

Analysis of the Benefits of Livestock to Oil Palm in an Integrated System: Evidence from Selected Districts in Johor, Malaysia

B. H. Gabdo^{1,2} & Ismail Bin Abdlatif¹

¹ Department of Agribusiness and Information System, Universiti Putra Malaysia, UPM Serdang, Selangor Darul Ehsan, Malaysia

² Department of Agricultural Economics and Extension, Adamawa State University, Mubi, Adamawa State, Nigeria

Correspondence: B. H. Gabdo, Department of Agribusiness and Information System, Universiti Putra Malaysia, UPM Serdang, Selangor Darul Ehsan, Malaysia. Tel: 60-192-407-532, 234-703-277-8850. Email: bhgabdo2007@yahoo.com

Received: June 13, 2013 Accepted: July 29, 2013 Online Published: November 15, 2013

doi:10.5539/jas.v5n12p47

URL: <http://dx.doi.org/10.5539/jas.v5n12p47>

Abstract

Symbiotic relationships have been known to exist in Livestock-oil palm integration; this survey demonstrates with statistical figures based on current evidence on only the benefits of livestock on oil palm in an integrated system. Data were collected from 255 respondents under smallholder scheme in districts of Johor for the 2011 production season; basic descriptive statistics and farm budget tools were used for analysis. Results indicate that farmers maintain an average farm size of 2.52 ha to obtain an average Fresh Fruit Bunches (FFB) yield of 18.45 t/ha/yr, representing 2.6 t/ha/yr or 14.1% increase in yield due to livestock integration, an average labour cost of RM5.12/manhour was estimated and Total Variable Cost (TVC) constitute 88% of cost of production as against 12% for Total Fixed Cost (TFC). The research also estimated a reduction in cost of weeding worth RM534.68/ha/yr; from RM568.17/ha/yr down to RM33.49/ha/yr; commensurate to 94% saved cost from weeding operations, 15% reduction in cost of labour and 8.6% reduction in total cost of production due to the influence of livestock grazing. Furthermore, analyses show that FFB accounts for the majority (81%) of the revenue in the integration system, while the livestock constitute (15%), Palm Oil Fronds (POF) (3%) and animal dung (0.03%). Although the revenue from the by-products is meager, but an indicator that revenue diversification is feasible to achieve increase in revenue and finally, a net income of RM7431.479/ha/yr was estimated. The production constraints identified in the smallholder livestock-oil palm integration were grouped into technical, economical, ecological and environmental constraints and suggestions were proffered on the management of the constraints with the view to minimize their militating effects for a more efficient and productive system to enhance better the income of the farmers.

Keywords: integration, fresh fruit bunches (FFB), palm oil fronds, net profit model, Johor

1. Introduction

The Malaysian livestock industry, particularly the beef (ruminant) sub-sector has not witnessed substantial improvement in the last two decades. Serin et al. (2008) stated that the livestock industry as a whole has managed to contribute an average of only 2% of the GDP over the past 20 years. Tohiran et al. (2007) stated that the demand for mutton (sheep meat) rose from 9160t to 15570t in 2003 but the supply made only 7% and 8.4% of the demand in 1993 and 2003 respectively. The deficit in the supply of the mutton of 91.6% in 2003 were valued at RM90 million. Similarly, DVS (2002) estimated that Malaysia only managed to produce 19,522t of beef out of a demand of 113,100t and urged that increase in production is necessary to raise the level of self-sufficiency from 17% to 30% as enshrined in NAP3.

