

# Crop-livestock Integration among the Oil Palm Smallholders

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## ABSTRACT

*This study attempts to analyse the extent to which integration in oil palm will continue to be practised by the smallholders and the extent to which integration will be able to increase their income. Data from a total of 140 oil palm smallholders were analysed in this study, using descriptive statistics. The findings show that the majority of the smallholders intend to continue integration in their oil palm in the future. On average, they are satisfied with the integration carried out over the years. However, only half of the smallholders agree that the integration is able to increase their family income. It is expected that the findings from this study will be used to enhance the practice of integration in oil palm smallholdings.*

**Keywords:** smallholders, crop-livestock integration, continuity, productivity, income.

## INTRODUCTION

Oil palm is one of the most important commodity crops in Malaysia. Oil palm cultivation is also carried out by smallholders. The smallholders' planted area of oil palm represents 40% of the total area of the oil palm in the country (Abazue *et al.*, 2015). Every oil palm smallholder is expected to increase productivity in order to increase income. To this end, the government has set the target of increasing oil palm smallholder

income to at least RM 4000 per month by the year 2020. In this regard, the oil palm integration programme was introduced by the Malaysian Oil Palm Board (MPOB) in the Ninth Malaysia Plan (9MP) as a catalyst to increase the smallholder income to the targetted goal.

The oil palm integration programme is a programme which integrates oil palm planting with other economic activities such as crop cultivation and livestock rearing. Integration of plants refers

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to the cultivation of two or more crops on a single piece of land by farmers (Sichoongwe *et al.*, 2014). Raising a combination of crops and livestock is known as integration with livestock (Anizah and Zalina, 2015; Zazali, 2015; Liyama *et al.*, 2007). Integration of crops and livestock is characterised by a relationship drive that spurs the increment in farmer income as well as the economic growth of a province on a continuous basis (Nkongho *et al.*, 2014; Cramb and Patrick, 2012; Pasandaran *et al.*, 2005).

Based on previous studies, integration of oil palm with other crops and with livestock is able to generate maximum income for oil palm smallholders (Kamil Azmi *et al.*, 2014; Kamil Azmi, 2012). Thus, the practice of integration of oil palm among the smallholders is strongly encouraged, and is expected to be implemented on an on-going basis. Besides that, among the integration's benefits which have often been raised in previous studies is the saving of cost for otherwise scheduled weeding (Gabdo and Ismail, 2013; Jusoh and Mohd Noor, 2002). However, there is no denying that the implementation of oil palm integration has some challenges for the smallholder, such as lack of capital and land resources (Shafirul *et al.*, 2015). According to Aziz *et al.* (2003), the problem of capital becomes a burden to the oil palm smallholders in their efforts to develop and maintain oil palm integration.

An agricultural integration programme was implemented in Tunisia aimed at reducing the poverty rate in rural areas (IADP, 2006). The programme had a specific objective of introducing sustainable agricultural development through the development of infrastructure, participative agricultural development and capacity-building among

the administration and stakeholders' organisations.

Anup *et al.* (2013) studied integrated development projects of a water catchment area which were implemented in 2004 and 2008 in the west of Khasi Hills, Meghalaya, in north-east India. The study aimed at evaluating and refining the integration practices of the crops, fish and livestock production system. The study results show that crop productivity had increased from 30% to 40% for potato and from 45% to 50% for rice. Additionally, the farmers were able to earn a higher monthly net income from the dairy products and fish ponds as well.

Rosli and Shariffhuddin (2003) studied a holistic approach to a system integrating cattle and oil palm. At the end of 2002, 214 farmers were involved in the programme with a total of 300 areas and 127 589 cattle. Two models of economic efforts, namely, 'cattle-calf operation' and 'fattening', were developed in the programme. As a result, it was found that 'cattle-calf operation' and 'fattening' achieved 13% and 77%, respectively. In other words, the oil palm integration programme showed potential for boosting the oil palm cultivators' income. The questions remain:

- to what extent will integration in oil palm continue to be practised by the smallholders?; and
- is integration in oil palm really effective in increasing their income?

Hence, the main objectives of the study are to analyse the extent to which integration in oil palm will continue to be practised by the smallholders, and the extent by which integration will be able to increase their income. It is expected that the findings from this study will be used to enhance the practice of integration in oil palm among smallholders.

