Native Forest Management
Implications for Grazing

Bill Schulke Feb 2017

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Introduction

Why talk about cows in a guide for managing private native forests? The private native forest resource in Queensland is subtly different to private forests in other parts of Australia. It tends to be based on dry eucalypt forests and woodlands that, compared to native forests in southern states, are of moderate to low productivity.

While there are huge areas of woodlands and open forests in Queensland the productive and privately owned forests tend to be concentrated in the southeast quarter of the state. Even in this region and at the individual property scale, the resource is fragmented and is often a minor component of the property.

Much of the property on which the typical private native forest exists has been modified primarily for grazing outcomes. On some properties, the landscape has been managed to produce a dual income stream from both grazing and timber.

The degree to which landscapes have been managed for dual income streams varies considerably between individual properties and across districts. Much of the private native forest resource occurs on properties where grazing is the primary enterprise and is owned by landholders who see themselves primarily as graziers and not foresters. As a result much of the private native forest resource is in poor condition due to a lack of silvicultural treatment and inappropriate harvest and fire regimes.

Fortunately for the timber industry, native forests have a forgiving nature. In many cases poorly managed and overstocked forests can be restored to a productive state with appropriate silviculture.

This guide in the PFSQ workshop series recognizes the need to incorporate private forestry with grazing and discusses some of the implications of management on both the grazing and forestry components of a dual income business.

Grazing lands as functioning ecosystems

Everything you manage on your property (and a fair bit of what you can't manage) is part of an ecosystem. It includes: -

- Soils (different quality soils, soil microbes and invertebrates)
- Climate (Rainfall, variability, ENSO, drought)
- Plants (grasses, herbage, trees, weeds)
- Animals (livestock, native animals, feral animals)
- Community and society in general (resource management perceptions and expectations)
- And you (your need to make money and look after your land)

How efficiently this ecosystem converts sunlight and rainfall (through photosynthesis) into kilograms of beef, is partly due to how productive your land is (its inherent fertility), and partly due to three "gateways"; *Land Condition*, *Pasture Utilisation* and *Feed Conversion Efficiency* (Figure 1).

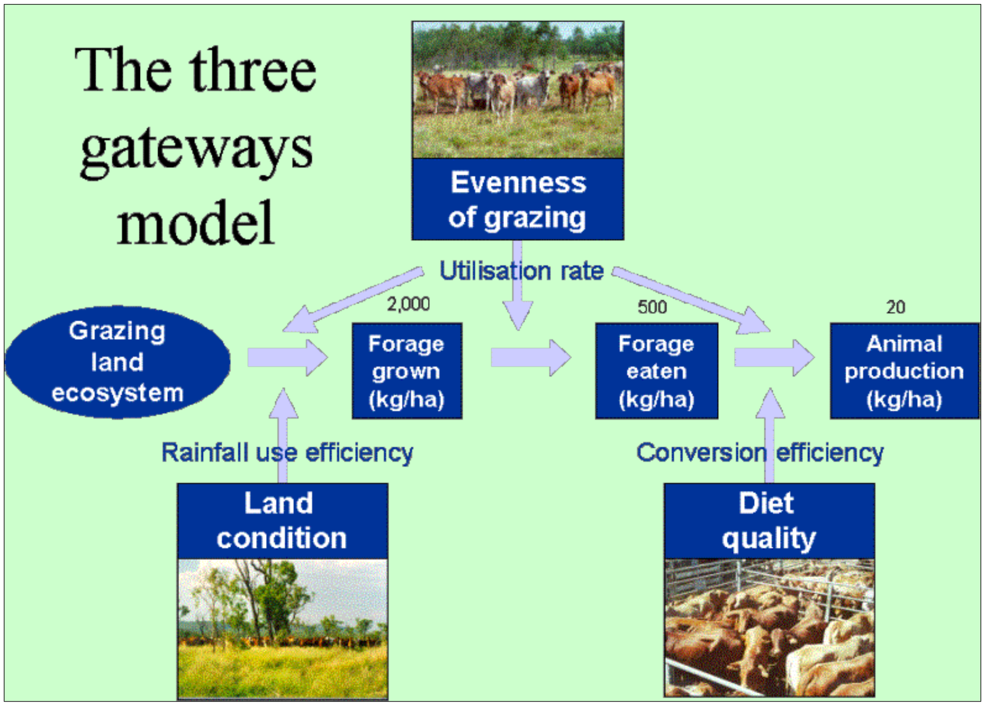

*Figure 1. Three Gateways model for grazing land management (*EDGE*network* GLM*)*

Land condition

Land in poor condition will grow less than half the useful forage (given the same amount of rainfall) as when it is in good condition. Land is in good condition when it has a good coverage of 3P grasses (Palatable, Productive and Perennial), has few weeds, shows little sign of soil erosion or scalding and the woody weeds are in check.

Land that only grows half of its forage potential is not very efficient at converting sunlight, rainfall and nutrients into useful forage, and hence beef. It is probably not giving you a very good return on investment either.

Land condition can be maintained or improved through: -

- effective grazing management (safe utilisation rates, grazing systems, pasture spelling)
- strategic use of fire
- sown pasture development
- woody regrowth control
- weed management

Pasture Utilisation

The proportion of annual forage growth that is eaten by livestock is called the utilisation rate. A low utilisation rate means that the conversion from forage to beef is inefficient. A high utilisation rate may lead to short-term increases in animal production per hectare, but does so at the expense of individual animal performance. Continual high utilisation rates over several years will lead to a decrease in land condition and a consequent reduction in forage growth.

For native pastures in southeast Queensland, utilisation rates of between 20 and 30 % are considered to be sustainable. Sown pastures can be sustainably utilised at slightly higher rates of 30 to 40%.

The forage that is not eaten by livestock is not wasted. It plays a very important role in providing soil microbes (the unseen workers in a grazing ecosystem) with a source of energy and nutrients and provides ground cover that protects the soil surface from the damaging effects of sun, wind and rain.

The utilisation gateway is managed by matching forage availability to forage demand and by setting or adjusting stock numbers accordingly. Part of this equation includes allowing for other grazers (feral and native animals, termites), and ground cover. The aim is to always come out of a dry season (including a drought) with stubble on the ground.

Infrastructure (fencing and watering points), grazing systems and/or fire are all used to regulate when and where cattle graze.