The local beef industry failed to meet the growing demand due to the perception of high domestic resource cost (Ministry of Agriculture, 1992). Mohd Fauzi and Ibrahim (1993) attributed the stagnation of the Malaysian domestic beef industry to inadequate capital by proprietors as 90% of the operators are traditional small farmers with scattered and poorly organized farms. This is further aggravated by the problem of land; a major cost component hindering beef production. These costs can be reduced to a bearable level if enterprises are combined together; such as cattle production under oil palm which will increase intensity of land use or land use

maximization, reduction in cost of oil palm maintenance and above all ensuring higher returns for both the joint oil palm and livestock enterprises (Latif & Mamat, 2002). Furthermore, cattle-oil palm integration was identified by Malaysian government as one of the avenues for foreign exchange saving in the economy; in 1997 alone, the Malaysian economy incurred RM418.4 Million in foreign exchange through importation of beef and live cattle. This low demand and shortage of grazing land and lack of available feeds year round made the livestock-oil palm integration a good option for farmers. Thus, livestock-oil palm integration is apparently eminent in view of the rising demand for meat consumption in Malaysia and since it guarantees quantity and quality of feeds sufficient enough for the animals kept, particularly if reasonable stocking rate is maintained. In the integration system both the livestock and oil palm benefits mutually, however, the analysis here focused only on the benefits the oil palm exerts on the livestock that leads to increased yield, reduction in cost of production for the overall benefit of the farmers.

2. Materials and Methods

2.1 Sampling Method

The survey focused on independent smallholder farmers on livestock (cattle and goats)-oil palm integration from Batu Pahat, Johor Bahru, Kluang, Kota Tinggi, Kulaijaya, Ledang, Mersing, Muar, Pontian and Segamat districts of Johor state of Malaysia. A total of 255 farmers were selected based on non-proportionate random sampling technique with the aid of questionnaire capturing data of January to December, 2011 production season.

2.2 Net Return-Profit Model

Net return, a profit model was used to analyze the costs and returns in the integration system. Several profit models exist for testing farmers' profitability in agriculture. Amaza (2000) inferred that the use of gross margin; gross returns minus gross variable cost as a proxy measure of profitability is common especially when the total fixed cost of production is insignificant as in small scale traditional farming (Olukosi & Ogunbile, 2005). In an effort to capture the effect of the total fixed cost of production, Onyeagocha et al. (2010) stated that the net return which may range between $-\infty \leq \Pi \leq +\infty$ can be estimated using the two equations below:

$$GM = \sum P_i Q_i - \sum P_i X_i$$

$$NR = GM - TFC$$

Where: $P_i Q_i$ = Value of Output, $P_i X_i$ = Value of Variable Input, GM = Gross margin, TFC = Total Fixed Cost, NR = Net Return

The two models above can be condensed in to a single equation as below:

$$\pi = \sum_{i=1}^n P_i Q_i - \left[\sum_{i=1}^n P_i V X_i + \sum_{i=1}^n P_i F X_i \right]$$

The model can also be simplified as a single equation and extended to accommodate more variables. In this research the extension is specified as below:

$$\pi = P_1 Q_1 + P_2 Q_2 + \dots + P_n Q_n - [P_1 V X_1 + P_2 V X_2 + \dots + P_n V X_n + P_1 F X_1 + P_2 F X_2 + \dots + P_n F X_n]$$

Where: Π = Profit (Ringgits), $P_i Q_i$ = A product of Unit price of output (such as prevailing price of a Kg of Fresh Fruit Bunches (FFB), prevailing price of an average sized live cattle or goat and prevailing price of a litre of milk from cattle or goat) and quantity of the outputs realized, $P_i V X_i$ = A product of Unit price of variable input (such as manday of labour, weeding cost, harvesting cost etcetera) and quantity of the variable inputs used, $P_i F X_i$ = A product of Unit price of fixed input (Cost of yearly depreciation on fixed assets such as land, machinery, equipments) and quantity of the fixed inputs used.

3. Results and Discussion

3.1 Socioeconomic Attributes of Smallholder Integrated Livestock-Oil Palm Farmers

Farmers' attributes based on age in table 1 shows that farmers' age range between 26 and 73 years old with a mean age of 55 years. The age distribution shows that 14 (5.49%) of the farmers range 21- 40 years of age. These categories of farmers are young and energetic and some are among the new generation of oil palm producers with most of them taking over from their late parents. Majority (72.16%) of the farmers fall between 41 and 60 years of age while the remaining (22.35%) of the respondents were aged above 60 years old. In terms of education, primary and diploma level were the lowest and highest educational attainment of the farmers;

