Animal Husbandry Development

Consultancy Report No 10

by

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I. SUMMARY

This report details practicable improvements in animal husbandry that could be adopted immediately by the Song Da Project.
The main constraints at present to improved cattle production appear to be lack of quality feed, lack of capital to purchase breeding stock and villager concerns about their ability to finance loans and provide the necessary security. The main constraints to improved buffalo production appear to be a high buffalo calf death rate and lack of quality feed. For goats, the main constraint appears to be concern about harm to crops and forests. For pigs and poultry, the main immediate problem is the high death rate. It should be noted that breed quality is not seen as an immediate constraint to improved productivity. It is recommended that 'improved' (i.e. outside breeds) not be extended until the above constraints are attended to. However, the extension of improved breeds can serve as a very effective incentive to farmers to improve their general animal husbandry practices. But it is important that new breeds not be extended without effective improvements in the main constraints as listed above.

Recommendations are made based on the above considerations.

There are many niches in the existing agricultural systems of the Project's villages that could profitably grow improved forages without detriment to current agricultural productivity. These niches are:- hedgerows in upland cultivation fields; fences; on paddi bunds; around fish ponds; in wastelands; in orchards, tea plantations and backyards; in fallow lands; intercropping with upland crops; in grazing lands and forests; and in paddies in the dry-season. Suggestions are made on appropriate forage species for the different agro-ecological niches and on practicable cultural practices.

For extension in cattle production, it is suggested that the Project trial a few forages in each of the above niches in the coming wet-season. Planting material should also be given to farmers for trialling. Based on the observations made in this coming wet-season, farmers could be given planting material in 1998 for larger expansion. In 1999, a revolving cattle fund could be initiated. Farmers who have developed a sufficient amount of protected improved forage could be given breeding cattle on credit. Cattle could be repaid in kind. Red-Sindhi bulls could be distributed at the same time to commence production of dairy heifers. The Red-Sindhi X native cow cross-breed could be inseminated with friesian semen. Dairy heifers could be used to commence a local milk production industry or for sale to existing dairy areas where dairy heifers are in demand.

For extension of buffalo production, it is suggested that demonstrations of drenching of newly born calves to control intestinal worms be conducted for one year in a few villages. Appropriate drenches should then be available for purchase in the villages.

For goats, it is suggested to establish a revolving fund as per cattle above. Preconditions would include the establishment of a sufficient amount of protected forage and the keeping of goats in pens. Improved breeds of goats could be trialled initially.

For pigs and poultry, improvements in the veterinary service are suggested. It is suggested that truly volunteer villagers be trained in the practical aspects of vaccination. Training should be incorporated with a comprehensive village vaccination programme to demonstrate the benefits of vaccination. Trainees would be given a veterinary kit and a starter fund to purchase veterinary supplies and equipment. Trainees would have to be adequately remunerated when acting as the village veterinary worker. Improvements should be made in the cold-chain. Finally, external consultancy is suggested to assist the veterinary services.
II. INTRODUCTION

This report is concerned with a one month's consultancy for animal husbandry in the two
districts in which the Song Da Social Forestry Development Project is currently working.

The broad objectives of the consultancy were:

"analyse the potential for livestock and pasture development in the existing farming
systems of the Project area, and
elaborate practical recommendations for agricultural extension".

More detailed specific tasks were given and they are listed in Appendix I. The itinerary is
contained in Appendix II.

Several project reports detail the general environmental and sociological conditions of the
Project area. They need not be repeated here except to list the pertinent points viz:

The Project is currently working in two communes only. These are Chiêng Dong
Commune in Yên Chàu District, Son La Province and Xinh Phinh Commune in Tua
Chuà District, Lai Châu Province.

Chiêng Dong Commune is occupied mainly by Black Thai ethnic people; Xinh Phinh
Commune is occupied mainly by Hmong people.

Most of the population and cultivated fields of Chiêng Dong Commune lie between
about 300 and 800m altitude; most of the population and cultivated fields of Xinh
Phinh Commune lie between about 900 and 1,100m altitude.

The average annual rainfall of Chiêng Dong Commune is about 1,400mm; Xinh
Phinh Commune receives about 1,700mm. Rainfall in the Project area is extremely
seasonal (more than 80% of the yearly rain falls in the six months April to
September).

The average annual temperature of cultivated fields of Chiêng Dong Commune is
about 22°C; that of Xinh Phinh Commune about 20°C (by extrapolation, accounting
for altitude differences, from data for Son La town). Infrequent, light radiation ground
frosts occur in the fields of Chiêng Dong Commune between November and
January; frosts are more frequent and severe in the fields of Xinh Phinh Commune.

Appendix III discusses the soils of the two communes. Soils observed in Chiêng
Dong Commune are mostly naturally fertile and well-structured and have a surface
pH close to ideal for the growth of most crop and forage plants. Some very acid soils
were found in some cultivation fields of Xinh Phinh Commune.

Both communes have small areas of rice paddi (about 0.2ha per household) some
of which, in Chiêng Dong Commune, can be irrigated for two rice crops per year.
Chemical fertilisers (mainly urea and single superphosphate) and dung are
intensively applied to Chiêng Dong Commune paddies; Xinh Phinh Commune
applies mainly dung.
Both communes cultivate 1-2 ha of unirrigated, unbunded (upland) fields per household per year. The major crops are upland rice (one year) followed by maize (2-3 years). After the last maize crop the land is usually abandoned to weeds for about 3 years or to a single crop of cassava for about 3 years. The cassava is generally clean weeded annually during its first two years. The cycle is repeated after the fallow. No chemical fertilisers are used and very little dung or vegetative material is added to the fields. A large proportion of the upland fields are on very steep slopes (measured in the field up to 38°); significant rill and slump erosion was obvious on the steeper slopes. Some very large erosion gullies were seen at Xinh Phinh where incipient soil slumping was also more obvious.

Small, sometimes fenced, gardens for vegetables, fruit trees and occasional specialist plants, are located around the houses.

Each household owns on average 1-2 buffalo (used for ploughing paddi and the less steep upland fields), 1 head of native yellow cattle (but very few at Xinh Phinh), 2 small ponies (but fewer at Chiêng Dong), pigs (2-4 at Chiêng Dong; 7-8 at Xinh Phinh), 4 goats (very few at Chiêng Dong) and about 17 head of poultry (common fowl but also appreciable duck at Chiêng Dong).

Animals, except for some pigs are not permanently stalled but graze in non-cultivated areas in the wet-season and generally over the lands of the Commune during the non-cropping season. Large animals are generally brought back to their owner's house at night especially in Thai villages (mainly because of the fear of theft).

No forage is especially sown for large animals; sometimes grass is especially cut from forests and wasteland for feeding at night; much untreated rice-straw is feed in the dry-season. Much feed is especially prepared for pigs (maize, banana stems, vegetables, crop by-products); some maize and rice-milling residues are feed to poultry.

The rationale for development of livestock in this predominantly forestry project is that the provision of improved forage will lessen the demand for forest grazing and that an increase in income from livestock will partially obviate the need for upland cultivation so that steep land, prone to erosion, may be returned to forest. An increase in livestock production will also provide more manure for paddi and upland fields. The Government has a policy that, to protect present and proposed dams, about two-thirds of the Song Da watershed is to be protected forest. The development of livestock can greatly assist the Government in its aim of watershed protection whilst alleviating the poverty of the farming population of the watershed.

