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The Food and Land Use Coalition

2019 Report of the FABLE Consortium

Pathways to Sustainable Land-Use and Food Systems

Published by International Institute for Applied Systems Analysis (IIASA) and the Sustainable Development Solutions Network (SDSN) 2019

The full report is available at www.foodandlandusecoalition.org/fableconsortium.
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Recommended citation: Ilham, J.I.J. and Low, W.S. (2019), "Pathway to sustainable Land-Use and Food Systems in Malaysia by 2050" In: FABLE 2019, *Pathways to Sustainable Land-Use and Food Systems,* 2019 Report of the FABLE Consortium, Laxenburg and Paris: International Institute for Applied Systems Analysis (IIASA) and Sustainable Development Solutions Network (SDSN), pp. 234-247.

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2019 Report of the FABLE Consortium

Pathways to Sustainable Land-Use and Food Systems in Malaysia by 2050

Malaysia

Jasmin Irisha Jim Ilham[1], Low Wai Sern[*1]

[1] Jeffrey Sachs Center, Bandar Sunway, Malaysia.
[*]Corresponding author: waisernl@sunway.edu.my

Land and food systems at a glance

A description of all units can be found at the end of this chapter

Land & Biodiversity

Fig. 1 | Area by land cover class in 2015

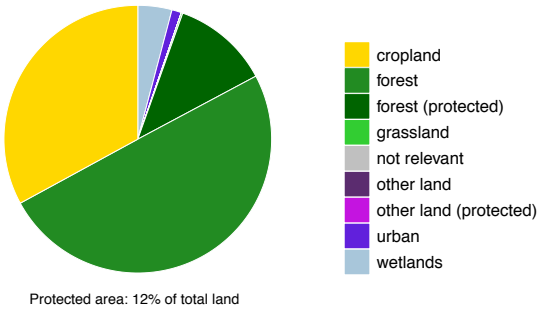
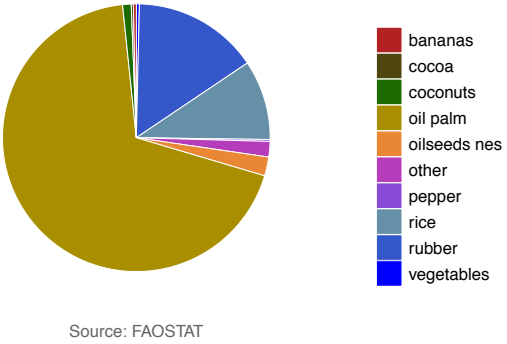


Fig. 2 | Share of harvested area by crop in 2012



Annual deforestation in 2015:
70kha = 0.38% of total forest area

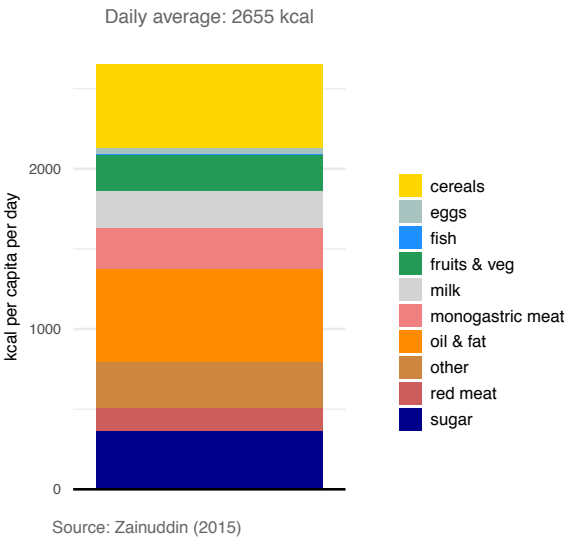
(UNFCCC and Ministry of Science, Technology, Environment and Climate Change, 2018)

Endangered species: 536

(IUCN Red List, 2019)