## RESEARCH METHOD

The research design was a quantitative survey method. The population for the study comprised smallholders practising oil palm integration in several districts in the state of Johor, namely, Tangkak, Muar, Pontian, Ledang, Segamat, Batu Pahat and Kluang. The purposive sampling technique was used to meet the study's purpose, focusing only on those smallholders who implemented integration in their oil palm as the sample for this study. In general, the smallholders in the area had homogeneous characteristics; therefore, the minimum sample size was 100. Questionnaires were used as the data collection instrument. As a result, a total of 140 oil palm smallholders were successfully interviewed by the study's enumerators. A descriptive statistics analysis was used to describe the overall findings.

## FINDINGS AND DISCUSSION

This section discusses the respondents' profile, information on their oil palm holdings, information on the oil palm integration, and the continuance of oil palm integration among the respondents.

### Respondent Profile

Table 1 shows the respondents' profiles. The majority of the respondents were male (90.7%) with only 9.3% female. Most of the respondents were Malay (67.9%), followed by 31.4% Chinese and 0.7% Indians. Generally, the respondents were over the age of 50 years, with 36.5% of 51-60 years and 26.4% above 60 years. Only a small portion (15.7%) of the respondents were youths. The scenario of old farmers has

become a concern to many parties (Abazue *et al.*, 2015; Nkongho *et al.*, 2014). The majority of the respondents were married (92.9%) while the duration of their marriage varied (*Table 1*). In general, the respondents had high school education (53.6%), with only small numbers who had not attended school (5.8%), and those who had degrees (3.6%). The main occupation of the respondents was being an oil palm smallholder (64.3%). Almost half of the respondents earned a monthly income between RM 1000 and RM 3999 (45.7%), and an almost equal number earned RM 4000 or more (47.9%). The respondents' source of income comprised income from the integration practice, oil palm yield and other incidental income such as businesses and other jobs. This

situation is also common among oil palm smallholders in other countries (Cramb and Patrick, 2012; Nkongho *et al.*, 2014).

### Respondents' Information on Oil Palm Holdings

*Table 2* shows the information on the respondents' oil palm holdings. Most of the respondents planted their oil palm in 2013 (18.6%), 2014 (38.6%) and 2015 (20.7%). Generally, the respondents had planted their oil palm under the Smallholders' Oil Palm Replanting Scheme (TSSPK) or the new Oil Palm Planting Scheme for Smallholders (TBSPK), each accounting for 74.3% and 19.3%, respectively. More than half of the respondents had a planted area of less or equal to 2 ha (69.3%), while the other respondents had areas of

3-14 ha (20.7%) each, and only 10% had a planted area exceeding 4 ha. Most of the respondents' palms were less than or equal to three years of age (87.9%). Oil palms aged three years and below are suitable for implementation of crop integration in oil palm.

### Respondents' Information on Oil Palm Integration

*Table 3* shows the information on oil palm integration practised by the smallholders. In general, the status of the respondents can be categorised into three, namely, owner of the holding (28.6%), operator of the holding (17.1%), and owner and operator of the holding (54.3%). The majority of the respondents started implementing oil palm integration from 2011 onwards (88.6%). Most

**TABLE 1. RESPONDENT PROFILE**

| Respondent profile       | Frequency | %    | Respondent profile   | Frequency | %    |
|--------------------------|-----------|------|----------------------|-----------|------|
| Gender                   |           |      | Ethnic group         |           |      |
| Male                     | 127       | 90.7 | Malay                | 95        | 67.9 |
| Female                   | 13        | 9.3  | Chinese              | 44        | 31.4 |
|                          |           |      | Indian               | 1         | 0.7  |
| Age (year)               |           |      | Marital status       |           |      |
| ≤ 40                     | 22        | 15.7 | Single               | 7         | 5.0  |
| 41 – 50                  | 30        | 21.4 | Married              | 130       | 92.9 |
| 51 – 60                  | 51        | 36.5 | Single parent        | 3         | 2.1  |
| ≥ 61                     | 37        | 26.4 |                      |           |      |
| Marriage duration (year) |           |      | No. of children      |           |      |
| ≤ 10                     | 9         | 6.4  | ≤ 3                  | 52        | 37.1 |
| 11 – 20                  | 29        | 20.7 | 4 – 6                | 70        | 50.0 |
| 21 – 30                  | 38        | 27.1 | ≥ 61                 | 18        | 12.9 |
| ≥ 31                     | 64        | 45.7 |                      |           |      |
| No. in household         |           |      | Main occupation      |           |      |
| ≤ 5                      | 108       | 77.1 | Oil palm smallholder | 90        | 64.3 |
| 6 – 8                    | 24        | 17.2 | Business             | 12        | 8.6  |
| ≥ 9                      | 8         | 5.7  | Others               | 38        | 27.1 |
| Education level          |           |      | Monthly income (RM)  |           |      |
| Did not attend school    | 6         | 5.8  | < 1 000              | 9         | 6.4  |
| Primary school           | 41        | 29.3 | 1 000 –3 999         | 67        | 47.9 |
| Secondary school         | 75        | 53.6 | ≥ 4 000              | 45.7      |      |
| Diploma/STPM             | 13        | 9.3  |                      |           |      |
| Degree                   | 5         | 3.6  |                      |           |      |