There appears to be a large demand for livestock products for all livestock types currently raised in the Project area. There appears to be no problem in marketing produce of any livestock that is being contemplated for the Project area.

This Report will not be much concerned with fish or bees. Fish raising is popular especially in Chieng Dong but there is little water or suitable land for expansion; Government and private sources appear to adequately service the industry at present. Bee keeping is a minor occupation at present but is being satisfactorily developed by another component of the Project.
This Report will briefly list the perceived main constraints to increased production for livestock and will then discuss possible development options. Finally, a suggested programme for immediate extension/demonstration will then be outlined. The Report is sectioned as per different livestock species.

III. DEVELOPMENT OPTIONS

A. CATTLE

i. Breed Improvement

The Government has had a long-term national programme of improving the small local breed by crossing with Red-Sindhi. Red-Sindhi is an Indian milk breed. Red-Sindhi bulls have been introduced to villages in Yen Chau and Tua Chua since 1995 but apparently none have been introduced to villages of the Project's Communes as yet. Bulls are given to a farmer with a small amount of feed; the bull becomes the property of the farmer once it has produced 100 calves. An artificial insemination programme using Red-Sindhi semen was introduced to Yen Chau in 1996; however it understood that only about 18 successful inseminations have been conducted to date. Both programmes are coupled with a programme to castrate local bulls; it is understood that this sub-programme has only been partially successful to date. Yen Chau District is keen to extend the Red-Sindhi programme to Chieng Dong in the near future.

It is too early yet to assess the success of this programme in the Project's Districts. Of introduced breeds, the Red-Sindhi is probably one of the more suitable; it is comparatively hardy and is a suitable breed on which to commence dairy development. The Project must not contemplate the introduction of more demanding breeds, such as the Brahman; such introductions have had disastrous results in neighbouring countries.

The native cattle is very well-adapted to the harsh environment of the Project's villages. Under poor feeding conditions, cows produce a calf nearly every year with few deaths of either cows or calves. Under improved feeding conditions, the native cattle is very capable of high productivity. Thus, until the suitability of the Red-Sindhi cross-breed can be satisfactorily demonstrated under conditions existing in the Project area it is suggested that caution should be exercised in replacing the local breed especially for beef production.

However, the Red-Sindhi x native cross-breed has good potential in the Project's area as the basis of a dairy animal. The cross-bred is inseminated with Friesian semen and the resulting heifer usually is a suitable dairying cow for small-holder farmers; other countries in Asia have successfully developed similar programmes. It is understood that small-holder dairying is very successful at Moc Chau. The Province intends to introduce a trial programme of dairying in Yen Chau. Fresh milk would initially be sold locally. In addition, it should be highly profitable for farmers to produce dairy heifers solely for sale to dairying areas such as Moc Chau. It is understood that dairy heifers sell at 3M Dong per animal and that the high cost of cows is an important constraint to the expansion of dairying. The extra value of a dairy heifer should be sufficient inducement to farmers to improve the feeding of the cattle.
ii. Feed Improvement

a. General

The Government's main programme for feed improvement appears to be the establishment of feed-mills and the expansion of sugar-cane production in Yen Chau. The residues of sugar-cane are to be used as dry-season animal feed. However, it should be noted that sugar-cane residues have a low protein content and further supplementation would be needed for high animal production. It is also understood that the District will trial maize in paddies in the dry-season for animal feed.

In addition to the above, it is suggested that forage production could be improved in the Project's Districts by the following:

b. Hedgerows and fences

The Project is promoting the adoption of permanent contour strips of leguminous shrubs in upland cultivation fields. The hedgerows are established both to reduce soil erosion and to add nitrogen to the soil for cropping. However, there are several deficiencies in the three species currently recommended for extension (see also other Reports which question the value of hedgerows and the appropriateness of the species currently being promoted):

Pigeon pea grows the fastest but is short-lived and subject to frost damage. *Leucaena leucocephala* has not grown well; it is much dominated by the other hedgerow species (see Photo 2) and, of the few plants examined, were not nodulated. *Leucaena* is also significantly attacked by the leaf-sucking jumping plant lice (psyllid). *Tephrosia candida* is by far the most common species in the hedgerows. However, *Tephrosia* is also short-lived (although it does persist longer than pigeon pea) and is frost-sensitive. More importantly, *Tephrosia* is not eaten by livestock. Also, *Tephrosia* does not seem to grow vigorously enough to make an appreciable contribution to the nitrogen nutrition of the soil. Well-nodulated legumes fix nitrogen in close proportion to the amount of growth of the legume. The SALT posters, which are commonly displayed in agricultural offices, show the amount of legume material that must be produced before hedgerows can add a significant amount of nitrogen to the soil. In addition, the current practice of placing cut *Tephrosia* along the hedgerow (to assist in reducing soil erosion) reduces the benefit of the hedgerow to the nitrogen nutrition of the crops growing between the hedgerows (the nitrogen remains in the hedgerow and is not transferred to the cropping area).

The recommendations of the Cover-crop Specialist can be greatly supported. There is much merit in replacing the hedgerows with more permanent, frost-tolerant (in frost-prone areas) species that also have an immediate economic use (as for food, sale or livestock feeding). The nitrogen nutrition of the cropping land can be significantly improved by the greater use of leguminous crops as suggested by the Cover-crop Specialist. However, it is important to ensure that the legumes are well-nodulated. No nodules were found on the few plants of beans and peanuts examined in the paddies at Xinh Phinh whereas nearby pigeon pea was well-nodulated. Some legumes are specific in their rhizobial requirements; they will nodulate effectively with only a comparatively few strains of bacteria. Where the appropriate bacterial strain is not present in the soil, it is important to inoculate the seed at sowing with the appropriate bacterium. This is easily done by mixing the seed with prepared peat inoculum or, if this is unavailable, to mix the seed with soil from underneath well-nodulated legumes plants of the same variety. Once effectively nodulated legumes are grown in a field, it should not be necessary to inoculate any future crops of the same legume variety in the same field.
*Leucaena leucocephala* is a very well-known, high quality feed for livestock. However, it seems to be poorly appreciated in Vietnam despite local research work which has confirmed its value as feed for poultry and beef and milking cattle. In Vietnam, leucaena has produced 13 tonnes of dry matter every year for at least 6 years; when 18% of the diet of cows was replaced with dried leucaena leaf, milk yield was increased by 22%. Despite this evidence, a dairy farmer was observed at Moc Chau destroying a well-grown hedge of leucaena on the basis that it did not produce much leaf. (In fact, much stem had been produced. Leucaena must be cut regularly to prevent the conversion of leaf growth into stem growth).

Leucaena can grow very fast in Son La. In one hedgerow at Huon village, Chieng Dong Commune, on a limestone soil, 2-year old leucaena plants were seen that were more than 3 metres in height. Just north of Son La town, also on a limestone soil, 4-year old leucaena plants were seen that were more than 7 metres in height. Also see Photo 1.

