THE POTENTIAL FOR ANIMAL PRODUCTION IN TROPICAL AUSTRALIA

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Summary

In Australia 298 million ha lies north of the Tropic of Capricorn and is vegetated by arid and semi-arid rangelands. Adequate rainfall for crops and improved pastures occurs in the coastal humid tropical zone of about 100 million ha. Soils and topographic constraints reduce the area suitable for improved pastures to about 40 million ha and that suitable for cropping to about 3 million ha. The cattle industry predominates in this zone with 5.7 million head in June 1975, of which 50% are zebu crosses in the Queensland, Darwin and Gulf regions.

Productivity of the zone can be increased by improving the cattle breeds and their fertility, better water supply and fencing, and by introducing low-phosphate demanding legumes into the native grasslands. Following improvement the zone could turn off 3 million head each year compared with about 0.5 million in 1974/75.

I. INTRODUCTION

For the purpose of this paper the tropical zone comprises the third of Australia that lies north of 21°S latitude. This zone has a well defined summer incidence of rainfall and lacks frosts and the winter rains found in the south. It has higher costs and a poor infra-structure.

In this tropical zone rainfall is the most important factor determining the suitability of land for agricultural development with further limitations being imposed by soils and topography. Only in the narrow humid coastal strip is rainfall sufficient in quantity and reliability for improved pastures and crops to be grown without irrigation. About 59 per cent of Australia’s river discharge occurs north of the Tropic, but most of it remains unharnessed. Thus, the greatest part of tropical Australia consists of arid and semi arid range-lands and dry unstocked areas. Over large areas the soils are shallow, stoney, too steep for cultivation or are subject to flooding. Also unlike some other tropical regions northern Australia does not have useful areas of fertile tropical highlands.

As a result of the climatic and edaphic conditions the dominant agricultural industry in tropical Australia is beef cattle production. The scope for increased production in this industry lies in the application of the results of past and present research which can be broadly defined as (1) greater use of tropical breeds, (2) property improvements, and (3) use of legume-based pastures.

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Before discussing these subjects more fully I will briefly consider the resources and other agricultural industries of tropical Australia.

II. RESOURCES

Fitzpatrick and Nix (1970) have shown that the dominant limitation to pasture (and thus animal) growth in the tropical zone is moisture. Assuming that any pasture or cropping system will be based upon legumes, the limit of the humid tropical zone coincides fairly closely to the southern boundary of the xerophytic midgrasses (figure 1).

Figure 1: Grazing lands (Moore 1970) and B.A.E. beef regions of the Australian humid tropical zone.

Annual rainfall over most of this area is in the range of 700-4500 mm, predominantly of summer influence (December to March) and often of high intensity. Relatively, the area of land with an annual rainfall in excess of 1500 mm is small. A large, and increasing, proportion of this land is being cropped with sugarcane and other tropical crops which contribute significantly to the cattle industry in providing by-products for animal consumption and an infrastructure of ports, roads and other facilities associated with a decentralized population. The three major vegetation formations on the humid tropical zone (Moore 1970) are tropical tall-grass, xerophytic midgrass and the combined group of forestland, sedgelands and heathlands which occur in a discontinuous band along the east coast (figure 1). The latter formations afford little grazing in their native state whilst the first two formations are grazed extensively. The tropical tall-grass species of Themeda, Heteropogon and Sorghum form an understory in open forest or woodland. Xerophytic mid-
grass species (Bothriochloa, Aristida, Chloris) may form an understory in a low woodland or an open grass plain.

Over much of the humid tropical zone the terrain is of low relief with extensive rocky outcrops. The intense weathering of the parent rocks has resulted in soils of poor nutrient status, particularly with regard to phosphorus and nitrogen (Williams and Andrew 1970). Many soils have a poor physical structure causing them to set hard and seal upon drying.

In Queensland the major soils are texture-contrast soils, massive earths, euchrozems and shallow loams and sands, whilst in the Northern Territory massive earths and sands, often shallow and gravelly, predominate. Further west cracking clays, massive earths, shallow loams and sandy soils, particularly in the northern Kimberley region, are the major soils.

III. POTENTIAL LAND USE

The humid tropical zone of which only 3 million ha is suitable for cropping defined in the previous section is about 100 million ha. Much of the area is unsuitable for agricultural development considering the constraints of terrain and soil type—With the relatively moderate constraints applied for pasture improvement with Townsville stylo (Stylosanthes humilis) (e.g. hilly, skeletal soils, saline soils, seasonally flooded) the suitable area is reduced to c 40 million ha (Begg 1972).

For cropland much more severe constraints are necessary upon soil type and terrain because the high density rainfall makes erosion a major hazard. Gifford et al. (1975) have estimated the area of cropland in the humid tropical zone at c 3 million ha. With the development of new techniques such as minimum tillage and mulching (Lal 1975) soils of lighter texture and of greater slope might possibly be used.

The failure of the large scale dryland sorghum cropping ventures in the humid tropics does not accurately reflect the potential for cropping in this zone. Failure was mainly due to poor management—Future development of cropping will probably be integrated with the cattle industry, thus allowing a pioneering phase during which cultural practices, varieties and managerial skills will be improved. Considering the current economic state of the cattle industry, the capital required for a cropping enterprise and the alternative areas for capital investment it is unlikely that cropping will have a major impact in the mid term at least.

