	0
-	8	0.2	0.6	0.3		0.02	22	3	19	22	21	16	5	-	-

This species is included because it is an abundant protein source which is virtually unutilised. It appears to be unpalatable and toxic at high intakes, but used just enough to suggest there is real potential.

Ipomea pes-caprae Roth Convolvulaceae

Kang kong laut, goat's foot ipomea, beachfront morning glory; herb, creeping but not climbing, leaves bilobed; Indo-Pacific; sandy shores.

Leaf and stem

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	12	0.4	0.8	-	0.7	0.12	16	5	18	27	26	20	6	-	-

Well known strand plant, along with *Canavalia maritima* occupies sandy shore closest to the drift line. Used as feed for pigs in Bali. No known problems but possibility of LSD-type constituents (see *I. caraica).*

Isachne globosa Kuntze — Poaceae

Kasuran (Java), Babantalan (Sund.); grass, slender much branched stems forming dense cover on wet ground; Java, fallow rice fields.

Aerial part, mature vegetative (mean and S.E.; n = 5)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
18	15	0.2	0.2	0.24	-	0.07	8	3	15	69	43	31	5	0.7	0
-	2	0.03	0.1	0.03	-	0.03	2	0.6		4	2	2	1.5	0.3	0

This is one of the species which is little known as a tropical pasture grass but has specific importance in Indonesia, in this case because very large amounts grow on fallowing rice fields.

Ischaemum timorense Kunth. — Poaceae

Suket tembagan (Java); grass, forming complete sward, leaves to 0.2 m; Java, Southeast Asia; open sites, many localities.

Whole aerial part, mature vegetative (mean and S.E.; n = 4)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
29	9	0.2	0.3	0.3	-	0.02	8	2.3	17	68	37	29	4	2.1	0
1	2	0.02	0.08	0.1	-	0	0.66	0.3	1	2	2	2	0.7	0.1	0

This is one of the grass species which is a major feed for livestock in Java, yet elsewhere in the world is barely known as a pasture grass (see also *Polytrias aneura*). Both productivity and feeding value should be further studied. Because both leaf and stem are rather fine, separation for analysis was not attempted. However, animals probably select higher quality fraction than the whole tops analysed here. A feature of the 'natural history' is the clear mucilage envelope surrounding young roots emerging from stolons close to the ground in damp localities. IVDMD 46%.

Lannea coramandelic — Anacardiaceae

Wit kuda, pagar hidup (Java); tree, leaves once pinnate, frequently lopped; Central, East Java; seasonally dry areas.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	12	0.6	2.0	-	0.6	0.06	11	4	18	43	32	21	8	-	-

Tree frequently seen as living fence or field boundary marker. Dry-season feed for cattle in Bali, TImor and Madura.

Lantana camara Linn. Verbenaceae

Lantana, kembang telek (Java); shrub to 3 m, climbing or trailing, thicket forming; pantropical weed of forest margins and uncultivated land.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
26	7	0.2	0.6	0.4	-	-	15	6	-	-	-	-	-	7.2	0
24	7	0.3	1.2	2.7	-	0.02	24	4	19	46	20	14	6	-	-

Well-known invasive woody weed. Found throughout Java but hardly a problem due to intensity of cultivation. Definitely a problem in the outer islands (the highly successful leucaena management system in Amarassi, Timor, was originally developed as a system to control lantana). The plant is sparingly utilised as browse for goats or cattle. There are well-documented toxicity problems due to triterpenoids (lantadenes) which cause liver damage with photosensitisation. When observed, the case is usually too advanced for the animal to survive on its own, but intervention with charcoal can save the animal. The importance of lantana toxicity in Indonesia and the actual lantadene content of the varieties in particular areas, is not clear. It does appear that there is substantial variation (Tri Budhi Murdiati, unpubl.).

Leersia hexandra Swartz Poaceae

Benta (Java), rice grass; grass forming sward to 0.2 m on flooded sites; Java, Southeast Asia, canal banks, fallow rice-fields.

Whole aerial part, early flowering

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	15	0.1	0.3	0.2	-	0.04	10	2	16	69	41	29	4	-	-
-	17	0.1	0.7	0.1	-	0.05	17	3	16	63	37	25	3	-	-

Highly regarded as feed. Probably valued also because it occurs in dense, easily cut, sward around the fields where

Leucaena diversifolia Mimosaceae

Leucaena tinggi; tree to 25 m, leaves doubly pinnate, finer than *L. leucocephala*; Central America, currently being distributed as alternative to *L. leucocpehala.*

Leaflets

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
3.5	5	0.2	0.9	0.1	-	0	22	8	-	26	25	14	12	4	4
3.2	5	0.2	1.4	-	0.2	0	24	6	-	32	18	11	7	-	-

Possibly more productive than *L. leucocephala*, and may be used to an increasing extent. Appearance similar but leaves more finely divided. Note higher tannin level. Mimosine 1-2% in mature leaflets. Not as common as *L. leucocephala*, but some large trees of this species and *L. pulverulenta* remain from early Dutch introductions on tea estates.

Leucaena leucocephala (Lam.) de Wit — Mimosaceae

Leucaena, lamtoro, petai cina; varieties range from much-branched shrub to tree to 20 m; shrubby form pantropical, productive forms widely planted.

Leaflets (mean and SD; n = 6)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
35	7	0.4	0.9	0.3	-	0.02	29	4	25	34	16	9	9	7.8	1.2
3	1	0	0.2	0.1	-	-	3	1	3	9	5	0.3	3	0.9	0.7

Seeds (whole)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	5	0.4	0.5	0.2	0.5	0.06	34	6	20	31	20	17	3	-	-

Leucaena has had much publicity for its multiple values. Both local naturalised forms and imported productive cultivars are important feed resources for ruminants. Indonesian ruminants are able to completely detoxify mimosine and the goitrogen 3-hydroxy 4(-lH)-pyridone (work on this has been one of the research highlights at BPT) and for practical purposes no toxicity problem exists (Jones and Lowry 1984). Note low Na levels; salt supplementation is necessary. Leucaena is important in farming systems and to human life in Indonesia in other ways; a detailed account is out of place here.