It is suggested that *Leucaena leucocephala* be promoted in hedgerows in the Project area. Suggested appropriate cultural conditions are as follows:

- Select limestone or other fertile soils below 1,000m altitude. Do not grow on soils of pH less than 5.5. Only sow cool-tolerant leucaenas above about 1,000m;
- Test seed for hard-seededness (soak overnight in water and observe the percentage that become soft). If the percent of hard-seed is more that about 60%, place the seed in a container and poor boiling water over the seed. Re-test for hardseededness. (It is understood that untreated seed is sown in the Project area; hence its poor establishment rate);
- Inoculate seed just before sowing. Either mix seed with soil from under a well-nodulated leucaena plant or, preferably, obtain the correct inoculum from an international source as listed in Appendix V. It should only be necessary to import inoculum once. Correctly nodulated leucaena plants will grow much faster than unnodulated plants in most soils;
- Sow leucaena seed alone; do not sow with other species;
- For the first wet-season, clean-weed a 15 cm area on either side of the leucaena row. Leucaena is susceptible to plant competition before it is properly established;
- Once leucaena is about 2 metres in height, it may be cut for forage to 1 metre in height at a minimum interval of 4 weeks in the wet-season and 8 weeks in the cold or very dry seasons.

Although leucaena is more fastidious in its cultural requirements than other species that could be recommended, the long-term (30+ years) provision of a large amount of high quality feed makes the initial investment well worthwhile.

Other forage species that could be sown as hedgerows are listed in Appendix IV A. Appendix IV A also lists the eco-agricultural requirements and characteristics of the species. Sources of seed are listed in Appendix V. Note that Bunch also recommends sugar-cane as a hedgerow species.

The grasses listed in Appendix IV A could also be established as a row immediately uphill of the legume shrub rows after legume establishment. This would greatly reinforce the ability of the
hedgerows to reduce soil erosion.

The above-mentioned legume species and napier and king grass are also suitable species to establish on the inside of existing fences around backyard gardens. A more permanent fence would result if the longer living legume shrubs were cut at a tall height.

c. Paddi bunds, fish ponds and wet wastelands

Forages could be profitably established on paddi bunds, around fish ponds and in unused patches in paddi fields. The forages could be profitably fed to fish. Many farmers at Moc Chau grow napier grass around fish ponds. Possible suitable forages and their eco-agricultural requirements and characteristics are listed in Appendix IV B. Sources of seed are listed in Appendix V.

d. Orchards, tea plantations, backyards

Fruit trees are commonly grown around houses. The orchards and backyard gardens are often fenced and are either clean-weeded or have an understorey of short, frequently slashed weeds. The same comments apply to tea plantations with the additional comment that tea plantations are often grown on steep land where soil erosion is obvious; such plantations must have a ground cover to reduce erosion (see Photo 3).

Such areas could well grow forage (see also Photo 5). The major concern is that the forages should not compete with the fruit trees or tea. For this reason, low-growing legumes or frequently cut, low-growing grasses are recommended. If manure is returned to the orchard, or if the forages are grazed rather than cut-and-carried, then the grasses as outlined in Appendix IV A can be recommended so long as they do not limit fruit tree production by competing for dry-season moisture.

Possible suitable forages and their eco-agricultural requirements and characteristics are listed in Appendix IV C. Sources of seed are listed in Appendix V.

e. Fallow lands

Upland fields when fallowed are allowed to revert to unsown weeds and grasses. Fallow periods are relatively short (3-5 years). Particularly at Chieng Dong, the fallow is often the one cassava crop grown for three years with an understorey of weeds; it seems the weeds are often weeded, but left on site, during the first year or so of the cassava fallow.

It has been shown that natural weed fallow, in south-east Asian uplands not recently claimed from forest, can be improved by supplementing or replacing the weed fallow with sown forage legumes (see Photo 6). In some islands of eastern Indonesia, leucaena is established as a thicket during the fallow phase; at the end of the fallow the leucaena is cut and burnt and crops sown in the burn.

It is suggested that similar systems could be tried in the Project area. The legume fallow would have to be protected from uncontrolled grazing during the fallow period although controlled grazing and some cut-and-carry could be encouraged. (Tephrosia has a distinct advantage in this system as it is not grazed). It should be noted that some upland fields are so steep that little grazing occurs on these fields at present.
The system would best be established by oversowing legume seed during the last weeding before the fallow but during the wet-season. Seed would be suitably treated for hardseededness and inoculated as necessary.

Possible suitable forage legumes and their eco-agricultural requirements and characteristics are listed in Appendix IV D. Sources of seed are listed in Appendix V.

f. Grazing lands and forests

It is understood that it is the Government’s intention to improve the forage in designated grazing lands and forests. Some, but not all villages, have comparatively small areas of designated grazing land. The grazing lands are often on the poorer soils (see Photo 8).

In general, the areas of grazing lands are insufficient, on their own, to support the number of grazing animals in a village. It probably requires about 4 ha of typical, unimproved grazing land to support 1 native cow and calf year-round on a sustainable basis so long as the grazing lands are relatively free of unpalatable weeds. Sustainable carrying capacity of forested areas will be considerably less depending on the amount of tree cover; a closed canopy forest is not likely to support more than 1 cow per 20ha on a year-round basis. The maximum safe stocking rate for well-grown improved pastures without fertiliser addition is probably about 1 ha per native cow per year; some slashing of unpalatable weeds would probably be required to maintain this level of production. Fertiliser application would increase stocking rates. Forage yields will decline with time if the pastures are cut-and-carried without the return of nutrients by way of dung or fertiliser. Unfertilised legume shrubs (example leucaena) may provide greater long-term stocking rates if managed on a rotational basis.

Developing forage resources in grazing lands and the forests has the major disadvantage of distance from the village. Animals must be brought back to the village every night because of the fear of theft; this requires additional labour which is already scarce during the cropping periods. Grazing lands have the additional disadvantage of common user rights; unless animal numbers and utilisation are strictly controlled then improvement in grazing resources will result in an increase in livestock numbers with no improvement in overall animal production.

It is understood that grazing in forests is to be discouraged. However, it is unlikely that grazing in well-treed areas will have serious environmental consequences; compared to clearing for cultivation, grazing in well-treed forests should not significantly increase erosion. Grazing will slow forest regeneration and will result in the preferred growth of unpalatable tree and weed species. But where the aim of reafforestation is for watershed protection rather than forest production, grazing should not be a major concern.

It is also understood that there is a proposal to establish forages in forests and to encourage cut-and-carrying to stall-fed animals in the village. The major disadvantage of this proposal is the great amount of extra labour this would entail. Forests lands are often located at some distance from the village. An adult buffalo requires about 30 kg of fresh feed every day just to maintain body weight; any production (growth, pregnancy, suckling calves) requires extra feed. Villagers do not have this amount of spare labour for most of the year.

Finally, it should be remembered that continual cut-and-carry of a grass without nutrient return will result in a continuing decline in grass productivity to low levels of production. Grass establishment for cut-and-carry may be applicable in the early years of plantation establishment but is not likely to be sustainable at acceptable productivity levels in the long-term. Leguminous
fodder trees are most applicable for long-term forage sustainability in forests; they may be lopped as high protein supplementary feed in the dry-season when feed is in shortest supply and labour in least demand. *Acacia mangium* is the only fodder tree seen widely grown; however *A. mangium* is of poor feeding quality suitable only for emergency feeding of goats.

Based on the above considerations some suggested forages suitable for development in grazing and forest lands are outlined in Appendix IV E. It is suggested that the most practicable strategy is to oversow recently burnt grazing lands with the herbaceous species listed in the Appendix without land preparation. Grazing might need to be regulated in the early stages of pasture establishment. Prolonged hard grazing will remove the more palatable species and will reduce productivity. Forage trees are best established as potted seedlings; grazing should be prevented until plants are above grazable height; trees are best used by lopping or by animals feeding on self-sown seedlings, lower branches and fallen flowers and fruits.