The development of a forestry industry in the tropics has been negligible except for exploitation of the rain forests in the wet tropical area surrounding Cairns and Ingham. The two forest types which are suitable for timber production (including pulp and chip forms) are the tropical eucalypt and the cyprus pine mixed hardwood forest. These forests occupy about 7.3 million ha of which 55% is in Cape York and the remainder in the Darwin—Melville Island—Arnhem Land region (Australian Forestry Council 1974). The estimated forest products in the Northern Territory are about one-seventh of the total in Queensland. The projected exploitation of these forests by the year 2000 is considered optimistic taking into account the low density of timber per hectare and

88.
the low annual production (I. Wood, pers. comm.). If however, the projected exploitation does proceed the possibilities of pasture development on cleared woodland, or in conjunction with plantation appears promising. Areas of 20,000 to 80,000 ha of irrigable soils are available in the Ord-Victoria, Dawson-Fitzroy and Burdekin regions. If such schemes were viable their influence would be similar to that of the agro-industrial cropped areas of the coastal wet tropics.

In summary it is considered unlikely that large areas of land currently used for grazing will be annexed for cropping or afforestation in the near future. In addition the majority of the land has no alternative use other than for extensive grazing. Considered in the long term this zone is ideally suited to respond to the worldwide increased demand for beef (Jasiorowski 1976) using efficient, low energy-input production systems and can not be used for any other purpose.

IV. THE CATTLE INDUSTRY

Table 1. Cattle industry statistics (1974/75) for the beef cattle regions of the humid tropical zone of Australia.

<table>
<thead>
<tr>
<th>Item</th>
<th>Coastal Peninsula</th>
<th>Inland Nth</th>
<th>Darwin Nth</th>
<th>Victoria Nth</th>
<th>Kimberley Nth</th>
<th>River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Property size (ha)</td>
<td>2.3</td>
<td>32</td>
<td>62</td>
<td>124</td>
<td>662</td>
<td>282</td>
</tr>
<tr>
<td>Mean Capital invested (ha)</td>
<td>127</td>
<td>258</td>
<td>163</td>
<td>480</td>
<td>2,357</td>
<td>597</td>
</tr>
<tr>
<td>Mean herd size (ha)</td>
<td>440</td>
<td>2180</td>
<td>2010</td>
<td>3730</td>
<td>32,090</td>
<td>7670</td>
</tr>
<tr>
<td>Branding rate (%)</td>
<td>55</td>
<td>62</td>
<td>48</td>
<td>44</td>
<td>48</td>
<td>35</td>
</tr>
<tr>
<td>Turn-off (%)</td>
<td>10.3</td>
<td>15.2</td>
<td>7.5</td>
<td>4.9</td>
<td>13.4</td>
<td>8.8</td>
</tr>
<tr>
<td>Breeding (% of herd)</td>
<td>30</td>
<td>41</td>
<td>40</td>
<td>46</td>
<td>54</td>
<td>55</td>
</tr>
<tr>
<td>Total Cattle number (000)</td>
<td>1,381</td>
<td>1,249</td>
<td>1,281</td>
<td>287</td>
<td>346</td>
<td>1,120</td>
</tr>
</tbody>
</table>

* as at 30 June 1975

Properties are generally very large with minimal development and stocking rates of 10-50 ha per beast. This is illustrated by the BAE Summary. The total cattle number at 30 June 1975 was 5.7 million head. Turn-off rates were down 5-7 per cent overall on those for the 1972/73 period (Johnston 1975) and the proportion of breeders in the Coastal North and Inland North herds had declined from about 60 per cent due to cattle being withheld from markets. Mortality rates were 6-10 per cent in all regions but the Coastal North (3 per cent).

In the extensive regions the investment in stock, plant and structures represents 56-58 per cent of the total capital investment. In the more intensively developed Coastal North region only about 33 per cent of the total capital is invested in stock, plant and structures.
In Northern Queensland and the Darwin/Gulf region about 50 per cent of cattle are Bos indicus crosses, compared with 25 per cent in the Victoria River region and 5 per cent in the Kimberley region (‘*t Mannetje et al. 1976, Kirby, pers. comm.*).

Most properties breed and fatten bullocks and spayed females — the exception being Cape York which produces stores for the more southern regions. Most of the beef produced is exported (70-100 per cent depending upon region) as boneless trade meat (Australian Meat Board 1975).

(a) Potential production

In some areas of the humid tropics beef production can be increased by fencing and watering, by improved husbandry, disease control and wider use of mineral supplements (compare the Inland North and Peninsula/Gulf beef regions in table 1). However this increase is limited by the dry matter production of the existing pastures (Henzell 1975). Already in many areas the native pastures are being grazed to their full extent and beyond. The sowing of new, more productive and stable pastures is therefore an essential component of the development of the cattle industry in the humid tropical zone.

