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The Impact of the Consumption of Palm Oil in Poland on the Global Natural Environment and Analysis of the Possibility of Replacing it by Other Vegetable Oils

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The Impact of the Consumption of Palm Oil in Poland on the Global Natural Environment and Analysis of the Possibility of Replacing it by Other Vegetable Oils

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1. PROBLEMS AND GOALS

The high estimated increase in the number of people in the coming years, combined with the gradual exhaustion of natural resources and arable lands, will become one of the greatest challenges of humanity. The United Nations (UN) estimates that in 2050 the number of people will reach 9.7 billion[1]. To face this challenge, it will be necessary to take up actions like: increase the surface of arable lands, their productivity, increase the production of high-energy foods or broader introduction of genetic engineering methods allowing to increase the productivity or the content of e.g. proteins[2].

THE HIGH ESTIMATED INCREASE IN THE NUMBER OF PEOPLE IN THE COMING YEARS, COMBINED WITH THE GRADUAL EXHAUSTION OF NATURAL RESOURCES AND ARABLE LANDS, WILL BECOME ONE OF THE GREATEST CHALLENGES OF HUMANITY

For several decades, the economies of developed countries have been using palm oil, which, due to high production efficiency, has become an important raw material in the production of food, biofuels, chemicals, and cosmetics. Chart 1 present the differences in production efficiency between the selected vegetable oils.

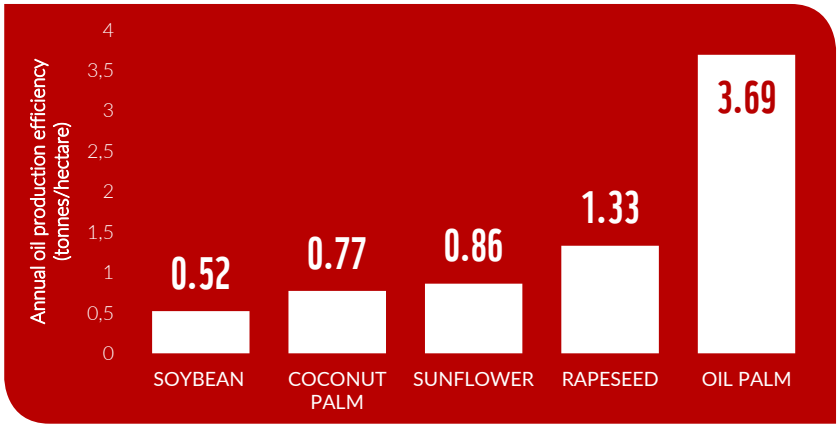


Chart 1. *Comparison of productivity of selected vegetable oils*[3]

With the increase in the area of arable lands, also the use of lands changes, which translates into changes of water relations and the quality of waters, decrease of biodiversity, and the resulting climate change. The global effects of these changes are a subject universally brought up by governments, non-governmental organisations, and also companies, specifically the ones directly connected to food production. Palm oil is currently one of the subjects more frequently discussed by governments, media, or organisations. The reason for this is the fact that oil palm plantations have significant impact on the natural environment and endangered species[4].

PALM OIL IS CURRENTLY ONE OF THE SUBJECTS MORE FREQUENTLY DISCUSSED BY GOVERNMENTS, MEDIA, OR ORGANISATIONS. THE REASON FOR THIS IS THE FACT THAT OIL PALM PLANTATIONS HAVE SIGNIFICANT IMPACT ON THE NATURAL ENVIRONMENT AND ENDANGERED SPECIES

Definite majority of the global palm oil production – 85% – takes place in Malaysia and Indonesia, which makes these countries especially vulnerable to changes in soil richness and their use[5]. In both these countries, the natural resources like tropical rainforests and natural peat bogs are, due to economic reasons, gradually replace by oil palm plantations. Changes in the use of land in Malaysia and Indonesia are followed by enormous consequences not only for the local ecosystems, but

they also translate into the increase of the global emission of greenhouse gases. It should be also emphasised that these countries have relatively low level of industrialisation, thus the production of palm oil has a disproportionately high share in generating carbon dioxide. These emissions are generated mainly due to draining peat bogs for palm oil plantations. Greenhouse gases emitted in industrial processes and also related to transport infrastructure have marginal impact in Malaysia and Indonesia.

PALM OIL NATURALLY GROWS IN PLACES, IN WHICH BIODIVERSITY INDEX IS VERY HIGH, TAKING PLACE OF TROPICAL RAINFORESTS IN THE FOLLOWING COUNTRIES: MALAYSIA, INDONESIA, THAILAND, NIGERIA, COLUMBIA, ECUADOR, OR THE DEMOCRATIC REPUBLIC OF CONGO

Greenhouse gas emissions are a global problem, not a local one. One should remember that the share of Indonesia or Malaysia in the global emissions of greenhouse gases is small, and the main emitters are highly industrialised countries like the United States or China. Why then growing oil palm and the growing consumption of palm oil cause so much controversy and activities on part of governments of not only European countries, but also of Malaysia and Indonesia?

Ecosystems of Malaysia and Indonesia are the habitats of plant and animal species, which are rare or non-existent in other parts of the world. These countries are one of the main locations of peat in the world. The area of peat bogs is decreasing, as peat bogs, and also the primeval forests inhabited by rare species of animals and plants are replaced with palm oil plantations. Therefore, it is not surprising that the production of palm oil has great impact on global biodiversity. Palm oil naturally grows in places, in which biodiversity index is very high, taking place of tropical rainforests in the following countries: Malaysia, Indonesia, Thailand, Nigeria, Columbia, Ecuador, or the Democratic Republic of Congo[7].

The global discussion on palm oil is aimed at analysing if it is possible to grow oil palm in a less expansive way, closer to sustainable development. Such attempts were made in 2004, when, on the initiative of WWF, Roundtable on Sustainable Palm Oil (RSPO) was created, and palm oil certification system was introduced. These action are supposed to minimise the negative impact of growing oil palm on the natural environment. RSPO assembles not only producers and providers of palm oil, but also representatives of FMCG (Fast-Moving Consumer Goods) using palm oil in their products, as well as global and local ecological public benefit organisations.

THE GLOBAL DISCUSSION ON PALM OIL IS AIMED AT ANALYSING IF IT IS POSSIBLE TO GROW OIL PALM IN A LESS EXPANSIVE WAY, CLOSER TO SUSTAINABLE DEVELOPMENT

The palm oil certification system, which requires the producers and providers to control it regularly and meet strict requirements at every stage of production of palm oil, made its price grow. The price of palm oil without certification falls. Between 2013 and 2018, it fell by 50%, while the price of certified sustainable palm oil (CSPO) is increasing8. In response to the price fluctuations, companies started using the less expensive alternatives, frequently grown in a non-sustainable way. Some palm oil growers left the system, justifying their decisions with the inability to meet the certification requirements[9]. Another problem was spotted several years later, when big corporations started declaring high level of transparency in tracking the sources of palm oil to certified plantations. A question arose if the same growers, who provide certified palm oil to big western corporations, do not also get oil from growing palms in a non-sustainable way and provide it to companies that do not have such high requirements.

The goal of this report is the analysis of the impact of using palm oil in Poland on the global natural environment. The report presents the analysis of theoretical possibility of total substitution of palm oil in Poland both in the form of raw material and of products, which are imported to Poland. These studies are aimed at answering the question about the effects of growing oil palm for the environment, and how it influences biodiversity or greenhouse gas emissions to the atmosphere. Additionally, the report includes an analysis of the possibilities and the anticipated effects of replacing palm oil with other oils, such as: rapeseed oil, sunflower oil, soybean oil, olive oil, coconut oil, jojoba and jatropha oils, cocoa butter, algae oil, shea butter, beeswax, or recycled vegetable oil.

This report determines the degree to which palm oil is indispensable as an ingredient of food, cosmetics and biofuels, and if its use is connected to positive results for the global bioeconomy (ecological economy). The data resulting from this analysis were used to develop a scenario, in which palm oil can be replaced with other vegetable oils or substitutes, and what would be the estimated impact of such substitution on the global biodiversity and climate change. The goal of this analysis is firstly to evaluate the impact of the consumption of palm oil in Poland and the potential effects of replacing palm oil consumption in various consumer products with other raw materials, such as rapeseed oil or sunflower oil.

The effects of palm oil consumption in Poland and its substitution shall be analysed based on various environmental parameters. The analysis will include the impact of the increase in the consumption of palm oil in Poland on the changes in land use, greenhouse gas emissions, and also changes in biodiversity throughout the world. Based on the analysis of the main sectors, in which palm oil has the greatest application, with the qualitative analysis of its composition, active substances, and also potentially harmful substances, an outline will be determined, in which its continuation or discontinuation would yield the most benefits.

The report touches upon the technological possibility of replacing palm oil, the qualitative superiority of some oils over others, and the effectiveness with which the soils for growing them can be used. The analysis was based on models of land use changes, burning and emitting greenhouse gases, and changes in biodiversity, based on the available factors. The social and economic effects were not taken into consideration in this report. However, its authors are aware that the existence of oil palm plantations is connected with benefits for labour markets in Malaysia and Indonesia, and discontinuation of production would have serious economic consequences for these countries. Another question is the implemented oil certification system, which puts on the growers the obligation of taking into account minimum wages, which constitutes one of the factors increasing the prices of the produced oil.

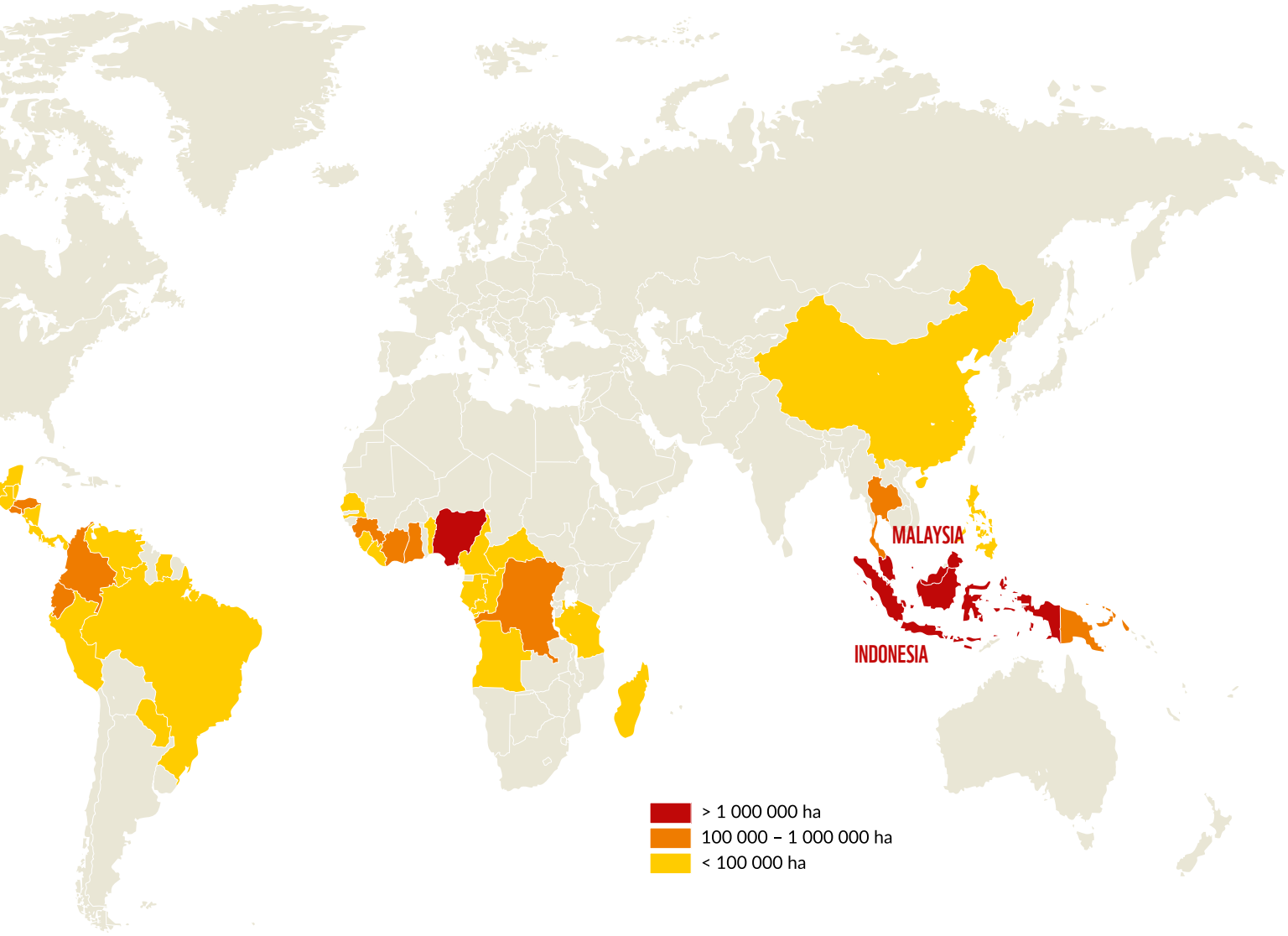
2. GLOBAL PRODUCTION OF PALM OIL AND CONSUMPTION IN POLAND

2.1. World Production of Palm Oil

Oil palm (*Elaeis guineensis*) produces two types of oils: crude palm oil (CPO) from the fibrous mesocarp, and crude palm kernel oil (CPKO). Despite the fact that both types come from the same tree, however, they have different physicochemical properties, which are more widely discussed in chapter three of this report. To simplify this analysis, both oils produced by palm oil are jointly named: **palm oil**.