Food & Nutrition

Fig. 3 | Daily average intake per capita at the national level in 2015



Share of undernourished in 2015:
2.9%

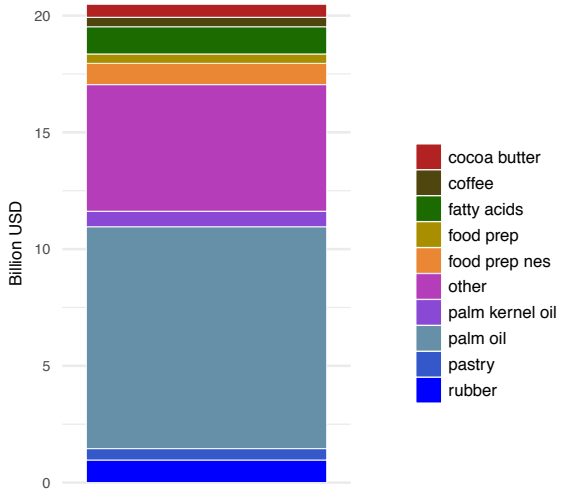
(World Bank, 2019)

Share of obese in 2016:
12.9%

(FAO, IFAD, UNICEF, WFP and WHO, 2018)

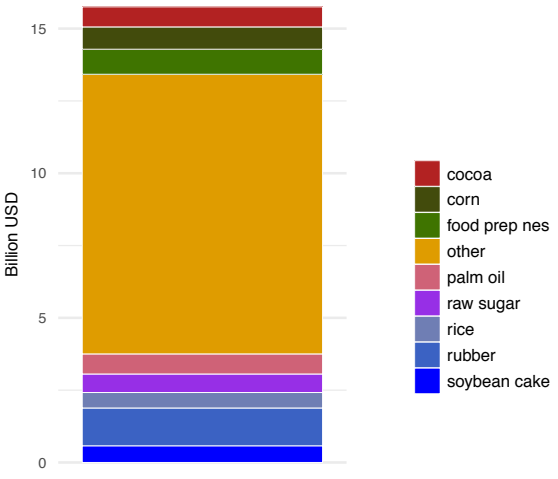
Trade

Fig. 4 | Main agricultural exports by value in 2015



Source: FAOSTAT

Fig. 5 | Main agricultural imports by value in 2015



Source: FAOSTAT

Deficit in agricultural trade balance in 2015: USD 4.7 billion

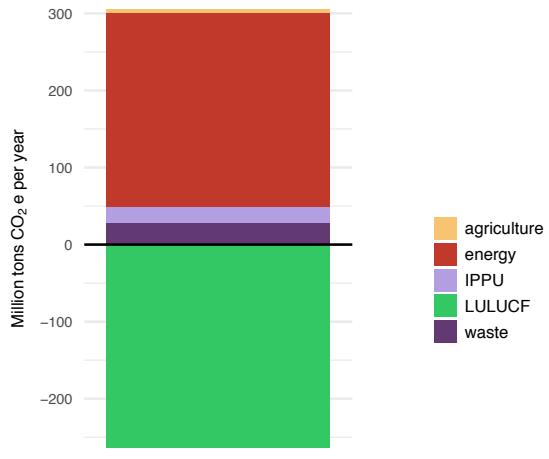
(FAOSTAT, 2019)

2nd most important palm oil exporter in the world in 2015

(FAOSTAT, 2019)

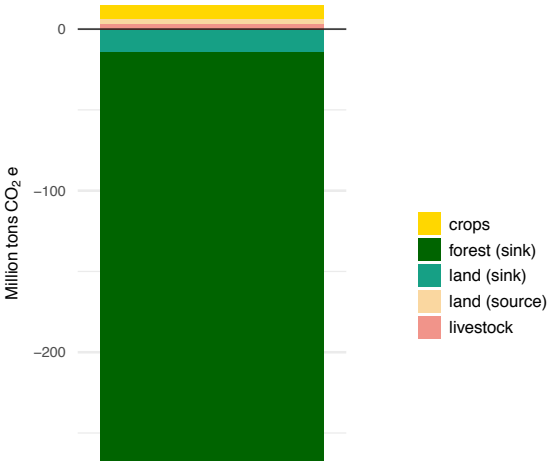
GHG Emissions

Fig. 6 | GHG emissions by sector in 2015



Source: 3rd NC and 2d BUR to the UNFCCC (2018)

Fig. 7 | GHG emissions from agriculture and land use change in 2015



Source: FAOSTAT

Main assumptions underlying the pathway towards sustainable land-use and food systems

For a detailed explanation of the underlying methodology of the FABLE Calculator, trade adjustment, and envelope analysis, please refer to sections 3.2: Data and tools for pathways towards sustainable land-use and food systems, and 3.3: Developing national pathways consistent with global objectives.

