Western Samoa - Running cattle under trees: an experiment in agroforestry

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Under the right conditions, beef and timber can be raised simultaneously on the same parcel of land. A two-year agroforestry experiment conducted in Western Samoa showed promising results but also pointed to some problems that need to be addressed in the future.

• The National Livestock Committee of Western Samoa predicted in 1975 that by about 1985 its total beef cattle population would number 45 000 and be accommodated on 18000 ha of improved pastures. Most of the grazing land would come from coconut plantations, where traditionally cattle had been kept as "sweepers" to control weeds. Further studies and economic projections referred to a potential of 80000 ha of pasture land. However, half of this new pasture would have to come from forest land (Parker, 1979).

Since the replacement of forests by high pasture lands traditionally means the removal of all tree cover and hence less stable soils on steep hillsides, flooding problems on the lower cropping lands and in the villages were likely to ensue. It was therefore suggested that grazing cattle under trees would make fuller use of the land resource under replanted forest.

In order to demonstrate the potential for cattle-fattening in a forest environment and to gain

insight into the practical problems and general logistics of running cattle under trees, an integrated cattle/forest trial was designed in Asau, in the northern part of the island of Savaii.

In recent years local farmers had shown interest in the practices of intercropping and multicropping. A farming system that had received attention both in temperate and in tropical countries was the grazing of cattle either in natural forests or in plantations (Barr, 1977; Gillingham, Klomp and Peterson, 1976; Knowles, 1975; Knowles and Cutler, 1980 Knowles, Klomp and Gillingham, 1973; Richards and Beverge, 1969). Because of the relatively long-term nature of the returns from forest, the attempt to intercrop while also raising cattle has important implications (Parker, 1979; Reynolds, 1978).

- Provided that cattle are not introduced too early after planting and therefore do not damage young seedlings or growing trees, they keep down weeds and reduce weed-control costs.

- Cattle provide a secondary financial return, which, in the period prior to tree harvest, may in fact represent the main return, apart from the occasional sale of thinned trees.

- The use of vegetable or root crops during the first two years after planting the trees, followed by cattle-grazing, may represent one of the few combinations likely to attract landowners to the idea of replanting trees, because forests are then seen as long-term investments.

- In tropical areas the shade offered by the forest creates a better environment for livestock than open spaces, particularly by reducing heat stress provided that suitable pasture species are found to grow under conditions of reduced light.

- Intercropping is far less expensive than entirely removing forest merely to provide additional but largely second-class grazing land.

The experiment

For the Asau experiment, an appropriate site for grazing cattle under trees was found in a four-year-old mahogany *(Swietenia macrophylla)* plantation with a spacing of 5 x 5 m. On the site, steep terrain interspersed with even steeper gullies accounted for approximately 70 percent of the grazing area. The remainder was either gently sloping or flat. The soil was generally very shallow, with underlying lava Big boulders were scattered everywhere. Ti grass *(Paspalum conjugatum)* and mile a-minute (Mikania micrantha) were the predominant edible pasture species in the paddocks.

***STRAY CATTLE DEBARKING FIVE-YEAR-OLD MAHOGANY TREES damage is heaviest at the start of the wet season (*DIRK POTIER)**

***IN A COCONUT PLANTATION IN THE PHILIPPINES why can't cattle graze here? (*F. MATTIOLI)**

The experiment began in 1979. Thirty Braford steers of varying genetic constitution and age (12-18 months) were chosen and put to grazing under young mahogany. For nearly a year there were no problems; but then the steers suddenly began damaging the trees. The development of a mahogany-bark appetite occurred approximately one month before the wet season {the end of August 1980). This led forestry officers to assume that rising sap played an Important role in making the mahogany bark palatable. Once cattle had developed this bark eating habit, they continued to debark the trees all year round, while the other tree species present In the trial area - Albizzia falcataria, Toona ciliate and Securinega samoana

(poumuli) - remained untouched.

The first herd was rounded up and removed from the experiment. A new group of 60 predominantly Hereford steers was introduced under mahogany In the middle of the dry season. No tree damage occurred in the first area where the new group grazed. However, when the herd was shifted to a fresh mahogany block, where abundant forage was available, barking started again. Once again, this period of debarking coincided with the onset of the wet season, it became evident that, under Samoan conditions, cattle need to be removed from mahogany plantations one month before the beginning of the wet season. In order not to jeopardize timber production, these plantations should be restocked in the second half of November.

