Journal of Positive School Psychology
2022, Vol. 6, No. 3, 9700–9723 http://journalppw.com

How Enhancement in Agricultural Education Affects the Employment Opportunities in the Oil Palm Plantation Sector in Malaysia?

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Abstract

"Agricultural sector plays an important role in Malaysia's economy. Among all the agriculture commodity, palm oil industry is leading the way. The role of palm oil as one of the Malaysia's main economic contributor cannot be denied, as this industry contributes to both employment and income from the exports. Educated labours in the palm oil industry has a positive significant effect to the industry growth. Hence, this study simulate the impact of education programs via the allocation budget given for university's scholarship and palm oil education program on the employment opportunity in the oil palm plantation sector. System dynamics modelling, was used to develop the oil palm education model and data collection was obtained from the secondary sources. Findings from this study highlighted that the education programs will help to produce higher number of employees with technical and vocational skills. This can be achieved through the inclusive and equitable quality education to promote lifelong learning as supported in Sustainable Development Goals (SDGs) 4 and gender equality in SDGs 5. Finding from this study will be beneficial to the Malaysian Palm Oil Board and palm oil related authorities on the appropriate actions related to the education opportunities in the oil palm plantation job sector in Malaysia.

Keywords : Education, Employment, Oil palm plantation, Poverty reduction, System dynamics

I. INTRODUCTION

The Role of Oil Palm Sector for Employment Opportunities and Poverty Reduction

Agricultural sector plays an important role in Malaysia's economy, not only helping the country to achieve food security for local consumption, but also generating higher earnings via export. Among the agriculture commodities, palm oil industry is leading the way. The role of palm oil as one of the Malaysia's main economic contributors cannot be denied, as this industry contributes to both employment and income from the exports. In

2019, oil palm sub-sector contributed RM72.30 billion representing 37.7% of the agricultural sector GDP, which was the highest in the sector. While in comparison to the GDP value of RM1421.5 billion, the oil palm sector contribution stand at 5.08% in 2019 (Department of Statistics Malaysia, [DOSM], 2020). The Malaysian economy has become much more open and dynamic as early as 1970 through the implementation of the New Economic Policy (1970-1990) and the National Development Policy (1991-2000). A long-term national economic agenda was disseminated to stimulate the economic development in order to achieve a developing country status by 2020. All the major policies embody the philosophy focuses on poverty reduction. Rapid expansion of the economy, especially the expansion of the modern sector, was the major factor contribute to poverty reduction by creating employment opportunities which resulted large improvements in the living standards across all ethnic groups (Abhayaratne, 2004). Hence, the creation of productive employment opportunities is essential for achieving poverty reduction and sustainable economic and social development. Given the importance of employment for poverty reduction, job-creation should occupy a central place in national poverty reduction strategies.

In any sector of industry, education has a substantial impact on the employment prospects. Education level refers to the academic credential or egress an individual has obtained. The term "educated employees" refers to those who hold technical or bachelor degrees because these are necessary form entry into many higher paying occupation (Howard, 1986; Trusty & Niles, 2004). In general, people with higher levels of education will have a better job prospect.

Scenario of Employment in Oil Palm Plantation Industry in Malaysia

The most recent statistics on employment by the DOSM showed that as of May 2021, the unemployment rate stand at 4.5% in Malaysia. However, trend scenario has indicated that the demand for labour exceeded its supply, thus creating supply and demand disequilibrium in the labour market in Malaysia. Thus, there is entry of foreign labour into the country which is caused by the booming economy and resultant additional demand for labour (Mohd Arif, 2010). Furthermore, referring to Figure 1, there were only around 931,3000 foreign workers in 2000 making up 11% of the total work force as indicated in Figure 2. However, the figure increased continuously to about 19% or over 2.1 million foreign labour in 2013. While from 2013 the trend declined to 2020 when the total workforce in Malaysia reached a value over 14 million, with foreign work-force accounting for about 16% (over 2 million) of the total work-force in Malaysia (DOSM, 2020).

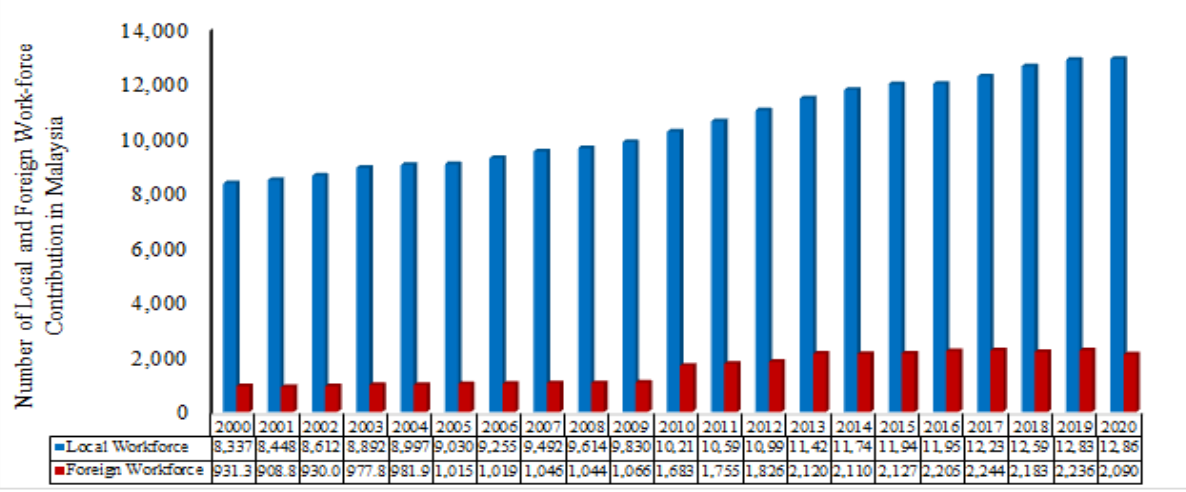


Figure 1. *Number of Local and Foreign Work-force in Malaysia (in '000) from 2000-2020 (Source DOSM, 2021)*

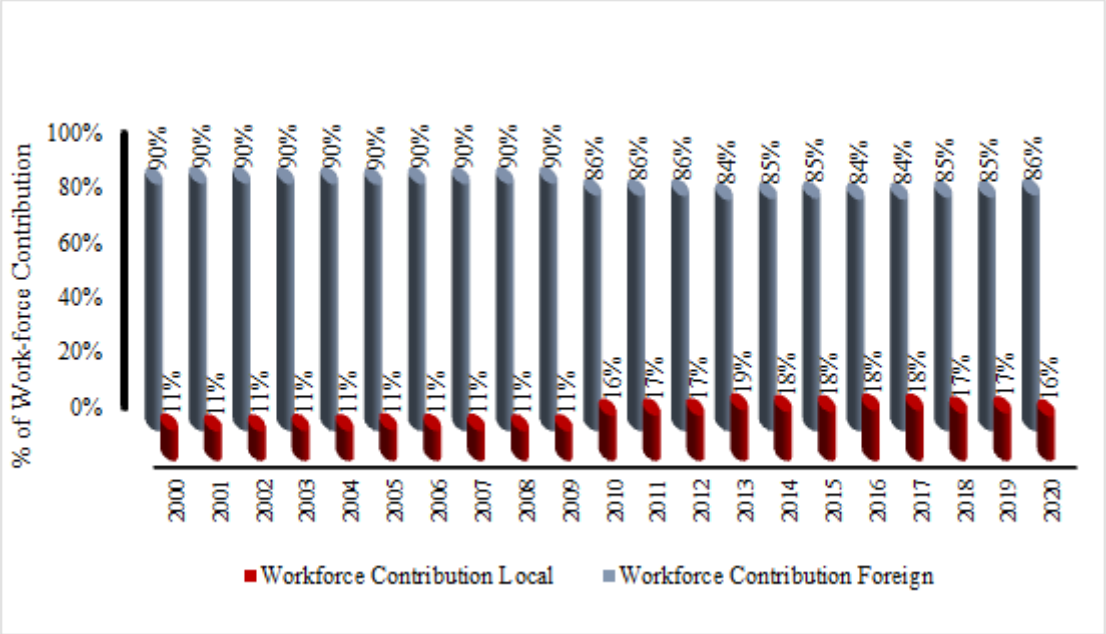


Figure 2. *Percentage Contribution of Work-force between Foreign and Local 2000-2020 (Source: MPOB, 2018).*

Malaysia is facing an acute shortage of labour not only in agriculture sector, but as well as the construction, manufacturing and services sectors. Highly dependent on exports of its primary commodities, labour intensive industry opens up job opportunities that are typically low-skill in nature and are eschewed by the local people. As a result, most of the workers are foreign workers to fill the shortages in the workforce. Foreign labour accounts for about half of the total workforce and a majority in the plantation sector (Ismail, 2013). It is a challenge for the state government to maintain its economy without employing foreign workers while trying to keep production costs low and be competitive in the global market. Improvements in education among the local people has inspired them to aspire to more lucrative and higher status white collar jobs.