Chart 2. *Map of global palm oil production with specified main producer countries, 2016*

Source: World Agroforestry, Ministry of Agriculture and Farmers Welfare, Government of India, Status Paper on Oil Palm.



Oil palm is grown mostly in the countries with tropical rainforest and tropical monsoon climates, which has been presented in Chart 2. Indonesia and Malaysia are responsible for the production of 85% of global palm oil production (according to Index Mundi data for 2017). Chart 3 presents the division of global production of palm oil with the division to main origin countries.

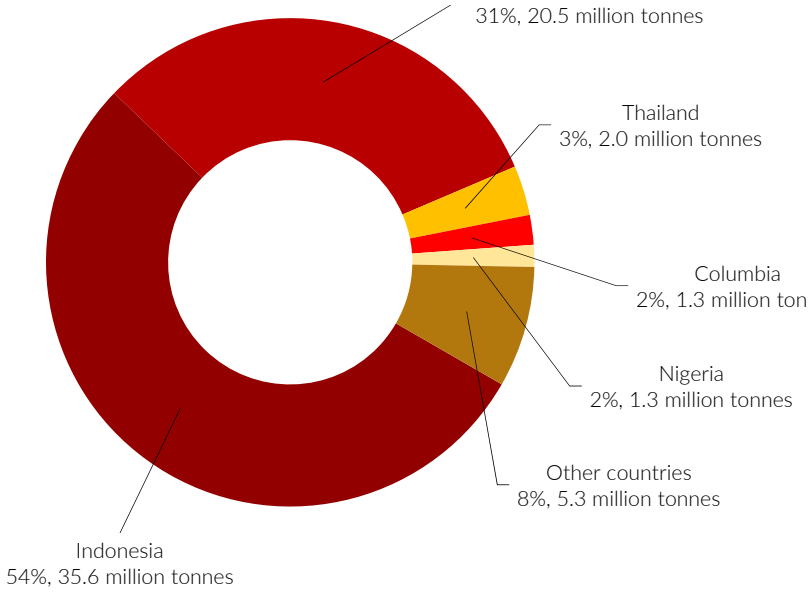


Chart 3. *World production of palm oil*

Source: Index Mundi 2017.

Global production of palm oil is currently over **66 million tonnes** annually[10], 35.6 million tonnes of which comes from plantations in Indonesia. This number increased from 33.4 million tonnes in 2015, and further increase in the production of palm oil is anticipated in the coming years[11]. Historical data from years 2000-2018 and a projection until 2025 are presented in Chart 4, showing the growth tendencies of palm oil consumption.

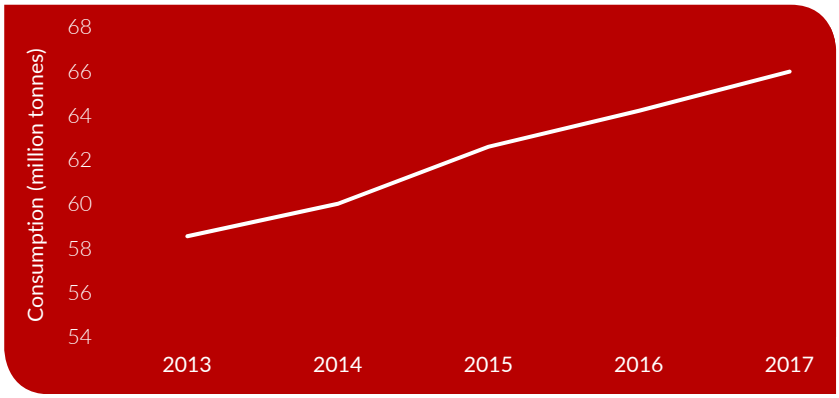


Chart 4. *Increase in the production of palm oil*

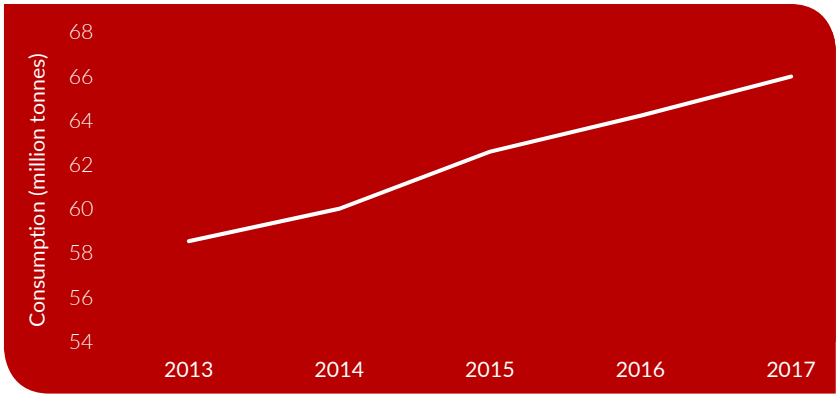
Sources: FAPRI-ISU 2011 World Agricultural Outlook Database, European Palm Oil Alliance, Frost & Sullivan.

The estimated rate of increase of the production of palm oil is related primarily with the increase of the number of people and the growing level of palm oil consumption observed in the past. Estimated data prepared by FAPRI in 2014 suggested crossing the level of production of 70 million tonnes in 2025. The increase of consumption proved faster than assumed by this report. According to the same report, the basis for the

estimated data is considered scientifically justified expectations, including global economic development, global population and income increase, along with technological progress and demand tendencies. Chart 5 presents the trend of increase in palm oil consumption in years 2013-2017.

Chart 5. *Global palm oil consumption in years 2013-2017*

Sources: FAPRI-ISU 2011 World Agricultural Outlook Database, European Palm Oil Alliance, Frost & Sullivan.



The increase in the production of palm oil is driven by its growing consumption, which is especially visible in the sectors of food and feed for livestock. In this report the following products were identified as the main applications of palm oil: foodstuffs, chemicals and cosmetics (including detergents), feed and biofuels. In the case of biofuels, forecasts include the most recent legal changes related to the decision made by the European Parliament in January 2018 on total discontinuation of the use of palm oil in biofuels until 2030 (*Renewable Energy Directive, RED II*)[12]. This will have great influence on palm oil market in Western Europe, where on average 40-50% of this oil is used in the biofuel sector, e.g. in Germany it is 41%13. In the case of Poland, the share of palm oil in biofuels is much lower. In order to understand the influence of domestic consumption on the global market, the next part of the analysis tracks the origins and the amount of palm oil reaching Poland. Palm oil import was divided into two parts: palm oil reaching Poland as raw material and palm oil imported to Poland in products (i.e. in hidden form).

INDONESIA AND MALAYSIA ARE RESPONSIBLE FOR THE PRODUCTION OF 85% OF GLOBAL PALM OIL PRODUCTION

2.2. Import of Palm Oil to Poland as Raw Material

Analysis of palm oil reaching Poland was made on the basis of generally available data (data from Central Statistical Office) and supplemented with reports and secondary analyses. In order to simplify the investigation, the route of palm oil imported to Poland from plantations in two main countries will be traced: Indonesia and Malaysia (85% of palm oil comes from these countries). Both Indonesia and Malaysia export the products of oil palm to the main ports i.a. in India or in Europe, from where they are distributed to further destinations. In Europe, the main import port is in Rotterdam (the Netherlands), and more than 30% of palm oil imported to the European Union gets there[14]. The rest of palm oil goes primarily to Italy (over 20%), Germany (14%), and also the United Kingdom (6%). From Rotterdam, palm oil is redistributed to other

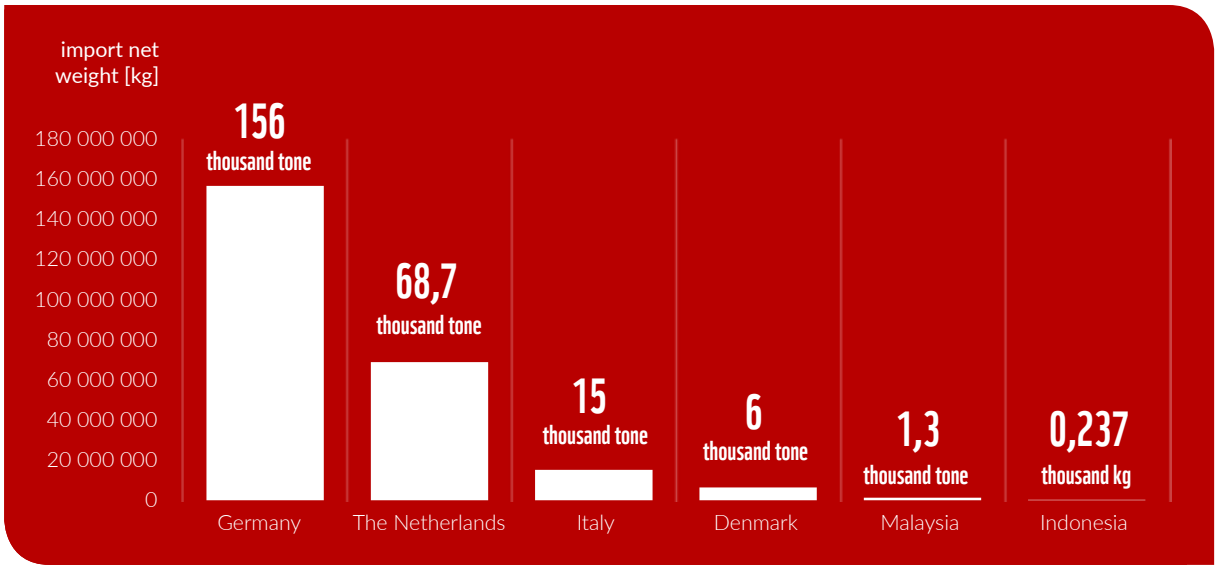


Chart 6. *Origins of palm oil in Poland*

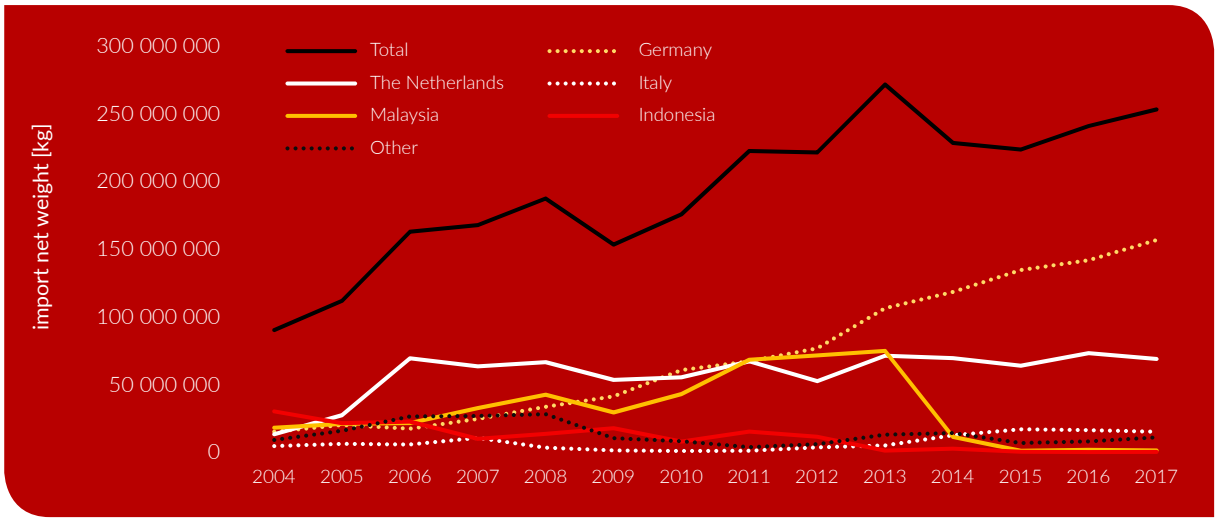
Source: Central Statistical Office, foreign trade.[15]

European countries: Spain, France, or Germany. Poland receives palm oil mostly from Germany and the Netherlands. Direct import from Malaysia and Indonesia is decidedly small in Poland. According to the Oil World Annual 2016 report, over 200 thousand tonnes of oil reached Poland in 2016. Taking into consideration the total import of palm oil to the European Union, its biggest part is redistributed to the Benelux countries (over 300 thousand tonnes annually), Germany (250 thousand tonnes), France (220 thousand tonnes), and Poland (210 thousand tonnes). According to the current data from Central Statistical Office (in accordance with the data provided by Oil World Annual 2016), it is estimated that 248 thousand tonnes of palm oil reaches Poland annually (2017). Chart 6 presents the origin of palm oil imported to Poland.

