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Transforming Oil Palm Plantation for Forage and Livestock Integration

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ABSTRACT

Transforming the oil palm plantation for forage and livestock integration is a revolutionary approach to optimise land productivity. It will create synergy between forage and livestock integrated in the same piece of oil palm land. The objective of this article is to highlight the various steps required to enable planting of forage crop and intensive livestock production in an oil palm plantation. The crop integration activity can best be extended to mature oil palm areas if the oil palm has been planted with the double avenue planting system. Several forage crops were tested, and they included Napier grass, forage sorghum and kenaf. Detailed guidelines for each crop, such as planting, maintenance, harvesting, processing and the nutrient values are provided in this report. Intensive livestock integration is the important component to complement the forage crop project. This is because the planting of improved pasture types has made it possible to increase the stocking rate of livestock for integration. Intensive practices of integration of cattle and goat have been used successfully to demonstrate the potential of the suggested production system. The technical performances of forage crops and intensive livestock integration are also discussed. Systematic approach of forage crop and livestock integration has indeed shown the potential of reducing the meat importation and to move towards reaching self-sufficiency.

ABSTRAK

Transformasi ladang sawit bagi tujuan integrasi foraj dan ternakan merupakan pendekatan revolusionari bagi mengoptimumkan produktiviti tanah. Ini akan mewujudkan sinergi di antara integrasi foraj dan ternakan dalam sebidang tanah sawit yang sama. Objektif artikel ini adalah untuk mengetengahkan langkah untuk melaksanakan penanaman foraj dan produksi ternakan secara intensif di ladang sawit. Aktiviti integrasi tanaman dapat dilanjutkan sehingga sawit mencapai usia matang jika sawit ditanam menggunakan sistem dua baris kembar. Beberapa jenis foraj telah dikaji termasuklah rumput Napier, sekoi jenis foraj dan kenaf. Garis panduan terperinci bagi setiap tanaman termasuk kaedah penanaman, pemeliharaan, penuaian, pemprosesan dan nilai nutrisi turut disertakan. Integrasi ternakan secara intensif adalah komponen penting bagi melengkapi projek tanaman foraj ini. Ini kerana kadar stok ternakan yang diintegrasikan dapat ditingkatkan hanya dengan penanaman pastura berkualiti sahaja. Amalan secara intensif integrasi lembu dan kambing telah berjaya digunakan bagi menunjukkan potensi sistem pengeluaran yang telah disyorkan. Prestasi teknikal tanaman foraj dan integrasi ternakan secara intensif juga dibincangkan. Pendekatan secara sistematik integrasi foraj dan ternakan telah menunjukkan potensi bagi membantu mengurangkan pengimportan daging dan mencapai kadar sara diri yang dikehendaki.

Keywords: oil palm plantation, double avenue planting, crop integration, goat integration, cattle integration, Napier, sorghum, kenaf.

INTRODUCTION

Food security is an important requirement, and it is a resilience factor of an independent country to develop in face of external and internal challenges. The resilience factor is indicated by self-sufficiency levels of the essential food commodities for that particular country. In Malaysia, the self-sufficiency levels for beef and mutton have yet to be significantly improved over the years. Although currently there are signs of an increasing trend, estimated at 29.5% and 12.9% of beef and mutton, respectively in 2012 (Department of Veterinary Services, 2013), but these are still very far from the previous achievement in 1970 where the levels were at 86.9% for beef and 24.8% for mutton (Tan and Ahmad Tajuddin, 1988). These ruminant products are important sources of protein for Malaysia. However, Malaysia is fortunate that this shortage is being fulfilled by chicken and pork, which have surplus produc-

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tion. Although Malaysia can depend on these two meat sources to meet the requirement, overall meat production shortage is a threat to the food security of the country as Malaysia experienced during the outbreaks of the deadly bird flu and nipah virus in the past. Further, the current production system is largely dependent on imported feeds which, during an economic crisis, will greatly affect the ruminant sector (Devendra, 2007).

Ruminant production through the extensive system of using open pasture grazing is certainly not an option for Malaysia to increase its internal protein supply. This is because the economic advantage of cattle integration in oil palm planting far outweighs the growing of pasture for ruminant grazing. Yusof (2007) has highlighted that although the proportion of oil palm plantation area is seen as significantly increased compared to other plantation commodities such as rubber, it has actually resulted from conversion rather than opening of new areas. As the rubber price dropped due to competition with synthetic rubber, and also to a higher labour requirement for rubber tapping, rubber areas were converted to oil palm. Therefore, the suggestion for deforestation activity to upscale the ruminant production through open pasture grazing is not a viable option to increase livestock production. Moreover, the Malaysian government announced its commitment to preserve at least 50% of its land with forests to preserve biodiversity.