GDP GROWTH & POPULATION

	GDP per capita	Population
Scenario definition	GDP per capita is expected to increase by 92.8% from USD 10,741 in 2015 to USD 20,713 in 2050 (SSP2 scenario selected).	Population is expected to increase by 43.9% between 2015 and 2050 from 30.7 mln to 44.2 mln (SSP2 scenario selected).
Scenario justification	Based on the International Monetary Fund – World Economic Outlook (2018), which forecasted a steady increase in Malaysia's nominal GDP per capita: USD 11,385 in December 2019 and USD 15,455 in December 2024.	Based on Department of Statistics Malaysia (2016), which projects that Malaysia's population will reach 41.5 mln by 2040.

TRADE

	Imports	Exports
Scenario definition	The share of total consumption which is imported is assumed to remain constant at 2010 levels for all commodities: - 100% for corn, - 97% for sugar, - 100% for wheat, - 100% for soybean, - 40% for rice, - 93% for milk, - 80% for beef, and - 20% for vegetables.	The exported quantity increases: - from 17.8 Mt in 2010 to 35.7 Mt in 2050 for palm oil, and - from 2.2 Mt in 2010 to 4.4 Mt in 2050 for palm kernel cake. The exported quantity remains constant at 2010 level for other products.
Scenario justification	Based on the Department of Statistics, Malaysia and the Ministry of Agriculture and Agro-based Industry (Department of Statistics Malaysia Official Portal, 2018).	Based on the Department of Statistics, Malaysia and the Ministry of Agriculture and Agro-based Industry (Department of Statistics Malaysia Official Portal, 2018).

Scenario signs no change · small change · large change

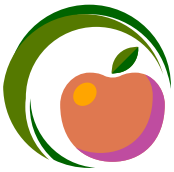
LAND

	Land conversion	Afforestation
Scenario definition	We assume that there will be no constraint on the expansion of agricultural land beyond existing protected areas and under the total land boundary.	We assume total afforested area will reach 2 Mha by 2045.
Scenario justification	Based on a projected 2.2% decline in land capable growing agrifood crops, from 870 kha in 2010 to 825kha in 2020. Forest areas also declined from about 6.1 Mha/year in 2010 to some 5.9 Mha in 2015 due to conversion of forests to other land uses. The rate of deforestation in the period was 0.66% yr-1 (Hamdan et al., 2016; Dardak, 2019).	Based on a positive historical reforestation trend from 33 kha/year in 2005 to 135 kha/year in 2010 (Hamdan et al., 2016; Raihan et al., 2017). Malaysia has not made a commitment to the Bonn Challenge, but it does target to retain 50% of its forest cover and is a signatory to international commitments such as CBD Aichi Target 15, UNFCCC REDD+ goal and the Rio+20 land degradation neutrality goal.

BIODIVERSITY

	Protected areas
Scenario definition	Protected areas remain constant over 2000-2050.
Scenario justification	There is a well-established trajectory in relation to forest biodiversity conservation through the establishment of Permanent Reserved Forest (PRF)/Permanent Forest Estates (PFE), which currently cover 14.5 Mha in Malaysia, collectively (Ministry of Natural Resources and Environment, 2014a). There is a clearly defined target in Malaysia's National Policy on Biological Diversity 2016-2025 (Ministry of Natural Resources and Environment, 2014b), under Goal 3, Target 6, which states "By 2025, at least 20% of terrestrial areas and inland waters, and 10% of coastal and marine areas, are conserved through a representative system of protected areas and other effective area-based conservation measures".