Feed conversion efficiency

Feed conversion efficiency is a measure of how efficiently a beast converts forage into beef (or milk production). The class of animal and its genetics play a role but the important factor is the quality of the forage eaten.

Forage quality varies between forage species. Leafy grasses, such as the 3P grasses, are more digestible and higher in energy than stemmy grasses; legumes are higher in protein than grasses. Within a grass tussock there are differences too; leaf is better quality forage than stem.

The largest determining factor of forage quality is the stage of maturity. Fresh growth (such as just after the spring/summer break) is much higher in energy and protein than when it is mature (such as in July and August).

The grazing land ecosystem can be managed through this gateway by: -

- ensuring land is maintained in good condition (ie. the desirable plants are not grazed out),
- establishing high quality plants such as legumes in the pasture,
- setting appropriate stocking rates (high stocking rates force animals to eat the poor quality plants and the stemmy parts of the good quality ones)
- and by supplementing to overcome nutritional deficiencies when it’s economical to do so.

Trees in the grazed landscapes of Queensland

Queensland is Australia's second largest state with a total area of 173 million ha. Just over half of the state contains remnant woody vegetation (91 Mha). Just under a third of the state contains remnant vegetation other than trees (50 Mha) most of which are natural grasslands. Despite 17% of the state (30 Mha) being mapped as non-remnant, much of this area contains regrowth woody vegetation.

Of the 91 Mha of remnant woody vegetation, 64 Mha is classed as grazed woodland. Most of the 30 Mha of non-remnant vegetation is also used for grazing. Grazing represents the largest land use in Queensland and for most beef producers land management involves managing the balance between trees and grass.

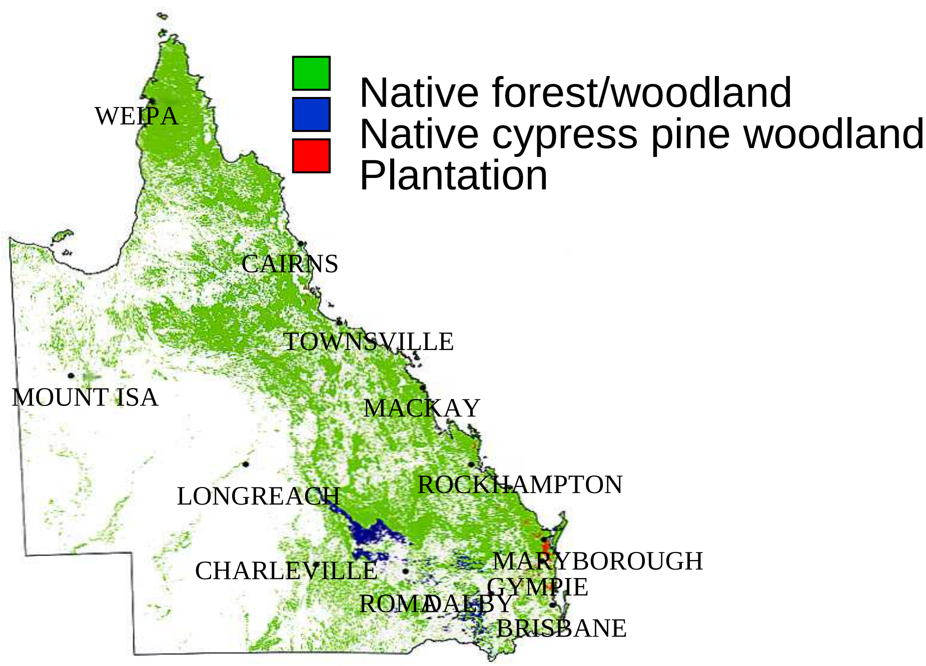

Figure 2. Woody Vegetation in Queensland

Tree – grass interactions

All of the grazing land in Southeast Queensland is (or was) woodland or forest. These woodlands and open forests generally have a tree layer with a herbaceous understory (grasses and forbs). In the absence of fire these woodlands and forests tend to develop a shrubby understory.

Most grazing properties in Southeast Queensland derive the majority of their economic value from the herbaceous layer being converted into animal product (beef). Some properties with stands of commercial timber derive significant income from the woody layer (timber sales).

Despite the supplementary income derived from trees, most grazing enterprises have traditionally focused on enhancing the herbaceous layer through clearing and thinning. In the eucalypt forests, this has occurred on a cyclical basis through-out the last century.

Impacts of trees on grass

Trees can have both a positive and negative effect on the grassy layer, caused by: -

- rainfall interception
- shading
- root competition (for nutrients and moisture)
- microenvironment changes (humidity, temperature, wind speed)
- effects on soil condition (soil structure)
- nutrient cycling