although farmers were educated but they acquire a low level of education. Thus, 99% of the respondents had formal education only 3 farmers constituting 1% were without any form of formal education. Series of research such as Vu (2012), Gul et al. (2009), Balcombe et al. (2008), Mugera and Featherstone (2008) have shown that farmers' education is vital in enhancing productivity and efficiency. In terms of ownership of the enterprise, all the respondents (100%) who owned the enterprise were male by gender; none of the female was found as owner; they were only found as family members who supply family labor to the enterprise. Perhaps the reason why the male farmers predominate as owners of livestock-oil palm integration is due to the tedious farm operations which the males endure. The high domestic responsibility of the males as household heads accounts for another reason why the male farmers participate highly as owners of livestock-oil palm farms.

Table 1. Socio-economic attributes of the livestock (goat/cattle)-oil palm integrated farmers in Johor, Malaysia

Attribute	Freq.	%	Attribute	Freq.	%
Farmers' age(yrs)			Years of integration		
21-40	14	5.49	1-10	231	90.59
41-60	184	72.16	11-20	18	7.06
>60	57	22.35	21-30	5	1.96
Palm age(yrs)			31-40	1	0.39
Young(0-9)	28	10.98	Integration system		
Matured (10-20)	216	84.71	Goat-oil palm	65	25.49
Old (> 20)	11	4.31	Cattle-oil palm	190	74.51
Race			Primary occupation		
Malays	254	99.61	Farming	225	88.24
Chinese	1	0.39	Civil service	12	4.71
Indians	0	0.00	Others	18	7.06
Gender			Production category		
Male	255	100	FELDA-self-managed	205	80.39
Female	0	0.00	Unorganized/Independent	50	19.61
Marital status			Farming Association		
Married	253	99.22	Member	215	84.31
Single	1	0.39	Non-member	40	15.69
Divorce	1	0.39	Ownership status		
Household status			Sole ownership	245	96.08
Head	255	100.00	Partnership	10	3.92
Spouse	0	0.00	Operating status		
Household size			Full time	225	88.24
1-5	214	83.92	Part time	30	11.76
6-10	40	15.69	Soil topography		
11-15	0	0.00	Flat soil	255	100.00
>15	1	0.39	Hilly soil	0	0.00
Education			Soil type		
No formal	3	1.18	Peat soil	17	6.67
Primary	14	5.49	Coastal soil	206	80.78
Secondary	68	26.67	Others	32	12.55
Post-secondary	161	63.14			
Diploma	9	3.53			

Majority (99.61%) of the farmers surveyed were Malays by race with only 0.39% as Chinese and none was Indian or other race as owners. This finding is a reflection of the fact that the Malays are predominantly owners of the smallholder oil palm production while the Chinese mostly operates at estate level or large scale operations. This finding concords with Ismail et al. (2003) who in their analysis of cost of production in smallholder also documented the Malays as the major race constituting 77% of their respondent. In terms of years of oil palm integration with livestock, majority (231) constituting 90.59% of the farmers started integrating oil palm with livestock for the past 1 to 10 years; thus less than 10 years of integration experience. Farmers with between 11 and 20 years integration experience constitute 7.09% of the respondents. Similarly, 1.96% and 0.39% of the respondents had between 21-30 and 31-40 years livestock integration experience respectively. This implies that livestock integration with oil palm is more patronized in the last decade than before. This may not be unconnected with factors such as increased demand for beef as a result of population rise in the last decade. The depletion in agricultural land being experienced recently also stimulates farmers to venture into the concept of scope economy to be able to maximize land use intensity. The persistent government efforts and support towards the integration project is an important stimulant to the livestock-oil palm integration. In terms of ownership of business, majority (96.08%) of the farmers were engaged in sole proprietorship and only 3.92% were partners with respect to the ownership of the oil palm sub-firm. On livestock ownership, it was observed that only 20% of them jointly own the livestock sub-firm. The joint ownership of livestock is more conspicuous on plantations with large number of livestock than those with less number of livestock and partners are mostly friends and family members.

