New Britain Palm Oil Limited, P. O. Kimbe, West New Britain Province, Papua New Guinea.

SUSTAINABLE INTEGRATION OF OIL PALM AND BEEF CATTLE

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'Numundo Plantation' P.O.Box 26, Kimbe, WNBP. PNG

ABSTRACT

New Britain Palm Oil Ltd's (NBPOL) integration of beef cattle with oil palm commenced in 1998. It replaced the previous unprofitable system of grazing cattle under coconut. The new beef production system, known as the 'Numundo Half Stand System', involves the rotational grazing of cattle in half stand oil palm and sole pasture areas, the finishing of stock in a feedlot and the processing/retail of beef through an on site abattoir- butcher shop.

The initial 1998 trial area of 36 ha has been extended over successive years and now comprises 596ha of half stand Oil Palm, 96ha of sole pasture and a 1200 head capacity feedlot. The total grazing area of 692ha provides a carrying capacity of 2036 Adult Equivalents (AE) at a stocking rate of 2.94 AE/ ha.
This paper outlines NBPOL's management of this integrated system and reports on its performance in comparison to a full stand of oil palm and its sustainability in economic and environmental terms.

INTRODUCTION

'Traditional' oil palm/ cattle integration systems

Commercial ventures integrating oil palm with cattle have been undertaken for a variety of reasons and involved grazing the inter-rows of full stand oil palm (Samuel, 1974; Gopinathan, 1998; Ahmad *et al*., 1998 and Nor *et al*., 2000). Cattle are generally introduced into mature oil palm once the palm has reached sufficient height to avoid detrimental setbacks from grazing damage. Under such systems, feed resources diminish as the canopy closes and underlying vegetation is shaded. A continuous oil palm replanting program is necessary to provide sufficient vegetation to maintain economically viable cattle numbers. In addition, most cattle introductions have been driven by labour shortages and the need to cut weeding costs.

NBPOL's system for oil palm/ cattle integtration

In Papua New Guinea, such extensive grazing systems associated with the traditional methods of integration are not sustainable due to our land constraints and as labour shortage is not an issue, an entirely new system of integration has evolved. New Britain Palm Oil Ltd's (NBPOL) approach has not been to introduce cattle into oil palm but develop a system of full integration beginning at planting. The company's system, known as the 'Numundo Half Stand System' (NHSS), has focused on maximising profitability while providing a means of diversification, value adding oil palm by-product and supplying an alternative protein source to the region. In this system the cattle are sustained on a constant area of land, throughout the entire production cycle of the oil palm, without reducing the stocking rates. The total grazing area of 692 ha currently supports a cattle herd of approximately 2 000 head.

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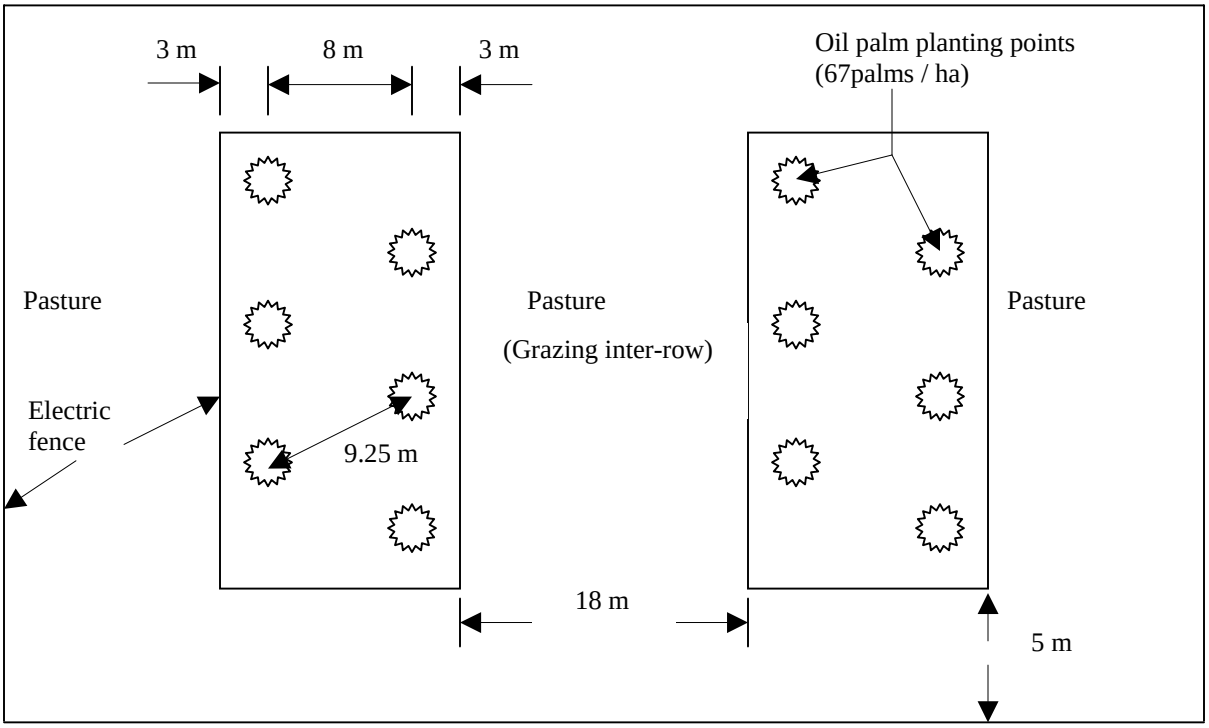
Development of the NHSS

NBPOL purchased Numundo, a 2430 ha beef and copra operation, in 1994. Wanting to maintain beef cattle, but remove the unprofitable coconut, it began development of an integrated cattle and oil palm project. Low lying, coastal areas were progressively replaced with full stand oil palm in the first two years. The cattle were initially maintained in the remaining coconut areas with the gradual introduction of improved pasture and a feedlot. Further development, commenced in 1998, replaced the coconut/cattle system for cattle integrated with half stand (67 palms/ha) oil palm in an initial trial area of 36ha under the NHSS design (Fig. 1). The procedures and costing for this development were detailed by Mann *etal*, 2002.