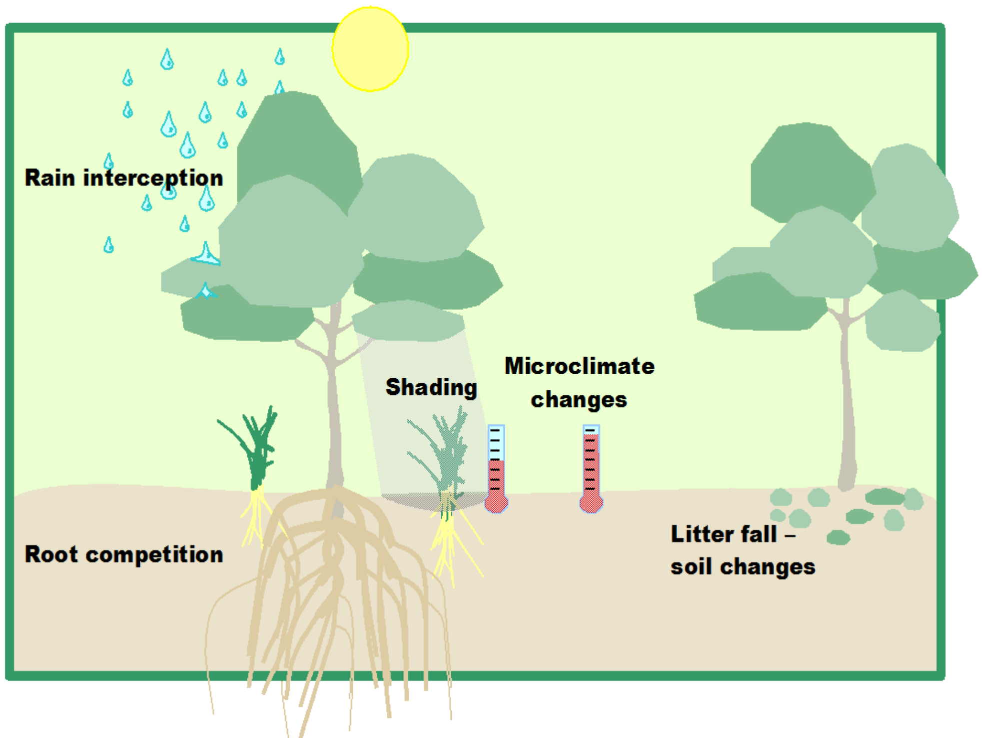

*Figure 3. Impacts of trees on pasture (*EDGE*network* GLM*)*

Trees intercept rainfall and store part of it in the canopy from where it evaporates. Some species can ‘funnel’ rainfall from the canopy, down the trunk onto the ground directly beneath the tree. The tree canopy can also alter the rain droplet size and the velocity at which it falls, which in turn can lessen the impact of heavy rain on soil surface condition.

The tree canopy captures sunlight and prevents it from reaching the grass layer. The proportion intercepted varies between species, canopy health, season and time of day (especially for the eucalypts and acacias). In the closed forest types (scrubs, rain forest, wet sclerophyll) grass is generally absent, but most land types used for grazing have a grassy understory.

Trees can act as nutrient pumps where they draw nutrients from deeper in the soil profile (from where grasses can’t access them) and cycle them through leaf fall into the top soil. Tree canopies can also trap dust which is washed into the soil beneath them with rain. Often the soil biological activity is higher beneath trees and the subsequent soil structure benefits.

The net result is that pasture quality is often higher under trees compared with pasture growing in the absence of trees.

Competition

Despite the benefits of trees in terms of pasture quality the net effect of trees is to suppress pasture growth. This is due primarily to competition for soil moisture. The impact of this competition on pasture growth is related to tree density. A useful measure of tree density is tree basal area (TBA) which is the sum total of the cross sectional area of all tree stems measured at 130 cm from the ground. Foresters often use the term 'stand basal area' to describe the same measurement.

Generally pasture growth decreases with an increase in TBA. In drier forests, this tends to be a curvilinear response; in moister forests the response in more linear.

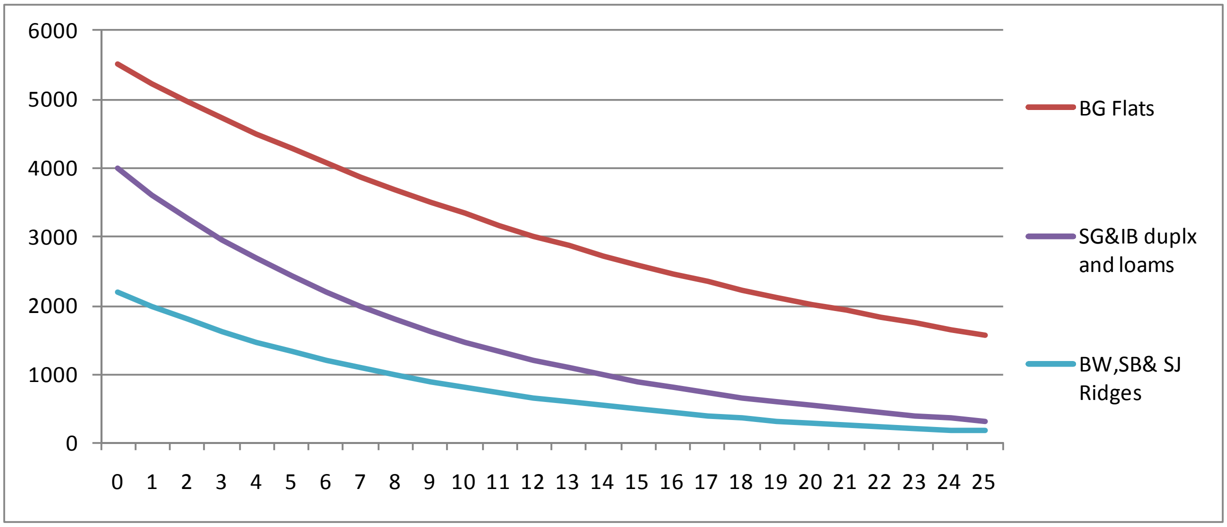

Figure 4. Impact of tree density on grass production

In Southeast Queensland, the major land types used for timber production are those with a high proportion of spotted gum, ironbark and bluegum. The best 'dual purpose' country is the ironbark and spotted gum on duplexes and loams. Bluegum flats are usually the most productive in terms of cattle production, but also have good potential for timber production.

Figure 4 shows the impact of TBA on grass production for three land types in the Coastal Burnett. The impact tends to be linear on the productive bluegum flats and curvilinear for the generally low producing bloodwood, stringy bark and supple-jack ridges.

Generally, fully clearing heavily timbered country leads to a three to four fold increase in pasture production. However, in many of the eucalypt forests, initial clearing costs and ongoing regrowth management renders such clearing as uneconomical. This is especially the case when the eucalypt forest has potential to produce commercial hardwood and fencing timber.

Other benefits of trees

Forests provide vital habitat for fauna biodiversity and are an important source of floristic biodiversity. In Southeast Queensland, the vast majority of remnant vegetation is eucalypt forest (much of which is on freehold land).

Trees also play an important role in the hydrological cycle within a landscape (Figure 5). Retaining deep rooted perennial plants, such as trees, reduces the risk of dryland salinity. Hazardous land types, such as those with saline sub-soils (such as those derived from marine sediments), or land types down slope of highly permeable soil types (such as deep red soils), can be protected by retaining trees in the recharge areas.