It should be noted that historical data on palm oil import to Poland were fluctuating significantly throughout the years, which has been presented in Chart 7.

Chart 7. *Import of Palm Oil to Poland in years 2004-2017*

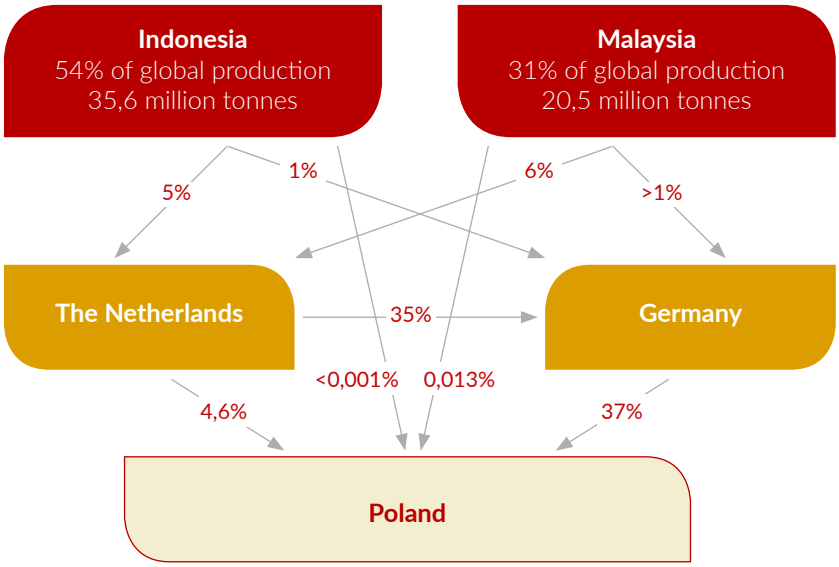
Source: Central Statistical Office, foreign trade.[15]



Based on the data provided by Central Statistical Office, in 2017 248 thousand tonnes of palm oil was imported to Poland as raw material. Germany, the biggest exporter of palm oil to Poland, import the raw material not only directly (from Indonesia, Malaysia, or other producer countries), but mostly from the Netherlands. In order to understand better where does palm oil as raw material come from, an analysis of import/export was performed based on the data from 2017, and its results are presented in Chart 8.

Chart 8. *Delivery chain of palm oil to Poland*

Source: Frost & Sullivan.



The above diagram does not include other countries producing palm oil, i.e. Columbia or Nigeria, and also the import of the raw material from Germany to the Netherlands. The above data are estimates, however, the values confirm the data of Central Statistical Office, according to which Germany take the first place among the countries exporting palm oil as raw material to Poland.

POLAND RECEIVES PALM OIL MOSTLY FROM GERMANY AND THE NETHERLANDS. MOST OF THE PALM OIL IN THE NETHERLANDS AND GERMANY COMES FROM PALM OIL PLANTATIONS IN INDONESIA AND MALAYSIA, SO IT CAN BE ASSUMED THAT THE PALM OIL REACHING POLAND COMES FROM THESE TWO ASIAN COUNTRIES

Palm oil from Germany reaches Poland mostly as direct import, whereas in the case of the Netherlands it is mostly direct and indirect (through Germany) import. Taking into account the marginal significance of direct import of palm oil to Poland from Malaysia and Indonesia, it should be assumed that the palm oil reaching Poland comes from the same countries exporting it to the Netherlands and Germany. The import[16] and export[17] data suggest that the main country of origin of the palm oil reaching the Netherlands and Germany is Indonesia. Based on source data and own calculations, it follows that it is respectively 30% in the case of the Netherlands, and 25% in the case of Germany. It can be concluded that most of the palm oil reaching the Netherlands and Germany comes from certified plantations. It is confirmed by RSPO data[18]. Based on the report prepared by ESPO (*Progress report on the import and use of sustainable palm oil in Europe, 2017*) it was concluded that **69%** of the total amount of palm oil exported to Europe to be used in food industry comes from certified sources, and **60%** of palm oil used for food production is CSPO (*Certified Sustainable Palm Oil*), taking into consideration data for 2016. The data on certified palm oil imported to Germany and the Netherlands is presented in Table 1. It has been assumed that the total share of certified palm oil imported

to Poland is equal to the European average for food industry, i.e. 69%. This is approximate data resulting from the lack of precise data. Taking into consideration the fact that food industry is one of the main applications of palm oil, and that most of palm oil as raw material comes to Poland from Germany, where 72% of palm oil is certified, one can conclude this assumption to be correct. However, accurate inspection of the amount of certified palm oil in Poland is quite complicated, and the lack of accurate data from producers is an additional difficulty.

Country name	Estimated ratio of used CSPO
Germany	Already in 2015 72% of palm oil used in food industry was certified oil.
The Netherlands	Already in 2016 90% of palm oil used in food industry (main application of palm oil in the Netherlands) was certified oil.

Table 1. *Import of certified palm oil to Germany and the Netherlands*

Source: RSPO.

Globally, certified palm oil is produced from 3.68 million hectares, translating into annual production of 13.64 million tonnes of RSPO certified palm oil. This constitutes only 19% of total global production[18].

Charts 9 and 10 present values of exporting palm oil from Malaysia and Indonesia to other countries.

Chart 9. *Data on palm oil export from Malaysia, with division into countries receiving the raw material[19,20]*

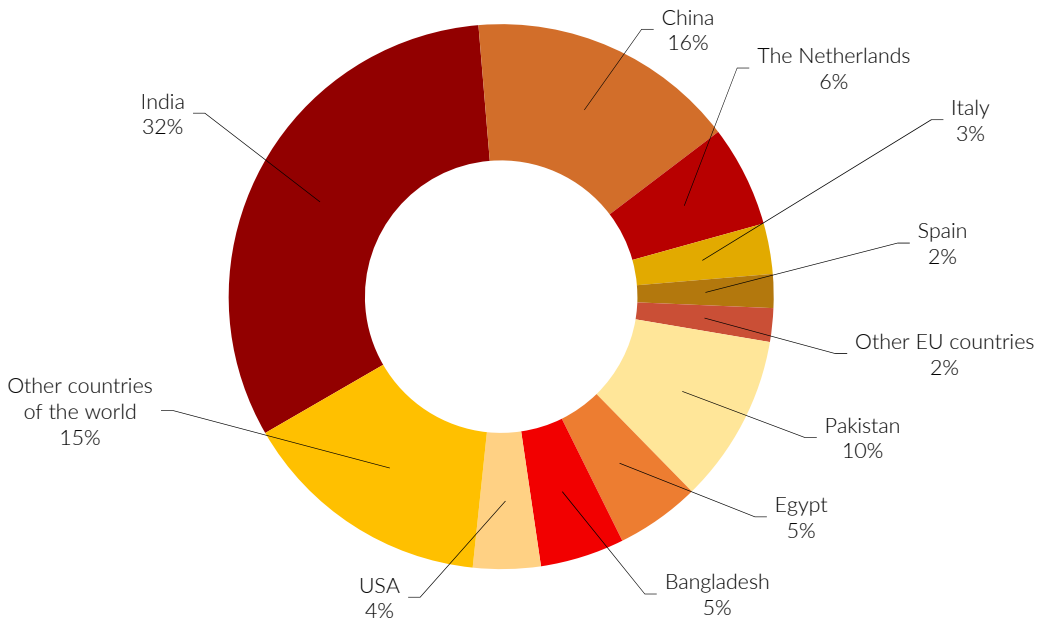
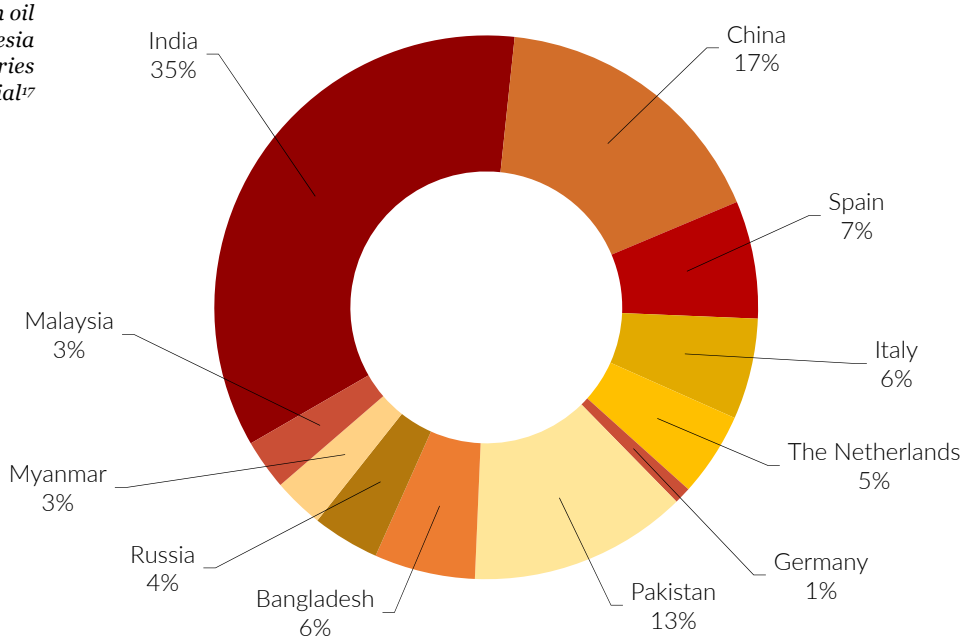


Chart 10. *Data on palm oil export from Indonesia with division into countries receiving the raw material*[17]



In Indonesia, 80% of palm oil production is exported abroad (according to *Palm Oil EU Fact Sheet*, 24/04/2018, and own calculations)[21]. On the basis of Charts 9 and 10 it can be concluded that Poland is not a significant buyer of palm oil. Among the European Union member states, the share of countries like the Netherlands or Germany would seem to have a more significant impact on the global circulation of palm oil. However, the traced palm oil routes to Poland presented in Chart 8 suggest that the Netherlands and Germany are not its destinations. The port in Rotterdam (the Netherlands) is a point of reception of palm oil, which then goes to other countries, including Poland, as raw material. It is traded both directly between the Netherlands and Poland, and also via Germany.

THE WHOLE IMPORT OF PALM OIL TO POLAND IS AS MUCH AS 445 THOUSAND TONNES (AS RAW MATERIAL AND IN HIDDEN FORM)

One should also not forget about the fact that palm oil reaches Poland in ready products, which is discussed in subchapter 2.3. According to the data of Central Statistical Office, it is estimated that 188 thousand tonnes of palm oil in products (in hidden form) reaches Poland annually. This shows how significant palm oil is for food and chemical industries, the whole import of which to Poland is as much as 445 thousand tonnes (as raw material and in hidden form). For comparison, the annual production of rapeseed oil in Poland is 465 thousand tonnes. The fact that a large amount of palm oil reaches Poland in hidden form makes the entrepreneurs, decisive bodies, and consumers can be unaware of the total scale of palm oil import to Poland.

2.3. Import of Palm Oil to Poland in Products

Palm oil is an ingredient of numerous foodstuffs, cosmetics, animal feed and biofuels. A more precise analysis of applications and the properties of palm oil are discussed in chapters 3 and 4.

In order to perform full volumetric analysis and analysis of scale scale of palm oil import to Poland, its content in products was also analysed. It is a simplified analysis, based on the assumptions and estimated data described in the further part of the subchapter, and it is aimed only at

estimating the scale in which palm oil reaches Poland in processed form. A similar report was prepared for the UK market in 201022 and it revealed that palm oil in hidden form can constitute from 30% to even 50% of the total import of this ingredient to that country.

In order to estimate the scale of palm oil import in products, import of products with palm oil content to Poland was analysed. In order to simplify the analysis, content ratios for individual product groups are going to be assumed, as well as their volumes, based on the generally available data prepared by Central Statistical Office. It should be noted that some products are exported from Poland. When calculating the total amount of palm oil in hidden form, the value of export and import of the listed products with palm oil content was taken into consideration. A more precise analysis of the application of palm oil in products, and also the physicochemical properties and the possibility of replacing it with other oils and their substitutes are presented in the following chapters (3 and 4).

When estimating palm oil consumption amount in Poland, the following product categories were taken into consideration:

- foodstuffs, i.e. margarines, ice cream, cookies, baked goods, chocolate goods, snacks and salty products, including bread and crisps,
- chemicals and cosmetics, i.e. soaps, shampoos, and detergents,
- animal feed,
- biofuels.