Scenario signs no change · small change · large change



FOOD

	Diet	Food waste
Scenario definition	Between 2015 and 2050, the average daily calorie consumption per capita remains quite stable from 2,600 kcal to 2,629 kcal. Per capita consumption: - decreases by 16.9% for cereals, - increases by 53.9% for monogastric animal meat, - increases by 142.2% for milk, - increases by 14.7% for oilseeds and oil, - increases by 23.7% for eggs, - increases by 0.4% for pulses, - increases by 72.9% for ruminant animal meat, - decreases by 11.3% for roots, and - decreases by 27.6% for sugar. For the other food groups, there is no large shift in consumption.	Between 2015 and 2050, the share of final household consumption which is wasted remains stable.
Scenario justification	Based on Zainuddin (2015) who found that the intake of energy among Malaysian adults falls short on recommended intake. Most of the studies in Malaysia on nutrient intake focuses on gender differences, instead of timeline comparison and projections. However, Lee and Muda (2019) specifically highlighted that fruit and vegetable intake was below recommended levels, while sugar and fat intake was substantially higher. This may lead to overweight and obesity.	Based on estimates that food waste is projected to increase from 4.4 Mt in 2005 to 6.5 Mt in 2020 (Abdul Hamid et al., 2012).

PRODUCTIVITY

	Crop productivity	Livestock productivity	Pasture stocking rate
Scenario definition	Between 2015 and 2050, crop productivity increases: - from 2.5 t/ha to 3.53 t/ha for rice, - from 61.9 t/ha to 67.6 t/ha for oil palm fruit, and - from 0.9 t/ha to 1.2 t/ha for rubber.	Between 2015 and 2050, productivity per head increases: - from 1t/TLU to 2.4 t/TLU for cattle milk, - from 0.5 kg/head to 0.55 kg/head for poultry meat, and - doubles for beef meat.	The average ruminant stocking density remains constant at 2.1 TLU/ha per pastureland.
Scenario justification	Based on data from Selected Agricultural Indicators from the Department of Statistics of Malaysia (2018). The sources contained in the DOSM data include Booklet of Crop Statistics (Food Crops Sub-sector) – Department of Agriculture Malaysia (2012), Malaysian Palm Oil Board, Malaysian Cocoa Board, Malaysian Pepper Board and National Kenaf and Tobacco Board) and the USDA (2019).	Based on efforts to ensure adequate supply of poultry and eggs for the domestic market and to capitalize on export markets, as well as to develop Malaysia's potential as an international halal food hub (Prime Minister's Office, 2019). Livestock productivity increases based on projected agro-food production (Bakar et al., 2012).	

Scenario signs = no change → small change ↗ large change

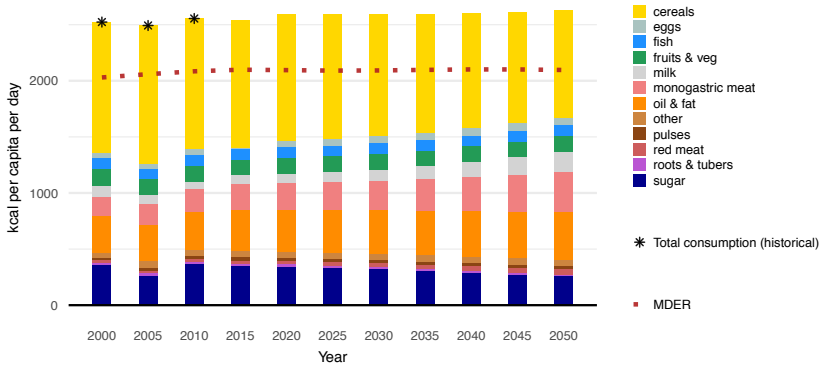
Results against the FABLE targets

The results for FABLE targets as well as "other results" are based on calculations before global trade harmonization.

Food security

Fig. 8 | Computed daily average kilocalorie intake per capita over 2000-2050

Note: The Minimum Daily Energy Requirement (MDER) is computed based on the projected age and sex structure of the population and the minimum energy requirements by age and sex for a moderate activity level. Animal fat, offal, honey, and alcohol are not taken into account in the computed intake.