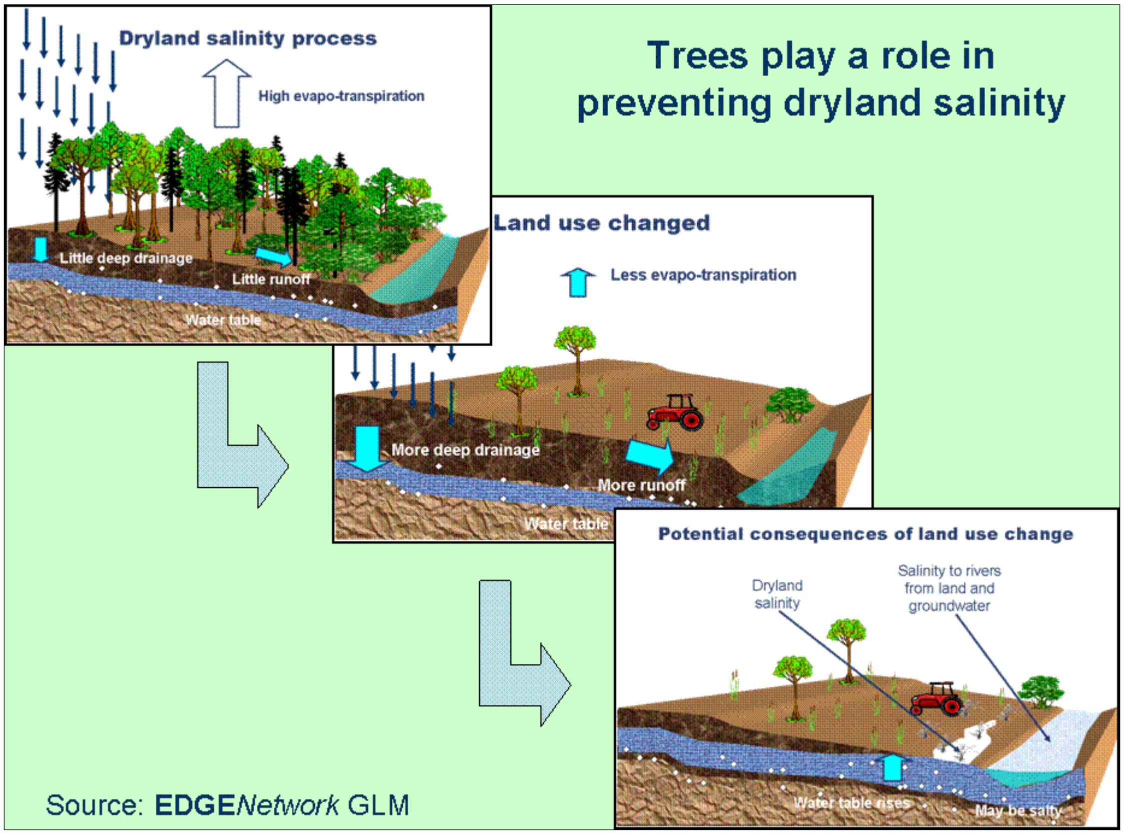

*Figure 5. Role of forests in preventing dryland salinity (*EDGE*network* GLM*)*

Impact of thinning for forest production and the grazing enterprise

Private native forests in Queensland are inherently of moderate to low productive capacity (1 to 2 m^3/ha/yr over a harvest cycle of 15 to 40 years). Unfortunately, because they are in poor condition, most are producing well below that capacity (< 0.1 m^3/ha/yr).

The reason they are in poor condition is that they have been subject to ‘high grading’ for many years and have had little silvicultural investment. Many landholders regard their native forests as a resource that they can ‘cash-in’ periodically or to ‘dispose of an asset’ prior to selling a block. Many of these landholders see little benefit in investing time, effort or money in improving them.

The following case study considers the implications of three management scenarios for a typical ‘high graded’ spotted gum / ironbark forest. This block contains both remnant and non-remnant vegetation, is overstocked with more than 650 stems/ha (sph), has a high proportion of non-commercial species and few merchantable stems (Figure 6).

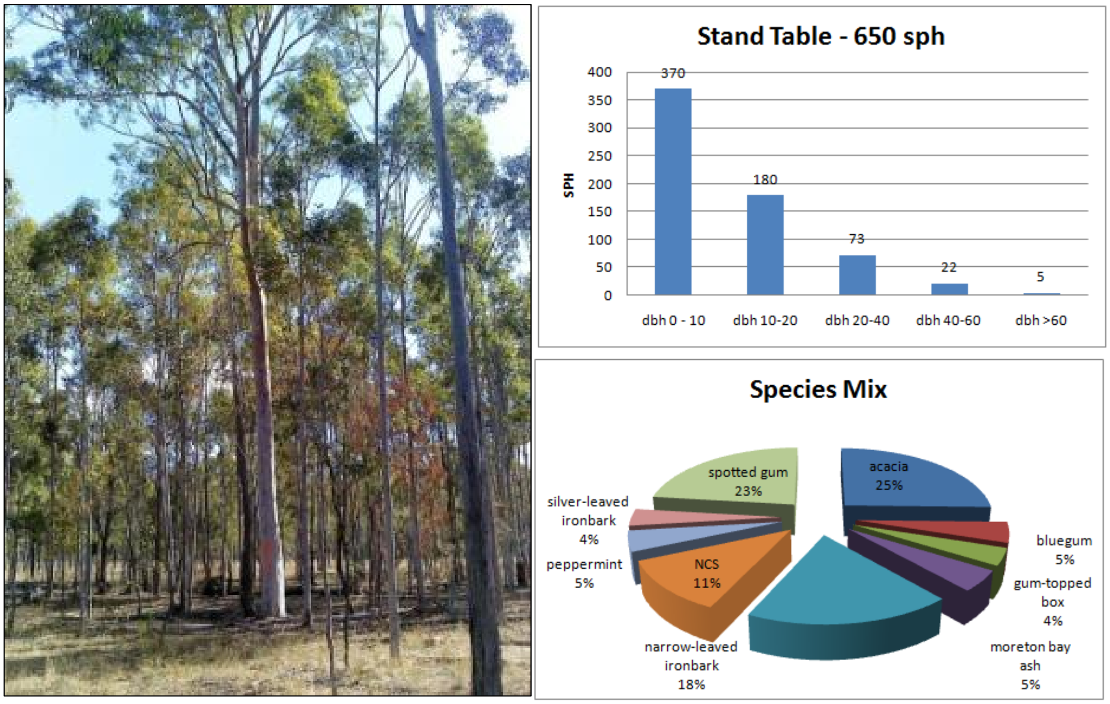

Figure 6. A typical 'High Graded' stand

Scenario 1. Business as usual – High Grading: -

- Only removing quality stems (about 10 sph)
- Leaving defective or suppressed trees (600 sph)
- Damage to some retained trees (from both harvest operation and post harvest fire – 40 sph)
- Harvest interval of > 30 years

Scenario 2. Well managed stand – Investing in silviculture: -

- Only removing stems that have reached optimum value; regardless of size (about 25 sph)
- Post harvest treatment within 5 years of harvest to remove poor quality stems (475 sph)
- Only retaining quality stems at adequate stocking (150 sph)
- Harvest interval of < 25 years

Scenario 3. Clear for grazing only (assume non-remnant stand): -

- Remove all trees by chaining
- Burn within 2 years of pulling
- Need to re-clear regrowth every 30 years or so

Forest response to treatment

Stand Density

Figure 7 below shows how stand density changes over time. In the high-graded scenario, basal area drops slightly at each harvest as trees are removed. Due to the high residual stocking (600 sph) and high proportion of defective or non-commercial stems, retained trees have a mean annual increment (MAI) of 0.1 cm. Basal area will vary between 12 and 20 m^2/ha over the harvest cycle.