Shifted immediately to a stand of *A. falcataria, T. ciliata* and *S. samoana*, cattle began debarking *Albizzia* and, to a lesser extent, *Securinega* (the probable reason these two were damaged by the second herd and not by the first being that twice as many steers were involved: 60, as opposed to 30) *Toona*, however, remained unaffected. In a last attempt to save the experiment (October 1981), cattle were brought to a *Eucalyptus deglupta* plantation, but the trees here were also debarked. With no other tree species available for experimentation, the project came to an end In November 1981.

Tree damage

As already discussed, the first group of Braford steers started to strip the bark off the sown mahogany trees around September 1980, after leaving them alone for almost one year. Over 80 percent of the trees were thus completely ring-barked or strip-barked. Only a few remained untouched. At the same time, another phenomenon related to debarking attracted some attention one of oozing trees. The damaged trees showed, especially on the margins but also on the wounds themselves, small spots of gum. A few debarked trees had no gum spots at all, while on others larger gum concentrations were observed, similar to those found on Dine.

Was the gum production of a tree a spontaneous recovery reaction to Its wound - the quantity dependent upon the age of the wound - or do trees produce and ooze a sweet gum whose smell attracts cattle? Since none of the undamaged trees was found to be oozing, it was concluded that gum production was related to tree recovery. The possibility that tree bark, because of the synthesis of a hitherto unknown substance, might become more palatable at the onset of the wet season should not, however, be ruled out. Limited laboratory facilities prevented a thorough investigation of this possibility.

Why do cattle debark trees? The answers are Inconclusive. Sufficient grass growth, to ensure that the daily energy and protein Intake requirements of the cattle are met, Is surely not the only prerequisite to the prevention of debarking. Other factors must be considered; for example, a decline pasture quality in the wet season as a result of heavily reduced light transmission. This results in a decreased palatability of the sward, making tree bark more palatable by comparison. Second, there is an activated tree metabolism at the beginning of the wet season, synthesizing a sweet unidentified substance (a complex polysaccharide) and thereby increasing the palatability of the bark. Reports from New Zealand on pasture type and condition are inconclusive (Knowles, 1975; Knowles and Cutler, 1980; Knowles, Klomp and Gillingham, 1973; Knowles and Tahau, 1978).

Pasture composition and condition have some effect on the amount of tree damage likely to occur. This has been illustrated by seasonal differences in the rates of damage by livestock (sheep and cattle). However, variation in pasture condition - that is, rankness and clover content - appears to have relatively little effect in spring in New Zealand, for example. The fact that less damage is done in autumn than in spring seems to have some connection with the clover mixture. The fresh regrowth of relatively palatable clover apparently diverted the

animals' attention from the trees. This was particularly evident from the results with Romney fattening lambs. With other classes of animals (dry Romney ewes, the BL/Romney crossbreed, Perendale, Friesian calves), the evidence of a relation between browsing damage and pasture condition in autumn also remains rather Inconclusive, and this points to a third factor. cattle behaviour. Rickman (1980), reviewing a similar experiment in Fiji, stated that calves born In pine *(Pinus caribaea)* plantations do not attempt to damage trees, since they do not require a period of adaptation to the change in environment, while in other experiments calves unaccustomed to *Eucalyptus deglupta* consistently damaged the trees in a particular plantation.

There are widely diverging reports on the success of grazing with various breeds and classes of cattle. Olsen (1973) reports successful grazing by weaner Angus, Hereford and dairy beef animals among large stands of very young trees. Older animals were successfully used in stands aged three years and older, but considerable care was needed. The use of licks for the animals does not seem likely to prevent tree damage either. In Asau, the animals were trained to use licks but this did not cause any perceptible change in their bark-stripping habits. In general, dairy breeds cause more damage than Herefords or Angus.

Reports on debarking are not restricted to Western Samoa alone they are widespread. Debarking by both sheep and cattle has been the most troublesome problem in the integrated pasture-conifer trials of New Zealand. Fortunately, pine quickly forms a resin sheet over a stem wound.