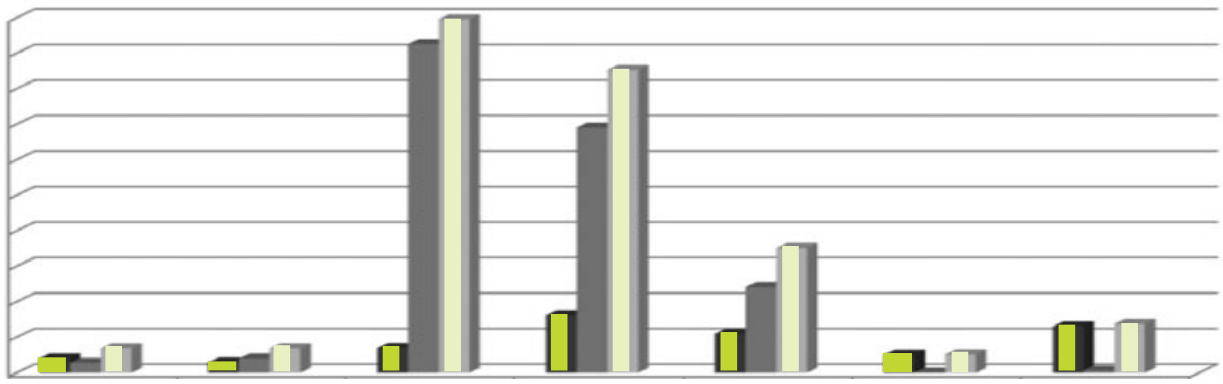
In the Malaysian's oil palm plantation sector, it is estimated about 451,507 of total workforce in this sector in 2014 as highlighted in Table 1. On a regional basis, the highest workforce based on larger palm oil areas, i.e. 180,850 workers (40.05%% of total work-force) is dominated by Peninsular Malaysia followed by Sabah 166,879 workers (36.96%) and Sarawak 103,778 workers (22.99%). According to job categories, 38.64% or 174,472 workers were hired as harvesters and fruit collectors, while 35.26% or 159,203 workers were hired as field workers. These two job categories represented 73.9% of the total workforce in oil palm plantations (MPOB, 2015). The oil palm plantation sector in Malaysian workforce is largely dominated by foreign workers mostly from Indonesia. The percentage of foreign workers with reference to the local labour is shown in Figure 3. Based on the trends, it shows that foreign workers were mostly hired as harvesters and loose fruit collectors (93.1%), field workers (81.0%) and other field workers (68.7%). Most of the local employees work as managers, assistant managers, and clerks (Mohd Ariff, 2010).

It is reported that oil palm sector in Malaysia faces a labour shortage issue. For instance, it was estimated that the sector was facing labour shortage of 26,874 in 2012. The highest labour shortage occurred in Peninsular Malaysia which is about 12648 workers or 47.4% of total shortage, followed by Sarawak, 6,186 (23.0%) and Sabah 8,038 (29.6%). Out of the total shortage, 96.2% or 25,874 were in field works. Harvesting and fruit collection faced the highest labour shortage, *i.e.* 12,486 labour shortages

and most of the shortage occurred in Peninsular Malaysia, 6,062, followed by Sarawak (3,280) and Sabah (3,144). Apart from that, the sector needed 9,521 workers for field workers such as manuring, weeding and pruning activities.

Table 1. *Estimated Work-force in Oil Palm Plantation in Malaysia 2014 (Source: MPOB, 2015)*

Job Category	Peninsular Malaysia	Sabah	Sarawak	Malaysia	%
Field Works					
General Mondore	4,953	4,288	2,668	11,909	3%
Harvesting Mondore	4,837	3,949	2,849	11,635	3%
Harvest & Collectors	75,334	61,354	37,784	174,472	39%
Field workers	58,293	62,035	38,875	159,203	35%
Others Field Workers	21,784	25,077	13,167	60,028	13%
Sub-Total	*165,201*	*156,703*	*95,343*	417,247	92
Office Works					
Executives	4,500	2,725	1,969	9,194	2%
Staff	11,149	7,451	6,466	25,066	6%
Sub-Total	*15,649*	*10,176*	*8,435*	*34,260*	*8*
Grand Total	180,850	166,879	103,778	451,507	100



	General mandore	**Harvesting mandore**	**Harvester & collectors**	**Field workers**	**Other field workers**	**Executives**	**Staff**
Local	8190	5821	14050	32569	22019	10183	26227
Foreign	5647	094	185183	138139	48344	151	1355
Total	13837	13915	199233	170708	70363	10334	27582
% Foreign	40.8	59.0	93.1	81.0	68.7	1.4	4.8

Figure 3. *Foreign Workers Compared to Locals According to Job Category*

(Source: Mohd Ariff, 2010)

Education in Malaysia at Glance

In Malaysia's context, the technical and vocational skills are provided through the Vocational-Technical Education (or known as Technical and Vocational Education and Training-TVET) for the technical and vocational secondary schools or at university level. This type of education will prepare students with high technology skills and thus will offer them a lucrative and higher status job

known as non-field works. By definition, non-field works refers to employees or professionals whose work is knowledge intensive, non-routine, and unstructured. Thus, the non-field worker can be described as a person who performs professional, managerial, or administrative work that works in an office or other administrative setting which includes in the field of business, management, finance, engineering, marketing, and medical (Hu, Dalal & Kapian, 2009).

In the Malaysian oil palm plantation industry, statistics shows that the country still have shortages in non-field works category. The shortage is about 3.72% which comes from the office works such as office staffs and executives. The remaining 96.28% is from the non-office type works or known as field works job (MPOB, 2013). On the other hand, field worker is a working class person who engaged in a manual labour requiring jobs such as manufacturing, processing, construction, warehousing, maintenance and other types of physical work, which may require skilled or unskilled work of physical nature (Hu, Dalal & Kapian, 2009). Referring to Table 1, although the statistics shows that the shortage is more on the field compared to the non-field workers, it cannot be denied that non-field worker is also important to palm oil industry due to their role to provide advice on the relevant workforce skillsbased on their expertise. In other words, graduates with equip fields have far greater job security because they provide with hands-on training which tends to be more theoretical than practical.

Similarly, field workers also need to have education to cope with the industrial revolution. This is because like in other industries, agriculture sector has also experienced changes through the different phases of industrial revolution (IR). As Malaysia aspires to become a self-sufficient industrialised nation, the palm oil industry is moving towards more innovative and highly likely disruptive technologies that can be incorporated at every level of the oil palm industry from upstream to midstream and all the way to downstream processes.

Realizing the importance of education on the employment opportunities, it is crucial to evaluate the effect of education on the sustainable development of palm oil industry in Malaysia as highlighted in the 4th Sustainable Development Goals (SDGs 4) that focuses on inclusive and equitable quality education. It is encouraged that universities in Malaysia should declare their commitment to support the achievement of SDGs in palm oil sector. University and schools provide an excellent platform to garner support for the sustainability agenda. In fact, special budget should be allocated more to raise awareness about the importance of sustainability towards the achievement of SDGs. In line with this issue, the objective of this paper is to highlight the role of scholarship and palm oil education program on the employment opportunities in Malaysia. This paper discusses on how the injection of budget through the education program will help to produce higher number of employees with technical and vocational skills in the oil palm sector through the inclusive and equitable quality education to promote lifelong learning as supported in SDGs 4.

Review of Studies on the Impact of Education on the Employment Activities

There has been numerous research conducted to look into how education effects on the employment opportunities. Riddell (2011), for example, studied the causal impacts of education on people' transitions between employment and unemployment, with a specific focus on the extent to which education enhances jobless workers' re-employment results. Wambugu (2011) studied the role of education on the structure of employment and wages for men and women in rural and urban Kenya. In 2016, Zimmer conducted a research on the value of education and its direct influence on pay in the re-employment market by linking unemployment and wage data. Finally, Jamir and Ezung (2017) looked into the effects of education on employment, income, and poverty in Nagaland. According to the findings, there is a significant relationship

between education and poverty from this study that shows that a large section of population with a low educational attainment is more likely to be poor compared to the educated population. Based on the review of these studies, it can be concluded that education level has a significant impact on the employment opportunities that lead to a better job prospect career.

With a focus on the agriculture sector, Alam et al. (2009) investigated the possible underlining factors for agriculture's lower productivity. The education system is not helping the development of the agriculture business for a variety of reasons. This article recommends a policy shift in agriculture education with the goal of improving the country's farm economics, which will lead to national development. According to Wambugu (2011), education is not a barrier to entering the agricultural industry; nevertheless, low levels of education considerably increase the likelihood of entering the informal sector. In 2013, Brooks and his colleagues highlighted on how the agriculture attracts the Sub-Saharan Africa youth in the agriculture sector. A study by Eric, Prince, and Elfreda (2014) explored the impact of education on agricultural productivity of farmers, as well as how different types of education affect agricultural production of farmers in the Municipality. The main finding was that as educational levels rise, output rises, with secondary school education providing the largest returns on agricultural investment. Finally, Bernatonyte et al. (2019) assessed the effects of higher education on employment and unemployment rates in the Lithuanian labour market. We've narrowed our focus to oil palm plantation. Based on our review, so far there is no study found which measure the effect of education on the oil palm sector, particularly in Malaysia. This is the gap of this research. Thus, the objective of this paper is to simulate the effect of education through the allocation budget given for university scholarship and palm oil education program on the employment opportunity in the oil palm plantation sector.