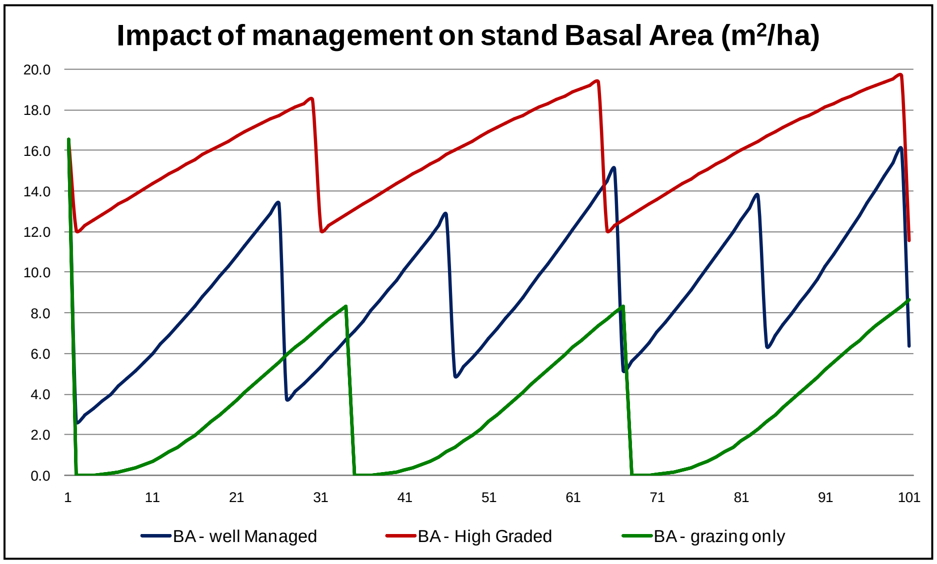

Figure 7. Impact of treatment on stand density over 100 years

Obviously, following clearing in the grazing only scenario, basal area reduces to zero. However, regrowth typically occurs in these forests from the lignotuber pool or from seedling recruitment. Eucalypt and acacia regrowth can be extensive and rapid. Within 35 years the basal area could be above 8 m^2/ha, requiring re-treatment to maintain grass growth.

In the managed stand, basal area falls significantly following harvest and treatment as the stand is reduced to 150 sph to encourage optimum growth in the retained stems. These retained stems will typically have a MAI in excess of 0.5 cm. Basal area will vary between 4 and 16 m^2/ha over the harvest cycle.

Wood volume and value

The total wood volume is related to basal area and the response curves are similar (see figure 8 below). However, in the managed stand, the commercial volume increases at a faster rate than in the high graded stand with-in each harvest cycle. This is because only trees that have reached their optimum value are taken at harvest, only trees with a potential product are retained during the thinning operation and the diameter MAI is much higher in the managed stand. The volume MAI over the harvest cycle can be lifted from 0.15 m^3/ha to 0.5 m^3/ha.

An additional benefit of silviculture investment in native forests is that the inter-harvest interval is reduced. Over a century there can be a 50% increase in the number of harvests.

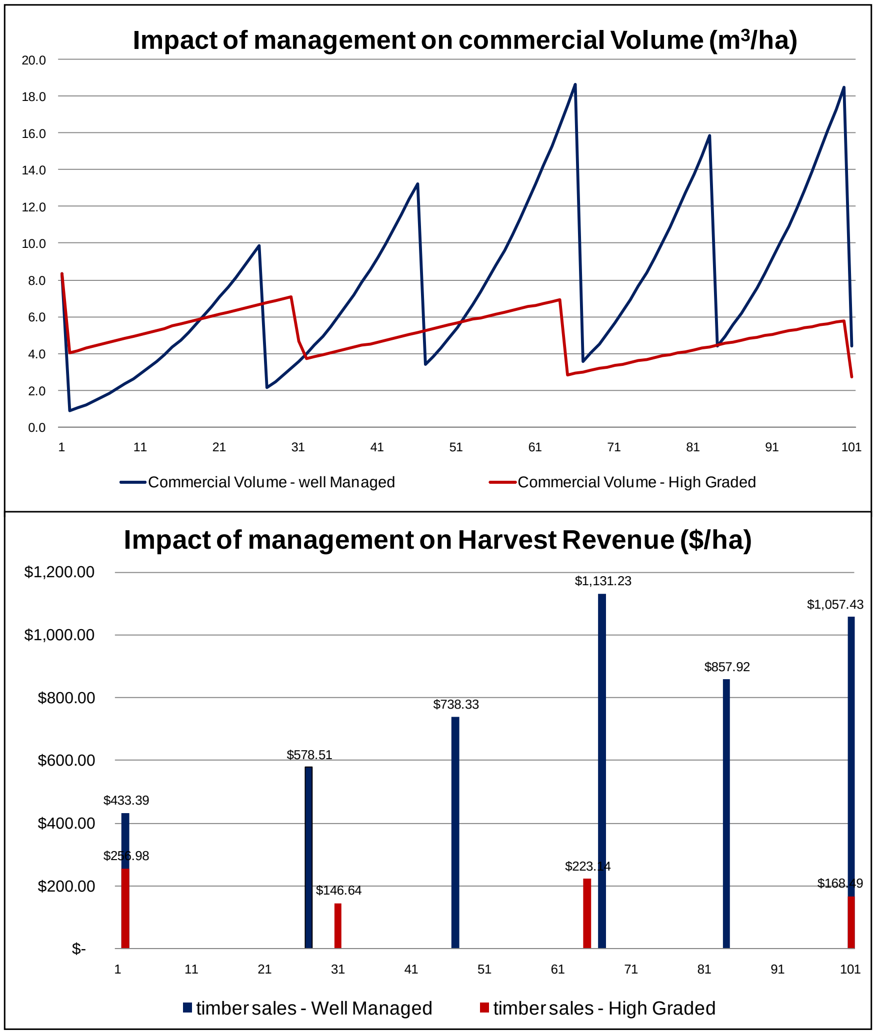

Figure 8. Impact of treatment on wood volume and value over 100 years

Grazing response to treatment

Thinning to enhance forest value and productivity positively impacts the grazing enterprise. As basal area changes following a harvest and thinning operation and in response to recruitment and tree growth, annual pasture growth will change in an inverse relationship (Figure 9).