Provided the debarking occurs on less than one quarter of the tree circumference, and does not affect the pith and the occluded pruned branch stubs, little long-term degradation results (Knowles and Cutler, 1980). But It should be stressed that cattle will damage trees that are up to eight years old.

As a result of the experiments In Western Samoa, species of four tree genera were observed in order to determine their compatibility with cattle there:

Mahogany Because of its limited canopy, mahogany *(Swietenia macrophylla)* could be ideal for certain agroforestry farming practices, provided that open pastures are provided and are stocked with cattle during critical periods - just preceding the onset of the wet season, for example. The lifetime of cattle-under-mahogany schemes can be expected to be 8-10 years.

Toona Neither *Toona ciliate* nor *Toona australis* was ever affected by cattle damage. Though evolving a denser canopy than mahogany, they would be ideal trees with which to experiment.

Albizzia *Albizzia falcataria* also develops a dense canopy and possesses a possibly palatable bark. As it was seriously debarked at one stage in Asau, it should not be considered suitable for beef cattle raising.

Eucalyptus Cattle tend to strip eucalyptus bark even without prevalent grazing pressure. As *Eucalyptus deglupta is* a fast grower, it should not be recommended for cattle-fattening purposes.

With the exception of *Eucalyptus deglupta,* all these tree species offer interesting scope for intercropping with cash crops like cocoa, root crops and bananas. Since it has a limited canopy and is not harvested for about 25 years, mahogany offers good possibilities for agroforestry experiments.

Improved pastures versus natural pastures

Improving forage provides animals with a more balanced diet and results in a faster live-weight gain and a higher land-carying capacity. In general, doubt exists concerning the

usefulness of planting improved pasture in a forest, for under conditions of declining light transmission it is almost impossible to prevent ti grass from reclaiming the a Both the closure of the tree canopies and the regeneration of the forest will lead to a gradual shading out of much of the forage.

***CATTLE UNDER TREES IN THE UPPER VOLTA extra income for rural villagers* (J. VAN ACKER)**

In Western Samoa, however, there is ample evidence of the productivity and persistence of the grass *Ischaemum indicum* under shady conditions. As this species also has low phosphorus requirements, it might well be considered for planting In forests, particularly in those situated at higher elevations, which often lack sufficient phosphorus In the soil to ensure a vigorous grass growth.

Another practice could be to graze sown patches of open pastures established within the forest, or fire breaks sown with improved pasture species in conjunction with grazing the natural understorey cover of the forest. Other grass species recommended for investigation under grazing conditions are: *Brachiaria brizantha, B. decumbens, B. humidicola* and *Stenotaphrum secundatum.*

Since cattle are kept not only as "cleaners" or "sweepers" of afforested areas but also for beef production, it is important to carry out regular thinnings in order to keep the photosynthetically active radiation of ground cover alcove 50 percent, a minimum for successful pasture production (Macfarlane, 1981).

This view is consistent with a Yew Zealand experiment described by Knowles and Cutler (1980), showing that a final stocking of 200 *Pinus radiata* stems per hectare at year seven can support about 50 percent of the livestock that is grazed on open pasture. This level of production is expected to last a further five years, after which the livestock carrying capacity rapidly decreases as the canopy closes. Here, bush should be clear-felled, as the removal of trees unsuitable for milling will enhance the light transmission and Improve the pasture stand.

It is noteworthy that estimates made for a final tree stocking of only 110 stems per hectare gave approximately the same net financial result, indicating that lower wood yields are offset by an increase In livestock-carrying capacity. Tree stockings as low as 50 or as high as 400 stems per hectare do not appear to be as profitable. This observation implies that, with favourable beef prices, thinning should be considered, as it leads to a greater profitability of the forest.

The main problems encountered in introducing livestock In forest or tree plantations are high incidences of browsing damage to seedlings and debarking of taller trees. To allow young trees to become established, it Is best to exclude livestock from the tree crop for the first two to three years. In order to reduce this period, trials have been conducted to test the possibilities of protecting trees from livestock, but with little success (Knowles and Tahau, 1978). To be satisfactory, physical guards must give protection until the tree is about 1.5 m tall (Gillingham, Klomp and Peterson, 1976). While It does keep animals out, this type of physical protection is usually too costly. Another possible solution is the spraying of egg-based repellents, which, In experiments with Pinus radiate, have significantly reduced the incidence of browsing. More research is needed on the cost and effectiveness of chemical deterrents to de barking.