The rest of this paper is organised as follows: Next section presents the methodology used in this research focusing on the modelling process. The following section presents the results and its discussion. Finally, conclusions and future works are explained in the last section.

II. MATERIALS & METHODS

2.1 Overview on System Dynamics Theory

System dynamics (SD) is a simulation method for modelling a system at the strategic level, where public policies are created. SD began with Professor J. Forrester's discovery of industrial dynamics in 1960 (Forrester, 1961). As the time progressed, the notion evolved into SD, which is now widely employed in the field of operation research in a variety of problem domains. To name few, such as in health (Abidin et al., 2014), financial (Suhaimi et al. 2021) and transportation (Mohamad Shafiq Abdul Ghani et al., 2021). In terms of characteristics, SD emphasis on the feedback process, which is common in complex systems. Furthermore, by capturing the nonlinear interaction among variables, SD can simulate the behaviour of a genuine system. As shown in Figure 4, the SD primary build consists of two sorts of feedbacks: positive (or reinforcing designated with a ‘R') and negative (or balancing marked with a ‘B'). Positive feedback is a self-reinforcing force that enhances the influence of changes in a loop's variables. Negative feedback, on the other hand, creates a balancing loop in which changes in one variable cause a counter-change in the loop's overall output (Morecroft, 2007).

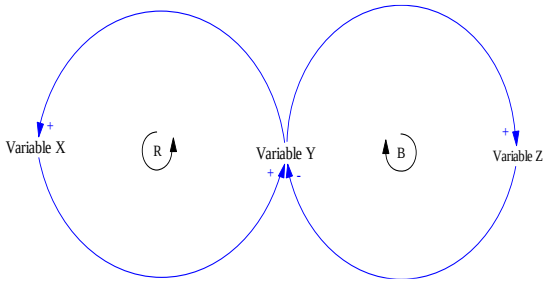


Figure 4: *The Positive and Negative Feedback Loops in System Dynamics*

The causal loop diagram (CLD) and the stock and flow diagram (SFD) are two essential diagrams used in the development of SD

models. The CLD is designed to represent the qualitative aspects of the system under investigation. It expresses the mental model in a non-technical way (Sterman, 2000). SFD, on the other hand, converts CLD's conceptual model into quantitative elements such as stock, flow, and auxiliary variables, as seen in Figure 5.

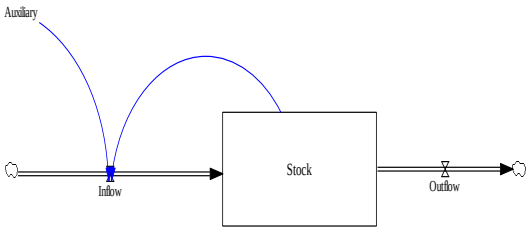


Figure 5: *Generic of Stock and Flow Diagram Model*

System Dynamics Model of Oil Palm Plantation Sector

Figure 6 is the SFD of oil palm plantation model. This paper adopts SD method due to its ability to model a holistic picture of oil palm plantation system that highlighted the feedback interrelationships between various sub-models to analyse the impact of education on the employment opportunities.

The SFD of oil palm plantation as shown in Figure 6 is developed using Vensim^{TM} software. The basic equations for the model are shown in the Equations 1-8 as follows:

Number of TVET students= INTEG (TVET intake student-TVET completed student, 0)
Units: person Eq. 1

Number of university students= INTEG (University student enrolement-University student graduated, 0)
Units: person Eq. 2

University student enrolment= Expected student for enrolment*Year of current enrolment for university
Units: person/ Year Eq. 3

University student graduated= (Number of university students/Year of completed for university)*Graduated rate
Units: person/ Year Eq. 4

Expected scholarship budget from palm oil companies= MAX(0,expected profit gain from CPO*Percentage for scholarship allocation)
Units: RM Eq. 5

Expected education budget for palm oil education program= MAX(0,expected profit gain from CPO*Percentage for palm oil program allocation)
Units: RM Eq. 6

Percentage for palm oil program allocation=0.05
Units: Dmnl Eq. 7

Percentage for scholarship allocation=0.12
Units: Dmnl Eq. 8

In this model, education is measured through scholarship given for students who interested to further their study in university or TVET schools. The higher the number of students

graduated from both university and TVET, the higher number of skilled workers able to be supplied to oil palm plantation sector. The question is, how to improve the number of employed workers with technical skills in oil palm plantation?

Referring to Figure 6, an amount of budget will be allocated through the scholarship for students who are interested to further their study in university or TVET. The budget is based on the profit (in Ringgit Malaysia) gained from CPO production. In this model, two variables namely as the *Percentage for Scholarship Allocation* and *Percentage for Oil Palm Program Allocation* were incorporated in the model representing scholarships budgets. Both variables referring to the percentage amount of money allocated for students to further their study in university or TVET. The higher the profit from CPO production, the higher the budget will be given for both scholarship and palm oil education program. In Malaysia, both university and TVET schools are the place to produce students that equip with technical skills. The number of university and TVET students which are model as two different stocks are increased through the enrolment/intake and decreased when students completed/graduated. The total number of non-field workers (e.g. office works and executives) normally hired students graduated from university. The higher (lesser) number of students from university, the higher (lesser) number of recruitment in non-field works category. In the oil palm plantation sector, non-field workers are those who are working in office such as executive position while field workers are the examples of those who works as general mandore, harvesting mandore and harvesters, and collectors as explained in Table 2. The total number of workers are measured from field and non-field works categories which then separated by gender to measure the proportion of male and female workers to highlight gender equality issue as in SDGs 5.

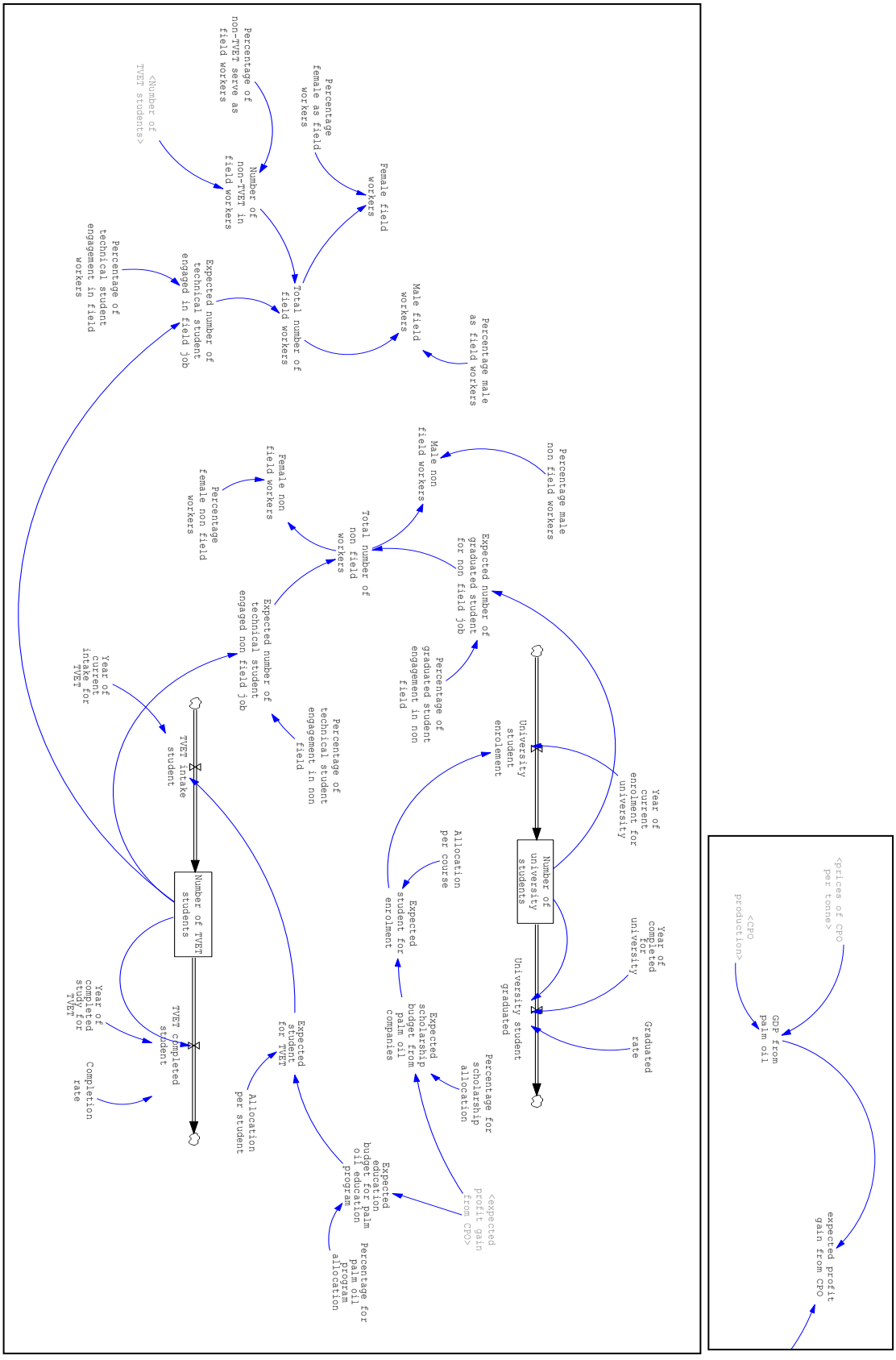


Figure 6. *Stock and Flow Model of Education Role in Oil Palm Plantation Sector*

Model Validation

In this validation process, the boundary adequacy of the model was examined, which was initially done by having a close look at the causal loop diagram (CLD). The CLD capture