**g. Dry-season paddies**

The more elevated paddies do not have access to sufficient water to grow a dry-season crop of rice. Such paddies are idle in the dry-season although they will often have some water available at least for part of the dry-season (see Photo 7). Such paddies can profitably grow very good quality temperate forages in the cool-season. The forages will be very suitable for pigs. If the forages are legumes, a benefit to the next wet-season crop of rice can be expected.

It should be possible to establish the forages without cultivation by burning rice stubble after rice harvest, oversowing and then flood irrigating. In neighbouring Xieng Khouang Province, Laos, burning greatly improved forage growth especially in acid soils. It is understood the District will trial dry-season maize in paddi for forage. In addition, it is suggested to also try the species listed in Appendix IV F. These species have grown well in Xieng Khouang rice paddies and also in upland fields on fertile soils at high altitude without irrigation.

**h. Intercropped forage legumes**

Suitable legumes could be grown with upland crops during the cropping season. Apparently some farmers adopt this practice at present. Some legumes could have the multiple purposes of providing seed for human feed, herbage for animals and nitrogen for the soil. This matter in adequately covered by Bunch.

**iii. Disease Improvement**

The native cattle are very resistant to diseases; deaths from disease are few. The Red-Sindhi crosses may also be relatively resistant.

The Government does have a comprehensive vaccination programme for cattle. The only improvements suggested are the general improvements as listed in Section III E ii.

**iv. A Suggested Extension Strategy**
During 1997

Trial the forages suggested in Appendix IV. Obtain 1-10kg of seed of each (or most) of the varieties listed. Possible sources and suggested sowing rates are listed in Appendix V. Seed should be obtained immediately as it is almost planting season.

The Project should have protected areas in each of the representative types of land as outlined above. Varieties of the forages as listed in the Appendices are sown as per the guidelines above. Care needs to be taken with seed treatment and inoculation where indicated as necessary. Mr. Tan is familiar with both procedures. No measurements are necessary, only visual observations. Great care must be taken in interpretation. It must be noted that many forage species are much slower to establish than crop species especially when they are not tended as thoroughly as crop species. This often results in abandonment of the observations when more patience and persistence would have resulted in successful forage development (farmers are not used to establishing improved forages and evaluate forages as they would crops). In addition, animals will often not eat new legumes when first offered them. This often leads to the rejection of very valuable legume forages. Forages which have a world-wide reputation as animal feed should be persisted with after initial refusal by animals. The ability to produce large quantities of quality seed is an important evaluation criterion; however, forages have to be protected from defoliation for about 3 months before seed maturity.

Forages must be established and managed by methods applicable at the farm level. Fertiliser must not be applied. In general, forages should not be hand-weeded (except for some legume shrubs grown singly). In general, forages may be lightly slashed to cut overtopping weeds 1-2 months after sowing. This is often all that is required to achieve successful pasture establishment.

Small packets of forage seed should be given to farmers to sow on their own land. Each packet should be accompanied by a single page of information on cultural requirements, etc.

Interested farmers should be taken on study tours. Napier grass is grown by private farmers around fish ponds and in fields for cattle feed at Moc Chau (see Photo 4). Flemingia is fed to goats at the Goat and Rabbit Research Centre, Ha Tay; nearby farmers keep goats in pens and have recently established Flemingia. Private farmers at Ha Tay are reportedly cutting leucaena to feed fresh to poultry. Leucaena is growing well in a hedgerow at Huon village and in coffee at Son La. Field-days could be held in the Commune to see examples of successful forages established by the Project but preferably by other farmers.

To encourage farmers, prizes could be offered to farmers who have established the best forage hedgerow, the best napier around a fish pond, the best forage under an orchard, who feeds the most improved forage to livestock, etc.

For 1998

In 1998, based on the 1997 observations, interested farmers would be given seed of whatever forage they preferred. The forage would be intended for general use but also in preparation for a cattle distribution programme to commence in 1999.

For 1999

Farmers would be given, on credit, one or two native cows when they have established at least
a certain defined amount of forage. Farmers may establish whatever species they like on whatever type of land. The only criteria for eligibility to obtain a cow would be:

- The presence of a certain length of row or fence or hedge of well-grown forage (1m² of block plantings would be equivalent to 1 m of row);
- The demonstrated ability to protect the forage by whatever means the farmer chooses; and
- The willingness to vaccinate and drench the cattle.

Cattle could be repaid in kind (e.g. two calves of a certain weight) which could then be given to the District to start a revolving fund for further expansion.

Farmers already owning cattle could join the scheme by receiving a Red-Sindhi bull which would be available to service the native cows received by the other farmers.

For 2000 and beyond

The offspring of the Red-Sindhi and native cows could be inseminated with fribesian semen to produce dairy heifers.

B. BUFFALO

i. Disease Improvement

Buffalo are not a priority for development by the Government. This is sensible given the much poorer productivity of buffalo compared to cattle. However, buffalo will be used by farmers for traction in the foreseeable future. Buffalo are expensive; an adult cow costs about 3M Dong. Thus improvement in productivity could be of great economic benefit to the owner.

The main constraint to increased productivity appears to be the very high death rate of buffalo calves. Farmers generally report about a 40% death rate before one-year of age (see Photo 9). Death rate is highest in the cool-dry season and is often associated with diarrhoea in calves. While farmers and extension workers attribute death to cold conditions, it is more likely that death is due to an abundance of alimentary tract nematode parasites (round-worms). The burden of worms is accentuated by poor nutrition and cold weather in the early dry-season. Intestinal worms cause disease by competing with the buffalo calf for food and by causing anaemia from blood loss from the walls of the intestine and stomach. Calves may be first infected from their mother's milk. All farm animals may be assumed to carry a worm burden which restricts animal productivity to varying degrees. However, buffalo calves are particularly susceptible to intestinal worms.

The Thai-German Veterinary Project in Khon Kaen investigated this problem. A drenching of a mixture of thiobenzole and piperazine at both 2 weeks and 6 weeks of age reduced buffalo calf death rate under village conditions from 30% to 10%. Kingston (1992) applied the Thai-German data to northern Laos and concluded that the administration of piperazine at 2 and 6 weeks of age resulted in a cost/benefit ratio of 69 for buffalo and 79 for cattle.
Some antihelminthic medicines are available in Chieng Dong. It is reported that some pigs are routinely treated with these worm drenches. Apparently cattle and buffalo are sometimes also drenched when they show severe symptoms of worm infestation but apparently never before 3 months of age.

Thus it seems that an buffalo calf drenching programme soon after birth is the most practicable strategy to immediately and significantly improve buffalo productivity.

Once worms are controlled in buffalo calves then improvements in feeding can be supported as outlined under the cattle section. There seems little justification in an improved buffalo breeding programme until both the disease and feeding situations are considerably improved.

**ii. A Suggested Extension Programme**

It is suggested that the Project support a trial drenching programme with co-operating villages on recently born buffalo calves. Drenches could be given free for the first year. Monitoring would be important. It would be important to check with appropriate veterinary authorities first as to the efficacy for buffalo calves of the anthelmintics currently in use in Yen Chau. The drenching programme could be combined with the veterinary extension programme as outlined in the veterinary section. Apparently no specific anthelmintics are available in Tua Chua.