The current total area planted with oil palm in 2013 is 5.22 million hectares (MPOB, 2014). Realising that new suitable areas are difficult to attain, and a sole livestock production system is less viable, MPOB has since promoted the systematic rotational grazing for cattle integration (Rosli, 2000; Suboh *et al*., 2007), and the semi-intensive system for meat and milk goat integration in oil palm. Interesting findings from these studies, which started as early as 1998, had received positive responses from some oil palm plantations to adopt the technology. The innovative cattle integration technology has managed to reduce the weeding cost, and the fresh fruit bunch yield was also claimed to be improved in cattle integrated area (Suboh *et al*., 2007; Zainudin, 2008). However, the drawback is that smallholders and mini estates find it difficult to adopt this technology because of land size constraint to have optimised stocking rate of livestock. On the other hand, if say, one million hectares of oil palm areas with flat to undulating topography are made available for the above technology, the holding capacity possibly reaches as high as 250 000 heads of cattle. However, even at this stocking rate, it is still far from reaching a satisfactory self-sufficiency level for beef.

The normal triangular oil palm planting, as practised currently, does not support activities on crop integration in the long-term. In this present system, the crop integration is limited to the first three years of planting only. Thereafter, the crop integration cannot be practiced anymore due to the shading by the oil palm canopy whose fronds cover the area between the palm rows. Therefore, it is recommended that oil palm be planted following the double row avenue planting system for forage crops integration to raise livestock feed resources. This double row avenue oil palm planting system allows more sunlight penetration through the oil palm canopy compared with the normal triangular planting. This will ensure that forage crops planting can be carried out in a much longer period (Raja Zulkifli *et al.,* 2009; Suboh *et al.,* 2009). Thus, a synergy exists where the planting of fodder crops could help increase livestock production by integration with oil palm.

NEW STRATEGY FOR LIVESTOCK INTEGRATION WITH OIL PALM

Normally in Malaysia, livestock is integrated in oil palm plantation through extensive or semi-intensive production systems. The systems are highly dependent on natural undergrowth available in the oil palm plantations as feed sources of the livestock. The amount and availability of natural undergrowth vary with the oil palm age, soil type, climate, weed species, weed control programmes and estate up-keep and maintenance. In addition, these factors will also affect the quality of natural undergrowth as feed sources. Therefore, both the quantity and quality of feeds available in oil palm plantations are not consistent in supply. As a result, it will be difficult to predict and manage the performance of livestock reared under these systems due to this variability.

This livestock integration system also requires a large oil palm area. This is to ensure enough supply of natural feed (undergrowth) to the livestock in relation to the land size of the oil palm plantation. Currently, the recommended stocking rate is one cattle to 4 ha of oil palm area for cattle reared under the systematic rotational grazing system. In other words, 100 cattle require 400 ha of oil palm plantation. Therefore, this system restricts small land owners, especially the smallholders, from carrying the project on livestock integration with oil palm. Due to this reason, only big oil palm plantations can participate in the livestock integration projects.

For smallholders, the majority of them practice the free-range grazing concept which requires minimum inputs. The cattle are allowed to move freely

from one area to another in the oil palm smallholding in search of feed, and also for the herd socialising activity. The optimum stocking rate is not followed, and no control measures are taken on the animal movement. Therefore, grazing pressure always arises due to uncontrolled grazing activity. At the same time, the livestock are also exposed to the risk of chemical poisonings from application of herbicides, pesticides and fertilisers in the oil palm plantation. This chemical poisoning has been reported as a factor for animal loss in the livestock integration enterprises; this problem has affected profitability.

Therefore, it is really a challenge to sustainably produce livestock through integration approach in oil palm plantation. It is now realised that the feed availability is the main issue that determines sustainability of the livestock integration project. Dependency on natural undergrowth as the main livestock feed source is not a long-lasting solution. Therefore, it is important to have strategies to overcome this shortcoming to make livestock and oil palm integration project sustainable now and into the future.

A strategy that appears promising to mitigate these issues is forage crops production in oil palm plantation by integration. In this system, the forage crops for livestock feeds are planted in between the oil palm rows of the double avenue oil palm planting. The forage crops are managed according to good agriculture practices for fodder production. Proper planning and implementation of these activities, especially planting, fertilising, weed control and harvesting/cutting will ensure good growth and yield for the forage crops. The forage crops are harvested at their optimum age in the field and transported to the animal house. The stubbles and stems of the harvested forage crops will be maintained to allow for re-growth. The forage plots will be re-fertilised and maintained against a heavy weed infestation. This is to ensure a fast re-growing process in the field for a high forage yield. The forage crops can be harvested for multiple times before reaching their full economic life. Then, the plots will be replanted.