Figure 1: The 'Numundo Half Stand System' Design



The half stand planting area was extended again in 1999 (203ha), 2000 (266ha) and 2003 (91ha). Half stand plantings subsequent to 1998 were planted at 72 palms/ ha.

As cattle alone could not match the profitability of oil palm it was theorised that under the NHSS, oil palm would yield up to 60–70% that of full stand and that cattle, reared profitably, would make up the remaining 30-40% deficit. As such, development of the cattle herd has focused on maximising the efficiency of production to optimise returns. Numundo plantation was purchased with 460 breeders plus progeny. Their main function under coconut was to control vegetation to aid nut collection and little thought was given to improving the beef characteristics. Distance from other breeding herds made on site breeding the only feasible option. Cattle numbers and quality were rapidly improved through the importation of 450 breeding heifers and 20 bulls. Artificial insemination has been continually used to

further improve genetic gain for the economically important traits of fertility, growth and carcass quality characters. The present breeding herd consists of 1600 cows supplying replacement breeding females and cull stock to fatten through the feedlot.

Utilising 66% of the total area, the current operation consists of 923ha of full stand oil palm and an integrated cattle and oil palm retail operation. The herd of 2036 adult equivalents (A.E) are supported on 96ha of sole pasture, 596ha of half stand oil palm and a 1200 head capacity feedlot. Finished cattle are processed and retailed through an on site abattoir and butchery shop to supply domestic markets.
This paper focuses on New Britain Palm Oil's commercial experiences with the NHSS describing its performance in relation to a full stand of oil palm and the overall sustainability of the operation.

OIL PALM MANAGEMENT UNDER THE NHSS

The management of oil palm and cattle under the NHSS is performed separately but requires co-ordination and co-operation between both.

Oil palm upkeep

Upkeep of young palms in a half stand is no different to normal immature upkeep. However, immature oil palm fronds are highly palatable to cattle and electric fences must be maintained to protect the crown foliage of young palms from damage. Fencing impedes some upkeep tasks and the lowest basal fronds need to be shortened to avoid loss of power from the electric fence. Additionally, a strip of grass is sprayed out directly under the fence to aid upkeep procedures and fruit collection. Power to the fence is removed whilst labourers carry out upkeep tasks.

Upkeep practises remain the same until 36 months after planting when the electric fence is removed to allow access to the cattle. Grazing is evident on the basal fronds but, higher fronds receive only minor damage to the tips and the crown remains untouched.

Oil Palm Harvesting

Harvesting procedures are only slightly inconvenienced by the presence of the electric fence. The fence needs to be isolated and fresh fruit bunches (FFB) lined away from the fence before in-field collection. Under the cattle integration system, the standard NBPOL mechanical infield collection system (MIC) can be utilised for FFB collection at an earlier age than in the full stand due to the easy access of machinery along the side of oil palm rows from the pasture strips. This collection system resulted in a harvesting cost saving of US$1.38 per tonne FFB, a 13% reduction in free fatty acid and improved oil extraction rates compared with FFB from conventional harvesting and collection methods (Graham & Soupa, 2000).

With the fences removed at 36 months after planting harvesting is unrestricted and MIC collection can begin using the inter- row of the oil palms instead of the pasture area. Damage to the pasture has been observed as a result of MIC during the wet season necessitating these areas to be replanted.

There has been no visible damage of the fruit bunches by cattle and this is supported by the findings of Samuel (1974).

CATTLE MANAGEMENT UNDER THE NHSS

Breeding herd

The current breeding herd of 1600 cows are run in five separate groups that are control mated to provide a staggered calving over nine months of each year. This ensures continuity of supply into the feedlot, evens out the grazing pressure and keeps labour requirements constant.

The initial herd was a mixed quality of purebred Brahmans. Brahman blood has been maintained for heat tolerance and parasite resistance but Droughtmaster (Australian) and Charolais (European) breeds have been introduced through artificial insemination and, in the former, by live cattle imports. Both these breeds have been crossbred with the initial herd to improve economically viable traits while maintaining the adaptation to the environment. Significant selection pressure is being imposed to maximise the productive efficiency of the herd. The aim of the selection policy employed is to retain breeding females that –

1. Produce a vigorous calf once a year (365 days) without calving difficulties
2. Have progeny with high growth rates
3. Have progeny with desirable carcass quality characteristics at target market weights
4. Have low maintenance requirements