Majority (88.24%) of the farmers indicated farming as their primary occupation while 11.76% of them have farming as secondary occupation. Of the latter category, 4.71% were civil servants and 7.06% have other occupations, such as mechanic and other unskilled related jobs. These farmers spend more time on the plantation while the farmers who had farming as secondary occupation resort to hired labor to be able to manage their plantations and in some occasions they resort to the plantations themselves to provide family labor. It has been observed in this research that farmers who had farming as primary occupation were better in terms of Fresh Fruit Bunches (FFB) yield and livestock performance, hence more efficient than farmers who had farming as secondary. This shows that they are more devoted and more skillful in the management of the integrated plantations. Most (99.22%) of the respondents are married with just 0.39% each as single and divorce. This marital distribution is not surprising considering their age structure. The marital status suggests that the farmers are responsible family men who shoulders family responsibilities. This is further justified in their distribution based on household status where all the farmers (100%) are heads of their family. Similarly, in terms of household size, majority (83.92%) of the farmers had between 1 and 5 members in their households, 15.09% of them had between 6 and 10 members and only 0.39% of the farmers had above 15 persons as members of their family in the household. Although family members are enough in some households, but they seldom contribute to the family labor requirements of the plantations, especially as it applies to their children who are within school age or children who have relocated to the cities for urban jobs. Supply of family labor mostly comes from the household heads, their spouse in some cases and some elderly people in the household who are neither schooling nor working.

Majority (76%) of the respondents surveyed had cattle-oil palm integrated plantations and 25.49% had goat-oil palm integrated plantations. This distribution is perhaps a reflection of the fact that there is more heads of cattle than goats by population in Malaysia. Distribution of plantations according to palm age shows that 11% of the farms surveyed had young palms (0-9 years), majority (85%) of the farms had matured palms (10-20 years) and only 4% of the farms had old palms (above 20 years). On the whole, the palms range between 4 and 23 years of age with a mean palm age of 16 years. Considering the mean palm age which is within an active or peak age of palm production, the high FFB yield obtained in this research is perhaps justifiable. Of the farmers surveyed, most (84%) were members of at least one farming association while (15%) of them were not member of any farming association. It has been discovered also that farmers join more of oil palm farming association than livestock farmers association. This means that farmers share more of oil palm management information than they do share livestock information. Membership of farmers association is believe to provide farmers with symbiotic ideas on current and viable management ideas to adopt in order to enhance productivity, this opportunity may not be readily available to none members of the farmers' association.

Of the respondents surveyed, 80% of them were under Federal Land Development Authority (FELDA) while 20% were under independent or unorganized scheme. We have also identified two categories of FELDA management: Plantations being managed by FELDA Company and self-managed plantations. The FELDA respondents were all drawn from the self-managed category where although they are under FELDA but they

manage their plantations by themselves. It has been substantiated by this research that the FELDA plantations are better performing than the independent plantations. All the farms surveyed operate on flat soil none was cited on either hilly or mountainous soils. This is not unconnected with the presence of the animals. Livestock are normally integrated in flat soil not in hilly soils due to its implication. Most (84%) of the farmers operates full time on their plantations and only 12% operates part time. They operate full time because farming is their primary occupation while those that operate part time have farming as their secondary occupation. This research has shown full time farmers to be better performing than the part time farmers.

2.2 Costs and Returns Analysis

Table 2 indicates that farmers maintain an average farm size of 2.52 ha to obtain an average FFB yield of 18.45 tonne/ha/yr.

Table 2. Estimated Inputs and Outputs in Livestock-Oil Palm Production (/hectare)

Average farm size (ha)	Fresh Fruit Bunches (FFB) (t/ha/yr)	Stock/ha	Family Labour (Manhours/ha/yr)	Hired Labour (RM/ha/yr)	Fertilizer (Kg/ha/yr)	Miscellaneous (RM/ha/yr)
2.52	18.45	19	576.92 *RM5.12/Man-hours	2956.67	551.31	6.79