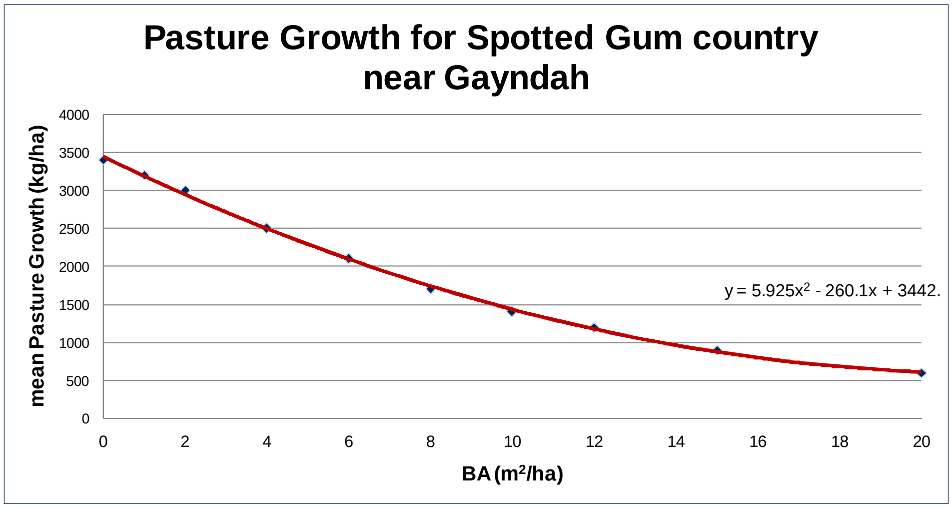

Figure 9. Impact of basal area on mean annual pasture growth.

As a result cattle carrying capacity and financial returns from grazing will also change (figure 10).

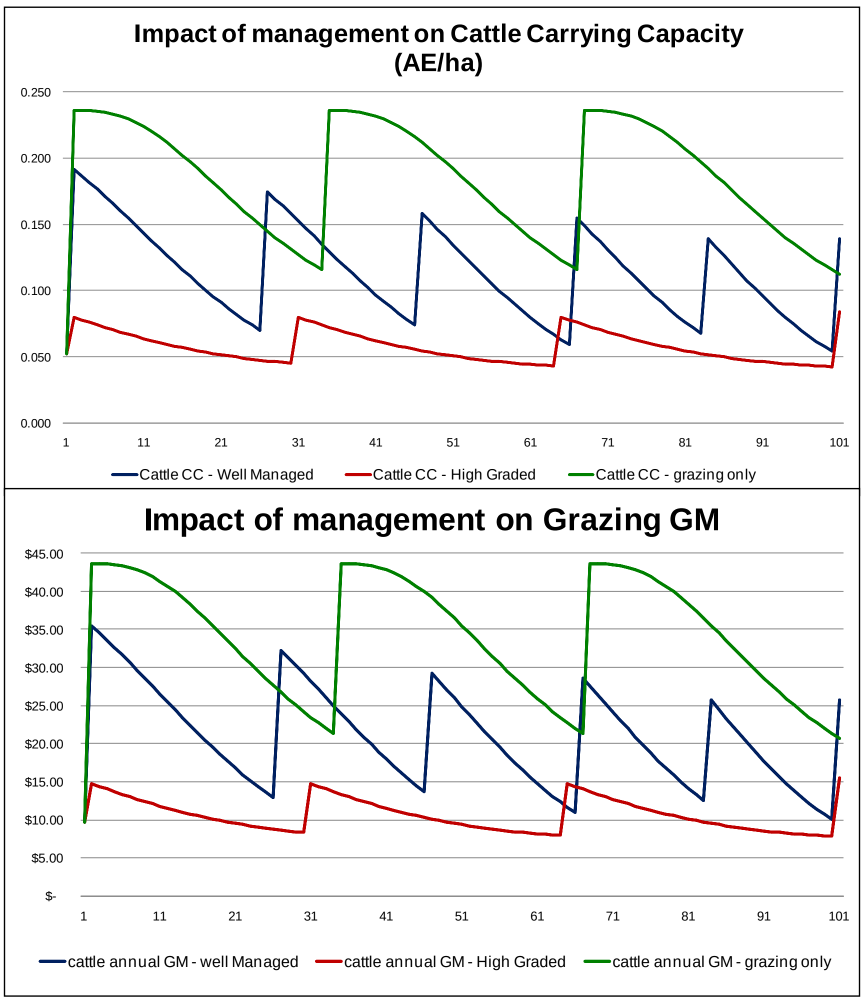

Figure 10. Relationship between BA and cattle returns over time.

In the high graded forest, carrying capacity will not vary much and remain low at between 0.05 and 0.08 AE/ha (1 AE:20 ha to 1 AE : 13 ha). The carrying capacity for the totally cleared option will see a dramatic increase to 0.24 AE/ha (1 AE : 4.2 ha), but regrowth will see this decline over time to 0.12 AE/ha (1 AE : 8.3 ha). For the managed forest scenario, carrying capacity will vary between 0.19 AE/ha and 0.06 AE/ha (1 AE : 5.3 ha to 1AE : 16 ha).

Returns from grazing vary with changes in carrying capacity. In the high graded forest returns from grazing will be low at between $8.00 and $15.00/ha/year; the grazing only option will see returns vary between $22.00 and $43.00/ha/yr; the well managed stand's grazing returns will vary between $10.00 and $35.00/ha/yr.

While total clearing may theoretically maximise cattle carrying capacity and return a GM of $43.00/ha, it foregoes a potential timber return of $50.00 - $70.00/ha/yr and usually incurs ongoing regrowth management costs.