42% OF TOTAL PALM OIL CONSUMPTION IN POLAND IS BASED ON PALM OIL IN PRODUCTS (IN HIDDEN FORM), AND 58% REACHES POLAND AS RAW MATERIAL

A big part of the products imported to Poland has palm oil content. Taking into consideration the results of the report for the UK[22], 30-50% of total palm oil consumption includes products, and the remaining 50-70% is as raw material. In the case of the Polish market, the analysis results suggest a similar division of the total amount of palm oil consumption. According to the analysis based on the data from Central Statistical Office and own calculations, 42% of total palm oil consumption in Poland is based on palm oil in products (in hidden form), and 58% reaches Poland as raw material.

Estimating the volumetric amount of palm oil reaching Poland in products poses a challenge. The main difficulty is the way this raw material is presented in statistical data from Central Statistical Office. Product groups can have palm oil content, but also include other vegetable oils. In order to obtain more accurate data, it would be necessary to trace all the product categories, one product after another, taking into consideration individual manufacturers.

In order to enable the assessment of the scale of palm oil import to Poland, the analysis should be simplified by applying certain assumption regarding the average content of palm oil in a given type of product, multiplied by the approximate evaluation of the market share of products with palm oil content in comparison to products with other vegetable oils or their substitutes.

The calculations from Table 2 were largely based on the data provided by the report for the UK market. Some data was corrected due to the specificity of the Polish market, in which, e.g. bread usually has no palm oil content, and peanut butter is consumed in much smaller quantities, despite the fact that it can have big palm oil content. Therefore, palm oil as peanut butter content was marginalised in the case of the Polish market. Additionally, there are significant differences regarding biofuels.

In the European Union over 50% of palm oil is used for the production of biofuels[23], while the share of imported biofuels in the Polish market and the application of palm oil in biofuels is much smaller than in the countries of Western Europe. Again, it should be noted that this proportion will be minimised in relation to the discontinuation of palm oil use in biodiesel in the next decade.

Table 2. *Import of selected goods to Poland, 2017*

Sources: secondary data[15,22], Frost & Sullivan.

Group of products	Type of product	Import [kg]	Estimated content of palm oil	Estimated amount of palm oil in products imported to Poland [kg]
Foodstuffs	Margarine	100 483 052	24%	24 115 932
Foodstuffs	Baked goods	81 969 104	1%	819 691
Foodstuffs	Cookies	83 128 104	10%	8 312 810
Foodstuffs	Chocolate	187 724 600	5,15%	9 667 816
Foodstuffs	Ice cream	22 433 221	10%	2 243 322
Foodstuffs	Potato chips	17 977 923	2%	359 558
Foodstuffs	Crisps	12 326 360	5%	616 318
Animal feed	Feed	706 592 861	1%	7 065 928
Chemicals and cosmetics	Soaps	51 702 665	55%	28 436 465
Chemicals and cosmetics	Surfactants	477 036 791	20%	95 407 358
Chemicals and cosmetics	Shampoos	56 107 454	5%	2 805 372
Biofuels	Biofuels	269 039 878	3%	8 071 196
Total				187 921 771

Detailed information on product groups, i.a. CN codes, and additional information on the methodology of calculations are included in Appendix No. 1.

The total palm oil import in products is estimated at 188 thousand tonnes. It should be noted that in the case of import in products, the largest amount of palm oil is in chemicals – 68%, 28% in food and animal feed, whereas only 4% of palm oil import in products is attributed to biofuels. According to the data from Central Statistical Office, all of the aforementioned products (excluding hair care products and chocolate) are mainly imported from Germany. Baked goods import (excluding i.a. pizza doughs, frequently with palm oil content) constitutes up to 65% of the total import of such products to Poland from Germany. Based on the data on foreign trade provided by Central Statistical Office, it can be concluded, therefore, that palm oil as product content reaches Poland primarily from Germany. Chart 11 presents the division of palm oil imported in products into specific economic sectors.

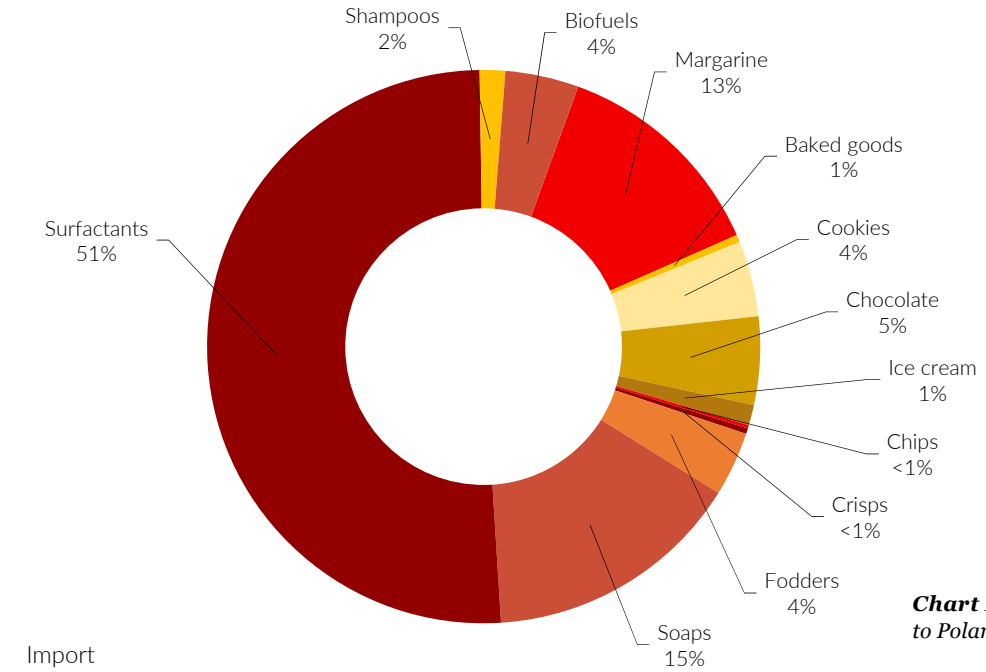


Chart 11. *Import of palm oil to Poland in products, 2017*

Source: Frost & Sullivan based on source data from Central Statistical Office and the DEFRA 2011 report.

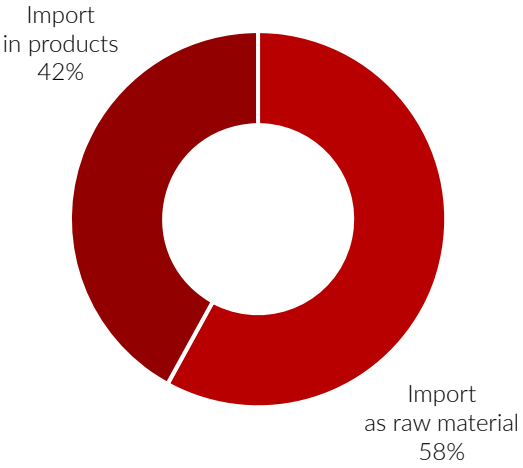


Chart 12. *Estimated amount of palm oil imported to Poland as raw material and in products, 2017*

Charts 11 and 12 present respectively the division of palm oil import to Poland in the form of products and the total palm oil import. Based on the calculations, which are largely estimates, one can determine the scale of total palm oil import to Poland. The total amount of palm oil imported to Poland in 2017 is 445 thousand tonnes. It is worth noting that this number includes also the additional 9,500 tonnes of palm oil from the solid remainder (ground or granules) from the extraction of oils from palm nuts or their kernels (CN230660-Makuchu).

It should be emphasised that this is estimate data, however, the fact that palm oil reaches Poland also in products, and in the amount equal to 42% of total import, is a credible assumption, significantly influencing the more reliable image of the market and oil consumption in Poland.

Palm oil – both as raw material and as a product ingredient (in hidden form) – reaches Poland mainly from Germany. One could assume then that it comes from the countries exporting it to Germany, i.e. primarily Indonesia and Malaysia (with slight dominance of Indonesia). As the country of origin in individual products is not known, it has been assumed that it comes from one of these two countries.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2.4. Poland's Position in the Global Palm Oil Trade

Global palm oil trade is very complex and the relative assessment of the traded quantities largely depends on the assumptions. As shown in the aforementioned data, palm oil is a subject of international trade, and it often reaches Poland indirectly. This part of the report includes an attempt at assessing the volume of palm oil consumption in Poland in comparison to other countries of Europe and world. Chart 13 presents average annual consumption of palm oil per capita. Palm oil consumption in Poland is decidedly lower than European average and it is 9.8 kg per capita, in comparison to 12.8 kg according to the EU average. The high degree of application of palm oil in the production of biodiesel can be one of the factors justifying this disproportion. However, Poland is above the world average, which is 8.8 kg per capita. Calculation of palm oil consumption per capita does not take into consideration the economy of a given country. In order to obtain a more appropriate analysis, palm oil consumption in Poland, Europe and world per GDP was compared. The data is presented in Chart 14.

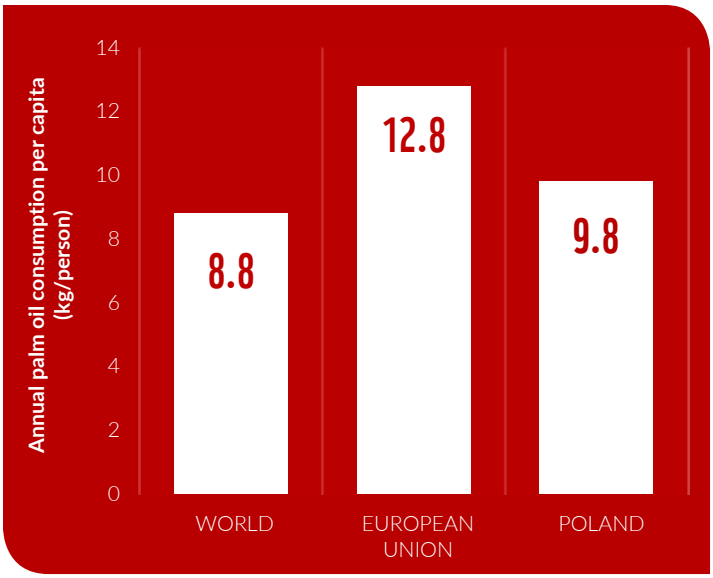


Chart 13. *Average annual palm oil consumption per capita*

Source: Frost & Sullivan.

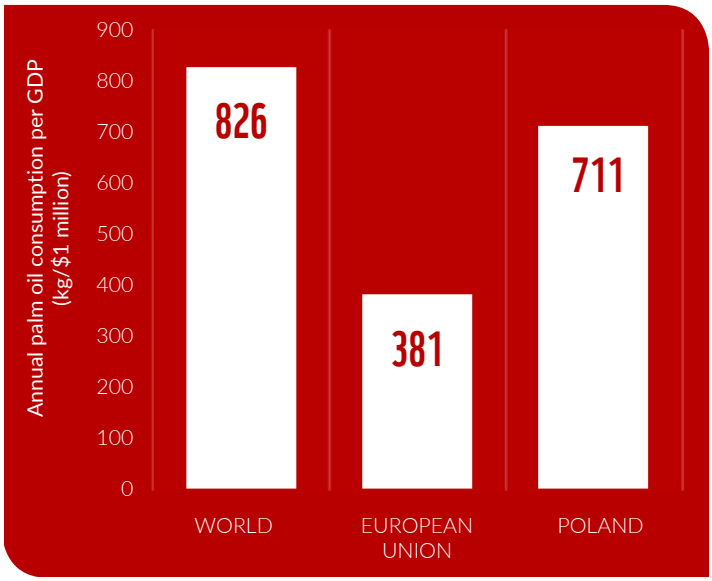


Chart 14. *Average annual palm oil consumption per GDP unit*

Source: Frost & Sullivan.

Per gross domestic product, Poland is decidedly above the average EU consumption, however, below the global average. The conversion factor presented in Chart 14 seems more objective, as it takes into consideration not only the number of citizens, but also the country's economic power. What follows from these calculations is that Poland consumes more palm oil than the EU average. Taking into consideration the country's economy (GDP per capita), Poland is a large driving force behind palm oil consumption in the European Union.