However, this yield is below the national average of 20.2 t/ha/yr but higher than the FFB yield of 15.85 t/ha/yr (Ismail et al., 2003) obtained in a non-integrated oil palm survey of smallholders in Johor. This is in accordance with the findings of Devendra (1991) and Shamsuddin (2001) who reported an increase yield of 0.49 to 3.25 t/ha/yr in a livestock-oil palm integrated farm. Thus, the increase of 2.6t/ha/yr obtained in this research may be attributed to the influence of integration among others. Similarly, Chen and Chee (1993) reported that livestock grazing on oil palm plantation can add up to 30% in yield of the oil palm plantation. The increase of 2.6t/ha/yr represents 14.1% of the increase in the FFB yield. This may imply that there are still opportunities for productivity increase since the percentage obtained in this research fall below the estimate by Chen and Chee in 1993. A mean livestock intensity of 19 stocks/ha was obtained in the independent smallholder scheme, which is contrary to the conventional livestock-oil palm integration with a stocking rate of 6-10 goat/ha or 1 bull or cow/ha or 2 calves/ha (DVS, 2003) under organized integration scheme. Farmers operating sole family labour, utilize 576.92 manhours/ha/yr of labour. In lieu of that, farmers operating sole hired labour used the sum of RM2956.67/ha/yr on their operations. Thus, an estimate of RM5.12/manhour of family labour was obtained; implying the amount of wage paid per head on hourly basis.

Table 3 depicts the production cost and returns components; an estimated average costs and revenues per hectare. The fixed cost accounts for about 12% of the total cost of production, maintenance of roads/paths and bridges are a major cost, accounting for 48% of the fixed cost. This is obvious especially where incidences of erosion and flood are prevalent. Replacement of death palm, another important cost component contributes 22% of the fixed cost. The contributions of maintenance of machines and equipments (13%) and maintenance of farm building (3%) is low owing to the fact that being a small holder production heavy machines and large farm buildings are not common, only few light machines and equipments and small and locally built farm building, thus the low cost of maintenance.

The variable relative to fixed cost, contribute 88% of the total cost. 24% of the total variable accounted for by the cost of fertilizer. This is in accordance with the fact that fertilizer can contribute up to 30% of cost of production, while 37% of the TVC is accounted for by payment for wage and remuneration. This is typical of farms employing hired labour to manage the animal, especially where many animals are involved and for general farm operations. Other significant contributor to TVC is the transportation cost, splitted into three: home-farm, in-field and transport of FFB to mills; together they account for 16% of the TVC and harvesting costs and tools accounts for 12% of TVC. Results show that PKC (commercial feeds) and concentrate feeds are provided to the animals as supplements together with the conventional salts and brown sugar. The cost of medicine, vaccine and supplements are less significant to TVC suggest that the animals were mostly healthy throughout the year. The lack of significance of fuel cost for machines is also obvious since only few light equipments and machines are owned by the smallholders.

Table 3. Breakdown of Cost Components in Livestock-Oil palm small holder Production

COST COMPONENTS	AMOUNT (RM)	PERCENTAGE (%)	
FIXED COSTS (RM/Ha/Yr)	(RM)	(%) of TFC	(%) of TC
Palm establishment	56.52	8.9	(0.989)
Maintenance of Roads/Paths/Bridges	301.12	48.0	(5.273)
Maintenance of Farm Building	20.49	3.0	(0.359)
Maintenance of Machines and Equipment	81.42	13.0	(1.426)
Replacement of Death Palms	137.24	22.0	(2.403)
Land Tax	36.21	5.7	(0.634)
TOTAL FIXED COST	633		12
VARIABLE COSTS		(% of TVC	
Pruning of Palm oil Fronds	127.06	2.5	(2.225)
Weeding	33.49	0.66	(0.586)
Fertilizer	1206.15	24	(21.123)
Harvesting	496.69	9.8	(8.698)
Harvesting Tools	117.14	2.3	(2.051)
Transportation	563.68	11.1	(9.871)
Transportation of FFB to the Mills	235.63	4.6	(4.126)
Fuel Cost for Machines	53.14	1.0	(0.931)
Family Labour (Man-hours/Yr)	576.92		
Concentrate Feeds	36.70 (1.94 stock/yr)	0.72	(0.643)
Salt	77.41(9.93 stock/yr)	1.5	(1.356)
PKC	138.72(4.10 stock/yr)	2.7	(2.429)
Brown Sugar	16.30 (0.86 stock/yr)	0.32	(0.285)
Medicine, Vaccines and Supplements (MVS)	67.14 (3.55 stock/yr)	1.32	(1.176)
Wage and Remuneration	1901.21	37.0	(33.295)
Miscellaneous	6.79	0.13	(0.119)
TOTAL VARIABLE COST	5077.26		88
TOTAL COST	5710.26		