All breeding cattle graze the pasture provided in the half stand oil palm and sole pasture area. Signal grass *Brachiaria decumbens* and Humidicola *Brachiaria humidicola* are the two pasture species predominantly used at Numundo. Maintaining vigorous pasture involves the timely application of fertiliser, programmed weed control and the use of rotational grazing. Soil testing is a necessary prerequisite to establish nutrient availability. On Numundo only nitrogen (N) is in short supply and pasture fertilising targets replenishing N by two applications of Ammonium Nitrate at the rate of 75kg /ha via a mechanical spreader. These applications are spread equally over nine months to coincide with the dry season. This effectively supplies 50kg N/ ha to the pasture system per year. Some of the fertiliser applied to the pasture reaches the palms but no alteration in plantation practises for the palms has resulted. The predominant weed in the grass pastures is *Mimosa pudica.* L and this has been successfully controlled by selective spot spraying with Starane (1%) at 3 rounds per year. Chemicals are applied after the paddock has been grazed when the target weeds are clearly visible.
Rotational grazing is practiced to allow grass rejuvenation. The grazing cattle are grouped in herds of approximately 250 and rotated between three or four paddocks to achieve a minimum 21 days between "grazings". This improves grazing land utilisation, maintains grass vigour by providing a higher leaf to stem ratio, and allows the grass to better compete with weed species.

In addition to pasture, cattle are supplementary fed Palm Kernel Expeller (PKE) to achieve daily intakes of 2.2 kg/AE. This meal is produced by NBPOL as a normal by – product of palm kernel oil extraction and provides a low cost protein and energy supplement for cattle. The supplement is provided on demand and consists of 87.5 % PKE, 10 % Molasses and 2.5 % minerals. The combination of improved pasture species and PKE supplement allows for a stocking rate of nearly 3 adult cattle/ hectare.

Feedlotting

The 1200 head capacity feedlot effectively maximises returns per hectare by increasing the throughput of cattle and removing slaughter animals from pasture, creating the opportunity to run additional breeding units. Calves are weaned from their mothers at 5 – 6 months of age and enter directly into the feedlot. Females required as replacement breeders are retained in the feedlot until they reach critical weights before being returned to pasture for mating. All remaining cull stock are fattened in the feedlot until reaching a target market liveweight of 520kg for male and 450kg for female cattle at an age of 18 – 22 months. The concentrate component of the feedlot ration consists of PKE, Molasses and a Vitamin/mineral supplement (Table 1).
Cattle under 300kg live weight receive Urea as an additional ingredient to meet their higher protein requirement. Roughage is supplied twice daily in the form of green, chopped grass fed over the top of the concentrate.

Table 1 : Feedlot ration components and costs / head / day

Ration Component	% of Ration	Cost US $ /t finished ration	Cost US$/hd/d*
Concentrate			
PKE	87.50	11.29	0.059
Molasses	10.00	6.00	0.031
Minerals & Vitamins	1.50	9.00	0.047
Urea**	1.00	8.00	0.042
TOTAL (Concentrate)	100.00	34.29	0.178
Roughage			
Green chop forage ***			0.057
TOTAL (Roughage)			0.057
TOTAL COST (Concentrate + Roughage)			**0.235**

Notes : * - Cost/hd based on average daily intake of 5.2kg for 1200 head.

** - Urea is only included for cattle under 300kg LWt. PKE in the ration increases to 88.5% of the finished ration for older cattle (US $0.193/hd/d)

*** - Forage costs are based on harvesting costs, feeding out labour and forage fertiliser costs for the year.

Cattle achieved an average growth rate of 0.8 kg/day on this ration in 2003. With an average daily intake of 5.2 kg per day, the feed conversion ratio (kg feed:kg liveweight gain) equates to 6.5:1 for the concentrate ration. The daily feeding cost of US $ 0.235 / head results in a cost per kilogram of liveweight gain of $US 0.294.

On site processing

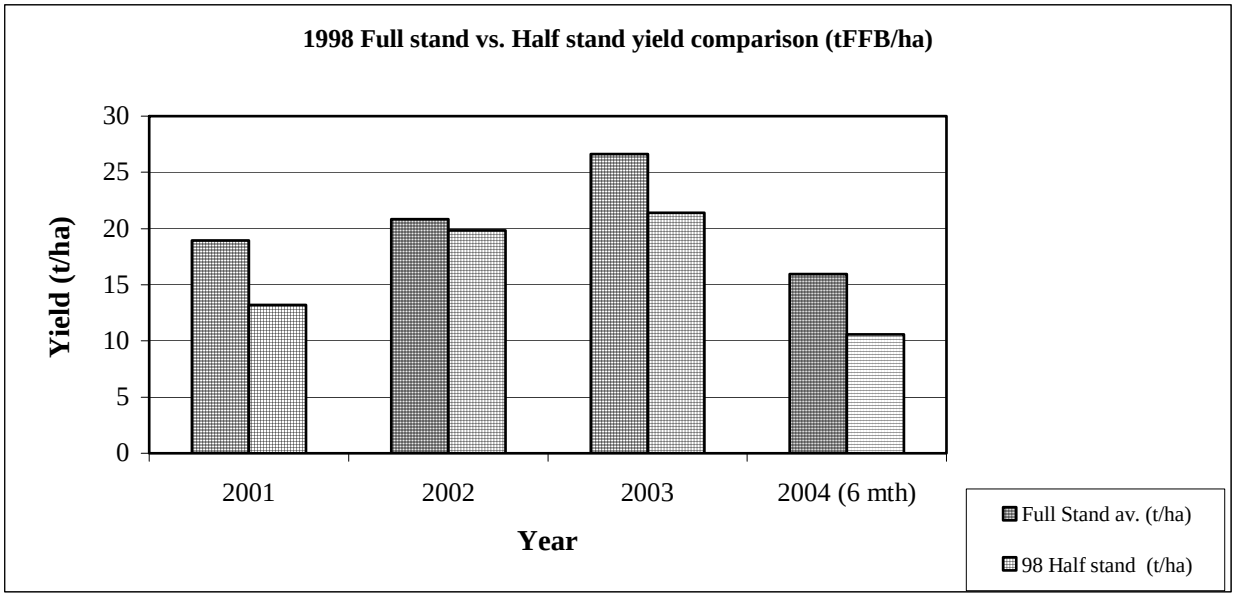
An abattoir and processing unit was constructed in 1999 to complete the intended vertical integration of the beef production system from breeding through to retail. This facility consists of a slaughter floor, chillers, processing room and retail outlet. A total of 1064 head were slaughtered in 2003 providing 283 tonnes of beef to be sold as quarters, meat cuts and processed beef products. Chilled quarters of beef account for 52% of the market share and are sent overseas to the mainland with the remainder sold locally in the islands. Total beef sales in 2003 returned a gross revenue of US $617 000