Maesopsis emenii Engl. — Rhamnaceae

Kayu afrika (Indonesia), maesopsis; large tree, dense shallow crown, leaves simple serrate; Java, plantation forests and villages, in the hills.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	4	0.2	0.6	0.9	-	0	26	4	-	20	15	9	5	2.4	0.3
-	5	0.8	1.5	-	0.4	0.15	24	6	-	27	18	12	6	-	-

Maesopsis has aroused some interest in plantation forestry because of timber quality and fast growth. It was introduced to Indonesia (from Africa) for this purpose. However it has become a widespread and locally abundant village tree in much of Java. The reason appears to be the combination of wood and forage production. One may frequently see trees that have been climbed to amazing heights (*c.* 30 m) in order to lop the lowest branches, which are fed to sheep and goats (see also *Albizia falcataria*). This often gives a distinctive appearance, all foliage in a dense shallow crown at the top of a long bare stem. This in turn may minimise shading of other crops in the dense mixed-garden system of West Java. The proximate analysis of the leaves (high protein, low fibre) suggests they could have high feeding value. A direct feeding trial and evaluation of this species is an urgent research objective.

Mangifera indica Linn. Anacardiaceae

Mangis (Indonesia), mango; large village fruit tree, dense leafy crown; pantropical, abundant, at best in seasonally dry areas.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
46	8	0.2	1.8	0.2	-	0	7	0	19	41	34	23	9	7.3	6.0
-	12	0.1	2.9	0.3	-	0.01	8	5	-	38	33	19	10	8.5	-

The large (200 × 60 mm) leathery leaves of the mango would seem an unlikely feed for ruminants, and their composition is unpromising. However they are a significant dry season feed in Central and East Java. If used to a substantial extent they result in strange metabolic effects, as the leaves contain large amounts (7% d.m.)) of an unusual phenolic compound called mangiferin (2,4,5,7-tetrahydroxy-3-glucosylxanthone). This may be excreted as the glucuronic acid conjugate giving intense yellow-orange staining by the urine. At one time in India there was a cottage industry based on recovering this material for use as a water-colour pigment ('piori yellow'). Attempts to obtain this compound at Ciawi failed, probably because mango leaves must be fed for longer periods than that employed (7 days). Highly pigmented urine in cattle fed mango leaves has been observed in Madura (R.J. Petheram, unpubl.).

Prolonged feeding of mango leaves was reported to adversely affect cattle in the Piori Yellow trade, but the effects of more moderate levels are not known.

Mango fruit by-products may be used as feed in some parts of the tropics but hardly at all in Indonesia.

Manihot esculenta Pohl. Euphorbiaceae

Singkon, ubi kaya (Indonesia), cassava; herb to 3 m, tuberous, leaves palmate; pantropical, cultivated, major food crop.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.4	0.9	0.3	-	0.04	29	9	-	19	19	9	10	6	2.3
-	6	0.3	1.1	-	-	0.02	27	9	21	29	25	15	9	3	0
-	8	0.4	1.5	0.4	-	-	25	7	18	-	-	-	-	-	-

Petiole

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.2	1.3	0.6	-	0.04	6	2	-	52	45	35	10	-	-

Peel of tuber

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	7	0	0	0.1	-	0	6	3	-	25	15	11	3	-	-
-	9	0.1	1	0.1	0.1	0	6	2	-	27	20	14	5	-	-
-	12	0.2	0.6	0.1	-	-	6	° 1	16	-	-	-	-	-	-

Cassava is a major food and industrial crop that is deeply involved in village farming systems. Wilted leaves are often fed at very high levels, apparently without any hypothyroidism, but animal weight gain is less than the protein intake would indicate. The initial results showing a good response to sulfur supplementation are well worth following up. Sulfur may have two roles, in overcoming induced sulfur deficiency due to metabolism of cyanide as thiocyanate, and in promoting metabolism of the condensed tannins.

The plant neatly partitions its production into a protein source (leaves) and energy sources (tubers, or tuber peelings).

Simple observation suggests that very large amounts of stem residues are produced (only about 5% is needed to replant the next crop; the usual use cited). We have observed these being peeled in the village; the peelings being used for feed, the dried cortex for fuel.

A tree-forming species of *Manihot* (pohon singkong) is commonly fed as a dry-season forage in E. Java, Madura and the outer islands.

Melastoma malabathricum Linn. Melastomataceae

Sendudok (Malaysia, Sumatra), Harendong (Sund.); shrub, simple 3-nerved leaves, purple flowers; Southeast Asia, abundant in disturbed open areas.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
27	10	0	2.3	0.5	-	0.01	14	3	17	28	24	19	5	7	6
31	10	0.1	2.0	0.5	0.1	0.03	12	4	14	34	28	23	4	7	1

There may be more than one species of *Melastoma* to which the above notes apply, with important differences in secondary constituents. The common *Melastoma* is an acceptable browse for goats although the phenolic content is quite high. It is also sometimes present in cut-and-carry loads although usually growing in association with less palatable species such as alang alang.

Melia indica Brandis Meliaceae

Mimba gringging (Java), Intaran (Bali); medium tree, large once-pinnate leaves; pantropical in seasonally dry areas; in fields.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.2	2.7	-	0.5	0.07	14	4	19	39	28	18	10	-	-

A well-known tree of India. In East Java and Bali common in and around cultivated fields. Retains dense leafy canopy in dry season, trees often of compact habit from repeated lopping. Better-branched ones sometimes used for storing corn stover out of reach of cattle (cf. cover of PARD 1983 Report). Although Meliaceae contain a variety of bitter (and in the case of neem, insecticidal) compounds the leaves are used as a dry-season feed for cattle.