To complement this system, the livestock are enclosed in the animal house built in a strategic location within the oil palm plantation. The livestock are managed according to the intensive production system especially on the feeding management aspect. Cut and carry system is employed to daily feed the livestock in the stalls. Harvested forage crops from the field are transported to the animal stall. Prior to feeding, the fodders are chopped using a chopper machine to increase the livestock's feeding efficiency and to reduce wastage. Feeding is carried out using *ad libitum* concept to ensure that the livestock have enough voluntary feed intakes. At the same time, feed supplements are also given to the animals to support any nutrient deficiency from the intake of green forages. The details about livestock management are discussed in the livestock integration section.

DOUBLE ROW AVENUE OIL PALM PLANTING

In the double row avenue planting system, two rows of oil palm are planted for every avenue as shown in *Figure 1*. The planting distance between the palms (marked 'X') in the same row is 6.1 m and 9.1 m between the rows, while the distance between two avenues is 15.2 m. The palm density is 136 palms ha^{-1}, similar to normal triangular oil palm planting at 9.1 m x 9.1 m x 9.1 m. The palm rows should be in east-west orientation so that when the palm grows taller, more sunlight can reach the area between two avenues to enhance growth of the integrated crops. This double row avenue oil palm planting system is recommended for flat to undulating terrain with the land slope ranging from 0^o - 6^o.

This oil palm planting system offers more space for planting of crops, specifically the forages, in areas between the double rows of oil palm even at the mature stage of the oil palm growth. The 15.2 m area is provided to accommodate crops for a long-time planting. The forage crops can be integrated in this area for producing fodder for livestock such as cattle and goat integrated in oil palm plantation. By adopting this system, the quantity and quality of feeds are assured and their supply can be regulated. The fodder production in double row oil palm planting can be improved from time to time with a good planning and good agriculture practices.

In this integration system, the oil palm is still managed according to good agriculture practices as in the normal triangular oil palm planting system currently adopted by plantations. Among the good agriculture practices include the use of good quality planting materials, and the adoption of the right planting technique, correct fertilisation and efficient pest and disease control. Ultimately, oil palm is managed according to the standard practice by oil palm plantation in Malaysia.

FORAGE CROP INTEGRATION WITH OIL PALM

MPOB has carried out several studies on the potential of forage crops planting in oil palm plantation. The aim is to produce green fodders for feeding ruminant livestock, *i.e.* cattle and goat, reared under the intensive production system. The harvested

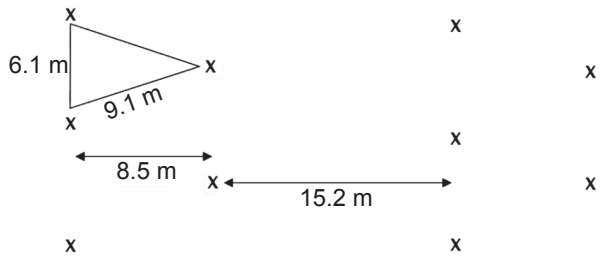

Figure 1. The double row avenue oil palm planting for forage crops integration.

green fodders from the field were delivered to the livestock in the animal stall/house through the cut and carry system. The forage crops which have been investigated included Napier grass, forage sorghum and kenaf. Trials on these forage crops, in double row avenue oil palm plantation at several MPOB stations, have been completed. It was found that these forage crops are technically and economically viable for integration in oil palm plantation.

In this system, it is highly advisable to establish the forage crops in the double row avenue oil palm plantation early, at least two to three months before the livestock is brought in. This is to ensure that green forages are ready for harvest to feed the newly introduced livestock. However, the most important thing is to ensure that the supply of the green fodder is consistent with specific quality and quantity to meet the project time line. To achieve these aims, good agriculture practices are really essential to be executed for forage crops integration in oil palm plantation.

Good Agriculture Practice (GAP)

The recommended GAP guidelines for forage crops planting such as Napier grass, forage sorghum and kenaf are as shown below.

Land preparation. Prior to planting, land preparation must be carried out properly. All the vegetations in between the oil palm rows must be cleared off mechanically or by using chemical herbicides. Then, the land is ploughed to produce a good soil texture suitable for planting the forage seeds or the stem cuttings. Normally, three rounds of ploughing are carried out in the field which consisted of two disc ploughing and one rotor tilling. After the first ploughing, lime should be applied to the soil and subsequently incorporated into the soil through the second ploughing. Ground magnesium lime at 2 to 3 t ha^{-1} can be used for liming purposes. Prior to the rotor tilling, basal dressing fertilisers are broadcasted evenly for incorporation into the soil. The rates of basal fertiliser for specific forage crops are discussed in fertilisation programmes for forage crops.