Note: STPM – *Sijil Tinggi Pelajaran Malaysia*.

**TABLE 2. INFORMATION ON OIL PALM CULTIVATED BY THE RESPONDENTS**

|                            | Frequency | %    |
|----------------------------|-----------|------|
| Started planting oil palm  |           |      |
| 1985-1995                  | 7         | 5.0  |
| 2005-2010                  | 6         | 4.2  |
| 2011                       | 5         | 3.6  |
| 2012                       | 13        | 9.3  |
| 2013                       | 26        | 18.6 |
| 2014                       | 54        | 38.6 |
| 2015                       | 29        | 20.7 |
| Oil palm planted area (ha) |           |      |
| ≤ 2                        | 97        | 69.3 |
| 3-4                        | 29        | 20.7 |
| 4-8                        | 10        | 7.1  |
| ≥ 2                        | 4         | 2.9  |
| Oil palm age (year)        |           |      |
| ≤ 3                        | 123       | 17   |
| ≥ 4                        | 87.9      | 12.1 |

**TABLE 3. INFORMATION ON OIL PALM INTEGRATION PRACTISED BY THE RESPONDENTS**

| Information on oil palm integration                     | Frequency | %    |
|---|-----------|------|
| Respondents' status                                     |           |      |
| Owner of holding  | 40        | 28.6 |
| Operator of holding                                     | 24        | 17.1 |
| Owner and operator of holding                           | 76        | 54.3 |
| Started implementing oil palm integration               |           |      |
| 1985-1995   | 6         | 4.3  |
| 2005-2010   | 10        | 7.1  |
| 2011  | 5         | 3.6  |
| 2012  | 13        | 9.3  |
| 2013  | 24        | 17.1 |
| 2014  | 48        | 34.3 |
| 2015  | 34        | 24.3 |
| Oil palm integration activity status                    |           |      |
| Run on their own  | 99        | 70.7 |
| Shared with third party                                 | 15        | 10.7 |
| Run by third party                                      | 26        | 18.6 |
| Oil palm integration implementation estimated cost (RM) |           |      |
| < 5 000   | 30        | 21.5 |
| 5 000 – 9 999   | 43        | 30.7 |
| 10 000 – 19 999   | 43        | 30.7 |
| ≥ 20 000  | 24        | 17.1 |
| Type of crop integration                                |           |      |
| Pineapple   | 46        | 32.9 |
| Banana  | 60        | 42.9 |
| Other crops   | 34        | 24.2 |
| Type of livestock integration                           |           |      |
| Goat  | 4         | 2.9  |
| Cattle/buffalo  | 3         | 2.1  |
| Chicken   | 2         | 1.4  |

of them implemented integration on their own (70.7%). The rest shared the practice with others (10.7%) or the integration activity was operated by others (18.6%). The implementation cost of integration was quite high. Almost half of the respondents (47.8%) spent RM 10 000 or more to carry out integration. This matter was expected to be linked to the total oil palm planted area owned or operated by the respondents.

The majority of the respondents implemented crop integration (92.1%), much more than integration with livestock. This may due to the prevailing age of the oil palm (87.9%) which was less than four years and was thus less compatible with livestock integration. The recommended age of oil palm for livestock integration by range feeding is preferably five years (Kamil Azmi *et al.*, 2010). The two types of crops cultivated by many of the respondents were banana (42.9%) and pineapple (32.9%), while the rest cultivated crops such as sweet potato, sugar-cane, papaya and galangal. Banana has become the main alternative crop among the oil palm smallholders because of its non-seasonal nature and good existing markets in Malaysia and other countries (Anizah and Nor Zalina, 2015). Similarly, pineapple integration is common in the peat areas in Johor. This situation may be driven by the good demand for pineapple, particularly from abroad (Zazali, 2015). Three types of livestock were reared by the respondents: goats, cattle/buffaloes and chickens.