the main component in Malaysia palm oil market, including palm oil production, education, and labour availability sectors. The main components of CLD were referred from key papers as were in Yahaya et al. (2006), Shri Dewi et al. (2010), Shri Dewi et al. (2015), and Mohammadi et al. (2016).

The following process involved the conversion of CLD into stock and flow diagram (SFD). In this process, the main components were modelled into individual sub-models and eventually combined into the main model. Again, the fundamental structure and behaviour of SFD were referred from key papers as in Yahaya et al. (2006), Shri Dewi et al. (2010), Shri Dewi et al. (2015), and Mohammadi et al. (2016). Modification has been made for the model to achieve the research objective. The non-linear relationship was also being incorporated using the system dynamics lookup function to permeate higher accuracy in depicting the real industry situation. Furthermore, behaviour validation was conducted via the interview process with the experts as there are not many variables are available with the data.

III. RESULTS AND FINDINGS

Business As Usual (Baseline Scenario)

A simulated trend for business as usual scenario are shown in Figure 7 and Figure 8. The description on the simulation results based on the three tested outputs of *University Student Enrolment*, *TVET Intake Students*, *Total Number of Field Workers*, and *Total Number of Non-Field Workers* are highlighted in Table 2. Furthermore, the behaviour of other quantified variables, i.e., *Female field workers*, *Female non-field workers*, *Male field workers*, and *Male non-field workers* are presented in Table 3. In the business as usual (baseline scenario), the *Percentage for Scholarship Allocation* variable is set with 12 percent (0.12) while *Percentage for Oil Palm Program Allocation* is set with 5 percent (0.05). Since we have limited data, this value was chosen based on the logical assumption for model development purpose. Then, changes were made to the baseline value for intervention purpose. The aim is to illustrate how changes in the given value has impact on the variable's outputs. The simulation shows that the trends are oscillating from 2000 until year 2030 followed by a fairly stabilize trends from year 2031 until 2050. The mentioned trends occurred during that period are influenced by the unforeseen CPO profit that varied every year

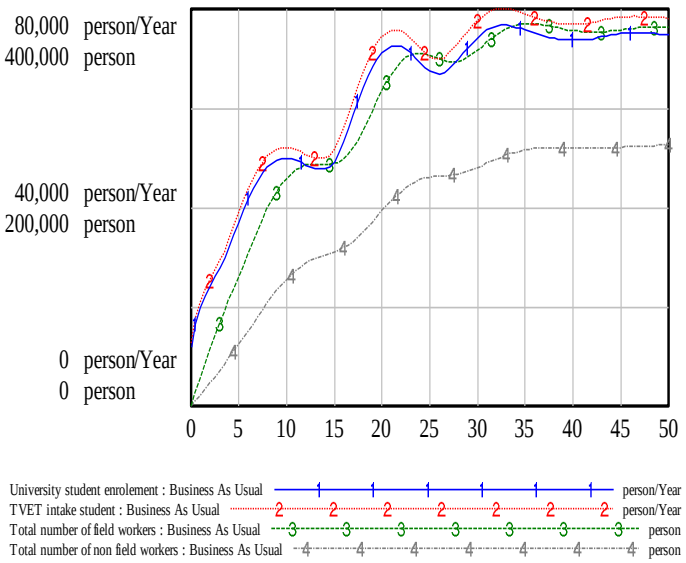


Figure 7. *The Behaviour of University Student Enrolment, TVET Intake Students, Total Number of Field Workers, and Total Number of Non-Field Workers for Business as Usual*

Table 2: *Simulated Outputs for Business as Usual Scenario*

Year	University Student Enrolment (person/year)	TVET Intake Student (person/year)	Total Number of Non-Field Workers (person)	Total Number of Field Workers (person)
2030	74,287	77,382	239,307	357,595
2040	73,708	76,779	259,312	377,475
2050	74,874	77,993	261,904	380,788

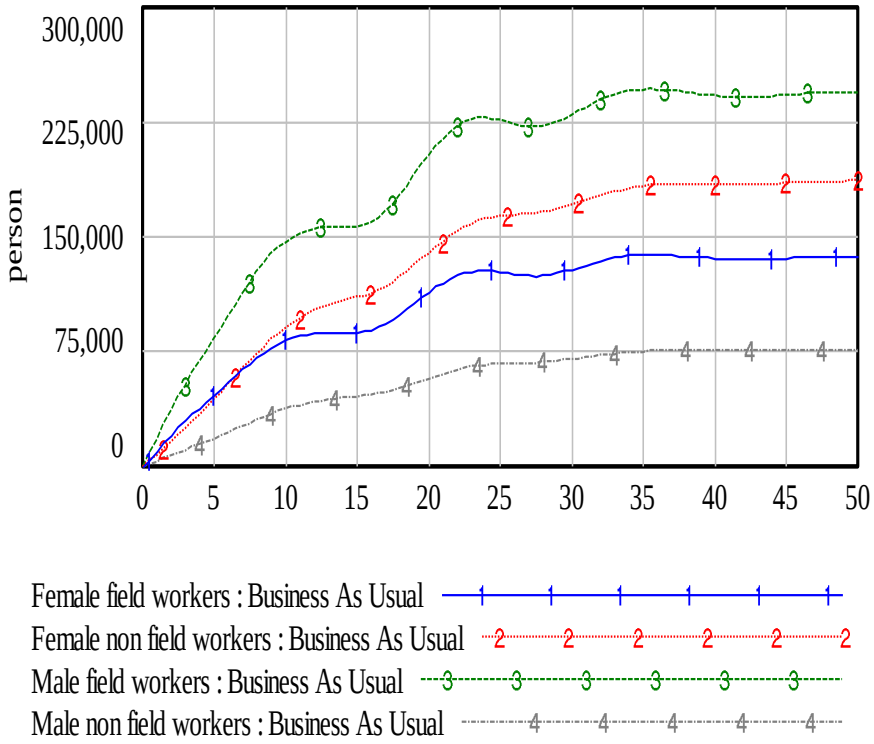


Figure 8. *Simulated Behaviour for Gender Variability for Business as Usual Scenario*

Table 3. *Simulated Outputs for Business as Usual Scenario Based on Gender Variability*

Year	Female Field Workers (person)	Female Non-Field Workers (person)	Male Field Workers (person)	Male Non-Field Workers (person)
2030	128,734	169,908	228,861	69,399
2040	135,891	184,112	241,584	75,200
2050	137,084	185,952	243,704	75,952

Scenario Interventions-to Evaluate the Effect of Changes in the Percentage for Scholarship

Allocation and Percentage for Oil Palm Program Allocation on the Tested Outputs

Based on the current situation (business as usual), three intervention scenarios were experimented to evaluate the effect of changes in the *Percentage for Scholarship Allocation* and *Percentage for Oil Palm Program Allocation* variables. In this regard, what-if analysis was experimented to evaluate the impact of tested variables on the output variables as described in Table 4.

Table 4. *Type of Intervention and the Description*

Intervention Scenarios	Description	Tested Outputs
Business as usual (Baseline scenario)	In this scenario, *Percentage for Scholarship Allocation* and *Percentage for Oil Palm Program Allocation* is set with business as usual value. The values are 0.12 (12%) and 0.05 (5%) respectively. The values are based on the baseline model.	• University Student Enrolment • TVET Intake Student • Total Number of Non-Field Workers • Total Number of Field Workers • Female Field Workers • Female Non-Field Workers • Male Field Workers • Male Non-Field Workers
Scenario 1: Increased to 15% in the percentage of scholarship rate).	It represents an increased percentage of given scholarship for students who are planning to further their study in university. The tested scenario is through the changes made from 0.12 (12%) to 0.15 (15%) of the *Percentage for Scholarship Allocation* variable. In this experiment, the other variables are maintain likewise in the baseline scenario except for the scholarship variable.	
Scenario 2: Increased to 15% in the percentage of palm oil education program)	It represents an increased in the percentage of palm oil education program for students who plan to further their study in TVET schools. The tested scenario is through the changes made from 0.05 (5%) to 0.15 (15%) of *Percentage for Palm Oil Program Allocation* variable. In this experiment, the other variables are maintain likewise in the business as usual scenario except for the palm oil education variable.	
Scenario 3: Combination of 10% for both scholarship and palm oil allocation program).	It represents a combination of increase to 0.1 (10%) in both percentage of palm oil education program and scholarship. The tested scenario is through the changes made in both variables which run simultaneously in a model.	