Planting. To have a good initial growth, the forage crops must be planted at the onset of rainfall. Therefore, it is crucial for the grower to plan properly the execution date for planting of the forage crop seeds (kenaf and sorghum) or stem cuttings for Napier grass. Forage sorghum and kenaf seeds can be planted using seeding machine or manual dibbling. These forage crops are recommended to be planted at 70 cm x 20 cm (71 428 plants per hectare). The seeds must be treated with suitable fungicide before planting in the field. For Napier grass, cuttings are taken from mature stems with 3-5 internodes (about one foot long) per cutting. The cuttings are planted in a slanting position at 60 cm x 30 cm (55 555 cuttings per hectare).

Fertilisation. Similar to food crops, the forage crops also need to be fertilised sufficiently to produce a higher fodder yield. Basal fertiliser is applied during land preparation prior to the planting of seeds. Then, row or top dressing fertiliser is applied after every harvest to promote re-growth from stubbles or stumps. The general fertiliser programme for forage crops integration in oil palm plantation is as shown in *Table 1*.

Weed control. Weeds compete with forage crops. If not controlled, weeds will dominate the forage crops which will later affect the forage growth and yield. To get a high green forage yield, the plots should be maintained from excessive weed growth. This can be achieved by carrying weed control programme manually or by using chemicals. Pre-emergence weeds are controlled by spraying pre-emergence herbicide immediately after seeds planting (for sorghum and kenaf). Then, the post-emergence weeds are controlled according to their growth in the plots. Generally, manual weeding is recommended to be carried out between 25- to 30-day interval. However, it is paramount to quickly control weeds after each harvest or cutting. If not, the weed will suppress the growth of forage crops. For forage sorghum and Napier grass, paraquat herbicide at 50% of the recommended concentration was observed to be effective for controlling the weeds after each harvest. It also does not significantly affect forage crops re-growth and yield.

Pest control. Pest and disease infestation is not serious in forage crops integrated with oil palm. From several trials that have been conducted, only leaf eaters were observed infesting forage sorghum and kenaf. However, this pest can be easily controlled with pesticide spraying. Generally, pests and dis-

TABLE 1. GENERAL FERTILISER PROGRAMME FOR FORAGE CROPS INTEGRATION IN DOUBLE ROW AVENUE OIL PALM PLANTING SYSTEM

Type of forage crop	Type of fertiliser	Basal dressing (kg ha^{-1})	Top dressing (kg ha^{-1})
Forage sorghum	Compound 15:15:15	500	-
	Triple superphosphate	98	-
	Muriate of potash	75	-
	Urea	-	150*
Napier grass	Compound 15:15:15	200	-
	Urea	65	150*
Kenaf	Compound 15:15:15	300	300*

Note: * Applied after every harvest/cutting.

eases have minimal effect on the green forage yield of sorghum, Napier grass or kenaf.

Harvesting. The optimum number of days after planting has a direct effect on the quality of forage crops as livestock feed. As a forage crop grows older, there will be a higher volume of feed per hectare, but at that stage, the feed will be of lower feed quality. When fed to the livestock, it will reduce their performance. Therefore, optimum time is critical for harvesting the forage crops to maintain their nutritional quality and green yield. For forage sorghum and kenaf, the first harvest of the green forage is recommended at six to eight weeks after planting. The stubbles and stumps are then allowed to re-grow in the field. Forages from the re-growth crops can be harvested again after six weeks. About four harvests can be carried out for forage sorghum and kenaf in one planting season of six months. One harvest from the main crop, and three harvests from the re-growth stubbles or stumps at every six weeks. For Napier grass, the first harvest is quite late, at about 75 days after planting. Then, the re-growth forage is harvested at every six weeks, similar to forage sorghum and kenaf. The Napier grass can be harvested many times before the forage is replanted, usually at about two years after planting.

Height of cutting also plays an important role in fodder crops integration with oil palm. This is due to the ability of the fodder crops to re-grow after every cutting. The cutting height below an optimum level will affect forage crops re-growth, and ultimately the fodder yield. It also affects the survival of forage stumps or clumps in the field. The clumps or stumps will have a short productive life if cut below the optimum height. For forage sorghum and Napier grass, the cutting height should be in the range of 15-30 cm from the ground level. For kenaf, the cutting height is a bit higher, at 50 cm above the ground level.

Forage Crops Yield

A good green fodder yield is correlated to the actual performance of fodder planting in the field during a specific growing season. The fodder yield is highest at optimum growing conditions such as good soil and climatic conditions. Furthermore, the fodder crops are managed according to, or following good agriculture practices. Based on several trials conducted on forage crops integration, the fodder yields for forage sorghum and kenaf integrated in double avenue oil palm planting system are as presented in *Tables 2* and *3*, respectively. For Napier grass, the dry matter yield was 20-30 t ha^{-1} for one season of one year. At 16% dry matter yield, the fresh yield of Napier grass ranged between 125 – 187.5 t ha^{-1} yr^{-1}.