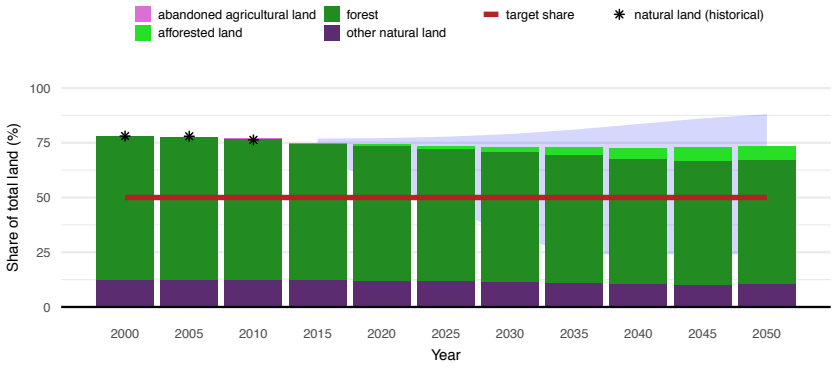
Historical data source: FAOSTAT

Our results show average daily energy intake per capita increases between 2,438 and 2,510 kcal/cap/day from 2000-2015. This is 5% lower than FAO due to some products not being taken into account into our calculation. Calorie intake reaches 2,512 over the period 2031-2035 and 2,550 kcal/cap/day over the period 2046-2050. In terms of recommended diet, our results show lower consumption of cereals.

The computed average calorie intake is higher than the Minimum Dietary Energy Requirement (MDER) at the national level in 2030 and in 2050.The recommended average daily dietary energy consumption per capita for energy requirements for a moderately active adult in Malaysia ranges from 1,840 to 2,240 kcal/cap/day (according to gender and body weight), based on Malaysia's Ministry of Health report.

Biodiversity

Fig. 9 | Computed share of the total land which could support biodiversity over 2000-2050



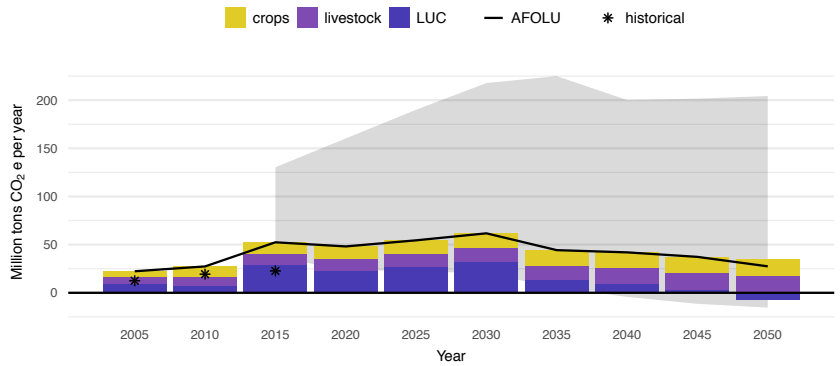
Historical data source: FAOSTAT

Our results show that the Share of Land which could support Biodiversity (SLB) decreased between 2000-2015 from 78% to 77%. The lowest SLB is computed for the period 2046-2050 at 73% of total land. This is mostly driven by forest conversion to cropland. SLB reaches 73% over the last period of simulation, 2046-2050. This decline is due to the reduction in forest cover which is only partly offset by higher afforested area.

Compared to the global target of having at least 50% SLB by 2050, our results are above the target. Other supporting national plans to help increase biodiversity conservation in Malaysia include the National Tiger Conservation Action Plan for Malaysia 2008-2020 and the Malaysian National Elephant Conversation Action Plan 2013-2022 (Economic Planning Unit, 2017).

GHG emissions

Fig. 10 | Computed GHG emissions from land and agriculture over 2000-2050



Historical data source: FAOSTAT

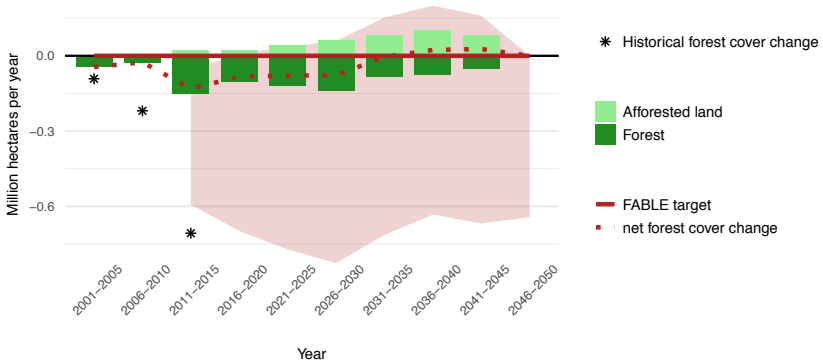
Note: AFOLU (Agriculture, Forestry and Other Land Use) is the sum of computed GHG emissions from crops, livestock and Land Use Change (LUC), emissions and sequestration from forestry are not included. Historical emissions include crops and livestock.