Melinus minutiflora Beauv. Poaceae

Molasses grass; grass, stoloniferous, leaves to 1 m, sticky; Java, wet tropics.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.1	0.4	0.3	-	0.04	9	4	-	65	37	32	3	-	-

Well known pasture grass in high-rainfall areas. In Java found in the hills around tea plantations.

Metroxylon sagu Roxb. Palmae

Rhumbia (Southeast Asia), kirai (Sund.), swamp sago; very large palm, terminal flowering, tillering; Southeast Asia, widespread in cultivation, and dominant in natural stands.

Stem pith

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
55	3	0	0.2	0	0	0.03	0.6	0.4	17	9	9	8	1	1.4	1

The swamp sago has great potential because of its productivity and other attributes. A major future option is to develop the use of whole pith as animal feed, thus avoiding loss during processing of the free sugars which were first identified in this laboratory (Wina et al. 1985). In contrast to most of the forage species covered here, feeding value of the sago stem arises almost solely from the starch content. The potential is for both monogastric and ruminant feeding. Other products are the extracted flour, and the fibrous residues.

Microstegium ciliatum Poaceae

Grass, leaves and stems to 2 m; Java, S. Sulawesi; forming dense cover on steep slopes and cuttings.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
25	9	0.2	0.3	0.2	-	0.03	10	2	-	66	36	28	4	1.7	0.1
25	9	0.2	0.5	0.2	-	0.02	7	2	17	74	45	35	6	-	-

A coarse grass, locally abundant and included in cut loads but not previously analysed as a forage species. Deserves more careful analysis in terms of leaf:stem ratio.

Mikania scandens Willd. Asteraceae

Mile-a-minute; herb, rapidly growing, creeping or climbing; humid tropics, weed, ground cover.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
22	13	0.4	1.7	0.6	-	0.4	15	2	17	35	25	18	7	5.0	0

Well known weed, notorious for its ability to smother slow-starting tree crops, but beneficial in throwing a contour-following green cover over rusting car bodies and other large scale litter. It is reported to be an acceptable feed under plantations in Malaysia, and is sometimes included in village feed loads in Java. As the proximate composition is quite favourable, the plant is probably of net benefit in Indonesia. However, it should be tested for toxicity, particularly the possibility of pyrrolizidine alkaloids.

Mimosa invisa Mart. Mimosaceae

Putri malu, giant sensitive plant; prickly herb, vigorously creeping and scrambling; pantropical weed of waste ground.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
26	5	0.4	0.5	0.2	-	-	26	5	-	-	-	-	-	5	4
-	7	0.2	1.2	0.4	-	0	31	6	-	15	14	9	5	5	4

Well known weed, more vigorous but shorter-lived than the common sensitive plant *M. pudica*. Composition of leafy part quite favourable but intakes low because of prickly stems. Comparative ability of village goats to deal with these two species would be of interest. Mimosine present but at very low levels.

Mimosa pigra Mimosaceae

Shrub, thorny, leaves sensitive, bipinnate; invasive weed of wet or periodically flooded soil.

Leaflets

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.3	2.2	0.3	0.2	0.01	23	5	-	44	43	21	22	9	8
-	6	0.2	1.4	0.2	-	-	21	4	-	34	28	17	9	-	-

Widespread in Java but not a problem because of pressure of human activity. In S. Kalimantan expanding thickets are excluding buffalo from seasonal grazing on flood plains. Leaflets readily detach from thorny stems. Leafmeal has been studied in Thailand and may be of value in Indonesia. Results included for this reason. IVDMD 40%.

Mimosa pudica Linn. Mimosaceae

Putri malu (Indonesia), sensitive plant; creeping thorny herb, leaves sensitive; weed of humid tropics, open ground.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	5	0.3	1	0.3	-	-	20	3	-	30	29	21	8	7.5	5.2
-	5	0.3	1	-	0.6	0.05	19	3	19	46	35	26	10	-	-
-	6	0.2	0.9	0.4	-	-	20	4	-	42	33	24	19	-	-

The common sensitive plant can become quite an important feed in frequently-cut areas, where it is probably the only high-protein herbage. Village ruminants appear able to utilise it despite the thorns. Although mimosine was isolated from this species the levels are lower than leucaena, which itself is no longer a toxic problem for ruminants in Indonesia.

Moghania macrophylla (Syn. *Flemingia macrophylla*) Papilionaceae

Shrub to 2 m, leaves trifoliate; occasional as nurse crop, edges of clearings.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	5	0.2	0.9	0.3	-	0.02	19	2	-	46	39	24	14	5.3	-

IVDMD 34%.

Musa sapientum Linn. Musaceae

Pisang, banana; giant tree-sized herb; tropics, subtropics; major economic plant.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
25	12	0.3	0.6	0.4	-	-	14	6	19	52	28	22	3	2.4	0
26	10	0.3	1.0	0.6	-	0.2	16	8	-	52	30	21	6	3.2	0

Stem (pseudostem)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
6	16	0.3	0.5	0.3	-	-	3	2	16	40	37	33	4	0.5	0

Bracts

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
14	12	0.2	1	0.4	-	-	10	7	17	43	24	18	6	1.9	0

In Indonesia the banana is not grown in large plantations for an export trade, but is found abundantly throughout the country in village gardens and small groves. Leaves are fed to village ruminants when the fruit is harvested, but probably only a small proportion of the resource is used in this way. There seems to be no attempt to utilise senescing leaves from the growing plant, although these could be regarded as potential feed. The dry matter of the pseudostem is supposed to be highly digestible but, perhaps because of the extraordinarily high water content, little use appears to be made of this resource. In general, from the abundance of the plant in villages, and its known productivity, one might expect it to make a greater contribution to village feedstuffs.