PRODUCTIVITY OF THE NHSS

The productivity of the NHSS relates to the production achieved from both the Oil palm (t FFB) and the cattle (t Beef) per unit of land area developed to this integrated system.

FFB Yield Comparison - Full Stand v Half Stand
An indication of the productivity of the NHSS oil palm is determined by the comparison of yields obtained from these palms with that obtained from a full stand of oil palm. Figure 2 shows the yield comparison between 36 ha of 1998 planted half stand oil palm (67 palms/ha) and the average yield of 2402ha of 1998 planted full stand palms (120 palms/ha) over five plantations managed by NBPOL.

Figure 2: Yield comparison FFB t/ha – 1998 Half stand v. 1998 Full stand (av. yield over five plantations within NBPOL)



The NHSS produced 70%, 98% and 80% the FFB yield/ha of 1998 full stand palms in 2001, 2002 and 2003, respectively. Projections based on yields for the first six months of 2004 indicate that the 1998 half stand will yield 66% the FFB/ha of a full stand of oil palm.

Figure 3: Yield comparison FFB t/ha – 1999 Half stand v. 1999 Full stand (av. yield over three plantations within NBPOL)

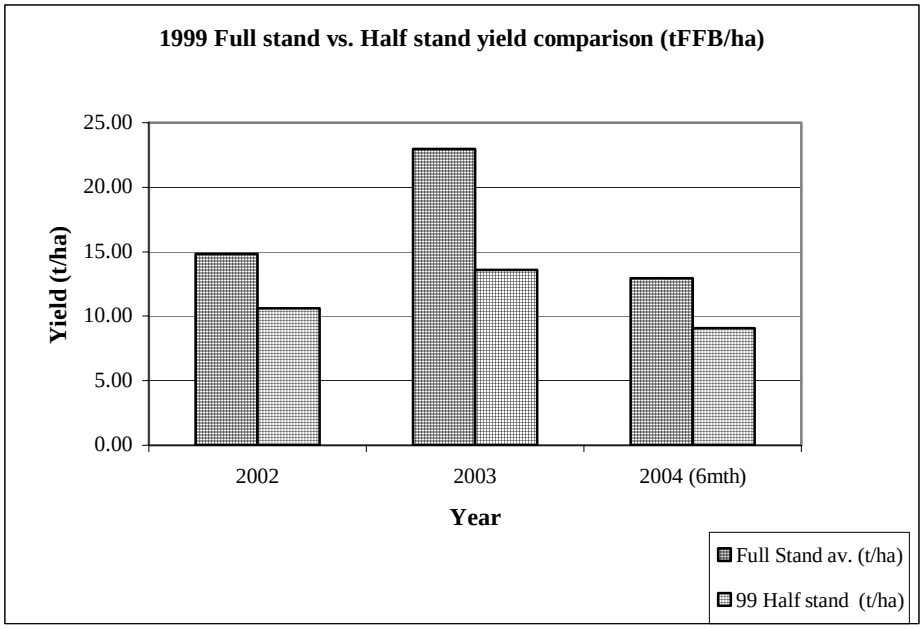


Figure 3 shows the yield comparison between 229 ha of 1999 planted half stand oil palm (72 palms/ha) and the average yield of 739ha of 1999 planted full stand palm (128 palms/ha) over three plantations managed by NBPOL

The NHSS produced 72% and 59% the yield/ha of 1999 full stand palms in 2002 and 2003, respectively. Projections based on yields for the first six months of 2004 indicate that the 1999 half stand will yield 61% the FFB/ha of a full stand of oil palm.

Beef production

Beef production is the combination of fertility and growth. Increasing calving percentage and the weight gain of these calves increases the amount of beef produced per unit of land area.

Figure 4 shows the calving percentages obtained since 2001 for the Numundo breeding herd. Calving percentages have shown a constant improvement over this time providing the opportunity to produce more beef.