Our results show annual GHG emissions between 10 and 52 MT CO_2e from 2000-2015, which increase over time. These are higher than stated in the Malaysia Third National Communication and Second Biennial Update Report to the UNFCCC which estimates a net carbon sink of 0.9 Mt CO_2e/year over the same period and an increasing trend. Our results on GHG emissions from agriculture are also above FAO statistics (+20% in 2000, +65% in 2015). Peak AFOLU GHG emissions are computed for the period 2026-2030 at 62 Mt CO_2e/year. This is mostly driven by GHG emissions from LULUCF. AFOLU GHG emissions reach 27 Mt CO_2e over the period 2046-2050: 17 Mt CO_2e from crops, 18 Mt CO_2e from livestock and -7 Mt CO_2 from LUC. Zero net emissions from LULUCF by 2050 are mainly explained by afforestation.

Compared to the global target of reaching zero or negative GHG emissions from LULUCF by 2050, our results meet the target. Our results show that there needs to be a decrease in deforestation in order to achieve zero or negative GHG emissions from LULUCF by 2050.

Forests

Fig. 11 | Computed forest cover change over 2000-2050



Historical data source: FAOSTAT

Our results show annual deforestation between 25 kha/year and 125 kha/year over 2000-2015 and which increases over time. This is lower than the deforestation estimates from Global Forest Watch (between 287 and 454 kha/year) but higher than the net forest cover change reported by FAO (140 kha of deforestation over 2000-2005 but with net forest gain over 2005-2015). Peak deforestation is computed for the period 2010-2015 at 150 kha/year. This is mostly driven by cropland expansion. Afforestation is computed for 2016-2045 at 100 kha/year maximum over 2035-2040.

Compared to the global target of having zero or positive net forest change after 2030, our results are below the target, but this target is met from 2040 onwards. With 60% of the total area covered by forest in 2050, our results meet a national pledge of having 50% of land area retained as forest cover (Convention on Biological Diversity, 2019).

Other relevant results for national objectives

Table 1 | Other Results

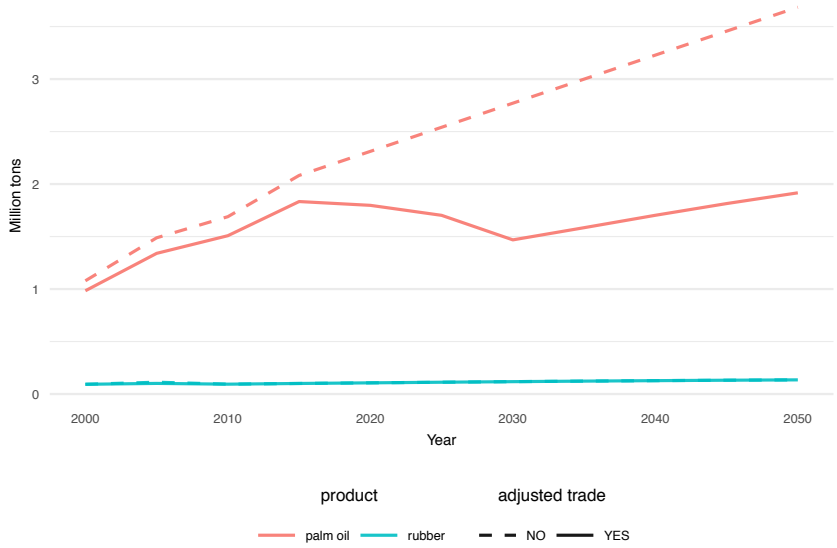
Variable	Unit	2000	2005	2010	2015	2020	2030	2040	2050
Area by land cover									
Cropland (historical)	Mha	6.7	6.9	7.2					
Cropland (calculated)	Mha	6.7	6.9	6.9	7.4	7.6	8.0	8.2	8.3
Pasture (historical	Mha	0.3	0.3	0.3					
Pasture (calculated)	Mha	0.3	0.4	0.3	0.4	0.5	0.5	0.5	0.5
Forest (historical)	Mha	21.6	20.9	20.5					
Forest (calculated)	Mha	21.6	21.4	21.2	20.5	20.0	18.7	17.9	17.6
Afforested land (calculated)	Mha	0.0	0.0	0.0	0.1	0.2	0.7	1.6	2.0
Otherland (historical)	Mha	4.2	4.8	4.9					
OtherLand (calculated)	Mha	4.0	4.0	4.1	4.0	4.0	3.8	3.5	3.4
Urban (calculated)	Mha	0.2	0.2	0.3	0.4	0.6	1.1	1.1	1.1