Nephelium lappaceum Linn. Sapindaceae

Rambutan; medium sized village fruit tree; humid Southeast Asia, villages, wild forms in forest.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
45	5	0.2	1.3	0.2.	-	0.02	9	5	-	35	33	14	17	2.1	3.7

Harvesting rambutan fruit inevitably dislodges much leaf because of the fruiting habit of the tree, and leaves may be fed for this reason. It is unlikely that they are a good feed.

Oplismenus burmanni Beauv. Poaceae

Bedesan, laronan tegal (Java); grass, creeping, stoloniferous; Southeast Asia, forming continuous cover in shady places and forest floor.

Leafy stem

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
22	22	0.2	0.3	-	0.3	0.08	13	3	-	66	48	31	3	-	-
27	9	0.2	0.8	0.4	-	0	10	4	18	68	37	27	-	-	-

Locally abundant in shady places, and cut for feeding. Apparently grazed readily in some locations.

Pachyrhizus tuberosus Spreng. Papilionaceae

Bengkwang (Indonesia), yam bean; herbaceous legume, climbing, cultivated; humid tropics, food crop (edible tubers).

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	11	0.2	2.8	0.9	-	0	-	5	-	35	29	22	6	-	-
-	11	0.2	3.3	-	0.3	0	22	6	-	35	28	20	6	-	-

As the tubers are harvested while the plant is growing vigorously, and the seeds are toxic, the whole green aerial part of the plant is available as a feed for ruminants. Although insecticidal isoflavones of the rotenone type have been reported in the leaves, there is no indication of toxicity to ruminants at the levels fed. However residues are often burned.

Panicum maximum Jacq. Poaceae

Rumput bengala, guinea grass; large tufted grass (to 2 m); pantropical as pasture grass, occasionally naturalised.

Leaf, 4-week regrowth

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	11	0.2	0.7	0.4	-	0.02	14	3	16	67	36	29	7	-	-

Leaf, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.3	0.4	0.2	-	-	7	2	18	69	44	36	5	0.6	-
-	14	0.2	0.7	0.3	-	0.01	8	2	16	73	43	31	5	-	-

This is a well-known tropical pasture species on which considerable information is available. Its large size probably makes it less acceptable than *Brachiaria decumbens* or *Setaria sphaceolata* for incorporation into farming systems in Java. IVDMD 40% (mature). There are many cultivars.

Panicum palmifolium Poaceae

Tall grass, leaves conspicuously plicate, 50 × 15 cm^2; S.E. Asia , forest margins.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
25	12	0.2	0.4	0.2	-	0.07	12	2	-	71	39	30	4	-	-
-	13	0.2	0.3	0.2	-	0	11	4	-	65	38	29	3	-	-

This species is another of the grasses obtained from unusually (for grasses) shady habitats. Conspicuously present in feed loads gathered from forest margins, and shady upland areas. Usual considerations of quality in relation to leaf:stem ratio do not apply because leaves are large enough to be selected separately.

Panicum repens Linn. Poaceae

Suket balungan (Java), torpedo grass; slender grass (leaves to 200 × 5 mm), creeping rhizome; pantropical, in vicinity of wet ground.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	7	0.3	0.2	0.1	-	0.4	12	3	19	74	38	34	4	1.0	0
-	5	0.2	0.4	0.2	-	1.2	12	4	17	65	32	27	5	-	-
24	7	0.2	0.4	0.5	-	1.4	18	3	-	61	28	23	3	-	-

Well known tropical grass. In Indonesia frequently seen in wayside vegetation although nowhere abundant. IVDMD 66%.

Paspalum commersonii Lam. Poaceae

Jaringan (Java); tufted grass to 40 cm; cosmopolitan, warm climates, pasture and open ground.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
20	8	0.2	0.3	0.4	-	0	10	3	18	68	37	33	3	4.2	0.2

This is one of the volunteer grasses that occupies harvested cropland .

Paspalum conjugatum Berg. Poaceae

Jukut pahit (Sund.), buffalo grass; stoloniferous grass, forming open turf; cosmopolitan, tolerant of wide range of conditions.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	11	0.2	0.3	0.4	-	0	8	3	-	65	37	30	4	2.3	0
26	10	0.2	0.4	0.6	-	0.03	8	3	16	66	34	28	3	-	-

This is a well known grass, not usually highly regarded as pasture. In Indonesia it takes on much greater importance, as it occurs abundantly in a wide range of habitats from which feed is gathered, and is one of the major components of village ruminant feed. In this it is comparable to *Axonopus compressus.* IVDMD 54%. Most Javanese farmers do not distinguish between these two species, which have the same name in most areas.

Paspalum longifolium Poaceae

Jaringin (Java); grass, tufted, to 50 cm; cosmopolitan in warm humid areas.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
25	9	0	0.3	-	-	0.04	6	2	17	74	44	37	4	6	0
-	13	0.1	0.6	0.2	-	0.09	6	2	17	68	42	32	3	-	-

This rather tall paspalum is found in fallowing rice fields that are not too wet, and could make a substantial contribution to the feed in some areas.

Paspalum notatum Flügge Poaceae

Bahia grass; grass, creeping rhizome, leaves to 30 cm; cosmopolitan in warm humid areas.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
0.29	10	0.4	0.7.	3	-	0	10	4	17	68	34	26	4	-	-

A sward-forming grass with a very distinctive growth habit (stout rhizomes cling to the soil surface, leaves emerge at an acute angle, and the dense sward tends to exclude other grasses). Sometime used as lawn or ground cover, but despite leafy appearance appears to be not very palatable, and in pure stand would not produce as much biomass as the larger pasture grasses. We have not as yet seen this species flowering in West Java.