Nutritional Values of Forage Crops

Feeds offered to the livestock must be in good form and contain an excellent nutritional value. Animal will perform better with good feed sources that contain sufficient quality and quantity of nutrition. Normally, the most limiting factor that affects animal growth is the nutritional value of specific feeds fed to the animals in any production system. In the intensive production system, it is likely that the most critical factor is that the animals do not have free access to grazing or browsing.

There are several food components that play major roles in livestock growth. The most critical components in any type of feed that contribute much to livestock performance are crude protein and metabolism energy. Protein is required for cell development, specifically at the growing age, for

TABLE 2. FODDER YIELD OF SEVERAL FORAGE SORGHUM VARIETIES INTEGRATED IN DOUBLE AVENUE OIL PALM PLANTING SYSTEM

Variety	Fresh weight (t ha^{-1} per season)	Dry weight (t ha^{-1} per season)
Sugar graze	78.71	13.74
BMR Revolution	53.27	10.12
Pacific BMR	53.89	9.36
Jumbo	56.91	9.12
Superdan	42.52	7.04

TABLE 3. FODDER YIELD FOR KENAF V36 INTEGRATED IN DOUBLE AVENUE OIL PALM PLANTING SYSTEM

Harvesting round	Fresh weight (t ha^{-1} per season)	Dry weight (t ha^{-1} per season)
1st	13.30	2.26
2nd	18.89	3.21
3rd	15.96	2.71
4th	20.84	3.54
Total	68.99	11.72

pregnant livestock and milking stage, and the energy is essential for regulating the body activities. A good feed should contain a sufficient amount of protein and energy.

Based on research conducted on the forage crop integrated with oil palm at several MPOB Research Stations, the nutritional value of Napier grass, forage sorghum and kenaf is as shown in *Table 4*. The nutritional values of these forage crops are sufficient for supporting normal growth of livestock, *i.e.* goat and cattle. In terms of nutritional ranking, generally kenaf is better than sorghum, and sorghum is better than Napier grass. These values represent the nutritional quality of forage crops at 42 days after each cutting.

The palatability will drop when livestock is offered with forage fodder that exceeds this optimum cutting age. Higher crude fibre content in older fodder limits intake by livestock. Another growth limiting factor for livestock is the accumulation of prussic acid in the sorghum forage with age; this does not apply to Napier grass and kenaf. The level of prussic acid will increase in sorghum fodder that experienced drought condition, stunted growth or harvested at older age. Therefore, it is important to ensure that the forage sorghum is harvested at its optimum age to prevent prussic acid accumulation that will hinder livestock growth.

INTENSIVE LIVESTOCK INTEGRATION

The description on the intensive integration concept in this article is based on research conducted in MPOB Research Stations. The aim of these projects is to increase the livestock production capability in oil palm area. There were three projects conducted namely; cow-calf, fattening beef cattle and doe-kid projects. Except for fattening male cattle project, the other two projects involved breeding and fattening activities. The breeds of animals used in these studies were yellow cattle and Brahman-Kedah-Kelantan cross for cow-calf, Brahman cross for fattening male cattle and Katjang goat crosses for the doe-kid project.

The idea of intensive beef cow-calf system was first discussed in 1991 (Mohd Sukri and Ibrahim, 1991). However, not many production performance results were highlighted in that article. Therefore, a modified study was conducted by MPOB to emphasise on production performances and to incorporate the advantages of oil palm planting system.

TABLE 4. MEANS OF NUTRITIONAL COMPOSITIONS IN FORAGE CROPS INTEGRATED IN OIL PALM PLANTATION AT 42 DAYS CUTTING INTERVAL

Parameter	Napier grass	Forage sorghum	Kenaf*
Dry matter, %	94.2[a]	94.0[a]	90.92[a]
Crude protein, %	9.35[a]	15.13[b]	22.83[c]
Crude fat, %	1.65[a]	2.21[a]	3.9[b]
Crude fibre, %	37.73[a]	36.63[a]	22.8[b]
Calcium, %	0.22[a]	0.25[a]	1.75[b]
Phosphorous, %	0.19[a]	0.21[a]	0.35[b]
NFE, %	37.68[a]	34.35[b]	n.a
TDN, %	55.66[a]	59.75[b]	68.25[c]
ME, Mj kg^{-1}	8.27[a]	8.94[b]	10.34[c]

Note: Means with similar alphabet in the same row are not significantly different at 0.05.
* Leaves.
n.a.- not available.

The technology on cattle fattening and intensive goat rearing is the alternative solution to those oil palm growers interested in adopting livestock integration but constrained by having small land size. This is also suitable for the smallholders.