It is instructive that cost of weeding (only 0.6% of TVC) is low due to the grazing pressure of the animals on the under growth hence signifying a reduced cost of weeding. Ismail et al. (2003) in their analysis of sole oil palm plantation under small holder scheme in Johor found that cost of weeding constitutes 10% of the total cost of FFB production. Applying similar concept in this research, 10% of cost of FFB production is RM568.17/ha; which ought to be the cost of weeding were the farms non-integrated, but integration influence made the weeding cost to decline drastically to RM33.49. Thus, the farms achieved a weeding cost reduction of 94%, corresponding to 15% reduction in labour cost and 8.6% reduction in total cost of production due to grazing influence resulting from integration. Similarly, Ongah (2004) obtained a mean weeding cost of RM41.34/ha, translated to 68% reduction in weeding cost due to grazing and DVS (2002) has reported a weeding cost reduction of 73.2%/ha/yr in FELDA plantations.

In terms of revenue components, Table 4 shows that FFB accounts for 81% of the revenue, while the livestock (15%), POF (3%) and animal dung (0.03%). This shows that the FFB component is still the major factor in the revenue of livestock-oil palm integration. However, the 15% contribution of animals to revenue, a part from being a source of enterprise diversification, is indeed worthy additional revenue in livestock-oil palm integration.

Table 4. Breakdown of Return Components in Livestock-Oil palm small holder Production (/hectare)

REVENUE COMPONENTS	AMOUNT (RM)	PERCENTAGE (%)
Fresh Fruit Bunches (FFB)	10749.64	81
Livestock	1971.265 (104.29/stock)	15
Palm Oil Fronds (POF)	417.0057	3
Animal Dung	3.823215	0.003
TOTAL REVENUE	13141.73	
GROSS MARGIN	8064.478	
NET INCOME	7431.479	

On the whole, a net income of RM7431.479/ha/yr was estimated, thus translates to RM619.289/ha/month. Depending on the farmers' farm size and monthly domestic expenditure, this revenue flow from the integration under smallholder scheme may or may not be enough to sustain their livelihood; hence some farmers still rely on off-farm income to overcome their basic needs. This also explains why the smallholders find difficulties expanding their size of production as the income are not very sufficient for expansion programs rather to persistently maintain the present level of production.

3.3 Identified Production Constraints and Recommendations

3.3.1 Technical Constraints

Low palm population and high livestock intensity are two technical issues most farmers are constrained with, which indirectly affect productivity. Most farmers fail to maintain the conventionally approved number of palms and livestock per hectare. It has been observed that farmers seldom replace their death palms immediately, most farmers prefer to wait until time for general replanting. While they wait they continue to suffer loss in yield of FFB and other by-products which are commensurate to the number of palms lost in the plantation. Most farmers end up with high livestock intensity per hectare as a result of the prolific nature of some animals (goats) and the desire to own more livestock, yet with no adequate arrangement for feeds. Farmers are reminded based on the feasibility studies of Latif et al. (2003) to maintain a palm population of 148 palms/ha on inland soil and up to 200/ha palms on peat soil. Similarly, DVS (2003) recommended a stocking rate of 1 bull/ha, or 2 calves/ha, or 6-10 goats/ha.

3.3.2 Ecological Constraints

Ecologically, flood and excess rainfall is another productivity constraint in the area. The flood/erosion and torrential rainfall recorded in the year 2011 has indeed caused a lot of productivity set back in terms of low and poor quality of FFB and loss of animal as a result of flood impact in few cases. Construction and rehabilitation of drainages and construction of check-dams at specific locations in the plantation are some measures suggested to the farmers to counter this menace.