Source of historical data: FAOSTAT

Our results align well with observed historical trends. In addition to the current pledge of retaining 50% of land as forest cover, additional national level afforestation targets need to be set to further maintain the amount of forest cover and limit the amount of conversion due to future expansion of crop and urban land.

Impacts of trade adjustment to ensure global trade balance

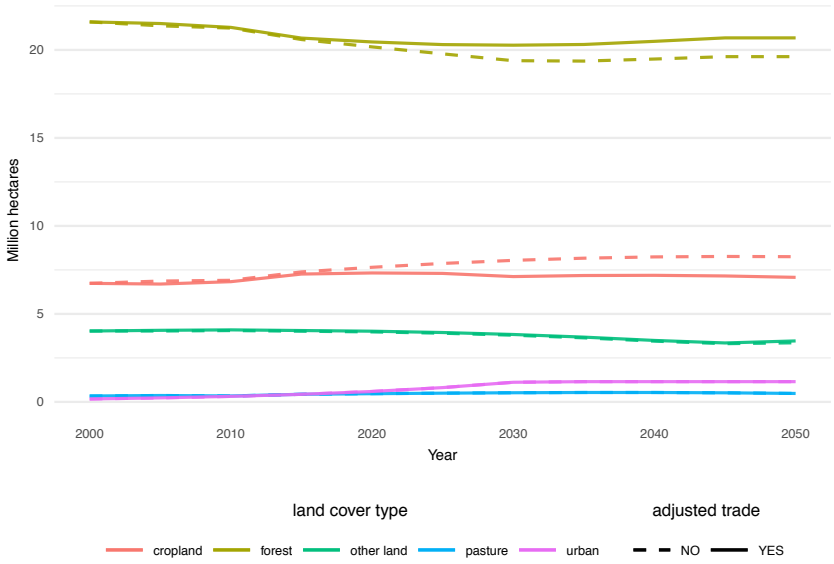
Fig. 12 | Impact of global trade harmonization on main exported/imported commodities over 2000-2050



Only oil palm was chosen, as it is Malaysia's main export commodity. The change in exports compared to no trade is evident beginning in 2000, when it increases and is continuously increasing at a high rate. When trade is not adjusted, exports reach up to more than 35 mln tons in 2050.

Trade adjustments made no change to imports of corn, milk, soycake, and wheat.

Fig. 13 | Impact of global trade harmonization on land use over 2000-2050



There is a clearly observed difference in cropland area when trade is adjusted, which is likely due to continuing expansion in oil palm plantations.

Discussion and next steps

Malaysia is a tropical developing country that covers an area of approximately 33.2 Mha, consisting of Peninsular Malaysia, the states of Sabah and Sarawak in the eastern region and the Federal Territory of Labuan in the northwestern coastal area of Borneo Island. The two regions of Eastern and Peninsular Malaysia are separated by about 540 km of the South China Sea. Malaysia is among the 12 mega-diverse countries in the world and is globally recognized via its significant representation of several G200 Ecoregions in East and West Malaysia, including tropical lowlands, mangroves, peat and montane forests, as well as its marine ecoregions. Historically, large scale plantations were introduced by the British for crops such as rubber, palm oil, and cocoa, which have been maintained until today. Agriculture makes up 12% of Malaysia's GDP.

The assumptions and scenarios in this chapter outline our initial findings for a sustainable food and land-use pathway for Malaysia. According to this pathway, GDP and population will grow following the "Middle of the Road" scenario. Productive land under the total land boundary could continue to expand while at the same time retaining 50% of forest cover (as per Malaysia's pledge to the Rio Earth Summit 1992). In terms of productivity, we assume the same productivity growth as per 2000-2010, which would lead to an increase of main crops such as rice, oil palm, and rubber. This is similar for the case of livestock productivity, which we expect to increase for cattle milk, poultry meat, and eggs. Imports are expected to increase proportionally with demand and palm oil exports are also expected to increase. The consumption of meat, a staple of the Malaysian diet, is expected to further increase.