Housing

The common features of a cattle house for cow-calf and feedlot cattle are loading ramp, cattle pens, 'cattle crusher', water tank, piping system and treatment ponds. The cattle house can be constructed using galvanised iron rods or wooden bars. The cattle house flooring is made of non-slippery cement rendered surface that will prevent cattle from slipping. Side drainage is constructed to reduce wetness of flooring surface caused by cattle's urine. Cemented water and feed troughs should be constructed in opposite side at the edge of the cattle pens, facing outside with enough space for every individual cattle in a particular pen. In the cow-calf system, each breeding cattle with an average of 220-270 kg live bodyweight is allocated 2.6 m^2 space individually. The space allocated for a bigger breed such as Brahman crosses in the feedlot system requires 3 m^2 per head. In this system, heat-insulated roofing such as asbestos is provided to cover the whole cattle house from direct sunlight, especially on the sunny days.

There are differences in housing specification between the cow-calf and feedlot systems. In the feedlot system, only a single-sex type (mostly male) and more or less similar age cattle are reared in the house. However, in the cow-calf system, cattle of different ages and physiological conditions are reared together in the house. The main purpose of establishing pen partition is to segregate the animals based on age, and physiological condition. Therefore, the possibility of cross infection and physical competition for space and feed can be minimised. For that reasons, only two types of pen are established in the feedlot system, namely fattening and isolation pens. In the cow-calf system, pens for breeding, mothering, fattening and isolating pens should be constructed.

For intensive goat integration, the suitable housing in our climate is raised floors stilted, which is normally constructed using wood. This type of housing is proven to be able to minimise health problems, especially those related to stress. It is also easy to manage and to maintain. The dimension of the goat house is 6 m wide and 15.3 m long, the floor is elevated 1.5 m above the ground. The goats are separated based on their physiological needs. The base floor below the house is cemented for easy removal of goat manure. The space allocated for breeding goat is summarised in *Table 5*. The maximum capacity is about 100 heads of goat.

Management in General

An important philosophy in livestock production that is applied globally is 'start with clean animals'. Therefore, selection of a reputable supplier is a necessity. All animals that are going to be brought in must be screened from diseases such as brucellosis, tuberculosis, Johne's disease, leptospirosis, foot and mouth disease and melloidosis. This procedure must be stated clearly in the purchasing tender document, to avoid any dispute in the future.

Upon arrival, the animals should be quarantined for a few days and treated with anti-stress drug to reduce stress as a result of transportation. Close observation is done on this group of animals, so that emergency steps can be activated, if neces-

TABLE 5. RECOMMENDED FLOOR AND TROUGH SPACE FOR GOATS IN INTENSIVE PRODUCTION RELATED TO LIVE WEIGHT

Type of animal	Weight	Floor Space			Trough space
		Solid floor	Slatted floor	Open yard	
	kg	m² / animal	m² / animal	m² / animal	m / animal
Doe	35	0.8	0.7	2	0.35
Doe	50	1.1	0.9	2.5	0.40
Doe	70	1.4	1.1	3	0.45
Kid	-	0.4 - 0.5	0.3 – 0.4	-	0.25 – 0.30
Buck	-	3.0	2.5	-	0.5

Source: FAO (2013).

sary. The quarantine procedure will help the animals to get familiar with their new environment, management routine and the handler, and to avoid disease spread to existing stock. Based on our observation, neglecting stress control has resulted in high abortion and kid's mortality cases. During the quarantine period, preventive measures, such as administration of anti-parasitic drugs, are normally done.

Livestock are prone to handling stress; therefore, they should be handled in a good manner. Normal management routines that cause stress conditions are weaning, isolation, medical treatment and any unpleasant procedures. Anti-stress drug should also be administered immediately after these routines.

Identification is an important requirement for any livestock management, especially for recording performance data and activity conducted on a particular animal, such as treatment. Good identification must be permanent and visible and readable from a distance. Cattle and goat farmers in this country normally prefer ear tagging versus other methods such as hot branding, ear tattooing or ear notching. This method is preferred as it is cheap and easy to execute. The ear tag is normally applied a few days after the animal is conditioned, or a few days after being born.

Cleaning is an important activity to avoid disease spread in cattle and goat houses, and it is being carried out daily. It is done by removing the faecal solids manually using rubber scrapper in the cattle house or broom in the goat house. During cleaning and feeding, the handler can observe the livestock behaviour, to identify those animals that require special attention. Goats especially like to be kept in clean condition. Feed trough, water trough and floor should be maintained clean.

In the cow-calf and does-kids systems, the animals are segregated based on age group and their different biological needs. This will reduce injury, feed and space competition and cross disease infection. Breeding cow and does are placed together with their bull and buck, respectively, in the breeding pens. This will last until the females become pregnant as indicated by the absence of oestrous signs (heat). Cows and does in their late pregnancy stage are transferred to mothering pens until their offsprings are born and weaned. Most of the healthy dams deliver their offsprings normally, without requiring any assistance. Newly delivered offsprings must be ensured to obtain their colostrum and their umbilical cords dipped with diluted iodine. Calf is weaned at six months old, and kid is weaned at three months old. Weaned animals are placed in growing pens until they reach maturity - one year for cattle and six to nine months for kids. Then, male cattle and goat are transferred into the fattening pens until they reach the optimum age for selling. Good fattening will result with good carcase percentage. Calf and kid losses can happen at birth, or from birth to weaning. However, the most critical period is at birth to weaning.