#### **Respondents' Intention to Continue with Oil Palm Integration**

Figure 1 shows the response of the respondents when asked if they intended to continue the practice of

oil palm integration. The majority of the respondents intended to continue the practice in the future (91.4%). This is a positive and encouraging finding in view of past research which shows that integration is able to increase the income of oil palm smallholders' (Kamil Azmi, 2012; Liyama *et al.*, 2007). However, there were also a handful of respondents who did not wish to continue (7.1%), or were not sure (1.4%) of whether they would proceed with the practice of oil palm integration in the future. Among the factors which contributed to the response was that their palms had already started to produce yield. This is in agreement with the FAO report (2001) which found that involvement in oil palm integration is to generate income while waiting for yields to be harvested in the first four years after planting (juvenile stage). Most of the smallholders focus on the routine of oil palm agronomic management after that period (Anizah and Nor Zalina, 2015).

Table 4 shows the crosstab result of the respondents' intention to continue the integration practice vs. their oil palm cultivated area. The majority of the respondents who intended to continue the practice of oil palm integration owned oil palm planted areas of  $\leq 2$  ha (90 people), while the rest had areas of 3-4 ha (24 people) or owned  $> 4$  ha each (13 people). The chi-square test ( $X^2=3.328$ ,  $df=4$ ,  $p>0.5$ ) showed that there was no difference in the size of the planted area with the intention to continue the practice of integration in the future. It means that the size of the planted area does not determine whether or not a oil palm smallholder will continue the practice of oil palm integration in the future.

Table 5 shows the crosstab result of the respondents' intention to continue oil palm integration vs. their monthly income. Most of the respondents who intended to continue the practice of integration had income exceeding RM 4000 or between RM 1000 and RM 3999,

with each income category recording 64 and 57 respondents, respectively. The chi-square test ( $X^2 = 5.417$ ,  $df=4$ ,  $p<0.5$ ) showed that there were differences in the respondents' monthly income with their intention to continue the practice of oil palm integration in the future. It means that the oil palm smallholders who had higher monthly income tended to have a stronger intention to continue the practice of integration in the future.

Table 6 shows the crosstab result of the smallholders' monthly income from integration vs. their oil palm planted areas. The chi-square test ( $X^2=12.452$ ,  $df=4$ ,  $p<0.5$ ) showed that there were significant differences in the respondents' income from integration with their oil palm planted area. However, the correlation test between the integration income and the oil palm areas (integrated with crops or livestock) showed that there was no significant relationship between the two. This is most likely caused by the majority of respondents owning less than 2 ha of land.

The types of integration which the smallholders intended to continue with in the future were mostly integration with crops rather than integration with livestock (Table 7). The main types of crops chosen for integration in the future by the respondents included banana (34.3%) and pineapple (31.4%). The types of livestock for integration that the respondents wished to continue with in the future are goats and cattle, registering 4.3% and 2.9%, respectively, of the 14 respondents who had intentions to continue integration of oil palm with livestock. The tendency of respondents in choosing crop integration over livestock may be due to a lack of knowledge and experience in implementing livestock integration. This is because the care and management

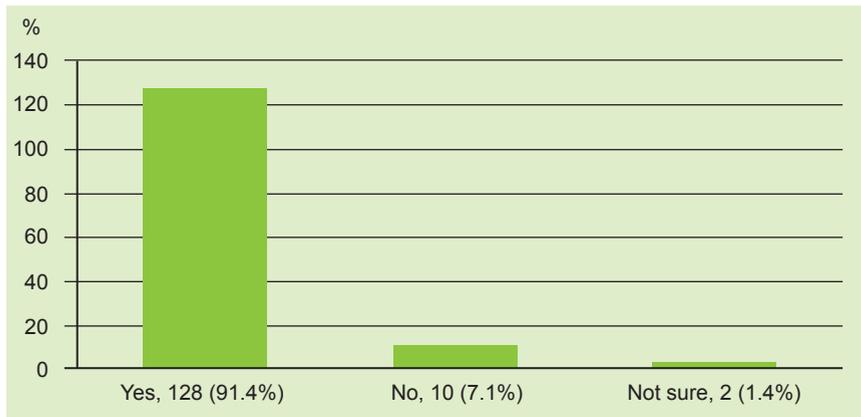


Figure 1. Intention to continue the practice of oil palm integration in future.