Agroforestry and the village sector

With the growing importance of both the beef-cattle and the timber-milling industries in Western Samoa, it is easy to see the attractiveness of agroforestry schemes at the village

level.

Over the last few years the cattle population on village land In Western Samoa has steadily increased, and at present It numbers 9 000. Despite this Increment, there Is still enough village land (as open pastures and intercropped with coconuts) to accommodate extra stock

On the other hand, many village cattle herds are stocked on very bushy areas. This land, in particular, could easily be converted into a tree plantation with cattle grazing underneath, which would require village leaders to be persuaded that such land development is in the interest of the village. With the incentive of extra income from the timber-milling operations on village lands (Leung Wai, 1982), the mutual advantage and profit from combining pasture, livestock and trees should be obvious.

The Asau experiment (1979-1981)

This experiment was initiated and carried out by staff from the Government of the Independent State of Western Samoa, Department of Agriculture and Forestry, and UNDP/FAO Project WES/76/003 - Animal Health and Production. The New Zealand Bilateral Aid Scheme provided a farm manager for the latter stages of the trial, in 1981, and the Western Samoan Trust Estates Corporation loaned 60 Hereford steers. (Eucalyptus species are not included in this table, because no light-transmission readings are available.)

Block	Trees	Age	Area	Density	Estimated light transmission	Steer grazing
		(years)	(ha)	(sterns)	(percentage)	(days/ha)
1	Mahogany/Toonal/Aibizia/Poumuli	5	55	400	50-55	200
2	Toona	6	56	400	30-35	72
3	Mahogany	6	40	300	7075	112
4	Mahogany/Toonal/Albizia/Poumuli	6	-	400	50	-

Here is a summary of the effects and reactions observed in the four tree blocks during the two-year experiment:

1. Substantial live-weight gains made by cattle. Debarking of mahogany after one year of uneventful grazing, coinciding with the end of the dry season.

2. Considerable grazing pressure (set stocking for 4 112 months) under a closed forest situation, resulting in cattle losing weight. No damage to trees occurred, though cattle had previously developed a taste for mahogany bark.

3. This block was set stocked for 2 1/2 months. New cattle herd in excellent condition. No damage to mahogany during prolonged grazing time.

4. Mahogany damage occurred less than one week after shifting of cattle to this block and was followed by slight damage to Poumuli trees and heavy debarking of *Albizzia falcataria.* Again, debarking coincided with the end of the dry season.

The incentive to combine timber and meat production is increased long-term profitability. Only when greater net returns are obtained from this type of land use than from either farming or forestry alone will agroforestry become accepted at the village level.

Unfortunately, any evaluation of the financial returns from the combination of forestry and grazing is hampered by lack of precise information. One economic study, however, suggests that, even with reasonably high agricultural returns and fairly pessimistic forestry assumptions, the combination is likely to be 20 to 25 percent more profitable than grazing alone.

Obtaining profitable results involves overcoming problems associated with forest grazing. Once the compatibility between cattle and trees is assured by selecting the fight type of trees,

the profitability of a cattle-under-trees scheme depends upon proper herd management. This is particularly so when cattle are not well controlled and start straying and damaging neighbouring crops, or when no open pastures are available to stock the animals during critical periods such as debarking.

With a need for more money in the villages, and a growing awareness that the potential for large-scale agricultural commercial production exists on village common land, agroforestry could become general practice sooner than might be expected.

Conclusions

What can be said about this particular experiment is that mahogany timber production and cattle-grazing were successfully combined in Asau for nine months of the year, but not for the remaining three, when problems arose.

Almost half of the affected mahogany died within a year after the September 1980 damage. The remaining trees appear to be healthy, but reduction in timber quality is inevitable. However, cattle performance was of a surprisingly high standard and health problems were kept to a minimum, thus showing that cattle can be of great use in controlling forest understory and in improving, through better work opportunities, the living conditions of the forest people.

Despite the potential for beef-cattle fattening in a forest environment, the project had to be terminated in 1981, after two years, as the financial losses caused by the reduction in timber production could no longer be tolerated. Although the experiment was not completely successful, it does show that forest land, under the right conditions, can be used for supplementary grazing, if open pastures are also available.

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