Will it pay?

While a six-fold increase in the value of timber harvested and a doubling of the carrying capacity sounds impressive, why do we see so few landholders investing in silviculture? There are a number of reasons: -

- It costs money to treat a forest. Current treatment costs can range between $150/ha and $750/ha.
- 20 to 25 years is a long time to wait for a pay-out from that investment; could that money be better invested elsewhere?
- Concerns about harvest security.
- Misperceptions about the relative value of timber compared with grazing.
- Taxation issues.
- Lack of skill in assessing forest products, value and potential.
- Ability to sell some timber from high graded forests and to run a few head of cattle at minimal cost.

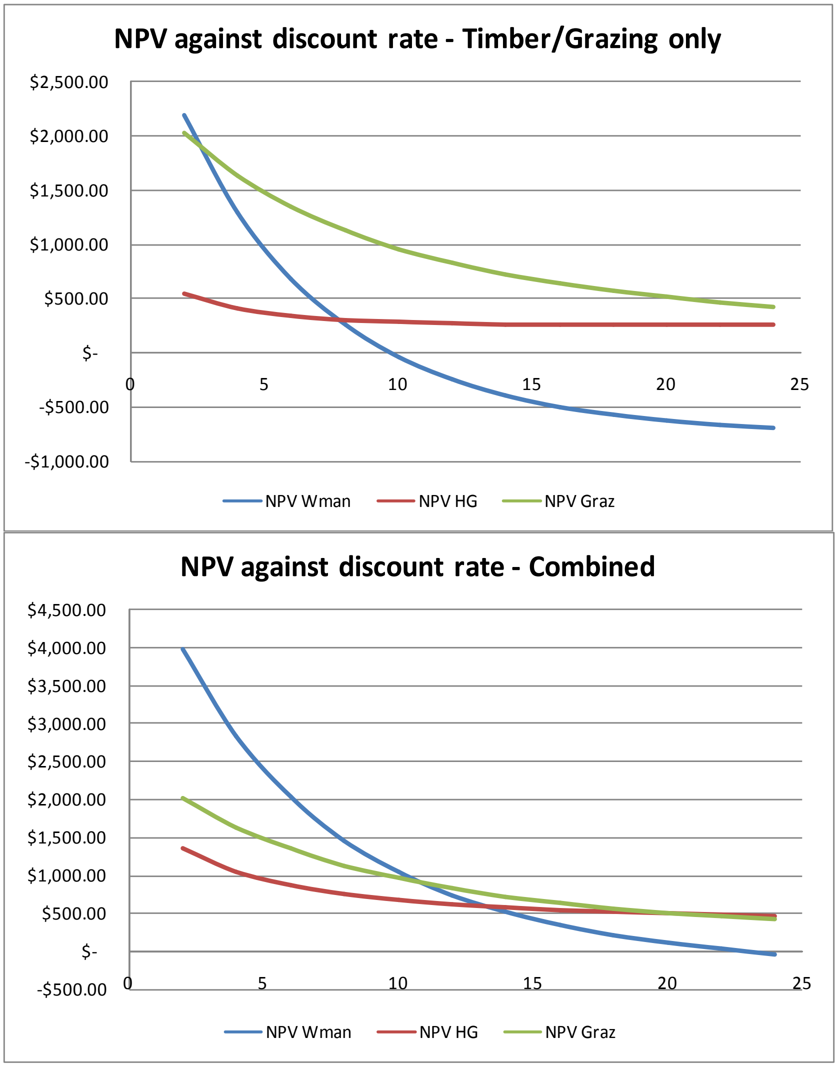

Figure 11. NPV of management options against discount rate

Figure 11 above shows the net present value (NPV) from each scenario at a range of discount rates. NPV is a measurement of the profitability of an investment and is calculated by subtracting the present values of cash outflows (including initial cost) from the present values of cash inflows over a period of time. Because a dollar tomorrow is worth less than a dollar today, the present value of future earnings are adjusted back to today's equivalent value using a nominal discount rate.

The top graph is where the timber enterprise is considered separate to the grazing enterprise; the bottom graph considers the combined returns from grazing and timber. In general for Agricultural investments, economists will use a discount rate of 6%.

The top graph suggests that more money can be made from this type of country by clearing for grazing. The reality is that this is often impractical or impacted by the Vegetation Management Act. It shows that investing in silviculture has a higher NPV than continuing to high grade the forest only at discount rates below about 8%. You may be able to generate higher returns from alternative investments.

A further reality is that both enterprises are generating income concurrently. When the two enterprises are considered together, investing in silviculture is a better investment than clearing for grazing at discount rates up to about 11% and better than doing nothing at discount rates up to 13%. Many superannuation funds have returned less than that over the last decade or more.

Grazing combines well with silviculture in that it provides cash flow, particularly at stages in the harvest and thinning cycle when basal area is below 10 m^2/ha. This cash flow helps offset the relatively poor internal rates of return typical of investment in these forest types.

Perceptions of relative value

The relative value of grazing and timber is not the same today as it was in the past and is likely to change more in the future (Figures 12 and 13). Despite the recent surge in beef cattle prices, in real terms beef is worth less than it was three decades ago. Timber on the other hand has actually appreciated in real terms over the same time frame (despite having reached a plateau over the last couple of years). If this trend were to continue into the future it would provide landholders further incentive to invest in their PNF.