| TABLE 4. INTENTION TO CONTINUE THE INTEGRATION PRACTICE vs. OIL PALM PLANTED AREA |             |        |         |     |
|---|-------------|--------|---------|-----|
| Intention   | $\leq 2$ ha | 3-4 ha | $>4$ ha |     |
| Yes   | 90          | 25     | 13      | 128 |
| No  | 5           | 4      | 1       | 10  |
| Not sure  | 2           | 0      | 0       | 2   |
|   | 97          | 29     | 14      | 140 |

**TABLE 5. INTENTION TO CONTINUE THE PRACTICE OF INTEGRATION vs. MONTHLY INCOME**

| Intention | <RM 1 000 | RM 1 000-RM 3 999 | ≥RM 4 000 |     |
|-----------|-----------|-------------------|-----------|-----|
| Yes       | 7         | 57                | 64        | 128 |
| No        | 2         | 6                 | 2         | 10  |
| Not sure  | 0         | 1                 | 1         | 2   |
|           | 9         | 64                | 67        | 140 |

**TABLE 6. OIL PALM AREA vs. INCOME FROM INTEGRATION**

| Oil palm area (ha) | <RM 1 000 | RM 1 000-RM 3 999 | ≥RM 4 000 |     |
|--------------------|-----------|-------------------|-----------|-----|
| ≤ 2                | 6         | 52                | 39        | 97  |
| 3-4                | 3         | 10                | 16        | 29  |
| > 4                | 0         | 2                 | 12        | 14  |
|                    | 9         | 64                | 67        | 140 |

**TABLE 7. TYPES OF OIL PALM INTEGRATION TO BE IMPLEMENTED BY THE RESPONDENTS**

| Crop intergration | Frequency | Livestock integration | Frequency |
|-------------------|-----------|-----------------------|-----------|
| Pineapple         | 44        | Goat                  | 6         |
| Banana            | 48        | Cattle                | 4         |
| Other crops       | 48        | Goat & cattle         | 2         |
|                   |           | Chicken               | 2         |

of livestock are more complicated than for plants, and these activities have to be carried out on a daily basis. Shafirul *et al.* (2015) found from a survey carried out that farmers who failed to manage their livestock properly were faced with death of the animals and high operating costs.

Benefits gained by the respondents from implementing the practice of oil palm integration are also expected to be the main catalyst for the future continuance of the practice (Figure 2). Overall, the respondents believed that oil palm integration was able to increase their income (92.1%). The rest believed that oil palm integration would fill their leisure time (65.0%), and half of them agreed that integration could diversify the crops in their holdings (50.7%). Nevertheless, there were also respondents who believed that oil palm integration did not

have any benefit (1.4%); however, the percentage was very small. The benefit of leisure time and diversifying the type of crops are expected to have a direct link with filling leisure time beneficially (to generate income).