**C. GOATS**

The Government has an active programme of extending the Bac Thao improved breed of goat. The Bac Thao is a milking goat but can be used solely for meat if feeding is not sufficient. No Bac Thao have been extended in Yen Chau to date. Four Bac Thao goats have been kept in Tua Chua but have not performed as well as native goats under free-roaming conditions.

Goats have not been actively extended in the Project area to date probably due to the real concern of harm to crops and forests. However, Bac Thao goats and crosses with the native goat have been seen successfully kept permanently in bamboo raised pens at Moc Chau and Ha Tay; small-holder farmers only feed locally available weeds, tree loppings and crop residues (see Photo 10). The goats are vaccinated regularly twice a year.

The native goat is resistant to disease when roaming freely. Goat products (meat and blood) are in high demand. The main constraints to development in the Project area appear to be feed availability and control of crop and forest damage.

An extension programme is suggested. Farmers should be taken on study tours to see goats successfully raised in pens by small-holder farmers. Farmers should then be offered breeding goats in a revolving loan scheme similar to the Cattle extension programme outlined in Section III A iv. Eligibility conditions to receive goats might be:

1. The presence of a certain predefined amount of improved forage adequately protected as outlined in Section III A iv;
The construction of a suitable pen; and, 

The agreement to keep goats permanently in pens and to adequately vaccinate and drench.

The Goat and Rabbit Research Centre may be able to assist with training courses and extension material. Farmers could choose either native or improved breeding goats or a mixture of both. The keeping of native goats permanently in pens would be a trial initially as native goats have not yet been kept permanently in pens.

D. PIGS AND POULTRY

Improved breeds of pigs have been introduced in the District for several years. It is not clear how successful the programme has been. Pig death rate is consistently reported to be high. Apparently very few pigs are vaccinated in Chieng Dong but some pigs are given antibiotic when sick and this is reported to be beneficial if administered early enough in the disease. The vaccination rate at Xinh Phinh seems to much higher but the death rate of pigs is still high.

The improved common fowl breed, the Tam Hoang, have been recently introduced into Chieng Dong. It is too early yet to assess the success of this programme. With the exception of the recently introduced Tam Hoang, very few poultry were reported as vaccinated in Chieng Dong. No poultry are vaccinated in Xinh Phinh. Poultry death rate is consistently reported as being very high in both Communes.

It is recommended that the Project does not support any development of pigs and poultry until the disease problem can be brought under control. Suggestions concerning the veterinary programme are given in the next Section.

E. VETERINARY MATTERS

i. The Present Situation

There is an unacceptably high death rate of buffalo calves and of pigs and poultry. This contrasts with the much reported lower death rates of pigs and poultry in Yen Chau town where there is a very active village veterinary worker.

There are four trained villager veterinary workers (VVWs) in Chieng Dong Commune of which one at least seems quite active. It appears that most cattle and buffalo are vaccinated twice per year in both Communes. The standard vaccine for cattle and buffalo appears to be against haemorrhagic septicaemia (pasteurellosis). In Chieng Dong, farmers are said to pay 4,000 Dong per vaccination of which the VVW receives 1,500 Dong. In some villages the Government subsidises an additional vaccination against anthrax but it appears that an anthrax case has not been reported for some years. Apparently some horses are also vaccinated against anthrax. An adult cattle cow is worth about 1.5M Dong. An adult buffalo cow is worth about 3M Dong.

All vaccines except for poultry, are free in Xinh Phinh. However, the remuneration to the VVW
for labour and time appears to be poor: apparently VVWs receive about 6,000 Dong per about 10 buffalo or about 20 pigs vaccinated at two injections per animal; there are also some concessions in communal labour obligations.

It appears that at Chieng Dong pigs are only vaccinated against swine fever (hog chlorea=typhoid?) every 6 months. Swine fever is a virus and is not cured by antibiotics. Thus the reported success in administering antibiotics to sick pigs suggests there is another common disease; haemorrhagic septicaemia could be suspected. The cost to the farmer of one vaccination is 1,500 Dong. The cost of a course of antibiotics is about 30,000 Dong although it is suspected that many farmers do not complete the full course. Apparently some farmers in Chieng Dong routinely drench at 1,000-2,000 Dong (depending on size) per 6 months. Apparently pigs are vaccinated against both Swine fever and Haemorrhagic septicaemia in Xing Phinh. An adult pig is worth about 600,000 Dong.

Vaccines are available against Newcastle disease and fowl chlorea (pasteurellosis) in common poultry. Cost to the farmer is 500 Dong per bird per single vaccination. Each vaccine is administered at 6 monthly intervals. An adult bird is worth about 30,000 Dong. Chicks are not vaccinated until at least one month of age; this is because the type of vaccine for young chicks is apparently not kept in the Districts. This may contribute to the reluctance of farmers to vaccinate since young chicks are most susceptible to Newcastle disease.

Goats and ducks are not vaccinated.

Vaccines, except for Newcastle and probably swine fever are not kept cool in Yen Chau; they are kept on shelves at room temperature. Although there was obvious concern that vaccines were not out-of-date, this method of storage can be expected to greatly reduce vaccine effectiveness in periods of hot weather. Newcastle vaccine is apparently kept permanently on ice and transported to villages in plastic insulating containers. Despite the more irregular electricity supply in Tua Chua, vaccines seemed to be well-kept on ice prepared during periods of power supply.

Anti-biotics are freely available in both Districts and are available from a retail outlet organised by the Districts. Anti-biotics are also supplied in Communes by the Commune Veterinary Co-ordinators and are widely used.

The reasons consistently given for non-vaccination include:

- Farmers do not have sufficient cash when vaccinations are due; and,
- Farmers are unaware of the benefits and necessity of routine vaccinations (they prefer to wait until an animal is sick before attempting to prevent or cure disease and will sometimes vaccinate after signs of disease; this will only accentuate disease symptoms).

Other reasons often mentioned include the economic hardship imposed on the more remote villages and hamlets. Either the farmer has to bring the animals to a village closer to the main road or pay a premium to the vaccinator for extra travel and the unused vaccine when a vaccine bottle is opened. Vaccinators have to pay for equipment that they use and the provision of a veterinary kit in each village was a common request. (At Xinh Phinh, apparently each VVW received one syringe and some needles at their initial training course). The problems with village vaccination programmes in Mai Son District, Son La have been well-documented by Action Aid.
ii. A Suggested Extension Programme

Volunteers to be VVWs should be called for from each village. The village should then select a volunteer. The VVW should not be appointed as this may result in a person being appointed who is not enthusiastic and diligent.

Volunteers should be trained for about 5 days. No more than 1 day's classroom training should be given. Most training should be practical. Most importantly, the training must incorporate effective methods of animal restraint. It is suggested that the training be combined with a comprehensive village vaccination programme. This would serve the dual purposes of practical training for the VVWs and demonstration of the benefits of vaccination to villagers. A cooperating village in the Commune should be chosen in which the trainees vaccinate all livestock under instruction from qualified trainers. The vaccination programme should be combined with a comprehensive drenching programme. Six months after the initial training, a short practical training refresher course should be given where-by all animals in the same village are revaccinated and redrenched. The Project could conduct a base-line survey before the first vaccination and again at 6-monthly intervals to assess the success of the programme.