Figure 4: Calving % of Numundo Breeding herd 2000 - 2003

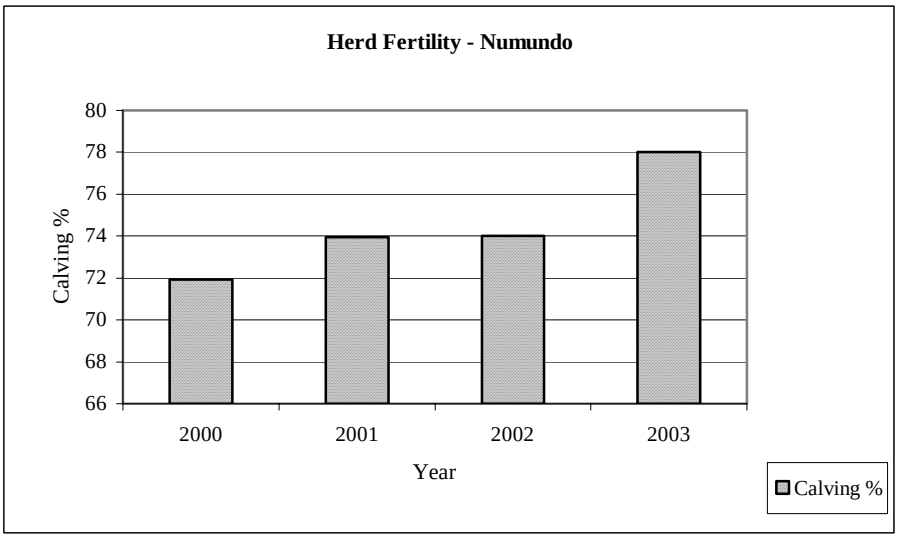


Figure 5 shows the average daily weight gain (ADG) of cattle in the feedlot. There has been a steady increase in ADG since 2001 resulting in heavier cattle at slaughter age.

Figure 5 : Average daily liveweight gain (ADG) for Numundo feedlot cattle 2000 - 2003

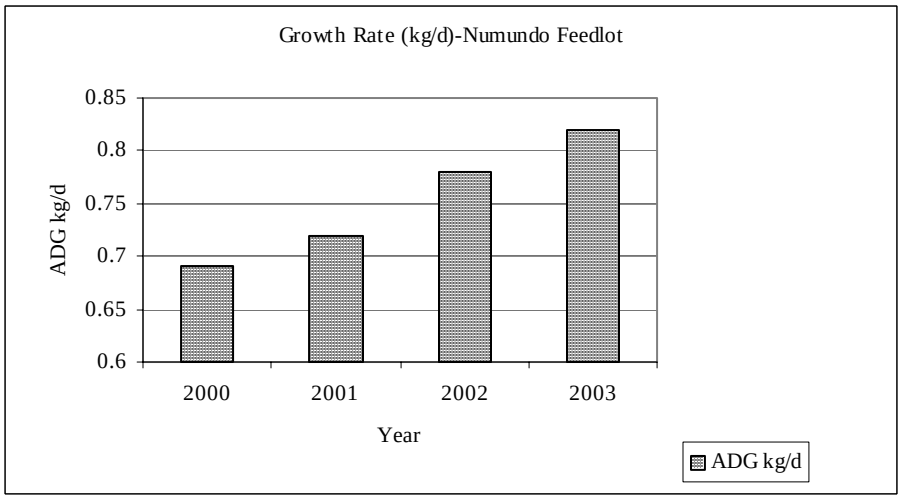
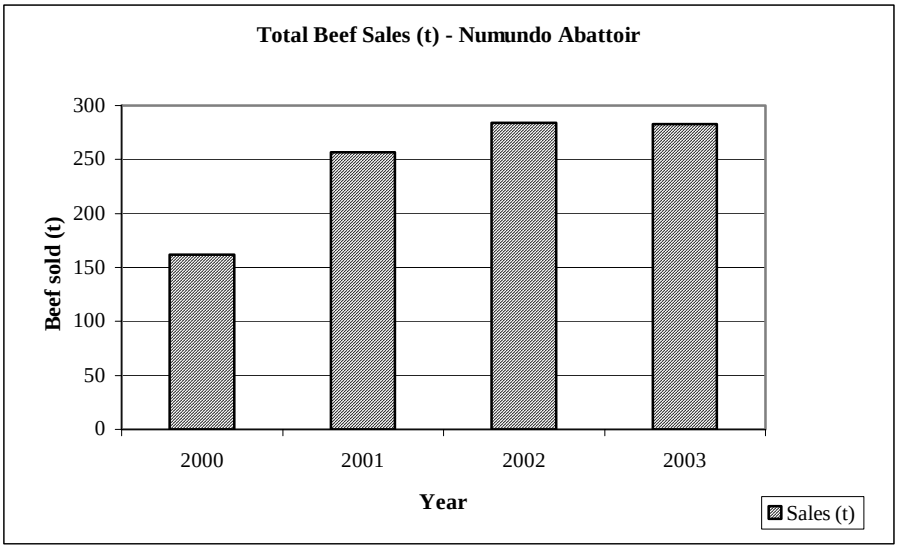


Figure 5 shows the average daily weight gain (ADG) of cattle in the feedlot. There has been a steady increase in ADG since 2001 resulting in heavier cattle at slaughter age.

The combination of improved calving percentage and higher weight gains has resulted in an increased beef output from the land developed to the NHSS as illustrated in figure 6.

Figure 6 : Beef sold (t) through the Numundo abattoir facility 2000 - 2003



SUSTAINABILITY OF THE NHSS

Cost/ Profit analysis

A cost/profit analysis comparing the 1998 Full stand and 1998 NHSS (table 2) provides an indication of the sustainability of the NHSS in economic terms. The comparison is based on the revenue and costs derived from 36 ha of half stand and 145 ha of full stand oil palm planted on Numundo plantation.