IV. RESULTS AND DISCUSSIONS

The results of intervention scenarios are explained as follow in the next sub-sections:

First Scenario (Changes from 0.12 (12%) to 0.15 (15%) of Scholarship Variable)

Referring to the Figure 9 and Table 5, the outputs of *University Student Enrolment*, *TVET Intake Students* and *Total Number of Field Workers*, and *Total Number of Non-Field Workers* show an increased trend from year 2030 until 2050. Similarly, the behaviour of *Female field workers*, *Female non-field workers*, *Male field workers*, and *Male non-field workers* also show a positive trend in the subsequent years as illustrated in Figure 10 and elaborated further in Table 6.

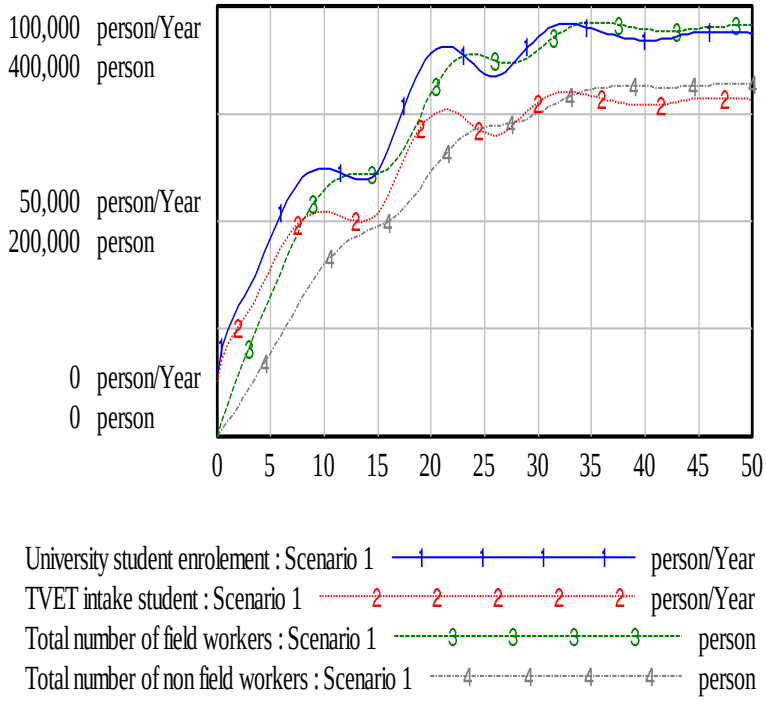


Figure 9. *The Behaviour of University Student Enrolment, TVET Intake Students, Total Number of Field Workers, and Total Number of Non-Field Workers for Scenario 1*

Table 5. *Simulated Outputs of Scenario 1*

Year	University Student Enrolment (person/year)	TVET Intake Student (person/year)	Total Number of Non-Field Workers (person)	Total Number of Field Workers (person)
2030	92,858	77,382	299,088	357,595
2040	92,134	76,779	324,092	377,475
2050	93,592	77,993	327,331	380,788

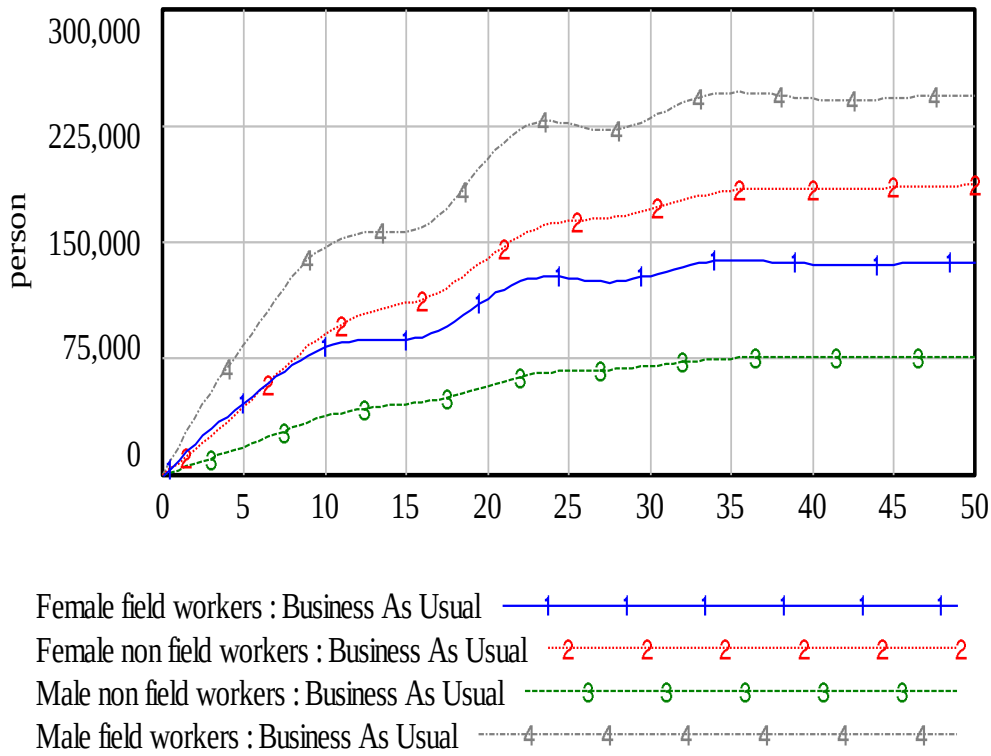


Figure 10. *Simulated Behaviour Trends Based on Gender Variability for Scenario 1*

Table 6. *Simulated Outputs for Scenario 1 Based on Gender Variability*

Year	Female Field Workers (person)	Female Non-Field Workers (person)	Male Field Workers (person)	Male Non-Field Workers (person)
2030	128,734	212,352	228,861	86,735
2040	135,891	230,105	241,584	93,987
2050	137,084	232,405	243,704	94,926

Second Scenario (An Increase from 5% to 15% of Oil Palm Education Program Variable)

Referring to Figure 11 and Table 7, the trends of *University Student Enrolment, TVET Intake Students* and *Total Number of Non-Field Workers, Total Number of Field Workers* outputs shows an increased trend from 2030 until 2050 if the percentage was increased from 5% to 15%. Moreover, the behaviour of *Female field workers, Female non-field workers, Male field workers,* and *Male non-field workers* show positive trend in the related years as presented in Figure 12 and Table 8.

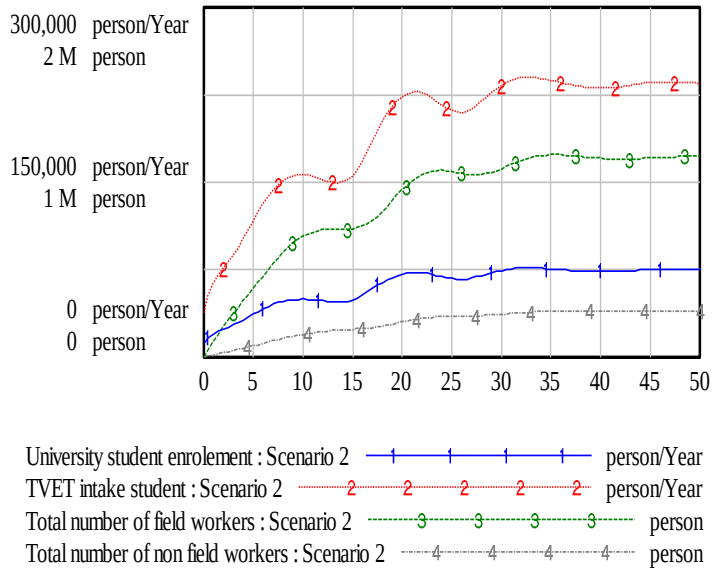


Figure 11. *The Behaviour of University Student Enrolment, TVET Intake Students, Total Number of Field Workers, and Total Number of Non-Field Workers for Scenario 2*

Table 7. *Simulated Outputs of Scenario 2*

Year	University Student Enrolment (person/year)	TVET Intake Student (person/year)	Total Number of Field Workers (person)	Total Number of Non-Field Workers (person)
2030	74,287	232,145	1,073,000	239,674
2040	73,708	230,336	1,132,000	259,699
2050	74,874	233,980	1,142,000	262,294