After training, each VVW should be given a comprehensive veterinary kit and a starter fund to enable the purchase of veterinary medicines. A supply of appropriately simple brochures containing pertinent information should be given to each VVW for distribution to villagers. The VVWs should be officially allowed and encouraged to charge a reasonable margin on the sale and administration of veterinary medicines and vaccines to compensate for labour lost and to allow the restocking of medicines.

The Project might also assist in providing a refrigerator at the District and Commune level for the storage of vaccine. Chieng Dong Commune is due to be connected to the main power line in the near future. The Project could consider assisting labour costs in the more remote places in the Commune. Study tours could be conducted for villages to areas where the vaccination programme is successful.

The veterinary component would benefit from external consultancy in technical matters. The main requirements of the consultancy would be (in consultation with local and national veterinary officials):

- To assist in the design of the VVW training course and to oversee the conduct of, at least, the first course;
- To conduct a disease survey of the important livestock in the Project's area (most diseases of livestock are currently identified by external symptoms which is an unreliable means of disease identification);
- To advise on improvements to the disease control and prevention programme (the necessity of early vaccination against Newcastle disease; the applicability of newer types of Newcastle vaccine [which can be fed in animal feed] and of haemorrhagic septicaemia [which need only be sprayed onto noses of animals]; the most effective anthelmintics; etc).
IV. ACKNOWLEDGEMENTS

Acknowledgement is due to villagers and Government and Project Officials who willingly provided information on which this report is largely based. Acknowledgement is also made of officers and consultants of other Organisations and Projects (and of their reports) who also willingly provided information and ideas. Project and Government staff provided every assistance to the consultancy.

V. APPENDICES

APPENDIX I: TERMS OF REFERENCE (TASKS)

1. To analyse the existing farming systems in the project area in view of animal husbandry based on existing documents and field visits.

2. To identify in close co-operation with the appointed national expert and relevant project-staff the potential for livestock development (through the introduction of new breeds, improvement of grazing regimes, fodder situation, veterinary services, etc.)

3. To elaborate a practical package of technical recommendations for extensionists

4. To estimate the carrying capacity under present regime and after pasture development and improved fodder production

5. To assess the impact of livestock on natural regeneration

6. To compare potential and benefits of big and small livestock development

7. To conduct on-the-job training for staff involved

8. To present and discuss preliminary results and findings at district level and as a debriefing workshop at Hanoi.

APPENDIX II: ITINERARY

<table>
<thead>
<tr>
<th>Time</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 March, 1997</td>
<td>Arrived Hanoi.</td>
</tr>
<tr>
<td>7 March, 1997</td>
<td>Discussions with SFDP, World Bank and UNDP</td>
</tr>
<tr>
<td>8 March, 1997</td>
<td>Discussions with SFDP, Forest Research Institute and Department of Animal Husbandry.</td>
</tr>
</tbody>
</table>
9 March, 1997    Report Reading
10 March, 1997   Travel to Yên Châu; discussions with Project Field Co-ordinator.
11 March, 1997   Discussions with District Extension Officers and Chairman of Chỉ Giêng Dong Commune; field trip to Chỉ Giêng Dong Commune and nearby villages.
12 March, 1997   Discussions and field trips with Department of Extension and Dairy Co-operative Company at Mộc Châu; return to Yên Châu - discussions with Dr. Bunch.
13 March, 1997   Attended District meeting re. cover crops; discussions with Veterinary Department and Fisheries Officers.
14 March, 1997   Field trip to Chỉ Giêng Dong Commune and nearby villages.
15 March, 1997   Field trip to Chỉ Giêng Dong Commune and nearby villages.
16 March, 1997   Field trip to Action Aid, Mai Son. Overnight in Son La town.
17 March, 1997   Discussions with Provincial Department of Agriculture and Rural Development Officials; discussions and field trip with North West Areas Forest Science Production Centre.
18 March, 1997   Discussions with Large Livestock Company. Travel to Tua Chuà.
19 March, 1997   Meeting Chairman, Tua Chua District. Discussions with District Extension Unit, Chairman Xinh Phinh Commune, Veterinary and Agriculture Units; field trip to Xinh Phinh Commune.
20 March, 1997   Field trip to Xinh Phinh Commune.
21 March, 1997   Presentation to Chairman of Tua Chuà District and District and Project Officials; travel to Dien Bien Phu.
22 March, 1997   Discussions with DARD Officials; field trip around Dien Bien Phu town.
23 March, 1997   Travel to Yên Châu.
24 March, 1997   Discussions with Womens’ Union and village veterinarians; field trip to Chỉ Giêng Dong Commune; presentation to Vice-Chairman, Yên Châu District and District and Project Officials.
25 March, 1997   Travel to Hanoi.
26 March, 1997   Discussions UNDCP, Project staff, Mr. Siep Littoij
27 March, 1997   Field trip to Goat and Rabbit Research Centre, Ha Tay
29 March, 1997   Report writing
APPENDIX III: SOILS OF THE PROJECT AREA

Only one soil-geological map of the Project area was sighted. The soil-geological map was of a scale too small to accurately map the soils of the Communes. Most soils of the Communes are mapped as "lightly yellow (humus) soils on sandstone". The map indicates that there are some areas of "brown red (humus) soils on limestone" in both Communes. Some "red yellow (humus) soils on claystone and metamorphic rocks" are also mapped for Xinh Phinh Commune.

A partial inspection of the Chiêng Dong Commune indicated that the soils near the main village near the main road are strongly aggregated, red-loams developed on limestone. These soils had a surface pH of usually 6.5 or greater and are the most fertile soils of the Commune.

The central part of the Commune, where most dryland cultivation occurs, consists of a less well-aggregated, brown loam developed on a mixture of sedimentary and lightly metamorphosed rocks. These rocks only rarely contained sandstone. Surface soil pH was between 6.0 and 6.5. The designated grazing land of Na Pan village was correctly located on a ridge of shallow soils derived from this mixture of rocks. The grazing soils are identified by the villagers as being the most infertile and are not cultivated; they can be identified in the field by the presence of remnant pine trees.

The partially forested, less intensively used high ridge on the northern boundary of the Commune was not inspected. On the Map this ridge is marked as "red brown (humus) soils on base and neutral igneous rock". This suggests these soils may be naturally fertile.

Xinh Phinh Commune also consisted of a mixture of fertile, red, limestone derived soils and more infertile soils derived from other sedimentary (claystone, sandstone) and lightly metamorphosed (shale and schist) rocks. Some very large erosion gullies have developed on rocks of the latter type. Soils derived from these inferior rocks had lower pH's than those derived from limestone; some paddi and upland soils had a pH of 5.0 which is very acid. Farmers indicated that legumes could not be grown on these acid soils; such soils can be identified in the field by the presence of the 1-2 metre high weedy shrub, 'mua' (Vietnamese name).

APPENDIX IV. SOME RECOMMENDED FORAGES FOR EXTENSION

30 March, 1997    Report writing
31 March, 1997    Discussions with Project Staff; report writing.
1 April, 1997     Workshop
2 April, 1997     Report writing
3 April, 1997     Discussions on extension programme
4 April, 1997     Depart Hanoi.
(these lists are not comprehensive; see Bunch for species for intercropping with upland crops).