Pennisetum polystachyon Poaceae

Vigorous tufted grass, leaves and spike-like infloresence to 1.5 m; cosmopolitan; volunteer in unused areas.

Leaf, early flowering

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.2	0.1	0.2	-	0	5	2	19	75	51	40	7	0.5	0

Leaf, preflowering

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	9	0.3	0.3	0.5	-	0.03	14	4	19	63	31	24	3	-	-

This is a rapidly growing grass that seems to be capable of establishing itself in untended land, in the presence of alang alang and woody weeds. Young material would appear to be a good feed but, as with so many tropical grasses, feeding quality drops drastically with maturity. IVDMD 34% (early flowering), 60% (preflowering).

Pennisetum purpureum Schum. Poaceae

Rumput gajah, elephant grass, Napier grass; large grass, tufted or stems rooting at the nodes; pantropical, as pasture grass.

Leaf, 4-weeks

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13	0.2	0.3	0.2	-	0.2	7	4	16	62	-	-	-	2.0	0.8

Leaf, 6 weeks

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	15	0.1	0.6	-	-	0.2	10	3	16	69	42	30	4	0.6	0.2

Well known tropical forage grass, also of interest as possibly the species with most potential for biomass production (dry matter yields of up to 80 tonnes/ha/year have been reported). Much composition data are obtainable elsewhere. Occasionally planted as feed in Indonesia, e.g. in association with *Calliandra* on steep upland slopes, or in dairy cooperatives. Probably too large to use conveniently in close association with food crops.

Peronema canescens Jack Verbenaceae

Sungkai (Sumatra), jati sabrang (Sund.); large tree, coppicing freely at base, pinnate leaves; Sumatra, Java; locally abundant in upland areas.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.3	0.3	0.4	-	-	18	3	-	-	-	-	-	-	-
29	9	0.2	0.9	0.2	0.4	0.1	14	4	-	58	50	37	9	-	-

This tree is said to be virtually unknown to science. It is a rapidly growing indigenous/pioneer species, adopted locally for fuel and roundwood production. Coppicing shoots produce very large (to 600 mm) pinnate leaves with a distinctive winged petiole and it is these that are cut for feed. More observations on the use of this species in the whole farming system is required.

Persea americana Lauraceae

Apokat (Indonesia), avocado; large village fruit tree; sporadic in Southeast Asia, in Java common in uplands.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.2	1.2	0.4	-	0	11	7	-	32	28	15	10	5.5	1.0

The avocado is another of the village fruit trees from which the leaves are fed, probably incidentally due to local abundance. It is not found in the areas where tree leaves are a vital dry-season feed. An unusual toxicity problem, induction of mastitis, has been linked with feeding avocado leaves (Craigmill et al. 1984).

Phaseolus sublobatus Papilionaceae

Creeping herbaceous legume, flowers yellow; Java, sporadic at edges of cultivation.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.3	1.2	0.3	-	0.02	18	4	-	40	34	24	6	1.0	0.3
21	6	0.2	1.0	0.7	-	0.04	18	4	19	42	34	23	6	-	-

Individual plants are of good size in relation to wayside vegetation (big enough to scramble over alang alang but not too woody or stemmy), but we know very little about this species. Although found at BPT Ciawi it has not yet been seen to occur abundantly.

Pisonia sylvestris Teijsm Nyctaginaceae

Kol banda (Java), lettuce tree; small tree; leaves large, entire, yellowish green.; villages in coastal areas.

Leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	19	0.3	1.0	-	0.6	0.6	25	3	16	31	19	16	3	-	-

Unusually high sodium content may be associated with coastal habitat in the sample analysed here. Young leaves are used as a vegetable. Thus, there may not be a large supply of mature leaf for ruminant feed. However, the leaf is an important feed for pigs in Bali.

Pithecelobium jiringa Prain Mimosaceae

Jering, jenkol (Java); tree to 15 m, stoutly branched, leaflets large; Java, Southeast Asia, widespread village tree.

Leaflet

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	3	0.1	0.3	0.2	-	-	16	4	-	52	35	18	16	16	5

Tree cultivated near villages. Pungent seeds used for food (contain rare sulfur amino acid djenkolic acid). Despite high phenolic content young leaf may be used in lalap. Lopped branches fed to buffalo. Once seen in conjunction with bamboo leaves (which would comprise the tallest grass-legume pasture known!).

Pogonantherum pulverulentum Poaceae

Tufted, highly branched, slender grass; Java, Sulawesi; stream banks, cliffs.

Whole aerial part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.1	0.4	0.3	-	0.04	7	2	-	74	42	31	8	0.4	0
32	8	0.2	0.7	0.2	-	0.06	6	2	18	75	45	31	10	-	-
32	7	0.1	0.2	-	0	0.07	8	2	18	78	47	36	7	-	-

A grass of delicate feathery appearance with an unusual and highly specific habitat requirement; it is almost invariably seen growing on vertical surfaces, often on rock rather than soil. Sometimes cut for feed, but quality low. Plants are probably slow growing because of habitat, and usually contain a high proportion of stem and dead leaf, even when not flowering. IVDMD 32%.

Polytrias amaura Kunz Poaceae

Suket lamuras (E. Java); small, creeping, much branched grass; widespread in Southeast Asia, forms close sward in open areas.

Whole aerial part, vegetative, early dry season

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	9	0.2	0.8	-	-	0.04	11	3	17	64	32	25	4	4.2	0
-	9	0.3	0.6	0.3	-	0	9	3	17	70	34	28	3	0.4	0

Whole aerial part, flowering, dry season

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13	0.3	0.7	-	-	0.02	8	3	17	72	42	31	5	-	-
31	10	0.2	0.8	0.2	-	0.04	5	2	17	76	42	30	7	-	-

This grass should be better known as it makes a major contribution to village ruminant feed, yet barely appears in the literature as a forage species. In this it is comparable to *Ischaemum timorense*, but this species is more variable, has a more slender highly branched habit, and forms a compact sward in open frequently-cut areas. Although probably not of high quality, the change of quality with maturity appears less extreme than with many tropical grasses. This may be a useful feature. The grass is quite inconspicuous until the synchronous flowering in the dry season reveals how abundant it really is. Highly valued in Madura for its palatability and rapid response to rain.