A herd health programme is designed to prevent disease prevalence or spread, and to maintain livestock in optimum health conditions. The routine activities during a herd health programme include ear tagging, de-worming, de-ticking, weighing, vaccinating, collecting blood for disease screening and bodyweight scoring. Monitoring of the nutritional programme is part of the herd

health programme as it contributes so much to the animal fertility (Robinson *et al.,* 2006). If there is a requirement to re-formulate the feed, it will be done accordingly. Vaccination programme must be scheduled based on disease prevalence is a particular locality. General guidelines can be obtained from the nearest veterinary department. 'All in and all out system' for the beef fattening project will eliminate possibility of cross infection between different cattle batches.

Feeding

In intensive management, the feeding system is done by cut and carry. The main source of raw material is pastures planted in the double avenue. In our study, the ration given is based on processed Napier, kenaf and sorghum. The feed was formulated with an objective to balance the energy, protein, minerals, vitamins and fibre for cattle optimal growth.

The minimum amount of feed offered daily must be more than 3% dry matter (DM) of animal body weight for normal maintenance, for lactating and growing animals, an extra amount should be given. Drinking water and mineral licks in the form of blocks are offered *ad libitum*. Although minerals can be given by mixing in the feed, Nor Ismail (1987) has suggested direct supplement (*e.g.* mineral block). The animals are fed three times a day to optimise the intake efficiency. Before a new batch of feed is offered, the remaining feed in the feed trough must be collected, the amount is recorded and used as a guideline to increase or decrease the amount of feed given. This will help to optimise the raw materials and effort used in their preparation.

The harvested fodders are cut into smaller pieces (1.5-2.5 cm) using a motorised chopper. By doing this, animals are encouraged to consume the leaves and stem parts, and a more even mixture can be made if other forms of feed are added into the feed formulation. Concentrates are among the raw materials added to complete the formulation. It will increase the protein and energy content of the feed. Feed sources that function as concentrates are commercial pellets based on palm kernel cake, soya waste, corn mash and sago waste. Goat is given additional 20%-40% concentrates, depending on their physiological requirement. Other studies on growing and finishing steers and heifers showed that increasing crude protein in the diet has contributed to the increase in the average daily weight gain (Bailey *et al.,* 2008). The rate of pellet added to the formulation is normally not more than 1%. Samples of fodder and pellet mixture are regularly sent to the laboratory to evaluate their content.

Breeding

In the cow-calf intensive system, one and half-year-old females and two-year-old males are selected as the minimum age for both sexes. The breeding practice in this production system is by following the natural mating. It is carried out by allowing one bull to stay with a group of 20 cows in the same pen for several days, before being replaced by another breeding bull. Two to three weeks before the cows are mixed with the bull, they are subjected to 'flushing' by supplying high-energy feed to stimulate ovulation and to increase the conception rate. Bull is selected based on good physical conformation and showing good libido. Pregnancy diagnosis is conducted three months after the start of the natural mating, and non-pregnant cows are treated as reproductive failure.

Katjang goat is ready to be bred when the doe reaches 7-8 months old or 20-25 kg live bodyweight, and the buck has reached 12 months or 27-30 kg live bodyweight. As in the cow-calf system, similar breeding method is applied following the natural breeding. The buck is allowed to stay with does in a breeding pen for several days before being replaced with another buck. The suggested ratio of buck to does is one buck to 20 heads of does. Flushing activity is also suggested in goat breeding management.

Replacement of breeding cattle and goat can be done by introducing a new batch of breeders, or selection from existing matured females. Female goats that have reached one-year old, or at least 65% of mature body weight, can be selected.

Marketing

There is a significant increase in demand for beef and mutton in this country. The Department of Veterinary Services (2013) has projected an increase of up to 40% in 2012 (198 338 t) as compared to 2003 (142 220 t). The majority of this demand was fulfilled through importation of chilled or frozen meat, especially from India and Australia. This business opportunity should be seriously considered by local entrepreneur, particularly the oil palm growers.

The price trend offered in the retail market for live goat and cattle is as shown in *Table 6*.

The price of animal for rearing is normally referred to as the price for breeding by most of the livestock farmers. This group of animals is offered at a higher price as compared to the animals for slaughtering (*Table 6*). The production cost and the risk in maintaining the breeding herd is higher.