### A. SOME RECOMMENDED FORAGE HEDGEROW SPECIES

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Environmental requirements</th>
<th>Characteristics &amp; Cultural Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common leucaena</td>
<td>See text - Section III A ii b.</td>
<td>See text</td>
</tr>
<tr>
<td>Diversifolia leucaena</td>
<td>As per Common leucaena but more cold and psyillid tolerant</td>
<td>As per Common leucaena but of lower feeding quality. Should be very suitable for goats.</td>
</tr>
<tr>
<td>Pallida leucaena</td>
<td>As per Diversifolia but probably even more cold and psyillid tolerant</td>
<td>As per Diversifolia but will produce much thicker stems very suitable for fuel-wood/small poles.</td>
</tr>
<tr>
<td>Acid-tolerant leucaena</td>
<td>As per Common leucaena but can grow satisfactorily in more acid soils</td>
<td>Under test at the Goat and Rabbit Research Centre, Ha Tay; probably as per diversifolia or pallida.</td>
</tr>
<tr>
<td>Flemingia</td>
<td>Can grow well in acid, very infertile soils without fertilisation. Growth poorer in cool situations.</td>
<td>A legume shrub; should not require inoculation. Poor quality feed but well-eaten by goats.</td>
</tr>
<tr>
<td>Calliandra</td>
<td>Can grow well in more acid and infertile soils than leucaena. Shows some cold tolerance.</td>
<td>A legume shrub of 3-5 years life; inoculation is probably beneficial but not essential. Good quality feed best fed fresh. Seed production sometimes poor. Seeds sensitive to very hot water.</td>
</tr>
<tr>
<td>Gliricidia</td>
<td>Can grow well in more acid and infertile soils than leucaena. Does not tolerate frost.</td>
<td>A long-lived legume shrub. Inoculation as per Calliandra. Good quality feed but sometimes not very palatable; best fed dried. Seed does not require hot-water treatment.</td>
</tr>
<tr>
<td>Napier (elephant) grass</td>
<td>Poor growth in infertile soils. Can grow at altitude but growth reduced.</td>
<td>Few (no?) viable seed. Good quality feed if fed young. Cut at 4 weeks in peak season; 8 weeks in poor season.</td>
</tr>
<tr>
<td>Grass Type</td>
<td>Description</td>
<td>Additional Information</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>King grass</td>
<td>Similar to Napier.</td>
<td>As per Napier but more prone to become stemmy. A hairy grass which can become very tall.</td>
</tr>
<tr>
<td>Setaria grass</td>
<td>Best suited to fertile soils; cool tolerant.</td>
<td>Produces viable seed. A very good quality grass but should be fed with other species to prevent possible nutrition problems. Less prone to become stemmy.</td>
</tr>
<tr>
<td>Gamba grass</td>
<td>Good growth in very acid, infertile soils. Cool temperatures reduce growth.</td>
<td>Produces much viable seed and tends to spread by seedlings if allowed to seed. Fair quality when young but not very palatable when old.</td>
</tr>
</tbody>
</table>
B. SOME RECOMMENDED FORAGE SPECIES FOR PADDI BUNDS, FISH PONDS AND WET WASTELANDS.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Environmental Requirements</th>
<th>Characteristics &amp; Cultural Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Napier and King grasses</td>
<td>Will not tolerate waterlogging; suitable for raised bunds and pond edges</td>
<td>Few (no?) viable seed. Good quality feed if fed young. Cut at 4 weeks in peak season; 8 weeks in poor season.</td>
</tr>
<tr>
<td>Para grass</td>
<td>Tolerates waterlogging and will grow into fish ponds; does not tolerate frost.</td>
<td>Usually planted by cuttings. Good quality grass.</td>
</tr>
<tr>
<td>Sesbania</td>
<td>Tolerant of waterlogging. Grows well in alkaline and mildly acid soils. Some cold tolerance.</td>
<td>Legume shrub of 2-3 years life. Seeds well; inoculation probably useful. Good feed for cattle; should be mixed with other feed for goats; should not be feed to pigs or poultry.</td>
</tr>
<tr>
<td>Glen american joint vetch</td>
<td>Tolerates waterlogging and infertile soils. Does not tolerate cold.</td>
<td>A very vigorous erect annual legume. Seeds very well; inoculation not required. Well eaten before stems become stemmy. Should not be cut low. Must be allowed to produce some seed for self-regeneration.</td>
</tr>
<tr>
<td>CIAT 184 stylo</td>
<td>Grows well in acid-infertile soils without fertiliser addition. Not tolerant of long-term water-logging or of cold. Very suited to raised bunds. A perennial legume semi-shrub. Seeds well; inoculation not required.</td>
<td>A lower quality feed; well-suited as a protein supplement for cattle, buffalo and goats. Should not be cut low.</td>
</tr>
</tbody>
</table>
### C. SOME RECOMMENDED FORAGE SPECIES FOR ORCHARDS, TEA PLANTATIONS AND BACKYARDS

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Environmental Requirements</th>
<th>Characteristics &amp; Cultural Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea grass</td>
<td>Wide adaptation. Tolerant of shade.</td>
<td>Should be grazed or fertilised to reduce competition with trees. A good quality tropical grass.</td>
</tr>
<tr>
<td>Koronivia grass</td>
<td>Very tolerant of very acid, infertile soils. Best suited to the harshish environments only. Tolerates waterlogging but not frost.</td>
<td>Should be grazed or fertilised to reduce competition with trees. A low-growing, creeping, poorer quality grass.</td>
</tr>
<tr>
<td>Greenleaf desmodium</td>
<td>Only grows well in fertile soils e.g. limestone soils. Grows well in warm and cool climates but frost causes leaf drop.</td>
<td>A vigorous, trailing legume with good seed set if not defoliated and is grown in frost-free environments. Inoculation not essential but beneficial. Should not be grazed or cut low for long periods.</td>
</tr>
<tr>
<td>Wynn cassia</td>
<td>Suited to non-clay, non-waterlogged soils. Grows well in infertile soils. Growth reduced in cooler environments.</td>
<td>A prostrate legume with very good seed production; generally spreads naturally. Inoculation not necessary. A poorer quality legume but should offer little competition to trees.</td>
</tr>
<tr>
<td>Lotoninonis</td>
<td>Grows well in acid, infertile soils. Tolerant of cool conditions.</td>
<td>A prostrate legume often with good seed production. Inoculation essential. A good quality tropical legume.</td>
</tr>
<tr>
<td>Pinto peanut</td>
<td>Grows best in wet, but not waterlogged, warm environments on moderately fertile soils. Shade tolerant.</td>
<td>A prostrate legume with good seed production (seeds are produced underground). Inoculation essential. Early growth may be slow. A good quality legume and very resistant to heavy grazing.</td>
</tr>
</tbody>
</table>
D. SOME RECOMMENDED FORAGE LEGUMES FOR FALLOW LAND