Pothomorphae umbellata Piperaceae

Herb, leaves large, peltate; Java; shady places.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
15	10	0.5	0.5	0.3	-	-	18	6	20	22	18	10	3	-	-

This plant is locally abundant in some areas from which feed is cut. It is one of those where a high water content is an adverse factor for use in cut-and-carry feeding, although quality on a dry-matter basis could be quite high.

Psophocarpus tetragonolobus Papilionaceae

Kecipir (Indonesia), kacang botor (Malaysia), winged bean; climbing herbaceous legume; Southeast Asia, commonly cultivated in villages.

Whole aerial part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
25	10	0.2	2.2	0.4	-	0.05	26	5	20	33	28	21	6	-	-

This plant has been the subject of much recent interest for its potential in other tropical countries. Tubers, pods, seeds, flowers and young leaves are all eaten as a vegetable. There seems unlikely to be any constraint on the use of any residues as ruminant feed. However unlike the yam bean, this plant is rarely grown as a complete field crop, but as a few plants near each house.

Pueraria phaseoloides Papilionaceae

Kudzu, pueraria, tropical kudzu; herbaceous legume, vigorously climbing; Southeast Asia, cover crop, pasture, or wild in open spaces.

Leafy aerial part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.1	1.1	0.3	0.16	0.04	16	2	-	51	29	21	7	0.9	0.3
26	7	0.2	1.1	-	0.2	0.01	19	3	18	52	38	29	8	-	-

This is one of the few indigenous legumes that has been adopted for tropical pastures or plantation cover crop, not only in Southeast Asia but elsewhere in the humid tropics. There is very little planted pasture in Java and the plant is not conspicuous in wayside vegetation. It is more robust (but probably more sparingly seeding) than *Centrosema* and tends to be found scrambling over semi-woody or rougher vegetation, often near streams. Hence it is not easily cut for feed. Probably a valuable component of buffalo grazing.

Rhynchelytrum repens Poaceae

Natal grass, red top; tufted grass to 50 cm, inflorescence red; pantropical, roadsides and disturbed areas.

Whole plant, early flowering

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
24	8	0.2	0.3	0.2	-	0	7	3	17	75	44	37	5	3.4	0.4

This grass appears as a volunteer immediately after soil disturbance, then as rapidly vanishes as other species establish themselves. It appears to prefer gravelly or stony soils and thus is typically seen along roadsides.

Saccharum officianale Poaceae

Tebu, sugar cane; tall grass, emergent stems, tillering at base; pantropical, plantations and village gardens.

Leaf at harvest

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
35	12	.0.2	0.4	0.2	-	-	11	3	18	66	40	31	5	-	-

The cane tops, bagasse, and molasses are all major feed resources, as can also be the growing cane itself since the dry matter production of this species is very high. There is of course a considerable literature on this. We note the above analysis only as a case where tops from cane grown as a back yard plant were fed to village sheep. IVDMD 42%.

Saccharum spontaneum Poaceae

Wild sugar cane; tall grass, individual stems erect, tillering, thicket forming; Southeast Asia, river banks and levees.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
37	10	0.3	0.2	0.1	0.2	0.05	10	4	18	68	46	33	3	-	-

In growth habit this somewhat resembles elephant grass. Leaves are more sharply folded toward the base and harsher to the touch. Not highly regarded as feed but used to a limited extent.

Samanea saman Mimosaceae

Kehujan (Indonesia), rain tree; tree, large, spreading crown; common as village and roadside tree, widespread in tropics; deciduous in very dry seasons.

Leaflets

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.2	1.3	0.2	-	-	21	4	20	54	42	24	18	4	0
-	7	0.3	1.5	0.2	-	0.02	25	4	22	48	38	19	18	-	-
-	6	0.1	1.1		-	0.04	28	6	20	42	33	24	28	-	-

Whole leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	9	0.6	0.8	-	-	-	28	4	21	55	-	-	-	-	-

Leaves fed to village goats. Fallen pods highly palatable.

Sandoricum koetjape Meliaceae

Kecape; tree, to 10 m, leaves pinnate; Southeast Asia, village fruit tree.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13	0.2	0.9	0.4	-	0	8	9	18	33	25	12	7	10	2

Leaves sometimes used as feed, the extent not known.

Selaginella wildenoviae Selaginellaceae

Selaginella; herb, somewhat fern like, but trailing with no distinct stem; humid tropics, shady places.

Aerial part bearing functional scale-leaves

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	8	0.2	0.2	0.4	-	-	11	2	17	57	35	25	7	0.6	0.3
20	11	0.2	0.4	0.3	-	-	15	2	-	54	42	29	9	0	0

Selaginella is a primitive plant somewhere between the mosses and ferns in structural complexity. It would be quite obscure in most temperate regions but in the humid tropics it can be a substantial component of the vegetation in shady places. The metallic blue-green irridescence of leaves has been the subject of an earlier study (Lee and Lowry 1975).

Sesbania grandiflora Papilionaceae

Turi (Indonesia), sesbania; tree to 10 m, monopodial when young, often short lived, leaves once pinnate; Southeast Asia, widespread in Indonesian villages, occasional groves planted in coastal plains of E. Java.

Leaflets

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	7	0.2	1.3	0.3	-	0.04	24	6	21	25	24	15	8	1.6	0

One of the tree legumes already important as feed for village ruminants. Spectacular height growth does not reflect production of edible dry matter, as plant does not branch as freely as leucaena. Flowers and young shoots used in food, but leaf meal found to have growth depresssing effects on chickens (Tangendjaja and Lowry unpubl). Phenolic fraction is largely a glycoside of kaempferol. Occasionally very high N values obtained for leaf (up to 37% CP).