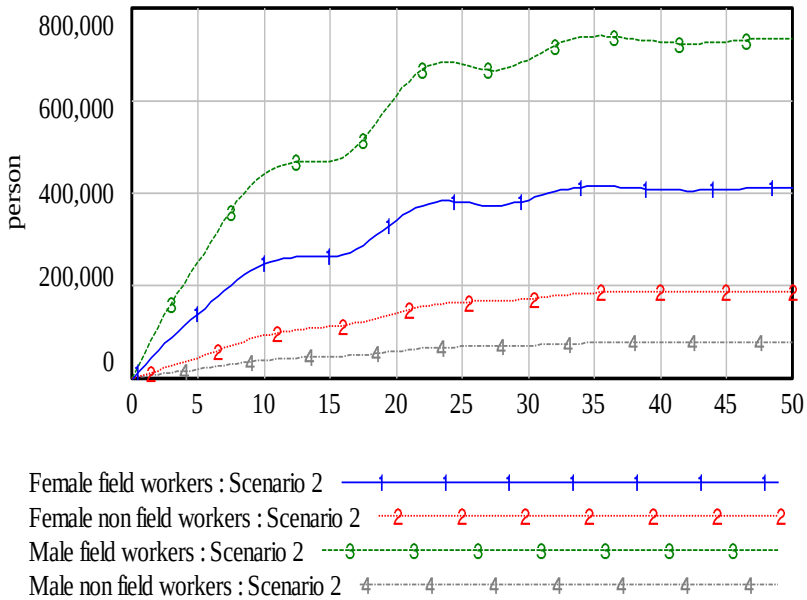


Figure 12*. Simulated Behaviour Trends Based on Gender Variability for Scenario 2*

Table 8. *Simulated Outputs of Scenario 2 Based on Gender Variability*

Year	Female Field Workers (person)	Female Non-Field Workers (person)	Male Field Workers (person)	Male Non-Field Workers (person)
2030	386,203	170,168	686,583	69,505
2040	407,673	184,386	724,752	75,313
2050	411,251	186,229	731,113	76,065

Third Scenario (Increase to 10% in Both Variables)

The analysis from the developed model shows that the *University Student Enrolment*, *TVET Intake Students* and *Total Number of Field Workers*, and *Total Number of Non-Field Workers* emerge an increasing trend from 2030 until 2050 if 0.1 (10%) increment was made for both *Percentage for Scholarship Allocation* and *Percentage for Oil Palm Program Allocation* variables. The trends of projection value can be referred in Figure 13 and Table 9**.** Subsequently, the behaviour of *Female field workers*, *Female non-field workers*, *Male field workers*, and *Male non-field workers* show positive trend in the respective years as illustrated in Figure 14 and elaborated further in Table 10.

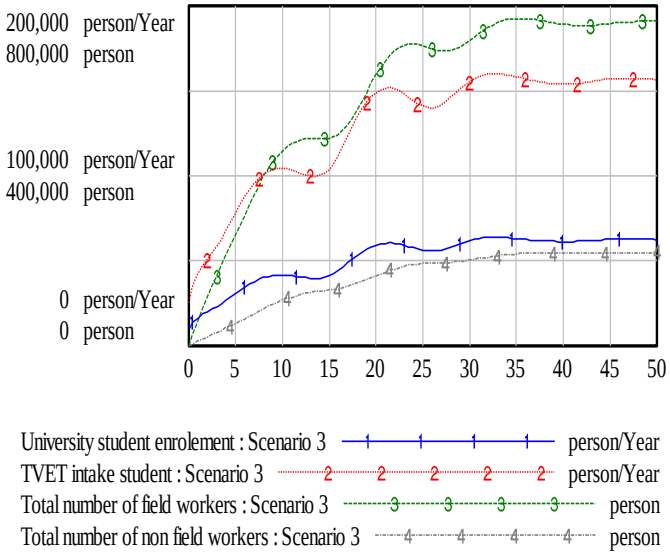


Figure 13. *The Behaviour of University Student Enrolment, TVET Intake Students, Total Number of Field Workers, and Total Number of Non-Field Workers for Scenario 3*

Table 9. *Simulated Outputs of Scenario 3*

Year	University Student Enrolment (person/year)	TVET Intake Student (person/year)	Total Number of Non-Field Workers (person)	Total Number of Field Workers (person)
2030	61905	154764	199,636	715,190
2040	61423	153,557	216,319	754,950
2050	62,395	155,987	218,481	761,576

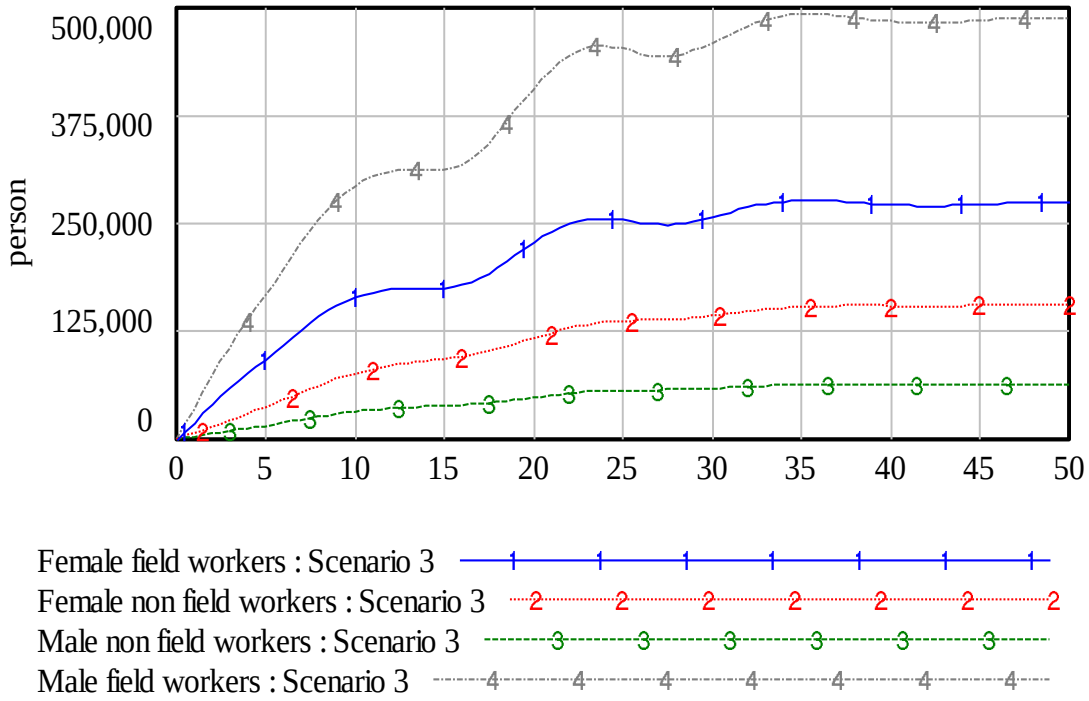


Figure 14. *Simulated Behaviour Trends Based on Gender Variability for Scenario 3*

Table 10*. Simulated Outputs of Scenario 3 Based on Gender Variability.*

Year	Female Field Workers (person)	Female Non-Field Workers (person)	Male Field Workers (person)	Male Non-Field Workers (person)
2030	257,469	141,742	457,722	57,895
2040	271,782	153,587	483,168	62,733
2050	274,168	155,122	487,409	63,359

The behaviour of *University Student Enrolment*, *TVET Intake Students*, *Total Number of Field Workers*, and *Total Number of Non-Field Workers* from Scenario 1 until Scenario 3 are presented in Figure 15 until Figure 18. The bar charts demonstrate the trend of related variables compared to the behaviour of business as usual scenario.