(i) Sown pastures

The soils of the tropical zone are of insufficient fertility to consider improving with a grass alone and it is necessary to sow legumes. At present less than one million ha of the 40 million ha suitable for improvement with townsville stylo have been sown (Sturtz et al. 1975, Cameron 1975). The rate of sowing has fallen off over the last few years. This is partly due to the beef recession but experience has shown that, even with good management, townsville stylo pastures are usually unstable and are invaded by annual grass weeds (Torssell 1976). This shortcoming has led to the introduction of a wide range of Stylosanthes species which are being evaluated and show great promise.

Profitability of pasture improvement will depend upon beef prices, relative to the costs of establishment and maintenance. The current aim of research is to identify pasture species that can be established with a minimum expense on land preparation, require little or no special management practices and will make efficient use of modest fertilizer dressings.

At Katherine, N.T., two of the recently introduced species, S. hamata and S. scabra are being compared with townsville stylo over a range of fertilizer and land preparation regimes. The pastures are grazed by steers at stocking rates ranging from 0.45-1.0 beasts per ha, compared with the native pasture carrying capacity of about 0.06 beasts per ha.

Numerous other experiments (see Norman 1974) have demonstrated the increases in liveweight gain that can be obtained firstly from introduction of townsville stylo alone into native pastures and secondly with the further addition of superphosphate. Unfortunately most of the fertilized treatments have been at high levels. However, some general conclusions can be drawn from the nil fertilizer treatments when compared with native pastures; individual annual liveweight gains are 50-100 per cent greater, the period of weight gain may also be 50-100 per longer and stocking rates may be increased by a factor of 2-7 times. As
a result more steers can be finished earlier at 3 to 4 years rather than in excess of 5 years on native pastures.

Areas of research at Katherine include the demography of sown and native species and their comparative utilization of nutrients and water. Animal nutrition is being studied in relation to the level of development as it effects pasture yield, quality and diet selection. No long term data are available on pasture stability or animal production from this experiment. Present indications are that conservative stocking rates for these improved pastures without any land preparation are 0.5 beasts per ha for nil fertilizer and 0.8 beasts per ha for a modest input of 100 kg/ha superphosphate initially plus 25 kg/ha annually.

(ii) Cattle breeds and breeding

The advantages of B. indicus/B. taurus crosses over various B. taurus breeds in fertility and growth rate in the tropics (Turner 1975) are documented. However, with better understanding of the genetics and physiological processes controlling fertility, tick resistance, temperature regulation, etc. it may be possible to obtain further improvement in beef cattle suitable for the tropics. Brahman cross types have already demonstrated tick resistance and a tolerance of internal parasites, heat and drought while Africander crosses have been more fertile and of more equable temperament.

Current crossbreeding programs, combined with a low selection differential, have resulted in a wide range of types with variable reproductive and growth potential: a fixed breed combining all of the adaptive characteristics mentioned above should be more productive.

The low fecundity of cows in the tropical zone (see branding rates in table 1) has long been recognized and researched (McClure 1973). However, the output of the cattle industry still remains limited by the effect of poor quality dry season feed on the productivity of the breeding cow (Shaw and Norman 1970). This problem has persisted even with improved pastures which have received adequate fertilizer. For instance Edye et al. (1971) and Williams and Edye (1975) have presented seven years data from pastures top-dressed with either nil, 126 or 377 kg of superphosphate annually.

With all animals pregnant in the first year the conception rates in the subsequent three year period were 57, 68 and 87 per cent respectively and in the second two year period were 57, 73 and 54 per cent respectively. The conception rates for the nil fertilizer treatment are similar to the regional average branding rate (table 1) but those for the adequately fertilized intermediate treatment were still lower than the branding rate obtained in southern Queensland.

Recent studies by Siebert et al. (1976), Little (1975) and Siebert and Field (1975) have shown that small quantities of protein fed to pregnant cows or heifers during the dry season have had marked effects on fertility. Siebert et al. increased conception rates from 25 to 84 per cent in lactating cows, Little increased the number of cows in oestrus eight weeks after calving from 38 to 100 per cent and Siebert and Field found that the number of heifers cycling during the next wet season was increased from 25 to 75 per cent, and the latter animals cycled for longer. In both of his studies Siebert used fertilized...
Townsville *style/native* grass pastures.

Phosphorus has also been linked with fertility. Edye et al. (1971) developed a prima facie case for phosphorus having a direct effect upon conception rate but subsequent work by Siebert et al. (1976) failed to clarify this issue. The role of uncomplicated phosphorus deficiency, i.e. not accompanying a protein or energy deficiency, is not clear (Cohen 1975) but if benefits are to be achieved in certain circumstances these should be delineated as phosphorus is cheap and easy to provide.

Considerably more research is required to investigate pathways of control of protein, phosphorus and body fat levels (Siebert and Field 1975) upon oestrus. In the field these subjects need to be studied in relation to the new legume species and low fertility inputs.

**v. CONCLUSION**

In the humid tropical zone the development of the cattle industry will depend primarily upon the demand for beef on the export market. If the demand for beef returns then the humid tropical zone of Australia has the potential for increasing beef production from the present 0.5 million head per annum to at least 3 million head.

**VI. REFERENCES**