3.3.3 Economic Constraints

This research has identified some by-products such as palm oil fronds and animal dung as a source of revenue generation especially where these are excessively in abundance. Despite the importance of fertilizer in the production of oil palm, the research has identified quite a few farmers who failed to apply fertilizer entirely on their farms. Among the farmers who did applied fertilizer, some applied below the recommended rate. The dearth of fertilizer application may not be unconnected with the cost of fertilizer which is still not within the reach of some independent smallholders and the fact that the livestock contributes organic manure for the fertility of the soil. The independent smallholders mostly rely on manual system of cultivation with limited or no mechanization effort, hence labour intensive, especially when family labour is in practice. Thus, the implication on the health of the farmers due to labour drudgery is obvious and their medications are indeed a cost to the farmers. This study advocates a policy of health subsidy by the government in favour of the farmers to enable them get sound treatment and save some cost.

3.3.4 Environmental Constraints

Occasionally, theft incidences are reported on some farms; this usually happens when harvested FFB are left overnight for a longer time and without adequate security measures. Farmers should ensure that all harvested FFB are transported without delay to the mills and security arrangement be made where it becomes necessary for the

harvested FFB to be on plantation site for a long time. Two sources of livestock feeds have been identified in this system of integration: undergrowth comprising of grasses, shrubs and ferns and oil palm by-products, which comprise of oil palm fronds (OPF), oil palm trunks (OPT), palm kernel cakes (PKC) and occasionally palm oil mill effluent (POME). These two sources contribute immensely to the livestock grazing demand but are sometimes insufficient; over stocking of animals and lack of effective utilization of the by-products has been found to be the major explanation for the insufficient grazing materials. In addition to maintaining the standard stocking rate of animals, this research has proposed a third source of livestock feed called “Household waste” for farmers to patronize. Household waste in this context refers to waste from domestic cooking or restaurants such as food waste, potato peels, yam peels and similar other stuff that can be sun-dried and used substantially as animal feeds at almost zero price. Another source of feed proposed is: “Other farm residues”; farmers are also advised to assemble cereal or grain residues (corn stalk, maize stalk), residues of leguminous crops (groundnut or beans residues after harvest) and threshed particles of cereal and leguminous crops from nearby farms as added source of livestock supplemental feeds. Additionally, farmers can also embark on pasture conservation such as hay making which ensures the availability of pasture in future and guarantee the faster regeneration of the undergrowth. Some of these suggestions may not be without some cost or drudgery; apart from addressing feed insufficiency that prevents livestock starvation, these options are still cheaper than feeding the livestock on entirely commercial feeds. Increase in stock/ha may be feasible provided farmers explore these options for abundant supply of feeds.

Due to poor condition of some roads, transportation of inputs to farms and FFB to the mills are sometimes hindered or delayed which makes transportation cost expensive and the delay affects the quality of the FFB. Despite the numerous efforts made against the eradication of Ganoderma disease, the disease is still being observed in some farms. Other factors of economic importance are the insect pests (Beetles, Grasshopper and worms) and the non-insect pests (rats and pigs) which cause a severe damage to both young palms and old palms and even the FFB. The FFB are attacked by these pests both on the palm tree and even after harvest. This affects both the quality and quantity of the FFB. Farmers should resort to either chemical or biological control methods to eradicate the insect population; rearing of snakes and owls are effective ways of controlling some insect population in the plantation. However, in an integration set up, the use of owls is more appropriate considering the detrimental effect of the snakes on the livestock.

4. Conclusion

It is pertinent that livestock contributes tremendously to oil palm in an integrated set-up via cost reduction, land use maximization and several other avenues; these benefits have been shown to culminate into higher yield/hectare and subsequently higher net income/hectare. Despite the benefits in the integrated system and the long years of oil palm cultivation in the study area, the classes of constraints identified appear to be a drawback from a much better productivity and income indexes. Adherence to the measures suggested for mitigating these constraints will help improve upon the present productivity and income status of the smallholder livestock-oil palm farmers in the area.

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