Sesbania sesban Papilionaceae

Janti; shrub to 4 m, leaves once pinnate, flowers yellow; rapidly growing shortlived shrub of flooded sites.

Leaflets

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
25	0.8	0.3	1.5	0.3	-	0	28	6	20	31	14	10	5	0.9	0

Possibly a useful feed plant under annual rice cultivation, i.e. with fallow period long enough to allow useful production. There are a number of smaller annual sesbanias which may be of value.

Setaria plicata Poaceae

Stoloniferous grass with broad plicate leaves; Java, Southeast Asia; usually scrambling through other vegetation.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	15	0.5	0.6	0.3	-	-	16	3	17	63	34	28	9	0.2	0
-	13	0.2	0.5	-	-	0.03	23	4	17	55	29	24	3	1.2	2

As indigenous setaria, not known as a pasture grass, but sometimes abundant at edges of field or along hedges, usually on fertile soils. Appears to be palatable and sometimes appears in feed loads in quantity. The protein content and in vitro digestibility appear high in relation to fibre values and deserve further study. IVDMD 72%.

Setaria sphacealata Poaceae

Setaria; tufted grass, leaves to 0.75 m, inflorescence 2 m; humid tropics, cultivated.

Leaf, early flowering

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
20	9	0.1	0.1	0	-	0.06	8	3	17	74	39	33	4	1.2	0.1
21	8	0.2	0.1	0.2	0	0.02	9	3	18	75	42	36	4	-	-

Well known tropical pasture grass. In Indonesia often planted (by division of plants) in rows among and near food crops. Farmers seem to regard it as more manageable than other grasses. One form is used, particularly in the Lampung area, from where it has been popularised elsewhere in Indonesia. The name '*Setaria lampungensis*' has no botanical validity. It is likely the cultivar was introduced by Athol Kilgour (at the time a N.Z. volunteer) about 1962, as part of an upland sheep production project.

Sida rhombifolia Malvaceae

Sidagolri (Indonesia), otok-otok (Java), Goeri (Malaysia); shrub to 1 m, stems tough and wiry, leaves small; pantropical weed of disturbed open sites.

(1) Whole aerial part (2) Leafy stem

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	9.2	-	-	-	-	-	14	2	21	56	41	33	8	-	-
-	9.2	0.4	2.0	0.5	-	0	20	4	18	37	29	23	6	-	-

This is a common woody weed in many warm areas. In Java it appears to withstand repeated cutting well and so persists on sites from which feed is collected. Frequently present in feed loads, normally at low levels. IVDMD 52%.

Smithia sensitiva Papilionaceae

Herbaceous legume, much branched, low, creeping; Java; forming dense low mat on wet ground.

Leafy aerial part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	6	0.1	1.2	0.4	-	0.04	16	6	-	35	27	20	7	3.1	1.8
20	7	0.1	0.6	-	0.3	0.06	18	4	-	41	29	21	7	-	-

Small sensitive pinnate leaves resemble *M. pudica* but the small yellow flowers show that this is in an entirely different subfamily of legumes. Locally abundant and then heavily cut for feed. Apparently restricted to ground that is continuously wet, so overall contribution not great.

Sorghum verticillifolium Poaceae

Wild sorghum; erect grass with terminal inflorescence; Southeast Asia, weed of cultivation.

Leaf, early flowering

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	8	0.4	0.4	0.2	-	-	9	3	18	68	33	26	4	2.4	0

A rapid growing and early maturing plant appearing opportunistically after cultivation. IVDMD 50%.

Sporobolus pyramidalis Poaceae

Wire grass; tufted grass, leaves very narrow, tough; tropics; roadsides, footpaths.

Leaf; mature, vegetative

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
36	6	0.3	0.4	0.2	-	0.01	10	2	-	77	37	30	4	0	0
-	9	0.1	0.6	0.2	-	0.07	11	2	17	75	36	28	4	-	-

A very tough wiry grass that probably becomes noticeable in wayside places because it is mechanically resistant to the impact of foot or wheel. Scarcely utilised except under extreme feed shortage. Results included to provide composition data for a grass known to be highly fibrous. IVDMD 42%.

Stachytarpheta indica Verbenaceae

Remekgetih, jarong laki (Java), snakeweed; herb or subshrub, twisted slender inflorescence; humid tropics, weed of waste ground.

Aerial leafy part (excluding woody stems)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
25	10	0.2	1.4	-	-	0.1	17	5	19	19	17	9	6	3.5	0.8

This plant becomes tough and woody if undisturbed but younger plants are easily cut for feed and appear to have a high protein and low fibre content. As far as we know no adverse effects are ascribed to this plant but the botanical relationship with lantana, and the presence of distinctive unidentified compound in the high performance liquid chromatography trace for each species (J.B. Lowry, unpubl.), suggests wariness about possible hepatotoxicity.

Tectaria crenata Pteridophyta

Paku; fern, tufted; Southeast Asia.

Whole green frond

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
18	7	0.1	0.6	0.4	-	0.02	15	3	-	43	37	18	18	3.6	3.0
-	8	0.2	0.6	-	0.3	0	11	3	19	54	40	30	10	-	-

Common fern of shady places, frequently cut for feed in West Java.

Tectona grandis Verbenaceae

Teak, jati (Indonesia); large tree, deciduous in dry season; Southeast Asia, monsoonal areas, in natural forests and plantations.

Mature leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	10	0.2	0.9	0.2	0.10	0.10	11	3						9	-

Apart from a few specimen trees, teak is only seen in forest plantations in areas with a marked dry season. The large rough-textured leaves appear an unlikely feed but young leaves are eaten by leaf monkeys in the reserve at Pangandaran. There are persistent reports of teak leaf as an adulterant in leucaena leaf meal. Hence the composition and uses must be kept in mind.