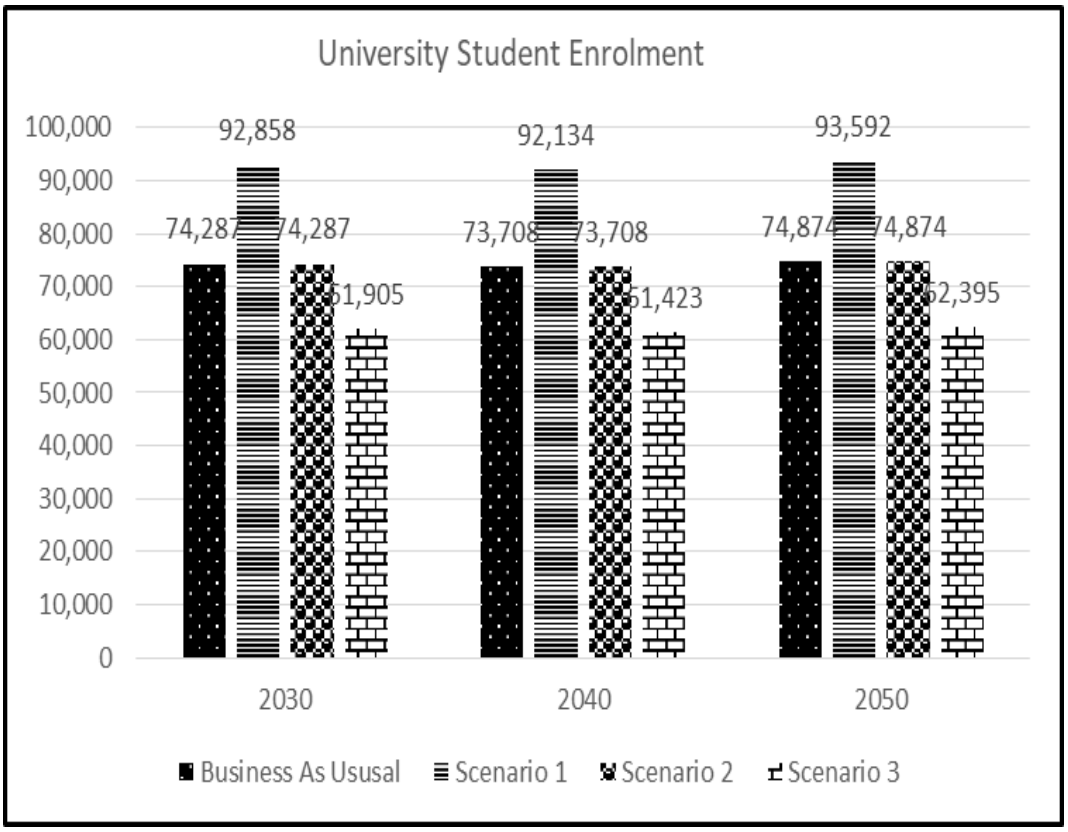


Figure 15. *The Trend of University Student Enrolment in Malaysia for year 2030, 2040 and 2050*

The behaviour of *University Student Enrolment* based on simulation outputs of Scenarios 1, 2 and 3 for three different future years 2030, 2040 and 2050 is presented in Figure 15. By the year 2030: under scenario 1 result indicated that while keeping other factors in the baseline scenario unchanged, a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) will increase the number of *University Student Enrolment* from 74287 to 92858. However, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), result showed the number of *University Student Enrolment* will remain unchanged. Whereas, under scenario 3 with a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) resulted to a decrease in the number of *University Student Enrolment* from 74287 to 61905.

In the year 2040, the results were found to be similar the increase in enrolment was slightly lower for this year: Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) will increase the number of *University Student Enrolment* from 73,708 to 92134. However, under scenario 2 when the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), result showed the number of *University Student Enrolment* was unchanged. Whereas, under scenario 3 with a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) resulted to a decrease in the number of *University Student Enrolment* from 73,708 to 61,423.

In the year 2050 the results were also similar whereas the increase was highest for this year compared to the other years. Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) will increase the number of *University Student Enrolment* from 74,874 to 93,592. However, under scenario 2 when the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), result

showed the number of *University Student Enrolment* was unchanged. Whereas, under scenario 3 with a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) resulted to a decrease in the number of *University Student Enrolment* from 74,874 to 62,395.

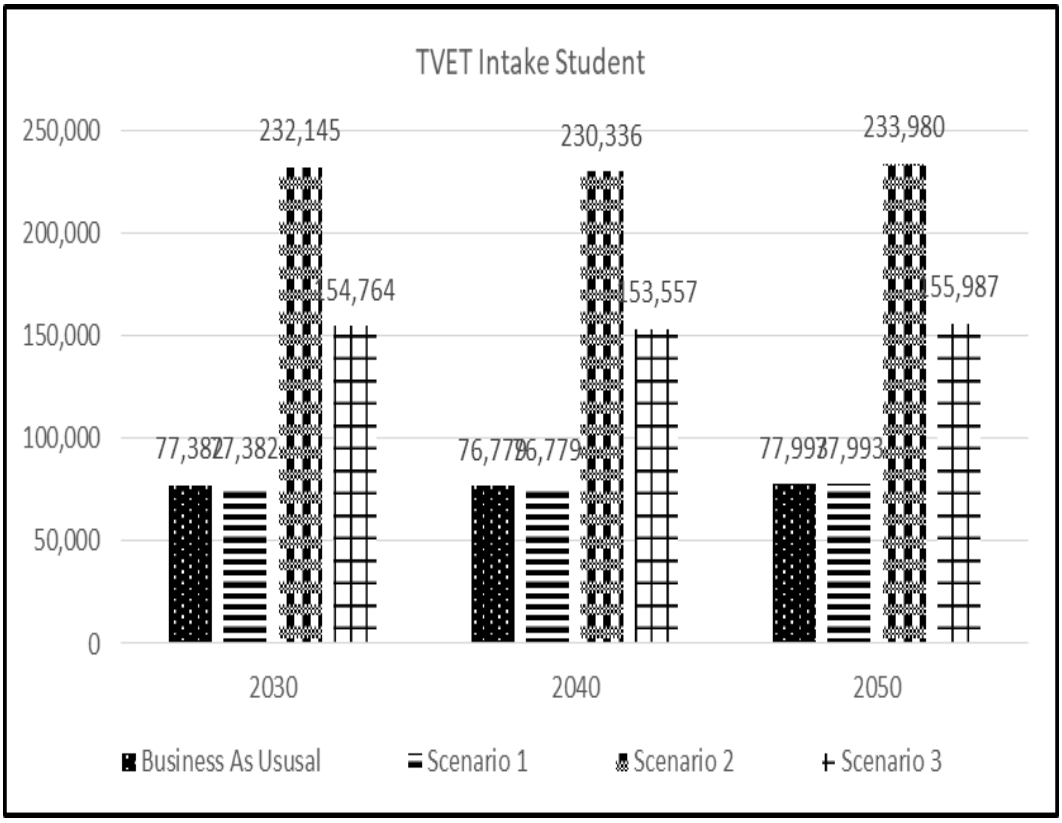


Figure 16. *The Trend of TVET Intake in Malaysia for year 2030, 2040 and 2050*

The behaviour of TVET Intake in Malaysia based on simulation outputs of Scenarios 1, 2 and 3 for three different future years 2030, 2040 and 2050 is presented in Figure 16. By the year 2030: under scenario 1 result indicated that while keeping other factors in the baseline scenario unchanged, a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) showed no change in the number of *TVET Intake in Malaysia as it remains at 77382*. However, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%) resulted to an increase in the number of *TVET Intake in Malaysia from 77382* to 232,145. Similarly, under scenario 3 when a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) is considered, result showed an increase in the number of *TVET Intake in Malaysia* from *77382* to 154,764.

In the year 2040, the results were found to be similar the increase in enrolment was slightly lower for this year: Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) resulted to no difference in the number of *TVET Intake in Malaysia* compared to the 76,779 in the baseline. However, under scenario 2 when the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), the result showed an increase in the number of *TVET Intake in Malaysia* from 76,779 in the baseline to 230,336. Whereas, under scenario 3 with a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%), there was a similar increase in the number of *TVET Intake in Malaysia* from 76,779 in the baseline to 155,987.

In the year 2050 the results were also similar whereas the increase was highest for this year

compared to the other years. Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) resulted to no difference in the number of *TVET Intake in Malaysia* compared to the baseline value of 77,993. However, under scenario 2 when the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), the result showed an increase in the number of *TVET Intake in Malaysia* from 77,993 in the baseline to 233,980. Whereas, under scenario 3 with a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%), there was a similar increase in the number of *TVET Intake in Malaysia* from 77,993 in the baseline to 155987.

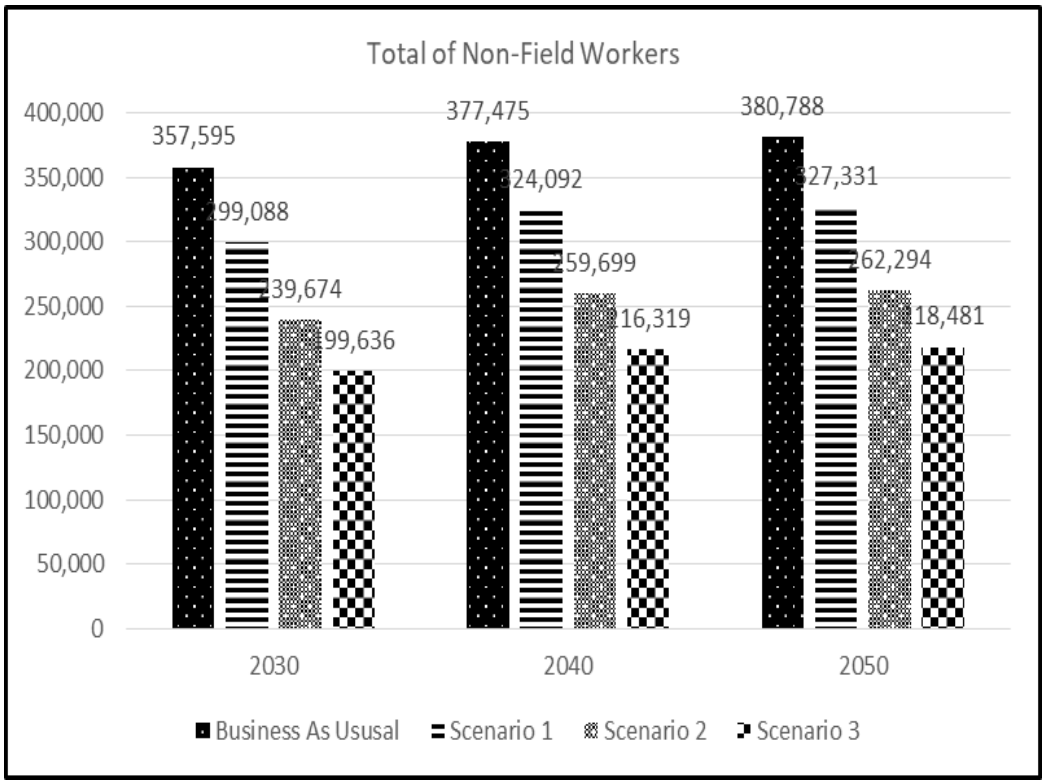


Figure 17. *The Trend of Total Number of Non-Field Workers in Malaysia for year 2030, 2040 and 2050.*