In the future, there are several limitations that we would like to address in the FABLE Calculator. Firstly, the Calculator calculates values based on global databases, which do not necessarily reflect local contexts. Secondly, in Malaysia, reported forest data comes from three different national sources, and is divided into Peninsular Malaysia, Sabah, and Sarawak. Forest definitions should be adapted to better reflect these geographic divisions.

While Malaysia does not have a set of afforestation targets as per the Bonn Challenge, it is committed to retaining 50% of forest cover, and is a signatory to international commitments such as United Nations Convention on Biological Diversity (CBD) Aichi Target 15, United Nations Framework Convention on Climate Change (UNFCCC) Reducing emissions from deforestation and forest degradation (REDD+) goal, and the Rio +20 land degradation neutrality goal. The Calculator only offers two scenarios for afforestation, which are "no afforestation target" and "Bonn Challenge". This is a third limitation as Malaysia's target to retain forest cover does not fall into either category and choosing one over another leads to discrepancies. Therefore, while we opted to select the more ambitious target it does not reflect the Malaysian context as well as we would like.

Fourth, in Malaysia, biodiversity conservation is pursued through the establishment of Permanent Reserved Forest (PRF) and via a network of Protected Areas (PAs) (both terrestrial and marine), which includes Wildlife Sanctuaries, National and State Parks, Nature Reserves and Protection Forests within the PRFs. The PAs are governed by different laws with varying degrees of protection status, as well as gazettal and de-gazettal procedures. In the future, we will seek to make the Calculator's definitions of "Protected Areas" and land conversion more specific so they can better support policy-oriented outcomes.

Finally, the dietary scenario does not take into account the status of malnutrition in the country.

In Malaysia, the recommended daily intake of energy is broken down by age group, gender, and level of activity of the individual, as reported by the Ministry of Health. This is the ideal case scenario, which we hope to incorporate in the Calculator in the future. We also hope to look at issues related to malnutrition, such as stunting and obesity.

Some of the core challenges for the realization of this sustainable food and land-use pathway in Malaysia include: poor accessibility of national documents; a lack of government monitoring infrastructure; a lack of data availability; a dearth of existing research on FABLE systems; limited consideration for environmental issues in policymaking; and weak enforcement mechanisms and legal precedence in environmental laws. Broadly, there is no constitutional protection for the right to a clean and low carbon environment.

In conclusion, Malaysia needs to be more ambitious in setting targets for a better environment. Malaysia is on the right economic-growth trajectory but falls short on socio-environmental equity. Projections developed as part of FABLE are crucial tools to raise greater awareness among Malaysians, in particular regarding what is to come by 2050. Therefore, we need to take the output data for mitigation and adaptation measures seriously. A deep decarbonization pathway needs to be pursued for a low carbon future. We also need to aspire to conserve forest and biodiversity the best we can via setting afforestation targets and increasing protected areas. Viable technological advancements and solutions should be taken into consideration in order to achieve such targets. More studies need to be undertaken in various sectors, including food, production, agricultural trade, biodiversity conservation, land use management, and greenhouse gas emissions. Strong political will be needed to achieve all this and push forward socio-environmentally just agendas for a sustainable future.

Units

% – percentage
bln – billion

cap – per capita

CO_2 – carbon dioxide

CO_2e – greenhouse gas expressed in carbon dioxide equivalent in terms of their global warming potentials

GHG – greenhouse gas

Gt – gigatons

ha – hectare

kcal – kilocalories

kg – kilogram

kha – thousand hectares

km^2 – square kilometer

kt – thousand tons

Mha – million hectares

mln – million

Mt – million tons

t – ton

TLU –Tropical Livestock Unit is a standard unit of measurement equivalent to 250 kg, the weight of a standard cow

t/ha – ton per hectare, measured as the production divided by the planted area by crop by year

t/TLU, kg/TLU, t/head, kg/head- ton per TLU, kilogram per TLU, ton per head, kilogram per head, measured as the production per year divided by the total herd number per animal type per year, including both productive and non-productive animals

tln – trillion

USD – United States Dollar

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