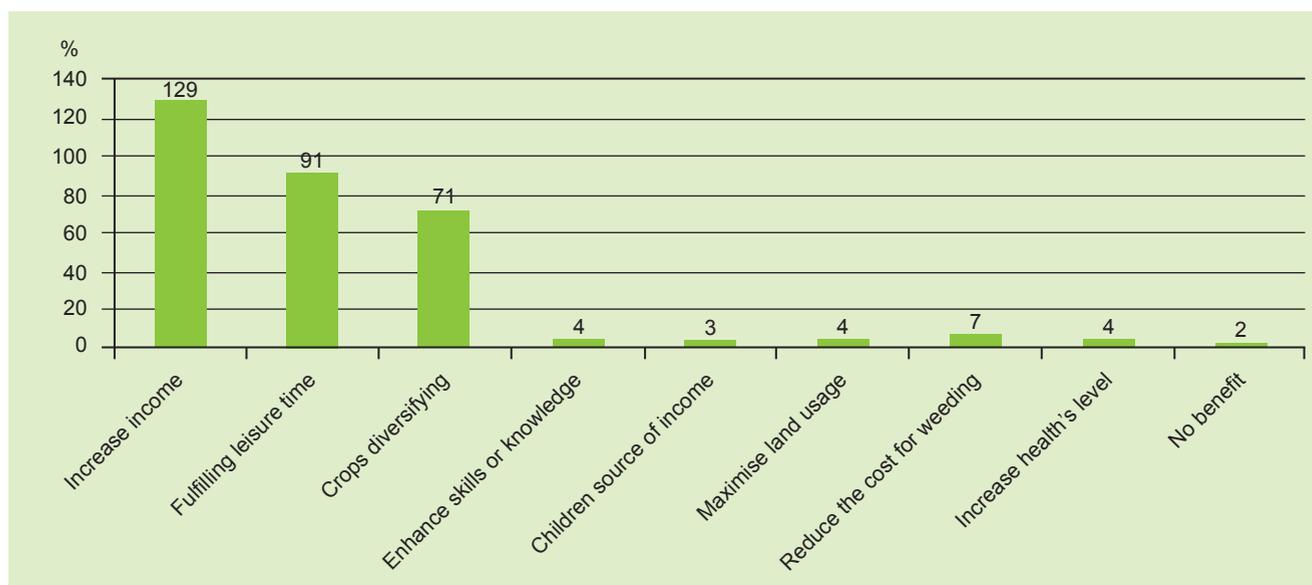
There were also some other benefits mentioned by the respondents themselves (grouped under 'Other benefits'); for example, they believed that integration could reduce the cost of weeding, maximised land use, and upgraded their skills or knowledge. In this study, only a few respondents pointed out the benefit of reduced weeding cost, probably because this benefit is gained more through the grass grazing activities of livestock, whereas crop integration was perceived to still require the same frequency of scheduled weeding.

There were a few obstacles to implementing the practice of oil palm integration. Most of the

respondents expressed two major obstacles, namely, the absence of financial assistance (66.4%), and the burdensome expenses incurred in implementing oil palm integration (55.0%). This is in line with the findings of Bambang *et al.* (2004). Both these obstacles revolved around the insufficiency of capital for implementing oil palm integration. The same observations were also emphasised by Shafirul *et al.* (2015), who found that the three major problems facing oil palm smallholders (59%) in implementing the integration of goat with oil palm are the lack of capital, high mortality of the kids and disease problems.

## CONCLUSION

The main objective of this study was to analyse the extent of continuance of the practice of oil



Note: The response frequency is not a reflection of the number of respondents; the answer may cover more than one benefit.

Figure 2. Benefits from oil palm integration.

palm integration among oil palm smallholders was achieved. It was found that the majority of them indeed intended to continue the practice of oil palm integration in the future. Most of oil palm smallholders chose the type of integration to implement based on the market readiness of the products. The advantage of oil palm integration in increasing the smallholders' income was one of

the main factors which influenced the intention. Nevertheless, obstacles such as the lack of capital in implementing integration need to be addressed to ensure the continuance of the practice of oil palm integration in the future by each smallholder. This is necessary in view of the ability of the integration practice to increase smallholder income. The expectation is that an increase in

income will increase the oil palm smallholder's quality of life.

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#### REFERENCES

- ABAZUE, C M; ER, A C; FERDOUS ALAM, A S A and HALIMA BEGUM (2015). Oil palm smallholders and its sustainability practices in Malaysia. *Mediterranean J. Social Sciences*, 6(6 S4): 482-488.
- ANIZAH, M S and NOR ZALINA, H (2015). Assessing farmer's interest on agroforestry systems through agricultural sustainability. *Advances in Environmental Biology*, 9 (19): 182-190.
- ANUP, D; MUNDA, G C and THAKUR, N S (2013). Integrated agricultural development in high-altitude tribal areas: a participatory watershed programme in the east Indian Himalaya. *Outlook on Agriculture*, 42(2): 141-144.

AZIZ, A M; AB LATIF, I; NORIZAN, M N and HASSAN, N K (2003). *Pertanian mapan: cabaran dan strategi pembangunan dalam sektor pertanian di negeri Perlis. Proc. of the Society, Space and Environment in Globalised World: Prospect and Challenge.* <http://eprints.utm.m/5024/1>, accessed on 6 April 2016.