The half stand oil palm together with the contribution from the cattle operation equalled the operating profit from the full stand of oil palm in the first full year of FFB harvest (2001) and then exceeded it in the following two years. Projections based on current FFB values and related costs for both oil palm and cattle suggest the operating profit derived from the NHSS will be 82% that of a full stand of oil palm in 2004.

Table 2 : Profitability comparison of 1998 Oil palm vs. 1998 NHSS

1998 Oil palm (145.37 ha)

Yield Profile	2000	2001	2002	2003	2004 (6mth)
Tonnes FFB/ha	13.3	20.7	20.32	24.66	16.78
FFB Value ($US/t)	71	55	95	93	97

DESCRIPTION	**2000**	**2001**	**2002**	**2003**	**2004 (6mth)**
1998 Full Stand Oil Palm Costs					
Upkeep Costs (US$/ha)	272.1	244.8	194.4	176.7	97.8
General Charges (US$/ha)	84.9	92.4	144.8	175.5	106.5
Harvesting Costs (US$/t)	5.1	5.2	6.2	6.8	4.0
Transport Costs (US$/t)	2.7	3.0	3.3	3.9	4.4
Milling Costs (US$/t)	3.6	4.4	4.8	5.8	4.5
TOTAL COST (US$/ha)	508.2	597.2	629.6	759.1	420.3
1998 Full Stand Oil Palm Revenue					
Sale of Oil Palm products (US$/ha)	945.6	1148.9	1930.4	2293.4	1627.7
Profit / Loss (US$/ha)	437.4	551.7	1300.8	1534.3	1207.4

1998 NHSS (36.3 ha)

Yield Profile	2000	2001	2002	2003	2004(6mth)
Tonnes FFB/ha	7.51	13.2	19.85	21.41	10.59
FFB Value ($US/t)	71	55	95	93	97

DESCRIPTION	2000	2001	2002	2003	2004 (6mth)
1998 NHSS Costs					
Breeding herd costs (US$/ha)	194.4	197.1	139.2	140.8	61.2
Feedlot costs (US$/ha)	84.9	82.5	172.0	196.7	96.0
Abattoir costs (US$/ha)	132.9	179.4	198.6	195.7	74.3
Upkeep Costs (US$/ha)	151.9	136.7	108.5	98.7	54.6
General Charges - Oil palm (US$/ha)	47.4	51.6	80.8	98.0	59.5
General Charges - Cattle (US$/ha)	17.4	54.3	39.6	53.5	71.6
Harvesting Costs (US $/t)	5.1	5.2	6.2	6.8	4.0
Transport Costs (US $/t)	2.7	3.0	3.3	3.9	4.4
Milling Costs (US $/t)	3.6	4.4	4.8	5.8	4.5
TOTAL COST (US$/ha)	714.3	867.9	1022.6	1136.6	553.8
1998 NHSS Revenue					
Sale of Oil Palm products (US$/ha)	533.2	726.0	1885.8	1991.1	1027.2
Sale of Beef (US$/ha)	450.0	682.5	761.0	929.5	513.6
TOTAL REVENUE (US$/ha)	983.2	1408.5	2646.8	2920.6	1540.8
Profit / Loss (US$/ha)	268.9	540.6	1624.1	1784.0	987.1
% of Full Stand profitability	61	98	125	116	82

Notes :

No allowance has been made for depreciation or capital outlays.

Plantation costs - Oil palm include upkeep, harvesting and general charges only

Plantation costs - Cattle include breeding herd, feedlot, abattoir and general charges only

FFB value is derived from average extraction rates achieved by NBPOL mills and FOB prices for CPO, PKO and PKE received in the respective years

Milling costs include the average direct milling costs and overheads for producing CPO, PKO and PKE.

Environmental practices

The management practices used in both the oil palm and cattle operations are performed in a manner that meet the environmental aims and objectives described by the ISO14001 environmental guideline. As such, NBPOL is committed to sustainable practices that prevent land degradation, maintain the quality of ground and surface water and reduce the impact on critical habitats from agricultural practices.
The practices used in the oil palm and cattle integration were comprehensively assessed to identify what aspects of the operation were having or could have an impact on the environment. From this assessment, an environmental aspect and impact register was developed to highlight those areas requiring remedial action based on their respective severity. Management guidelines were written to encompass the procedures to be followed in performing every aspect of the cattle and oil palm tasks with particular emphasis on those procedures preventing or reducing impact on the environment.
Some of the improvements in our management procedures for dealing with those aspects identified as having a potential impact on the environment are detailed below.

1. Sediment runoff from the feedlot

   The sediment washed from the feedlot pens during rainfall was identified as having a potential impact on water quality as it entered into the waterways. Run – off from the feedlot pens is captured in effluent ponds to settle out sediment before it enters discharge drains. Liquid discharge from effluent ponds will be analysed on a regular basis for its organic matter levels and compared to industry standards to ensure the water quality of streams/ ocean is not compromised.
   Silt from the effluent ponds is removed and spread on forage grass as an organic fertiliser preventing it from entering the waterways. This forage is mechanically harvested after a sufficient growing time to be fed back to the feedlot cattle.