Legume shrubs as per Appendix IV A. Herbaceous legumes as per the following table:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Environmental Requirements</th>
<th>Characteristics &amp; Cultural Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenleaf desmodium</td>
<td>Only grows well in fertile soils e.g. limestone soils. Grows well in warm and cool climates but frost causes leaf drop.</td>
<td>A vigorous, trailing legume with good seed set if not defoliated and is grown in frost-free environments. Inoculation not essential but beneficial. Is very palatable and grazing <strong>must</strong> be controlled.</td>
</tr>
<tr>
<td>CIAT 184 stylo</td>
<td>Grows well in acid-infertile soils without fertiliser addition. Not tolerant of long-term water-logging or of cold. A perennial legume semi-shrub. Seeds well; inoculation not required.</td>
<td>Not very palatable in the wet-season; therefore applicable where grazing can only be partially controlled. Should not be cut low.</td>
</tr>
<tr>
<td>Axillaris</td>
<td>Grows well in medium fertility soils. Some cool tolerance (will grow in early cool-season).</td>
<td>A twining perennial legume. Seeds well. Inoculation beneficial. Not very palatable during the wet-season; therefore applicable where grazing can only be partially controlled. Should not be cut low.</td>
</tr>
</tbody>
</table>
### E. SOME RECOMMENDED FORAGES FOR GRAZING AND FOREST LANDS

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Environmental Requirements</th>
<th>Characteristics &amp; Cultural Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucaena</td>
<td>Suitable for the more fertile soils. There is a wide range of eco-types. See text for more detail.</td>
<td>Grow only the tree types; diversifolia leucaena probably less suitable. See text for further detail.</td>
</tr>
<tr>
<td>Gliricidia</td>
<td>Can grow well in more acid and infertile soils than leucaena. Does not tolerate frost.</td>
<td>A long-lived legume shrub. Inoculation beneficial but probably not essential. Will drop its leaf readily in the dry-season when conditions become harsh. Good quality feed but sometimes not very palatable; best fed dried. Seed does not require hot-water treatment.</td>
</tr>
<tr>
<td>Indian siris</td>
<td>Can grow well in more acid and infertile soils than leucaena. Is more cool tolerant.</td>
<td>A long-lived legume tree. Inoculation and hardseeded treatments not necessary. Produces plentiful seed. Produces new leaf during the dry-season. Young leaf and fallen flowers and pods are good quality feed.</td>
</tr>
<tr>
<td>Axillaris</td>
<td>Grows well in medium fertility soils. Some cool tolerance (will grow in early cool-season).</td>
<td>A twining perennial legume. Seeds well. Inoculation beneficial. Not very palatable during the wet-season; therefore applicable where grazing can only be partially controlled. Should not be cut low.</td>
</tr>
<tr>
<td>CIAT 184 stylo</td>
<td>Grows well in acid-infertile soils without fertiliser addition. Not tolerant of long-term water-logging or of cold. A perennial legume semi-shrub. Seeds well; inoculation not required.</td>
<td>Not very palatable in the wet-season; therefore applicable where grazing can only be partially controlled. Should not be cut low.</td>
</tr>
<tr>
<td>Wynn cassia</td>
<td>Suited to non-clay, non-waterlogged soils. Grows</td>
<td>A prostrate legume with very good seed production;</td>
</tr>
</tbody>
</table>
### F. SOME RECOMMENDED FORAGES FOR DRY-SEASON PADDIES

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Environmental Requirements</th>
<th>Characteristics &amp; Cultural Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persian clover</td>
<td>Does not grow well at pH less than about 5.5.</td>
<td>A legume growing to about 75cm height. Requires inoculation.</td>
</tr>
<tr>
<td>Woolly vetch</td>
<td>Grows well in acid, infertile soils</td>
<td>A twining legume. Requires inoculation.</td>
</tr>
<tr>
<td>Italian ryegrass</td>
<td>Requires fertile, non-acid soils</td>
<td>A fast-growing grass.</td>
</tr>
<tr>
<td>Forage oats</td>
<td>More tolerant of infertile soils</td>
<td>A fast-growing grass.</td>
</tr>
</tbody>
</table>
## APPENDIX V. SOME SOURCES OF FORAGE SEED AND SOWING RATES

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Some Sources of Seed and sowing rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucaenas</td>
<td>Common leucaena available locally. Improved lines maybe available through FSHP and UQ*. Line CPI 64189 (tree type, some psyllid resistance) maybe available through ForDAH*. Important to obtain correct inoculum initially (through FSHP). Sow treated seed at about 200 grams per 100m of row.</td>
</tr>
<tr>
<td>Flemingia</td>
<td>1 kg obtained through GRRC*. Improved varieties probably available through FSHP (highly recommended). Sow at about 100 grams per 100m of row.</td>
</tr>
<tr>
<td>Calliandria</td>
<td>AGF*. DLCSIRO* may have selected lines. Sow at about 200 grams per 100m row.</td>
</tr>
<tr>
<td>Gliricidia</td>
<td>AGF, maybe ForDAH*. More palatable lines maybe through OFI*. Sow at about 200 grams per 100m row.</td>
</tr>
<tr>
<td>Napier, King grasses</td>
<td>Moc Chau. Selected lines from ForDAH*. Plant cuttings at about 20cm intervals.</td>
</tr>
<tr>
<td>Setaria grass</td>
<td>Vegetative material probably from ForDAH*. Seed from AusCom*. Cultivar Kazungula is the tallest and suited to hedgerows; Nandi more suited to better conditions; Solander for cooler conditions. Sow at about 50 grams per 100m row.</td>
</tr>
<tr>
<td>Gamba grass</td>
<td>AusCom*. Sow at about 50 grams per 100m row.</td>
</tr>
<tr>
<td>Para grass</td>
<td>Vegetative material available locally or through ForDAH*.</td>
</tr>
<tr>
<td>Sesbania (sesban)</td>
<td>AGF. Selected line maybe through UQ. (Specify Sesbania sesban). Sow at about 100 grams per 100m row.</td>
</tr>
<tr>
<td>Glenn American joint vetch</td>
<td>AusCom. Sow at about 10 kg per ha.</td>
</tr>
<tr>
<td>CIAT 184 stylo</td>
<td>FSHP. Sow at about 10 kg per ha.</td>
</tr>
<tr>
<td>Guinea grass</td>
<td>ForDAH*; AusCom. Cultivar Hamil is a tall line. Sow at about 10 kg per ha.</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Koronivia grass</td>
<td>AusCom. Sow at about 10 kg per ha (check for dormancy first).</td>
</tr>
<tr>
<td>Greenleaf desmodium</td>
<td>AusCom (supplies might be restricted at present; try ILCA, TFGRC*). 100 grams from TFGRC* has been left with Project; two small plots were sown at Son La. Sow at about 4 kg per ha.</td>
</tr>
<tr>
<td>Wynn cassia</td>
<td>AusCom. Sow at about 5 kg per ha.</td>
</tr>
<tr>
<td>Lotononis</td>
<td>AusCom. Sow at about 2 kg per ha.</td>
</tr>
<tr>
<td>Pinto peanut</td>
<td>AusCom. Sow at about 20 kg per ha.</td>
</tr>
<tr>
<td>Axillaris</td>
<td>AusCom. Sow at about 10 kg per ha.</td>
</tr>
<tr>
<td>Bahia grass</td>
<td>AusCom. Sow at about 10 kg per ha.</td>
</tr>
<tr>
<td>Indian siris</td>
<td>AGF; sample maybe through FSHP. Plant seedlings at about 5 metre intervals.</td>
</tr>
<tr>
<td>Persian clover, Woolly pod vetch, Italian ryegrass, forage oats</td>
<td>AusCom (specify environment to obtain most suitable varieties). Sow clover and vetch at about 20 kg per ha; ryegrass and oats at about 30 kg per ha.</td>
</tr>
</tbody>
</table>