PER GROSS DOMESTIC PRODUCT, POLAND IS DECIDEDLY ABOVE THE AVERAGE EU CONSUMPTION

3. GENERAL CHARACTERISTICS AND APPLICATION OF PALM OIL

3.1. Palm Oil Characteristics

Palm oil can be obtained both from fruit flesh of oil palm and from oil palm kernels. Depending on the part of the plant the oil is obtained from, it can have different physicochemical properties, which translates into different applications. Fresh fruit are ground in order to extract raw palm oil from mesocarp (flesh) of the fruit, and palm kernels are isolated from palm nuts and ground in order to obtain palm kernel oil. Palm oil can be used both raw and refined. Only 25% of palm oil and palm kernel oil worldwide is used raw[24]. In Europe and in the United States palm oil is used mostly in the refined form – light yellow odourless substance with half-solid consistency. The product of refinement process is a distillate, which is fractionated in order isolate stearin and palm olein with different physical properties, which differentiates their applications. Refined palm oil is an ingredient providing texture and consistency to many products. Thanks to moderate price, it is an ingredient present in numerous foodstuffs, e.g. in margarine, sweets, chocolate, ice cream and confectionery. Palm kernel oil has more saturated fats than palm fruit oil, which makes its consistency solid. Therefore, it is a perfect raw material for the production of soaps, detergents, and cosmetics, which is discussed in more detail in further subchapters. Palm kernel oil is similar in composition and chemical properties to coconut oil, therefore, its applications are similar: it is used interchangeably or in combination with other vegetable oils in cookies, glazing agents for food, ice cream or icings[25]. Palm kernel oil is the main raw material for the production of short-chain fatty acid, alcohols, methyl esters, fatty amines for use in detergents and cosmetics[26]. To simplify the analysis, it has been assumed that the term “palm oil” refers to both palm oil and palm kernel oil of African oil palm.

REFINED PALM OIL IS AN INGREDIENT PROVIDING TEXTURE AND CONSISTENCY TO MANY PRODUCTS. THANKS TO MODERATE PRICE, IT IS AN INGREDIENT PRESENT IN NUMEROUS FOODSTUFFS, E.G. IN MARGARINE, SWEETS, CHOCOLATE, ICE CREAM AND CONFECTIONERY

In the global context, palm oil has application primarily in food industry (Chart 15). Locally, the main applications of palm oil vary and differ significantly from the global values. E.g. palm oil application in Poland is different from the application e.g. in Germany, where palm oil application in biodiesel is 41% (data: WWF Germany report, 2016), whereas in Poland biofuel consumption is much smaller, and according to own calculations taking into consideration biofuel import to Poland (data from Central Statistical Office, 2017), it is 2% of the total palm oil market in Poland (estimate). Food, including animal feed, is estimated at 64% of the total (calculation methodology is included in the appendix to chapter 3), and industrial applications (soaps, surfactants and hair care products) are 34% of the total market. The dominant products with the

Chart 15. *Basic sectors of palm oil application globally*

Source: WWF Au der Olspur 2016 Germany.

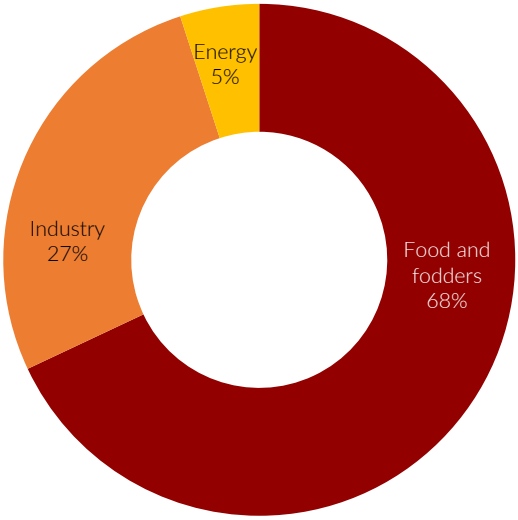
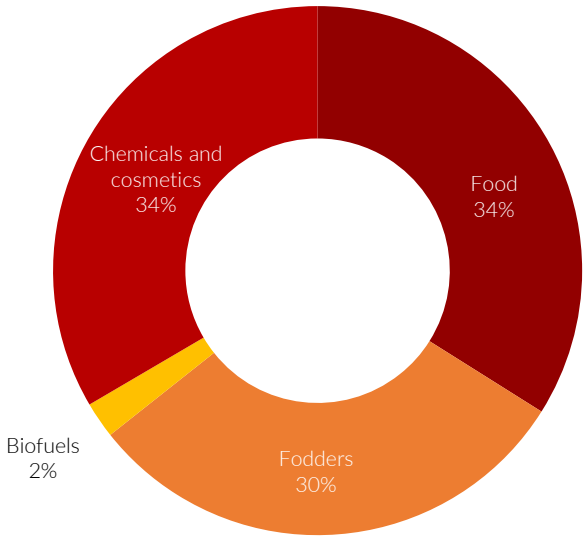


Chart 16. *Application of palm oil in individual segments in Poland*

Source: Central Statistical Office, Frost & Sullivan.



highest estimated palm oil content in Poland are soaps and surfactants. It results primarily from high content of vegetable fats and from the fact that a very big part of such vegetable oils, specifically due to the cost factor, is palm oil. Chart 16 presents estimated division of palm oil applications in Poland. The calculation procedure is included in appendix to chapter 3.

3.2. Application of Palm Oil

The applications of palm oil in Poland relate to the sectors included in Chart 17.

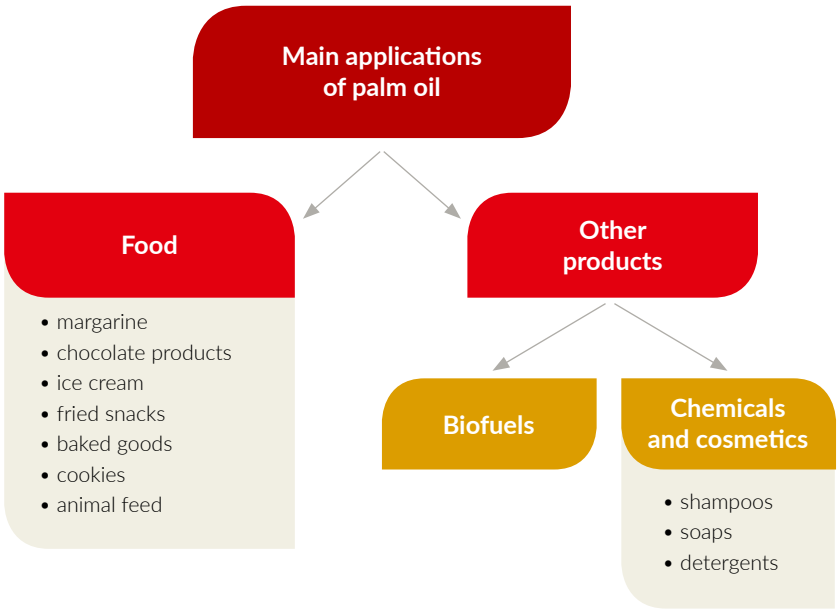


Chart 17. *Main applications of palm oil in Poland*

3.2.1. Foodstuff Market

The wide range of the foodstuff sector in Poland includes processing vegetable and animal products, secondary processing (baking, confectionery, concentrated food, non-alcoholic beverage industries), and the production of stimulants[27]. Poland is currently the eighth market size for trading foodstuffs in Europe[28]. In 2017, the value of agricultural and food products was approximately 20% of all the products manufactured in Poland[29]. Palm oil has wide applications in the production and processing of food. The estimated use of oil in this branch of industry is 68% globally (Chart 15). A big advantage of using palm oil in the production of food and preparing meals are its nutritional properties. Palm oil contains almost the same amount of saturated fatty acids (primarily palmitic acid – approximately 43%), and unsaturated fatty acids (oleic acid – approximately 36%, and linolenic acid – approximately 10%). The ratio of saturated fatty acids and unsaturated fatty acids is more favourable than in other oils and butters with similar applications. Apart from the balanced acid homeostasis, palm oil contains many nutrients, i.a. carotenoids, tocopherols, tocotrienols, sterols, squalene, coenzyme Q10, phospholipids, or polyphenols. Despite the fact that these nutrients do not exceed 1% in the oil, they play an important part in such parameters as persistence and quality of oil. Additionally, all of the aforementioned substances have antioxidative properties. The presence of natural antioxidants in palm oil extends the use-by date of the oil itself and of the products containing it. Palm oil has low melting point, high smoke point, and it is chemically stable in a wide range of temperatures, making it a frequently used ingredient in cooking and frying food[30]. The properties of palm oil, such as high melting point and

IN CONTRAST TO LIQUID OILS, PALM OIL DOES NOT HAVE TO UNDERGO THE PROCESS OF HYDROGENATION, IN ORDER TO GET AN APPROPRIATE, SOLID CONSISTENCY OF FAT. SIMILARLY TO MOST OF NATURAL KERNEL OILS, PALM OIL CONTAINS VERY SMALL AMOUNT OF TRANS FATS (LESS THAN 1%). IN MANY FOOD APPLICATIONS THE USE OF PALM OIL AND ITS FRACTIONS TURNED OUT TO BE OF KEY IMPORTANCE TO LOWER THE LEVEL OF TRANS FATS

half-solid consistency (in room temperature) allow to use it in many food applications. For some food applications (cookies, chocolate products), the liquid state of matter of oils is undesirable. In contrast to liquid oils, palm oil does not have to undergo the process of hydrogenation, which is based on breaking double bonds in mono- and polyunsaturated fats, and binding hydrogen molecules to them in order to get an appropriate, solid consistency of fat. Similarly to most of natural kernel oils, palm oil contains very small amount of trans fats (less than 1%). In many food applications the use of palm oil and its fractions turned out to be of key importance to lower the level of trans fats. E.g. lowering their content in margarine is mainly the effect of using a special combination of palm oil and liquid oils[31].

Palm oil found an application in various types of modifications, such as interesterification or blending fats with different physical properties[32].

Pursuant to the Resolution of the European Parliament and Council (EU) No. 1169/2011, which became effective in December 2014, palm oil content in foodstuffs should be provided on the label. Also, the use of palm oil or its derivatives may be indicated by designations: E471 emulsifier (used in margarines), and CBE and CBS fats (cocoa butter substitutes in chocolate products).

Hydrogenating oils is a special case of palm oil application. The process of hydrogenating oils and fats has been widely used since the 20th century, as it allows to adjust the properties of a broad range of fats. The process of hydrogenating fats is used, because it allows to make solid and half-solid fats out of their liquid counterparts. Despite the fact that hydrogenating palm oil is not necessary, food manufacturers use this process for several reasons. Due to its structure, hydrogenated fats oxidise slower, and can be used for a longer time (also for repeated frying), and baked goods prepared on the basis of hydrogenated fats have a longer use-by date, better porosity and smoother texture. Hydrogenated oil (or its fractions) is especially frequently used in the production of salty snacks, crisps[33], and sweets, where hydrogenated fats play the role of an inexpensive filler[34]. The reason why specialists dissuade from consuming products containing partially hydrogenated fats is the fact that during this process trans fats are formed, which have a negative impact on health. World Health Organisation (WHO) appeals to the governments of countries of the world to eliminate industrially created trans fats from circulation. Consuming them is related to increased risk of diseases, i.a. circulation diseases. It should be noted that in milk fat and in the meat of ruminants there are naturally present small amounts of trans fats. WHO recommends limiting the total consumption of trans fats to less than 1% of total energy consumption, which translates to less than 2.2 g per day in a diet of 2000 kcal. Another important issue is the question of of full hydrogenation of fats. Despite the fact that as a result of this process no trans isomer of fatty acids are formed, but saturated acids, however, this process eliminates the most valuable oil and fat compounds – unsaturated fatty acids[35].

3.2.1.1 Margarine and Spread Market in Poland

Palm oil and its derivatives are indispensable ingredients of fat spreads, mixes and margarines. Margarine contains at least 16% of water and a minimum fat content of 80%, although low-fat creams (mixes) have lower fat content and higher water content. Usually, fat content includes a mix of oils – palm oil, palm kernel oil, palm olein (liquid fraction of palm oil), palm kernel olein, rapeseed oil, and it can also include soybean oil, coconut oil, or sunflower oil. The possibilities of using these oils are discussed in detail in the chapter on the possibilities of replacing palm oil.

It should be emphasised that among margarines, most of the products contain palm oil. The first place as the ingredient of margarines is held by vegetable oils. Apart from sunflower oil, the majority of margarines has from 20% to as much as 80% mass content of palm oil[22]. To simplify, an average content of palm oil (and its derivatives) in margarine has been assumed at the level of 24%.

In Poland, the consumption of margarine and mixes in 2017 was estimated at 167 thousand tonnes (Central Statistical Office report, 2018), which is 4.3 kg/person on average. Also, assuming an average palm oil content of 24% (average palm oil content in margarine, taking into consideration that not all margarines contain palm oil), the amount of palm oil consumed annually by a Polish citizen only in margarine is estimated at 1 kg.