2. Liquid waste from the abattoir

   Liquid waste from the abattoir was identified as having a potential risk on water quality. All liquid waste from the abattoir facility is captured in a dedicated effluent pit. This liquid is then removed and sprayed over the forage grass as a liquid fertiliser. Application dates are recorded to ensure sufficient time has elapsed between effluent application and subsequent mechanical harvesting to eliminate any contamination risks when fed back to the feedlot cattle.

3. Solid waste from abattoir

   Solid waste from the abattoir facility was identified as having the potential to contaminate soil and water. The previous practice of burying this waste material in pits has been ceased. All solid waste is now composted with empty fruit bunches from the oil mill to be used as an organic fertiliser on oil palm or as a potting mix for oil palm seedlings in the company's nursery.

Human resources

While the NHSS involves the integration of oil palm and cattle the management of each is performed separately and therefore requires labour with skills specific to cattle as well as labour with skills specific to oil palm. While the high unemployment rates within Papua New Guinea ensure that labour resources are more than adequate it is not always possible to find personnel with skills in either cattle or oil palm. As a result of this, the company has comprehensive training programs to ensure staff are competent in

performing all the required tasks to meet identified standards in terms of quantity and quality and to do so in accordance with the environmental goals of the company.
Appraisal of work performance enables work standards to me measured and corrected where necessary to meet required standards. With this system in place, the human resources to perform the tasks required for managing cattle and oil palm is sustainable.

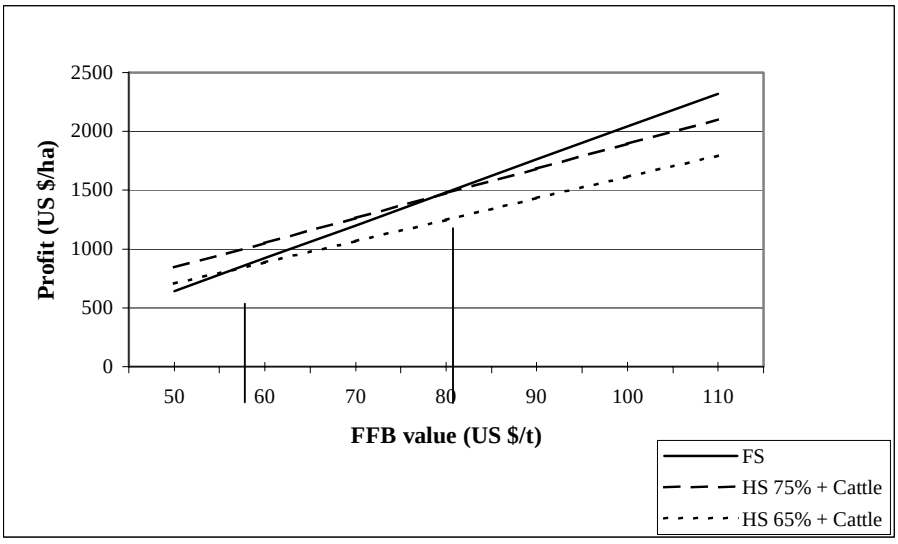
DISCUSSION

The NHSS is significantly different to traditional methods used to integrate cattle with oil palm where cattle graze the forage available in a full stand of oil palm. The NHSS involves a half stand of oil palm planted with every alternate double row of oil palm omitted to allow for the development of improved pastures for the grazing of cattle. This method of integration was developed on Numundo to allow economically viable numbers of cattle to be sustainably maintained on the limited land area available to the integrated operation. The vertical integration of the beef operation from breeding through to retail combined with the oil palm describes the NHSS that is practiced on Numundo plantation today. The system has progressively evolved since the purchase of Numundo as a copra and cattle plantation in 1994. With the first of the half stand planted in 1998 the NHSS is still in its infancy and while initial results are encouraging it will be the performance of the system in the long term that determines the success or otherwise of the system.

In terms of the FFB yield of this integration method compared to a full stand of oil palm, results have varied between the 1998 and 1999 planted half stand oil palm when compared with full stand palms of the same planting year on five different plantations within the company. The 1998 planted half stand oil palm achieved 98% the yield/ha of the average FFB yield obtained from 1998 planted full stand palms in the second full year of production (2002). This compares with 59% the FFB yield/ha obtained in the second full year of production for the 1999 planted oil palm when compared with the average yield/ha of 1999 full stand palms. The planting density difference between the 1998 half stand (67 palms) and 1999 half stand (72 palms) when compared with the full stand (120 palms) represents an expected yield/ha of 56% and 60% for the 1998 and 1999 planted half stand palms respectively. The yield /ha received from the 1998 half stand has exceeded expected yields by an additional 14-42% for the first three years of full production (2001 – 2003) while the yield /ha for the 1999 half stand palms has remained at an expected level when compared to a full stand of oil palm based on stand /ha alone. As discussed by Mann et. al (2002) the additional advantage received from the half stand planting in 1998 is most probably due to the planting regime used and the reduced competition for resources experienced by the palms compared to a full stand. The advantage of 42% does however appear exceptionally high and cannot be solely attributed to planting regime and may be a combined effect of planting regime and the introduction of cattle (Chen & Harun, 1994). The lack of any yield/ha advantage from that expected from differences in planting density in the 1999 planted half stand palms does not support this view. Predictions based on harvest yield from 1998 planted half stand palms in the current year suggest the advantage will be significantly reduced to an additional 10% the yield /ha over that expected based on planting density. It would be expected that the yield /ha advantage to the half stand palms would increase as the palms got older and the canopy closed increasing competition between palms planted in the full stand. However, the competition experienced between the palms in the half stand because of the higher planting density within the row may counteract the expected yield/ha advantage when compared with the full stand. This would agree with the observed decline in yield/ha advantage experienced with the 1998 half stand palms since its peak in 2002.