The behaviour of Total Number of Non-Field Workers in Malaysia based on simulation outputs of Scenarios 1, 2 and 3 for three different future years 2030, 2040 and 2050 is presented in Figure 17. In the year 2030: under scenario 1 result indicated that while keeping other factors in the baseline scenario unchanged, a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) showed a decrease in the *Total Number of Non-Field Workers in Malaysia* from 357,595 in the baseline to 299,088. Also, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), the result showed even a higher decrease in the *Total Number of Non-Field Workers in Malaysia from baseline value of* 357,595 to 239,674. Similarly, under scenario 3 when a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) is considered, result showed a decrease in the *Total Number of Non-Field Workers in Malaysia* from baseline value of 357,595 to 199,636.

In the year 2040, the results were found to be similar the increase in enrolment was slightly lower for this year: Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) showed a decrease in the *Total Number*

of Non-Field Workers in Malaysia from 377,475 in the baseline to 324,092. Also, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), the result showed even a further decrease in the *Total Number of Non-Field Workers in Malaysia from baseline value of* 377,475 to 259,699. Similarly, under scenario 3 when a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) is considered, result showed a decrease in the *Total Number of Non-Field Workers in Malaysia* from baseline value of 377,475 to 216,319.

In the year 2050 the results were also similar whereas the increase was highest for this year compared to the other years. Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) showed an increase in the *Total Number of Non-Field Workers in Malaysia* from 380,788 in the baseline to 327,331. Also, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%), the result showed further decrease in the *Total Number of Non-Field Workers in Malaysia from baseline value of* 380,788 to 262,294. Similarly, under scenario 3 when a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) is considered, result showed the lowest decrease in the *Total Number of Non-Field Workers in Malaysia* from baseline value of 380,788 to 218,481.

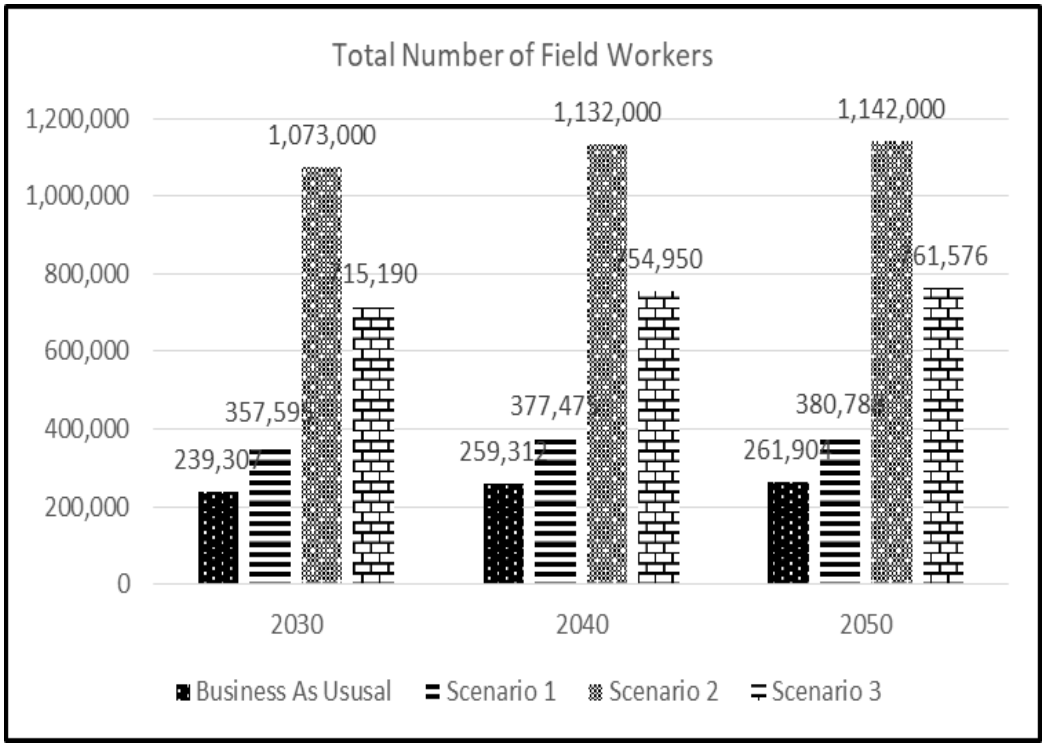


Figure 18. *The Trend of Total Number of Field Workers in Malaysia for year 2030, 2040 and 2050*

The behaviour of Total Number of Non-Field Workers in Malaysia based on simulation outputs of Scenarios 1, 2 and 3 for three different future years 2030, 2040 and 2050 is presented in Figure 18. By the year 2030: under scenario 1 result indicated that while keeping other factors in the baseline scenario unchanged, a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) showed an increase in the Total Number of Non-Field Workers *Intake in Malaysia* from the baseline value of 239,307 to 357,596. However, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%) resulted to higher increase in the Total Number of Non-Field Workers *Intake in Malaysia from* baseline value of 239,307 to 1,073,000. Similarly, under

scenario 3 when a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) is considered, result showed an increase in the Total Number of Non-Field Workers *Intake in Malaysia* from baseline value of 239,307 to 715,190.

In the year 2040, the results were found to be similar the increase in enrolment was slightly lower for this year: Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) showed an increase in the Total Number of Non-Field Workers *Intake in Malaysia* from the baseline value of 259,312 to 377,475. However, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%) resulted to higher increase in the Total Number of Non-Field Workers *Intake in Malaysia from* baseline value of 259,312 to 1,132,000. Similarly, under scenario 3 when a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) is considered, result showed an increase in the Total Number of Non-Field Workers *Intake in Malaysia* from baseline value of 259,312 to 754,950.

In the year 2050 the results were also similar whereas the increase was highest for this year compared to the other years. Under scenario 1 result indicated that a change in the *Percentage for Scholarship Allocation* from 0.12 (12%) to 0.15 (15%) showed an increase in the Total Number of Non-Field Workers *Intake in Malaysia* from the baseline value of 261,904 to 380,788. However, under scenario 2 when only the *Percentage for Palm Oil Program Allocation* is changed from 0.05 (5%) to 0.15 (15%) resulted to higher increase in the Total Number of Non-Field Workers *Intake in Malaysia from* baseline value of 261,904 to 1,142,000. Similarly, under scenario 3 when a joint increase in both percentage of palm oil education program and scholarship by to 0.1 (10%) is considered, result showed an increase in the Total Number of Non-Field Workers *Intake in Malaysia* from baseline value of 261,904 to 761,576.

V. CONCLUSIONS

This paper simulated the impact of education through the allocation budget given for university scholarship and palm oil education program on the employment opportunity. It is recommended that the allocation budget for students to pursue their studies through university scholarships and palm oil education program should be increased since the number of non-field workers in oil palm plantation sector has contributed a positive trend, thus the shortage in the number of non-field workers can be fulfilled. However, the allocated budget should be in an appropriate amount to avoid surplus enrolment of students for both programs. Based on the results of intervention scenarios, the increment percentage contributed by CPO profit is recommended to not more than 12% for scholarship while 5% for palm oil education program to ensure the university student enrolment, TVET intake student and total number of non-field workers are under controlled.

As a summary, the analysis from this paper supported that the injection of budget through the education program will help to produce higher number of employees with technical and vocational skills through the inclusive and equitable quality education to promote lifelong learning as supported in SDGs 4 and gender equality in SDGs 5. This is due to the university and schools courses provide an excellent platform to garner support for the sustainability agenda. Hence, the creation of productive employment opportunities is essential for achieving poverty reduction and sustainable economic and social development.

VI. ACKNOWLEDGEMENTS

Special thanks to the Universiti Utara Malaysia in funding this study under the Research Expansion for Commercialization Grant Scheme (RECGS) S/O Code 13968. Our appreciation also goes to Innovation Management Centre (RIMC), and Innovation and Commercialization Centre (ICC), Universiti Utara Malaysia, Kedah for administration of this study.

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