AMONG MARGARINES, MOST OF THE PRODUCTS CONTAIN PALM OIL. THE FIRST PLACE AS THE INGREDIENT OF MARGARINES IS HELD BY VEGETABLE OILS. APART FROM SUNFLOWER OIL, THE MAJORITY OF MARGARINES HAS FROM 20% TO AS MUCH AS 80% MASS CONTENT OF PALM OIL

3.2.1.2 Chocolate and Chocolate Product Market in Poland

Due to its texture and physicochemical parameters, products made from palm oil are used as a substitute or addition to cocoa butter in chocolate, chocolate products, and bars. An important aspect that makes palm oil an attractive addition to this type of products is the high melting point in comparison to vegetable oils. This is especially significant in the production of chocolate products, where melting point should be at the level of 30-35°C[38].

The consumption of chocolate and chocolate products in 2017 in Poland was 164 thousand tonnes (source: Central Statistical Office report, 2018), which means, that the consumption per capita in Poland is 4.26 kg annually. Chocolates contain on average approximately 30-32 g of fat in 100 g of product[39]. Some cocoa fat is substituted or supplemented with vegetable fat. Pursuant to Directive 2000/36/EC, a fat addition other than cocoa fat can be used in chocolate products in the amount of up to 5% of the total cocoa mass content, otherwise the product cannot be called chocolate. The above clause, however, does not apply to chocolate fillings in baked goods, chocolate candies, and bars[40]. The application of fat other than cocoa fat or its substitutes imposes on the manufacturer the obligation to place an appropriate information on the packaging of the ready product (Directive 2000/36/EC of the European Parliament and Council of 23rd June 2000 on cocoa and chocolate products intended for consumption by people)[41]. Palm oil constitutes a decided majority of substitutes and cocoa butter substitutes. Another very popular vegetable fat used in the production of chocolates and chocolate products is shea butter[42]. In order to simplify the analysis, the average palm oil content for chocolate products has been assumed at the level of 5.15%.

DUE TO ITS TEXTURE AND PHYSICOCHEMICAL PARAMETERS, PRODUCTS MADE FROM PALM OIL ARE USED AS A SUBSTITUTE OR ADDITION TO COCOA BUTTER IN CHOCOLATE, CHOCOLATE PRODUCTS, AND BARS

3.2.1.3 Ice Cream Market in Poland

Another important sector, in which palm oil is applied, is the production of ice cream and milk products. In a lot of industrially-produced ice cream the relatively expensive cow milk cream is replaced with cheaper oils, with the most important being the coconut oil[45]. On the other hand, however, the addition of coconut fat causes the increase of the saturated fatty acid content in ice cream, which has adverse effect on the nutritional value of products. In comparison to milk fat and coconut fat, palm oil has less saturated fatty acids. The estimated share of palm oil in ice cream in 2011 was 10%[22]. According to data provided by Central Statistical Office and own estimates, the consumption of ice cream per capita in Poland was 5.7 L per capita in 201715, which, with the assumed ice cream density of 0.6 g/cm^3, means that ice cream consumption can be respectively approximated to 3.4 kg per capita annually[45,46].

IN A LOT OF INDUSTRIALLY-PRODUCED ICE CREAM THE RELATIVELY EXPENSIVE COW MILK CREAM IS REPLACED WITH CHEAPER OILS, WITH THE MOST IMPORTANT BEING THE COCONUT OIL

3.2.1.4 Cookie Market in Poland

For the production of sweet cookies and salty crackers margarine and fat spreads are used, which can contain palm oil and its derivatives. Additionally, creams, fillings and sponge cakes, as well as dyes, flavours, and emulsifiers are often made from products of palm oil processing. Higher fat content in cookies usually indicates higher content of palm oil[22]. Also butter and margarine mixes are used, probably with palm oil content. The issue that should be emphasised in this product category is the consumer trend regarding the consumption of sweet baked goods like doughnuts, sweet rolls and cakes. Data from Central Statistical Office report on Poles' eating habits indicate average consumption of 15 kg of products from the category of cakes and sweet baked goods (excluding cookies) in an average household[48]. According to the estimates based on data from Central Statistical Office, in 2017 Poles bought over 365 thousand tonnes of cookies and sweet breads, including: wafers, sweet buns, or croissants. Having in mind the aforementioned data, the total consumption of cookies and sweet baked goods was estimated at 9.5 kg per capita in 2017. This data is confirmed by the figures from Statista[49,50]. 10% of average volumetric content of palm oil has been assumed in the category of cookies and sweet baked goods.

FOR THE PRODUCTION OF SWEET COOKIES AND SALTY CRACKERS MARGARINE AND FAT SPREADS ARE USED, WHICH CAN CONTAIN PALM OIL AND ITS DERIVATIVES

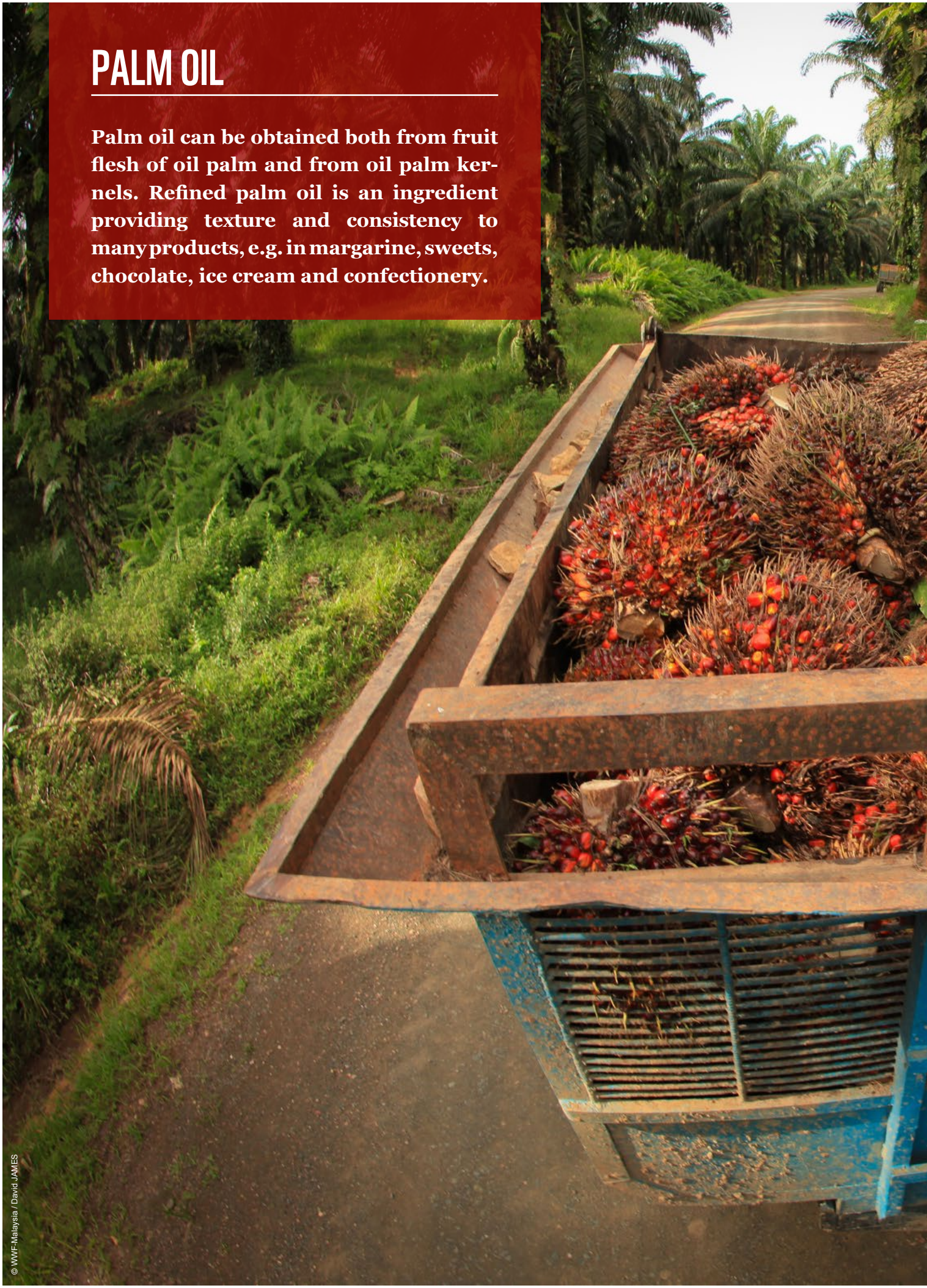
3.2.1.5 Salty Snack Market

High smoke point and persistence of chemical properties of the oil in high temperature make palm oil generally used for frying i.a. crisps, chips, and other foodstuffs included in salty snacks. According to own estimates, approximately 3.1 kg of crisps and 6 kg of chips are consumed per capita annually in Poland. In comparison to Germany, the estimated content of palm oil in snacks is significantly higher in Poland, because in Germany sunflower oil is used in some products[52].

Crisps are the most frequently consumed product of the salty snack group (up to 45%), however, products like crackers, sticks, puff snacks, nuts and popcorn also can contain palm fat[53].

PALM OIL

Palm oil can be obtained both from fruit flesh of oil palm and from oil palm kernels. Refined palm oil is an ingredient providing texture and consistency to many products, e.g. in margarine, sweets, chocolate, ice cream and confectionery.



3.2.1.6 Bread

Palm oil is widely used in the production of bread, especially in salty rolls and ready-made pizzas sold in supermarkets. In pizzas, palm oil content is on average 3%[22]. Retail chains, e.g. Lidl, declare that all of the palm oil used for the production of bread or cakes is 100% certified (RSPO)[55]. Despite the low content of palm oil in products, the production of bread is an important market of palm oil, which results from the high production volume. In comparison to the countries of Western Europe (e.g. the UK), palm oil content in bread in Poland is significantly lower. This results i.a. from eating habits taking into consideration the lower consumption of toast bread (containing relatively higher amount of palm oil) in comparison to rye bread, spelt bread, mixed bread, etc.

The Central Statistical Office reports show that in 2017 the estimated bread consumption in Poland was 42 kg per capita. Eating habits in Poland (regarding baked goods) are different from Western Europe. We eat much less high-processed products, such as toast bread or ready-made pizza crust. Palm oil content in the bread consumed in Poland (most frequently baked in local bakeries) is lower. In order to simplify the calculations, the average palm oil content in baked goods has been assumed at the level of 1%.

HIGH SMOKE POINT AND PERSISTENCE OF CHEMICAL PROPERTIES OF THE OIL IN HIGH TEMPERATURE MAKE PALM OIL GENERALLY USED FOR FRYING I.A. CRISPS, CHIPS, AND OTHER FOODSTUFFS INCLUDED IN SALTY SNACKS

3.2.2. Chemicals and Cosmetics

3.2.2.1 Cosmetics Market

Refined palm oil is used in cosmetic industry as a direct ingredient of balms and creams. Oleochemicals of palm origin are used in the sector of personal hygiene products as surfactants and emollients (moisturisers), and also as viscosity modifiers, conditioners and antioxidants[56]. Unrefined (raw) palm oil is valued for high content of carotenoids and lycopene, which have antioxidative properties. The volume of use of unrefined palm oil in cosmetics is not significantly high, as its mass content in creams is small, therefore, to simplify the analysis, it has been assumed that palm oil derivatives in the form of surfactants are used in shampoos and washing products, in which their proportional content is decidedly higher[57].

REFINED PALM OIL IS USED IN COSMETIC INDUSTRY AS A DIRECT INGREDIENT OF BALMS AND CREAMS. OLEOCHEMICALS OF PALM ORIGIN ARE USED IN THE SECTOR OF PERSONAL HYGIENE PRODUCTS AS SURFACTANTS AND EMOLLIENTS (MOISTURISERS), AND ALSO AS VISCOSITY MODIFIERS, CONDITIONERS AND ANTIOXIDANTS

3.2.2.2 Soap Market

Soap constitutes approximately 30% of the current global market of surfactants[22]. Anionic surfactants included in soap are good detergents. Mesocarp oil is used to provide hard consistency of the product, while palm kernel oil is used to provide foaming properties. Soap base manufacturers obtain raw palm oil from refineries or entities trading in raw materials. Soap bases are then delivered to secondary manufacturers, who make surfactants and add perfumes, dyes and other components (constituting less than 2% of total mass of ready product), and give soap its final form[22]. Soaps and agents including soap are also used in industry. According to German FNR report, toilet soaps can contain up to 90% of mass derivatives of vegetable oils. However, not all manufacturers use palm oil as the raw material for the production of soaps. Taking into account the above data, palm oil content is soaps was averaged to 55%.