Tephrosia noctiflora Papilionaceae

Small shrub to 1 m, leaves once pinnate; Southeast Asia, open areas.

Whole leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
34	6	0.3	1.1	0.2	-	0	33	10	21	32	24	15	9	-	-

This and other similar *Tephrosia* species are readily browsed by ruminants. Those adjacent to Jagorawi Highway have developed a pronounced woody base due to repeated cutting of aerial parts for village feed loads. Leaf has high protein and low fibre. However there are possible toxicity problems associated with this genus (insecticidal isoflavones and non-protein amino acids).

Themeda arguens Poaceae

Suket merakan (Java); grader grass; wiry grass, leaves tufted, inflorescence conspicuous; Southeast Asia, open places.

Leaf, mature vegetative

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
36	6	0.2	0.6	0.2	-	0.05	9	2	18	69	36	30	4	-	-
36	12	0.3	0.3	-	0.2	0.06	9	3	-	69	42	32	4	-	-

Inflorescence (stem and flowering heads)

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
42	8	0.3	0.4	0.2	-	0.02	4	1	17	76	41	30	7	-	-
-	8	0.2	0.1	-	0.2	0.02	6	1	-	75	46	37	4	-	-

An abundant grass of wayside places. The leaves are inconspicuous in the existing sward but not so the bright-red-stemmed emergent inflorescences which, when this species is flowering gregariously, appear to have sprung from nowhere. The young inflorescence is relatively easy to gather into feed loads, but the composition is dominated by the large proportion of stem. Surprisingly , the leaf is hardly less fibrous. IVDMD 44%.

Tithonia diversifolia Asteraceae

Daun pahit; tall herb (2.5 m), flowers large yellow; pantropical; in Java often in dense thickets, roadsides.

Leaf

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	13	-	-	-	-	-	25	8	-	15	13	-	4	-	-

This plant has an intensely bitter leaf and is said to be effective when administered (forcibly) as a vermifuge for sheep and goats. These observations together with the botanical relationships suggest the presence of sesquiterpeniod lactones such as those of wormwood (*Artemisia*). The value of the plant for suppressing internal parasites is certainly worth checking. It also draws attention because it grows vigorously in wayside thickets totally untouched by animals, and has high protein and low fibre. Can this unpalatability be overcome? Alternatively these features suggest the plant as a rational choice for leaf protein extraction studies. Preliminary results (Budi Tangendjaja and Susana, unpubl.) show that a protein concentrate is quite easily obtained by heat precipitation.

Vigna hosei Papilionaceae

Creeping herbaceous legume, leaves trifoliate, yellow flowers; Java, forming compact ground cover, near water.

Aerial leafy part

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
21	6	0.4	1.2	0.9	-	0.1	24	3	21	39	20	15	5	0.7	0.4
29	8	0.2	1.1	0.3	0.19	0.07	19	3	-	47	33	24	7	-	-
-	7	0.2	1.1		0.2	0.1	19	5	21	62	26	18	6	-	-

This indigenous legume makes a substantial contribution in wayside vegetation, at least when close to water, and is probably the most valuable after centro. It forms a more luxuriant ground cover under favourable conditions but is scarcely climbing. Fertile plants cannot be mistaken for centro (flowers small, yellow instead of large, blue and inverted) but vegetative plants may look similar. However they are easily distinguished by examining underside of leaf: Vigna has 3–4 pairs of side veins; centro has 7–9 pairs. The vigour of this species in West Java suggests a need for further research on feeding value and management.

Zea mays Poaceae

Jagung, maize, sweet corn; grass of unique habit, well known crop plant; cosmopolitan crop in frost-free areas, invariably cultivated,

Whole green aerial part less cobs

DM	Ash	P	Ca	Mg	S	Na	C P	EE	GE	NDF	ADF	Cel	Lig	TP	T
-	11	0.2	0.1	0.3	0.2	0.04	15	4	-	50	30	23	3	-	-
-	7	0.1	0	0.4	-	0.04	11	3	-	57	31	27	3	-	-

Maize is a major local food crop in the drier nonirrigated areas of Indonesia, and there is also substantial commercial production. Dried maize stover is a much better feed than rice straw, and maize-growing areas support larger numbers of large ruminants than rice-growing areas. In West Java the crop is grown largely as a vegetable for the immature cobs to be eaten as sweet corn ('jagung muda'). Recently hybrid sweet corn has been introduced. Thus in West Java the plant is usually fed to village ruminants after harvest of the immature cobs and still in a green growing condition, often with a number of green tillers. It is then clearly an excellent feed. In E. Java the tops of plants are commonly cut after pollination for feeding to ruminants, and would thus be of higher quality than fully mature stover.

The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. Its mandate is to help identify agricultural problems in developing countries and to commission collaborative research between Australia and developing country researchers in fields where Australia has a special research competence.

Where trade names are used this constitutes neither endorsement of nor discrimination against any product by the Centre.

ACIAR TECHNICAL REPORTS SERIES

This series of publications contains technical information resulting from ACIAR-supported programs, projects, and workshops (for which proceedings are not being published), reports on Centre-supported fact-finding studies, or reports on other useful topics resulting from ACIAR activities. Publications in the series are distributed internationally to a selected audience.

Lowry, J.B., Petheram, R.J., and Budi Tangendjaja, ed., 1992. Plants fed to village ruminants in Indonesia. Notes on 136 species, their composition, and significance in village farming systems. ACIAR Technical Reports No. 22, 60p.

ISBN 1 86320 071 1

Typeset and laid out by Arawang Information Bureau Pty Ltd, Canberra, Australia.

Printed by Goanna Print Pty Ltd, Canberra, Australia.