The profitability of the NHSS has been based on the yields obtained from the 1998 half stand and full stand oil palm planted on Numundo to remove any variation in yields associated with factors such as month of planting, soil and rainfall. The operating profit from the NHSS based on revenue and expenditure from beef and oil palm has shown encouraging results when compared with the 1998 full stand oil palm. The profit per hectare has exceeded that received from the full stand of oil palm since 2001. Current year profitability suggests that the NHSS will be less than the full stand of oil palm as a result of lower than expected yields from the half stand oil palm and the high price received for oil palm products. Variation in a number of elements will have a significant influence on the profitability of the NHSS. The critical elements determining the profitability of the NHSS in comparison to the full stand oil palm are yield of FFB, FFB value, quantity of beef produced / ha and prices received for the beef. The demand for beef remains strong and the revenue from the sale of beef has steadily increased as a result. The contribution of beef to the overall system offers revenue stability to a system that is historically characterised by large fluctuations in prices received from oil palm products as evidenced by the 70% variation in FFB value from 2001 to 2003. As a result of this, the contribution of the cattle to the overall profitability of the NHSS went from 31% in 2001 down to 19% in 2003 despite a 36% increase in the revenue derived from the cattle operation alone. The yield of FFB and FFB value then has the most significant impact on the comparative profitability of the NHSS. As determined by Mann et. al (2002) in their review of literature, it is reasonable to assume palms planted under the half stand design will yield in the range of 65 and 75% the FFB/ ha of a full stand of oil palm. Based on this small variation, it is the fluctuation in FFB value that is most significant in determining comparative profitability of the NHSS. Figure 7 shows the range of FFB values below which the NHSS will be more profitable than a half stand of oil palm based on a full stand yield of 28t/ha and using costs of production for oil palm and cattle and revenue received from cattle in 2003. FFB values less than US $56 and US $79 will result in the NHSS being more profitable than the full stand of oil palm when the half stand palms yield 65% and 75% the FFB/ha of a full stand of oil palm, respectively.

Figure 7: Profitability comparison – Full stand vs. NHSS for the expected FFB yield/ha range of 65% - 75% and various FFB values



While the current economic environment for oil palm is strong, it is possible that the average FFB value over the life of the oil palm will be nearer the threshold values making the NHSS more profitable than a full stand of oil palm due to fluctuations in FFB values that have historically been experienced. If this is the case the NHSS is certainly economically sustainable in comparison to a full stand of oil palm. If palm oil prices remain buoyant the NHSS is unlikely to be as profitable as a full stand of oil palm but will nevertheless be economically sustainable in its own right due to the system itself being profitable.

Given NBPOL's commitment to perform operations in accordance with the ISO 14001 environmental standard the NHSS will not only be economically sustainable but, environmentally sustainable as well. This is supported by the modifications that have already been made to those practices identified as having a potential impact on the environment. The practices currently used will be continuously monitored to measure environmental impact so that the operation remains proactive rather than reactive in preventing any degradation of natural resources. Our human resources provide the key to preventing any environmental impact. While labour resources are abundant they are predominantly unskilled. As such, programmed training of staff in all aspects of the operation to provide awareness on potential environmental impacts will ensure that NBPOL's environmental policy is upheld in the long term. .

The results currently being achieved from the NHSS have been encouraging enough to further expand the integration system. An additional 90 ha of land was developed to half stand oil palm at the end of 2003 from existing pasture areas and previously undeveloped land. A further 70 ha is programmed for development in 2004 which will complete the development of suitable land on Numundo. To maximise the productivity of the NHSS, it is planned to take breeder numbers from 1600 head to 2000 head by the end of year 2007. The continued selection of cattle for improved fertility and growth rates in conjunction with this expansion will see the continued improvement in contribution of the cattle operation to the NHSS.

CONCLUSION

The NHSS was developed by NBPOL to sustainably maintain an economically viable number of cattle on the same area of land through the productive life cycle of the oil palm. This method of integration differs significantly from the traditional methods of integration in that cattle are grazed on dedicated pasture areas in a half stand of oil palm allowing cattle to be introduced at the time of oil palm planting. The overall performance of the NHSS in comparison to a full stand of oil palm has given mixed results. Where a direct comparison can be made between a half stand of oil palm and a full stand of oil palm as a result of other influential factors being minimised, the integrated system has outperformed its full stand counterpart in economic terms.

It is however, difficult to draw conclusions based on these results as the system is still in its infancy and its performance will need to be measured over the full productive life cycle of the oil palm. It is expected that the FFB yield/ha from a half stand of oil palm will achieve 65 – 75% the yield obtained from a full stand of oil palm in the longer term. Based on the assumptions made in this paper, the NHSS will be more profitable at these expected yields than a full stand of oil palm if FFB values fall within the range of US$56 and US$79.

The current performance of the NHSS indicates it will be sustainable in all aspects. It is a profitable operation and forms an ideal integration combining the sometime volatile prices of palm oil with the stability of revenue from the cattle as a result of the strong demand for beef. The adoption of the ISO 14001 environmental standard to govern work practices and the ongoing development and training of

staff will ensure environmentally sustainable methods of production continue to be practiced into the future.

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