THERE ARE MANY OTHER OLEOCHEMICAL INGREDIENTS GENERALLY USED IN COSMETICS, WHICH CAN BE PALM OIL AND PALM KERNEL OIL DERIVATIVES HIDDEN UNDER THE NAMES LIKE ISOPROPYL MYRISTATE, PALMITIC ACID, GLYCERYL STEARATE, SORBITOL STEARATE, CETYL ALCOHOL, ASCORBYL PALMITATE, TOCOPHERYL ACETATE, STEARYL ALCOHOL, OLEYL ALCOHOL AND OCTYLDODECANOL, SORBITOL OLEATE AND STEARATE, ETHYLHEXYL PALMITATE

3.2.2.3 Shampoo Market

In the segment of shampoos, palm oil is used for the production of surfactants or emulsifiers. Personal hygiene products contain several different types of surfactants, which can originate from palm kernel oil and coconut oil (commonly called lauric oils). Anionic surfactants include the widely used sodium dodecyl sulphates, which are the most frequently used surfactants in shampoos. The content of surfactants in shampoos is on average from 5 to 25%[61,62]. The volume of consumption of hair care cosmetics in Poland in 2017 was 2.5 kg per capita, as estimated on the basis of data from Central Statistical Office. Due to the fact that shampoos constitute a decided majority of hair care products, this value has been rounded[63].

It has been assumed that the average content of products of palm oil origin is 5%. There are many other oleochemical ingredients generally used in cosmetics, which can be palm oil and palm kernel oil derivatives hidden under the names like isopropyl myristate, palmitic acid, glyceryl stearate, sorbitol stearate, cetyl alcohol, ascorbyl palmitate, tocopheryl acetate, stearyl alcohol, oleyl alcohol and octyldodecanol, sorbitol oleate and stearate, ethylhexyl palmitate. Despite the fact that these ingredients can come from other vegetable and animal fast, many of these raw materials come from processing palm kernel oil[65].

3.2.3. Biofuels

Biofuel is one of the three basic applications of palm oil in the global context (Chart 15). In 2017, 51% of palm oil in the European Union was used for the production of biofuels[66]. In Poland, the biocomponents used as additives to motor gasolines (ethanol fuel) and diesel fuel (fatty acid methyl esters) are of the basic importance in the sector of biofuels. The biofuel component of diesel fuel is called FAME (fatty acid methyl ester). FAME are manufactured in the process called transesterification, which is a catalysed reaction between refined oils (vegetable oils, refined animal fats, tallow or used cooking oil) and methanol. The side product of this process is glycerol. The effectiveness of converting from vegetable oil to methyl ester is 98%. In 2014, Poland attained self-sufficiency in producing methyl esters, which dominate both in the consumption structure and in production. The biofuel market in Poland is significantly based on first-generation biofuels, which use oils from useful plants and in the process of transesterification. Currently, traditional rapeseed oil esters hold the dominant position67. Palm oil consumption as raw material in Polish sector of biofuels is relatively low and estimated at 3%. The data is based on information on import (Central Statistical Office, 2017). Export data and data on the domestic production of biodiesel, due to the marginal importance of palm oil, have not been included in the analysis[68,69].

BIOFUEL IS ONE OF THE THREE BASIC APPLICATIONS OF PALM OIL IN THE GLOBAL CONTEXT. IN 2017, 51% OF PALM OIL IN THE EUROPEAN UNION WAS USED FOR THE PRODUCTION OF BIOFUELS

Also palm kernel shells, i.e. the residues of the production of oil, are imported to Poland. They have very high caloric values (on average 4,000 kcal/kg), and include low amounts of sulphur and dust, which makes them attractive vegetable fuel. Palm kernel shells can be burned as independent fuel or high-quality pellets burned in CHP boiler as coal additive[70,71]. To simplify the analysis, this sector has not been taken into consideration, due to the lack of quantitative data.

3.2.4. Animal feed

Another big sector, in which products with palm oil and palm meal are used, is the sector of animal feed. Production of industrial feed in Poland was, according to the data from Central Statistical Office, 10.9 million tonnes in 2016, in comparison to 9.3 million tonnes in 2015. What is more, further increase in production is observed. Palm oil and palm kernel meal are ingredients of animal feed (cattle, sheep, and pigs), pet food (e.g. cats and dogs), and also aquarium fish food. Palm kernel expeller is a source of fibre and minerals, like phosphorus, copper, zinc, and manganese, which makes it a good animal feed ingredient[72]. Based on the data from DEFRA UK 2011, palm oil content in feed and foods is estimated at 1%. Based on the data from Central Statistical Office report on industrial production and own estimates, in 2017 the use of palm oil in feed was approximately 11 thousand tonnes.

PALM OIL CONSUMPTION AS RAW MATERIAL IN POLISH SECTOR OF BIOFUELS IS RELATIVELY LOW AND ESTIMATED AT 3%

3.2.5. Other Applications

3.2.5.1 Chemicals

This category includes primarily cleaning agents used in households and in industry. In detergent industry it should be noted that palm oil in this type of applications is not used as direct unprocessed raw material, but in the form of surfactants and emulsifiers[22]. Almost all cleaning and household products, such as: washing agents, dishwashing liquids, cleaning agents and air fresheners contain surfactants. Surfactants can be made from both petrochemical sources (petroleum derivatives) and oleochemicals (from agriculture). Raw materials for producing vegetable surfactants include primarily palm oil, palm kernel oil, and coconut oil. Oleochemical and petrochemical surfactants are usually used together in detergent formulas. Cationic surfactants, one the other had, are used in softening textiles and in disinfection products. Due to the broad range of applications and the lack of available data on every branch of chemicals, in order to simplify this analysis, general application for soaps and surfactants in industry branch of chemicals and cosmetics has been assumed, without dividing it into industrial and consumer segments.

3.2.5.2 Other Applications

Palm oil and its derivatives also have application in dairy product substitutes (creamers, cheese analogues, vegan cheeses), peanut butter, or in food additives. It should be noted that due to relatively small volume of consumption in Poland, these amounts were skipped.

3.2.6. Data Summary

The data collected during market analysis are summarised in Tables 3 and 4.

The consumption was calculated based on the production data from Central Statistical Office report for 2017, reduced by the export and increased by the import from 2017. The exact methodology of calculations and descriptions of categories are included in the appendix to chapter 3. In the case of soaps and surfactants, consumption per capita was not determined. This shows that some soaps and surfactants are used both in industrial applications and by individual customers. In the case of biofuels, biofuel import has been assumed as the basis, without taking into consideration domestic production, which in Poland is based on oils of domestic origin, mostly rapeseed. Chart 18 presents division of palm oil consumption in Poland, taking end products into consideration.

Annual palm oil consumption in Poland in 2017 was 373 thousand tonnes. Taking into consideration the total import of palm oil as raw material and in products, amounting to 445 thousand tonnes, it is estimated that 72 thousand tonnes is exported from Poland in the form of products. To simplify calculation it has been assumed that export as raw material is minimal.

Table 3. *Summary of the analysis of palm oil market in Poland in food products*

Product	Consumption [kg]/year	Consumption per capita/year	Average palm oil content	Consumption of palm oil in product [kg]/year	Consumption of palm oil per capita [kg]/year
Chocolate	163 914 591	4,8 kg	5,15 %	8 441 601	0,2
Cookies and sweet baked goods	364 872 396	9,5 kg	10%	36 487 240	1,0
Crisps	118 392 237	3,1 kg	5%	5 919 612	0,2
Potato chips	231 657 620	6,0 kg	2%	4 633 152	0,1
Margarine	166 684 189	3,6 kg	24%	40 004 205	1,0
Bread	1 602 665 763	42 kg	1%	16 026 658	0,4
Ice cream	217 875 431	3,4 kg	10%	21 787 543	0,6
Total				**133 300 011**	**3,5**

Table 4. *Summary of the analysis of palm oil market in Poland in products other than food*

Product	Consumption [kg]/year	Average palm oil content	Consumption of palm oil in product [kg]/year
Feed	11 046 749 239	1%	110 467 492
Soaps	64 307 820	55%	35 369 301
Shampoos	96 145 307	5%	4 807 265
Surfactants	406 994 026	20%	81 398 805
Biofuels	269 039 878	3%	8 071 196
Total			**240 114 059**

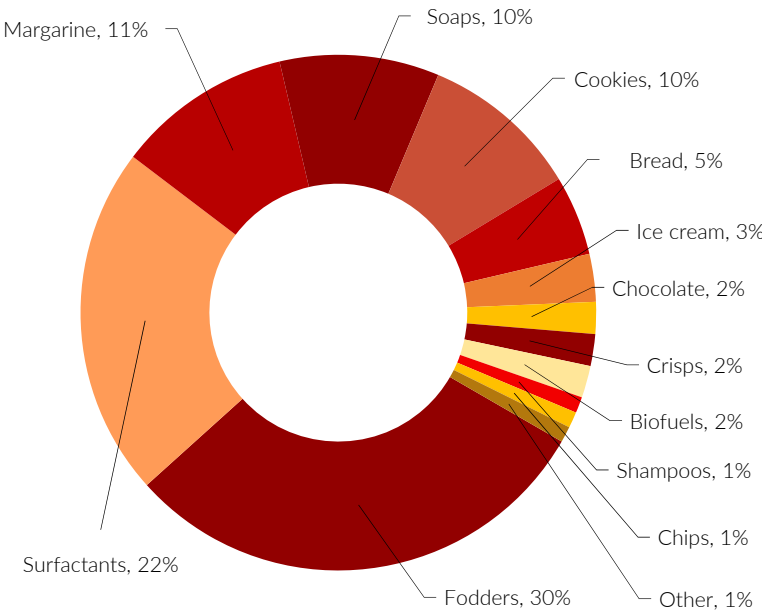


Chart 18. *List of data on palm oil consumption in products in Poland. The calculation method is included in appendix to chapter 3*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4. TECHNICAL POSSIBILITIES OF REPLACING PALM OIL WITH OTHER OILS

4.1. Properties of Vegetable Oils

This chapter presents the possibilities of replacing palm oil with other oils, depending on the area of application. The general analysis of technological possibilities of replacement is summarised in Table 5.

Table 5. *Technological possibilities of replacing palm oil*

Oil type	Food	Chemicals, cosmetics	Feed	Biofuels
Rapeseed oil	+	+	+	+
Sunflower oil	+	+	+	
Soybean oil	+		+	
Olive oil	+	+		
Coconut oil	+	+	+	
Jojoba oil		+		
Jatropha oil				+
Cocoa butter	+	+		
Algae oil				+
Shea butter	+	+		
Beeswax		+		
Recycled vegetable oil				+

The possibilities of replacing palm oil in specific applications are based i.a. on its physicochemical properties, which are described on the basis of the technical data presented in Table 6[74]. Additionally, in some cases of applications, a given fat cannot be used, due to its organoleptic properties. A good example can be algae oil, which, due to its characteristic, strong smell and taste, has small application in food industry.

Fat type	Smoke point [°C]	Melting point [°C]	Saturated fatty acid content [%]	Monounsaturated fatty acid content [%]	Polyunsaturated fatty acid content [%]
Sunflower*	227°C	-17°C	12,8	22,4	66,0
Rapeseed*	220-230°C	-10°C	6,0	62,0	32,0
Soybean*	232°C	-16°C	15,7	24,2	59,8
Olive oil	160°C	-6°C	15,3	73,8	10,0
Coconut oil*	232°C	25-28°C	92,6	6,1	1,9
Shea butter	233°C	28-35°C	46,5	48,0	5,4
Cocoa butter	187°C	34-38°C	64,9	34,1	3,0
Fruit palm oil*	220 °C	30-35°C	43,0	36,5	10,0

* Physicochemical parameters of refined oils have been taken into consideration.

Table 6. *Summary of technical data for selected oils* [74,75,76,77]

4.2. Possibilities of Replacing Palm Oil in Food

Olive oil, due to relatively low smoke point, can be used raw and for cooking. Frying, however, requires fats with higher smoke point. In products for which small amounts of fat (e.g. pizza, baked goods) or liquid fractions of palm oil (olein) are used, it is possible to use liquid oils, such as soybean oil, rapeseed oil, or sunflower oil (frying salty snacks)[78,79]. Many chocolate manufacturers use shea butter instead of cocoa butter in chocolate products, as it has high-quality fats. The possibility of modifying the melting curves of this fat and its persistence make it an attractive ingredient of chocolate products and cookies[75].

The solution that can be used in the production of margarines is replacing palm oil with coconut oil, which has the appropriate physical properties. In the production of soft margarines, the process of interesterification is employed, which results in obtaining solid fat with persistent crystallisation structure. This process is used to decrease saturated acid content and it enables retaining high content of liquid fats (up to 80% of liquid oils in the mass). Interesterification process allows for obtaining tub margarines containing 3-4 times less fatty acids than butter. However, replacing palm oil with other fat more beneficial healthwise (without trans isomers and with smaller amount of saturated fatty acids) would decrease the quality of margarine (it would become too soft and unstable)[77]. It is possible to physically replace palm oil with coconut oil in margarine, however, this will decrease the taste value[78]. Table 7 presents summary of the possibilities of replacing palm oil in food products.