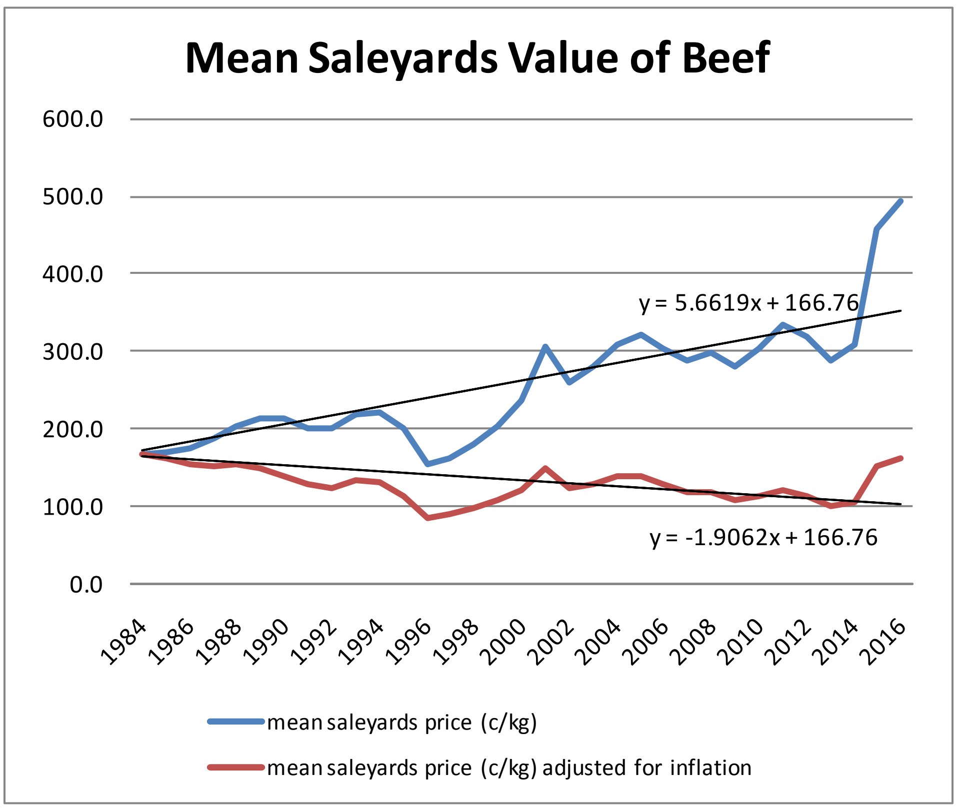

Figure 12. Change in the value of beef; adjusted for inflation

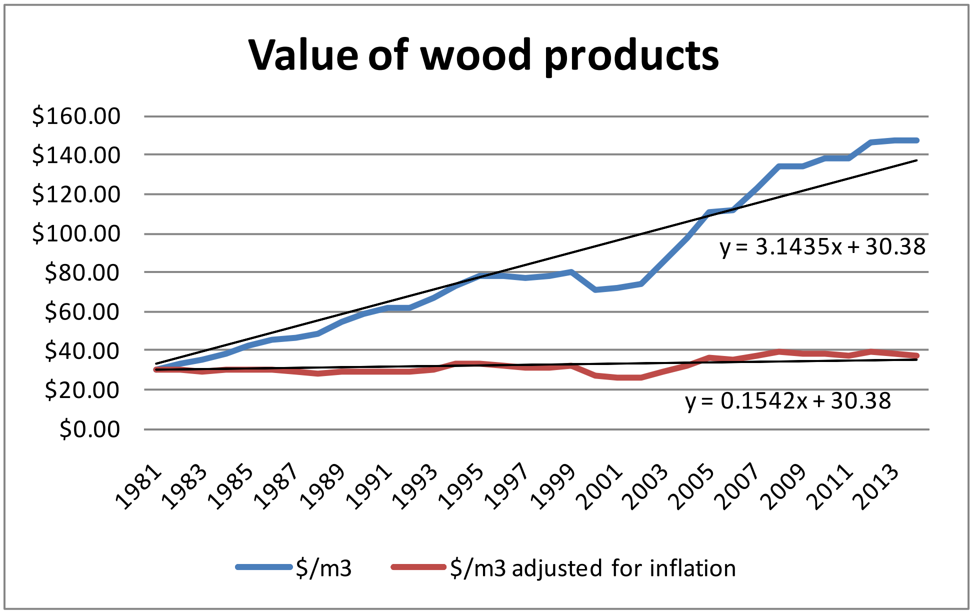

Figure 13. Change in the value of timber; adjusted for inflation.

Broader implications of silviculture on the grazing enterprise

The economic analysis of the cased study described above demonstrates that there are significant opportunities to enhance income across the two enterprises. However there are some additional interactions that need to be considered and subtle changes to specific management activities may be required.

Managing changes in carrying capacity.

Figure 10 above shows how cattle carrying capacity changes over time and is inversely correlated with changing tree density. If stocking rates aren't adjusted down in line with the increase in tree density, then the resultant excessive utilization rates will lead to a loss of grazing land condition (see Figure 1). The impact of changing carrying capacity in a given part of the property may require some changes in herd structure and/or turn off policy. There may also be tax implications.

Cattle often browse, especially during the dry season when the protein of the herbaceous layer is low. Grazing can often suppress the lignotuber pool. Where it is desirable to promote tree regeneration, it may be necessary to destock a paddock for a period to allow the regeneration to lift from the lignotuber pool into the sapling stage from which future sawlogs can be selected during thinning.

Fire regimes

Fire is a useful land management tool in native pasture systems and can be used to: -

- manipulate pasture composition
- improve feed quality
- even out grazing distribution
- manage woody regrowth

- reduce risk of wildfire

Each of these management outcomes requires subtly different fire regimes (fire timing, frequency and intensity).

Similarly, fire is a useful management tool in silviculture and is used to:-

- reduce understory and fuel loads prior to harvest and thinning
- reduce harvest residues and cycle nutrients
- promote regeneration
- temporarily suppress the lignotuber pool
- address nutrient imbalances that impact tree health
- reduce the risk of wildfire

The fire regime used to achieve these outcomes may be subtly different to that used for grazing outcomes. There may be a need to reduce stock numbers prior to burning to ensure adequate fuels loads. Conversely crash grazing can reduce fuel loads.

As regular fire suppresses the lignotuber pool, not burning for a few seasons may be required to promote a regeneration response.

Conclusions

Private native forests in Queensland are concentrated in the south-east corner of the state and are dominated by dry sclerophyll ‘remnant’ and ‘regrowth’ forests. As a resource it is generally extensive, of moderate to low relative productivity and, due to past management practices, in poor to moderate condition. The vast majority of the resource exists on freehold land where extensive grazing is the primary land use and owned by landholders who see themselves primarily as graziers.

For most beef producers in Queensland, property development has always involved managing the balance between trees and grass. While trees can contribute to feed quality and play important roles in landscape function, traditionally for many producers there has been an economic return to the grazing enterprise by reducing tree density.

In some regions, particularly in Southeast Queensland, many producers have benefited financially through their private native forest resource. It has provided complementary income particularly during drought or times of depressed beef prices.

There is considerable potential to improve the condition, productive capacity and value of the private native forest resource through enhanced silvicultural practices, particularly harvest and thinning operations. Investment in silviculture can lead to enhanced long term economic outcomes by providing a dual income stream.