BAMBANG, R P; ANDI, D; ATIEN, P and DARWINSYAH, L (2004). *Beberapa masalah di dalam pengembangan sistem tanaman-ternak di Lahan Kering.* Pusat Penelitian dan Pengembangan Ternakan Bogor. <http://digilib.litbang.pertanian.go.id/v2/katalog/buku/P/prosiding-seminar-nasional-sistem-integrasi-tanaman-ternak/0/0/2004/beberapa-masalah-di-dalam-pengembangan-sistem-tanamanternak-di-lahan-kering>, accessed on 4 April 2016.

CRAMB, R A and PATRICK, S S (2012). Pathways through the plantation: oil palm smallholders and livelihood strategies in Sarawak, Malaysia. Paper presented at the 56<sup>th</sup> AARES Annual Conference, Fremantle, Western Australia, 7-10 February 2012.

FAO (2001). <http://www.fao.org/DOCREP/004/Y0501E/Y0501E00.HTM>, accessed on 31 May 2016.

GABDO, B H and ISMAIL, A L (2013). Analysis of the benefits of livestock to oil palm in an integrated system: evidence from selected districts in Johor, Malaysia. *J. Agricultural Science*, 12(5): 47-55.

IADP (2006). Integrated agriculture development project (IADP) for Khairon. Appraisal Report. February 2006. <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/TN-2006-017-EN-ADB-BD-WP-TUNISIA-AR-INTEGRATED-AGRIC-DEVELOPMENT-PROJECT-IADP-FOR-AIROUAN>. PDF, accessed on 23 May 2014.

JUSOH, L and MOHD NOOR, M (2002). A financial study of cattle integration in oil palm plantations. *Oil Palm Industry Economic Journal*, 2(1): 34-44.

KAMIL AZMI, T (2012). *Bebiri baka Barbados Blackbelly sesuai ditenak.* *Berita Sawit*. 1 March 2012. [http://www.mpob.gov.my/images/stories/pdf/Berita\\_Sawit/2012/2012\\_BS\\_Mac.pdf](http://www.mpob.gov.my/images/stories/pdf/Berita_Sawit/2012/2012_BS_Mac.pdf), accessed on 30 April 2016.

KAMIL AZMI, T; MD ZAINAL RASYIDI, M R and ROSLI, A (2010). *Integrasi ternakan pemacu ekonomi. Integrasi tanaman dan ternakan pemacu kesejahteraan industri sawit.* MPOB, Bangi. p. 92-119.

KAMIL AZMI, T; RAJA ZULKIFLI, R O; NORKASPI, K; MD ZAINAL RASYIDI, M R; NOOR KHAIRANI, M B and WAHID, O (2014). Transforming oil palm plantation for forage and livestock integration. *Oil Palm Bulletin No. 60*: 1-4.

LIYAMA, M; MAITAMA, J and KARUIKI, P (2007). Crop-livestock diversification in relation to income and manure use: a case study from Rift Valley Community, Kenya. *African J. Agricultural Research*, 2(3): 058-066.

NKONGHO, R N; FEINTRENIE, L and LEVANG, P (2014). Strengths and weaknesses of the smallholder oil palm sector in Cameroon. *Oil & Fat Crop and Lipids*, 21(2): D208.

PASANDARAN, E; DJAJANEGARA, A; KARIYASA, K and KASRYNO, F (2005). *Kerangka konseptual integrasi tanaman-ternak di Indonesia. Integrasi Tanaman-Ternak di Indonesia*. Badan Penelitian dan Pengembangan Pertanian. p. 11-31.

ROSLI, A and SHARIFFHUDIN, H M (2003). Systematic beef cattle integration in oil palm plantation with emphasis on the utilization of undergrowth. *Lokakarya Sistem Integrasi Kelapa Sawit-Sapi*. p. 23-35.

SHAFIRUL, A W; KAMIL AZMI, T and AYATOLLAH, K (2015). Adoption of goat integration technology by participants of the RMK-9 Scheme. Paper presented at the Community Meeting No.716/2015(22), 6 July 2015.

SICHOONGWE, K; MAPEMBA, L; TEMBO, G and NG ONG OLA, D (2014). The determinants and extent of crop diversification among smallholder farmers: a case study of Southern Province Zambia. *J. Agricultural Science*, 6 (11): 150-159.

ZAZALI, M (2015). Pineapples in demand overseas. <http://www.thestar.com.my/metro/community/2015/03/28/pineapples-in-demand-overseas-ministry-willing-to-assist-farmers-in-getting-loans-from-agrobank-says>, accessed on 31 May 2016.