TABLE 6. PENINSULAR MALAYSIA: PRICE OF LIVESTOCK FOR REARING AND SLAUGHTERING (RM kg^{-1}), 2001 AND 2010

	Year	Price for rearing		Price for slaughtering	
		Male	Female	Male	Female
Cattle	2001	5.71	5.26	5.15	4.71
	2010	8.11	7.69	8.13	7.54
	Price different	2.4	2.43	2.98	2.83
	% Different	42	46	58	60
Goat	2001	12	9.63	9.1	7.33
	2010	17.56	16.65	16.4	15
	Price different	5.56	7.02	7.3	7.67
	% Different	46	73	80	105

Note: Modified from the Department of Veterinary Services (2013).

Most livestock fattening farmers in this country also play the role of animal traders. Normally, they enjoy a better margin as a result of supply and demand pressure, heightened during festival and holiday seasons. *Table 6* shows this pattern, which resulted in an increase of up to 105% for female goats for slaughter in 2010 as compared to 2001 price. Therefore, cattle and goat farmers must strategise their marketing activities in order to maximise their return on investment. Forecasted sale is always giving greater returns than forced sale. For example, when poorly handled, animals incur injury and this will force the farmer to sell his animals at lower price. Hence, a good animal husbandry ensures a maximum return.

There is a niche market for male animals, especially for religious reasons. Malaysia, where Islam is the most widely professed religion, has a Muslim population of 61.3% (Department of Statistics Malaysia, 2011). For Muslims, they are encouraged to sacrifice selected animals during 'The Festival of *Sacrifice-Eid al-Adha*'. It is becoming a norm in this country that the male animal is preferred during this festival. Targeting for such a niche market has resulted in profitable returns to the livestock producers. The demand and prices are significantly higher during the festival.

Animal is sold when it reaches maturity age either for breeding or slaughtering purposes - 12 months for cattle and three months for goat. Normally, before being sold for slaughter, these animals are fattened to maximise the income. Cattle normally take three months, and goat about two months to be fattened. Culled animals are also a source of revenue for the livestock farming enterprise. Animals can be culled for several reasons, which include injury, sterile, too aggressive or too old for breeding. Another source of income generated from livestock production is the organic fertiliser. However, it requires a good processing method to minimise the negative side effect. Grass seeds are commonly found in ruminant faeces and, therefore, the wet faeces need to be stacked to increase the temperature during the decomposing process. This will destroy the grass seeds. The detailed procedure has been reported by many researchers (Kamil *et al.*, 2008).

Technical Performance

The results obtained from the intensive cow-calf integration project carried out at MPOB Research Station in Keratong indicated that yellow cattle in this project had high calving rate (85%) and low mortality rate (5%). The calves' mortality was due to *Brucella* sp. infection on their dam. Based on our experience, quick test kit does help in quick detection of *Brucella* sp. infected animals. For adults, no incidence of mortality was recorded up to five years of the project. The carcass percentage of male calves fed with Napier and palm kernel cake was 52.3% and 57.1%, respectively. The proportion of meat against bone was 74% and 26%, which was higher compared to Kedah-Kelantan cattle.

Brahman cross cattle responded well to the feedlot system. No mortality was recorded throughout the project. When offered with 2% DM of improved pasture and added with 1% palm kernel cake, the daily weight gain of the cattle ranged from 0.5 kg to 1.0 kg. In our study, cattle were treated with three rations, *i.e.* Napier grass + palm kernel cake (Ration

A), sorghum forage + palm kernel cake (Ration B) and Napier grass + sorghum forage + palm kernel cake (Ration C). It was found that the sorghum forage + palm kernel cake ration gave the highest average daily weight gain compared to other rations. Ration B gave 0.85 kg average daily weight gain compared to Ration A, 0.72 kg and Ration C, 0.77 kg. However, the results were not significantly different ($P< 0.05$).

Results of production parameters on intensive Katjang goat integration showed that this project was technically viable. The kidding rate recorded was at 83%, and the mortality rates for adult goats and kids were at 7% and 9%, respectively. The average birth weight for the male kids was 1.69 kg, slightly higher than the female kids at 1.65 kg. However, the average weaning weight at three months old was significantly different ($p< 0.05$) at 8.0 kg for male and 5.5 kg for female.

CONCLUSION

Transforming the crop and livestock integration in oil palm area is beneficial in optimising the productivity of the land. Systematic approach involving forage crops planting in double row avenue oil palm in combination with intensive livestock integration has shown promising results. Therefore, efforts to increase livestock production can be made possible with this innovative system which has demonstrated synergistic combination between forage crops and livestock when integrated in oil palm area. With this approach, farmers with small hectarage will be able to participate in this livestock and forage crops integration. Thus, it is expected that, with wide adoption of this integration system, the national self-sufficiency in meat production can be increased. However, the benefit of livestock manures should also be studied to optimise the nutrient recycling for the benefits of fertilising the forage crops as well as the oil palm.

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