Oil type	Margarine	Chocolate	Cookies	Salty snacks
Rapeseed oil	+		+	+
Sunflower oil	+			+
Soybean oil	+		+	+
Olive oil	+			
Coconut oil	+	+	+	+
Cocoa butter		+		
Shea butter		+		

Table 7. *Possibilities of Replacing Palm Oil in Food*

4.3. Possibilities of Replacing Palm Oil in Chemicals and Cosmetics

Palmitic acid made of palm oil is especially useful in the production of soap. However, it can be replaced with stearic acids, which are present in many vegetable oils and animal fats. Due to the composition of fatty acids, the most appropriate are cocoa butter, olive oil, and shea butter[75]. Shea nut extract butter is generally used in the production of food, as a substitute for cocoa butter and palm oil. It contains significant amounts of vitamins A, E and F, fatty acids (oleic acid, stearic acid, palmitic acid and linolenic acid), as well as triglycerides, waxes, and allantoin. It is a cosmetic raw material with many valuable properties, i.a. it is a natural UV filter. As raw material, shea butter can be used as a substitute for palm oil in the cosmetic sector[80]. Another oil that, due to its composition, is used in the cosmetic industry, is olive oil. It is applied mostly in the production of surfactants and emulsifiers used in cosmetic formulas with soothing and moisturising activities. Similarly to shea butter, olive oil contains many vitamins and antioxidatives. Jojoba oil has the form of light-yellow liquid wax and it is used in the production of cosmetics. Due to its composition similar to sebum, i.e. the lipid protective skin layer, is easily digestible. It contains vitamin E, and it has softening properties. Jojoba oil is a very persistent oil and can be stored in room temperature for a very long time[81]. In cosmetics, jojoba oil is used to make milk cleansers, creams and beauty masks for face and body, hair beauty masks, bath oils, massage oils and micellar liquids, and even perfumes (as fragrance carrier)[82]. Properties of beeswax allow for maintaining a persistent form of emulsion, which is used in cosmetics and care products requiring cream consistency. Waxes also increase the lipid thickness of stick-type products, e.g. lipsticks, providing them with structure, allowing smooth putting on and keeping them solid. Beeswax can also be used for the production of hair removal cosmetics. Additionally, it is used in shine agents for floor or as an ingredient of varnishes[83]. Summary of the possibilities of replacing palm oil in chemicals and cosmetics is presented in Table 8.

Oil type	Soaps	Care products, creams	Shampoos	Colour cosmetics	Household chemicals
Rapeseed oil			+	+	+
Sunflower oil			+		+
Soybean oil			+		+
Olive oil		+			
Coconut oil	+	+	+	+	+
Jojoba oil		+	+	+	
Beeswax		+		+	
Shea butter	+	+	+	+	

Table 8. *Possibilities of replacing palm oil in chemicals and cosmetics* [83,84,85,86,87]

4.4. Possibilities of Replacing Palm Oil in Feed

Livestock animals require high-energy feed, that is why fats are used for their production as effective energy sources. Important properties of the fat used in feed are its persistence and stability of nutrients. E.g. the compositions of soybean oil and rapeseed oil correspond to the compositions of the fats produced by sows during lactation. Piglets reared by sows fed with feed with addition of oil gain weight faster, as with the milk the get easily digested unsaturated fatty acids. Other oils used so far as feed additives are coconut oil and sunflower oil[88]. The production of feed is important in the development of Polish economy, due to high significance of breeding pigs (Central Statistical Office report, 2018).

4.5. Possibilities of Replacing Palm Oil in Biofuels

One of the more promising sources of triglycerides used for the production of biofuels are thyrotrophic algae[89]. They are microscopic, unicellular, prokaryotic or eukaryotic organisms living in seawaters and fresh waters[90]. Thanks to the very big biological potential and properties like high biomass productivity, it was attempted to use them in the energy sector. Microalgae are compared to miniature factories able to simultaneously proliferate biomass and synthesise lipids, mainly triglycerides, and their productivity is much higher than plant productivity[91]. Oil content in dry cell mass for some strains can exceed 80%, however, it usually ranges 20-50%[92]. In contrast to cultivating cereal crops, growing microalgae is not competition for cooking oil, it does not require large spaces, arable lands, it is less dependent on the climate, seasons, and weather. The cycle of growing microalgae is usually approximately 10 days, therefore, biomass can be harvested ten-odd times per year or constantly, making algae an interesting alternative in the production of biofuels. Another promising source of oil in the production of biodiesel is jatropha oil[93]. However, this oil has marginal application in the global

production of biofuels. A significant element of the analysis of the possibility of replacing palm oil as a biofuel ingredient are the current and planned legislative changes. Study results obtained as part of the European framework programme of Horizon 2020 have shown low effectiveness of reducing CO2 emissions by using traditional first-generation biofuels, which are made of raw materials that can be used in food products. This led to proposing amendments to the directives (opinion of the European Economic and Social Committee of 18th April 2013 and the legislative resolution of the European Parliament of 11th September 2013). The discussions and analyses of the functioning of biofuel market resulted in modifying the hitherto adopted solutions with the Directive of the European Parliament and Council (EU) 2015/151313 of 9th September 2015. One of the key changes is identifying the limit of first--generation biofuel amounts, which in 2020 can be maximum 7%[94]. The remaining part, i.e. at least 3%, is to be produced by advanced--generation fuels, i.a. made of algae, side products of agricultural production (e.g. straw, manure, seed hulls, etc.) or waste. In order to encourage their production, the system of double counting was introduced. This means that to meet plan goals, every litre of such fuel is treated as equivalent to 2 litres of traditional biofuels[94,95,96]. Due to high local availability, oils like rapeseed oil, soybean oil, and sunflower oil are good primary substitutes for technical oil to be used in biofuels[97,98].

As part of the EU goals, it is planned to completely eliminate palm oil from biofuels by 2030[99]. Generally, by this year, 32% of the energy consumed in the European Union is supposed to come from renewable sources, and for the transport sector this threshold is lower and set at 14%. Additionally, transport fuel has to contain at least 3.5% of the so--called advanced biofuels, and 7% of energy coming from renewable sources (e.g. in electric cars). What follows is that first-generation biofuels (coming from crops used also for the production of food), will be able to constitute maximum 7% of the fuels used in transport in country scale, and the share of palm oil is to be reduced to zero. The way to reach this goal leads through the implementation of gradual limits to its use. From 2020 on, the member states will be obliged not to exceed the value of consumption of first-generation biofuels from that year, assuming the maximum share of 7% in country scale. In the case of palm oil and soybean oil, already in 2019 the share of these oils in biofuels cannot exceed the value from this year, and from 2023 at the latest it is supposed to fall and reach 0% in 2030[99].

To sum up, the above analysis considered physicochemical properties of oils, which make them proper for use in a given sector. Therefore, this analysis is based on the theoretical possibility of replacing them, without consideration of the economic factors.

STUDY RESULTS OBTAINED AS PART OF THE EUROPEAN FRAMEWORK PROGRAMME OF HORIZON 2020 HAVE SHOWN LOW EFFECTIVENESS OF REDUCING CO2 EMISSIONS BY USING TRADITIONAL FIRST-GENERATION BIOFUELS, WHICH ARE MADE OF RAW MATERIALS THAT CAN BE USED IN FOOD PRODUCTS. THIS LED TO PROPOSING AMENDMENTS TO THE DIRECTIVES (OPINION OF THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE OF 18TH APRIL 2013 AND THE LEGISLATIVE RESOLUTION OF THE EUROPEAN PARLIAMENT OF 11TH SEPTEMBER 2013). THE DISCUSSIONS AND ANALYSES OF THE FUNCTIONING OF BIOFUEL MARKET RESULTED IN MODIFYING THE HITHERTO ADOPTED SOLUTIONS WITH THE DIRECTIVE OF THE EUROPEAN PARLIAMENT AND COUNCIL (EU) 2015/151313 OF 9TH SEPTEMBER 2015. ONE OF THE KEY CHANGES IS IDENTIFYING THE LIMIT OF FIRST-GENERATION BIOFUEL AMOUNTS, WHICH IN 2020 CAN BE MAXIMUM 7%

4.6. Certifications Systems for Other Oils

There are also certification systems of other vegetable oils, including coconut oil. In September 2011, BASF, Cargill, P&G, and GIZ created an initiative of certifying coconut oil obtained from sustainable plantations with transparent delivery chain and improved living conditions of the farmers growing coconut palms in the Philippines, the country with the greatest productivity of this raw material[95]. Over 300 small manufacturers of coconut oil from the Philippines and Indonesia received their Rainforest Alliance sustainable crop certificates meeting the standards of SAN (Sustainable Agricultural Network). Another oil plant with a uniformed crop certification system is soybean[100,101,102]. In 2006, the Round Table on Responsible Soy initiative was created in order to promote sustainable production, processing, trade and use of soybean by developing, implementing and verifying the global standard of production. Currently, over 4,000 manufacturers in Argentina, Brazil, Canada, China, India, Paraguay, and the United States produce over 1.2 million tonnes of certified soybean (RTRS). The number of sustainable plantations is constantly growing[101].

5. IMPACT OF USING PALM OIL SUBSTITUTES ON THE NATURAL ENVIRONMENT

This chapter presents calculations and the results of the theoretical substitution of palm oil with other types of vegetable oils, according to the scenario presented in the previous chapter. This scenario is considered the base and most probable solution. Additionally, an analysis of substituting part of palm oil with the locally produced rapeseed oil was performed. This oil is often listed as the potential substitute for palm oil in the European countries, due to the possibility of growing it locally[13]. The analysis included in this chapter is related to three aspects of plant oil life cycle.

a) land use,
b) carbon dioxide emissions,
c) biodiversity.

The term "palm oil market in Poland" covers both the oil imported as raw material (directly and indirectly), and the oil included in ready products imported to Poland. For the purpose of comparison, it is important to investigate which countries produced the oil reaching Poland. Out of the total amount of 445,000 tonnes of palm oil in the Polish market, 248,000 tonnes reaches Poland as raw material, while the rest is included in the imported products (estimate). The analysis did not include products exported from Poland, treating them as a significant element of the use of palm oil in Poland. In other words, the profits for the Polish companies using palm oil in their products is still counted among the internal palm oil trade. The market of palm oil was similarly described in the report for Germany[13].

5.1. Impact on Global Land Use

Changes in land use are often considered one of the most important factors why palm oil has been the target of criticism in public opinion. This problem mainly applies to Malaysia and Indonesia, especially the provinces of Sumatra and Kalimantant. Changes in land use were calculated with the application of the methodology called "Virtual Agricultural Trade"[103]. The factors used for calculations were based on the data from FAO[104] and Eurostat[105]. Substitution of palm oil with other vegetable oils is based on the analysis performed in chapter 4 and presented in Table 9. Only the vegetable oils which are produced in mass scale and generally used in products have been taken into consideration as the possible substitutes of palm oil. Therefore, the list of potential substitutes was reduced to four types of oil: rapeseed oil, soybean oil, sunflower oil, and coconut oil.

In 2017, rapeseed oil in Poland came mostly from domestic production, which yielded 465 thousand tonnes. The import of rapeseed oil closed in the amount of 142 thousand tonnes, and the main countries of origin

were Germany (47%), Ukraine (18%), and Czech Republic (12%). The import of soybean oil in the same year was 116 thousand tonnes, and it reached Poland mostly from Ukraine (56%) and Germany (34%), while the import of sunflower oil was 150 thousand tonnes and came mostly from Ukraine (56%), Czech Republic (19%), and Hungary (12%). Coconut oil, similarly to palm oil, reached Poland via countries intermediating in trade. From the 24 thousand tonnes of coconut oil in Poland, as much as 76% was imported from the Netherlands, and 14% from Germany[15]. This data is related only to the import of raw materials and does not include oils hidden in product.

Table 9. *Scenario of substituting palm oil with other vegetable oils*

Application	Palm oil (tonnes)	Rapeseed oil	Soybean oil	Sunflower oil	Coconut oil
Margarines, spreads	48 950	25%	25%	25%	25%
Chocolate, chocolate products	8 900	0%	0%	0%	100%
Ice cream	13 350	25%	25%	25%	25%
Cookies	44 500	25%	25%	25%	25%
Fried snacks	13 350	0%	0%	100%	0%
Bread	22 250	25%	25%	25%	25%
Soap, shampoos, surfactants	146 850	0%	0%	0%	100%
Biofuels	8 900	25%	25%	25%	25%
Animal feed	133 500	50%	25%	25%	0%
Other (undetermined)	4 450	0%	0%	0%	0%

In every of the analysed applications a scenario was suggested assuming equal distribution of the production value, for which palm oil was formerly used, by other vegetable oils. E.g. if all four types of fats can be used as palm oil substitutes in the production of margarine and spreads, it is assumed that every one of these oils will substitute 25% of the currently used palm oil. 4450 tonnes of palm oil reaching Poland has undetermined applications, therefore, this value was not analysed.

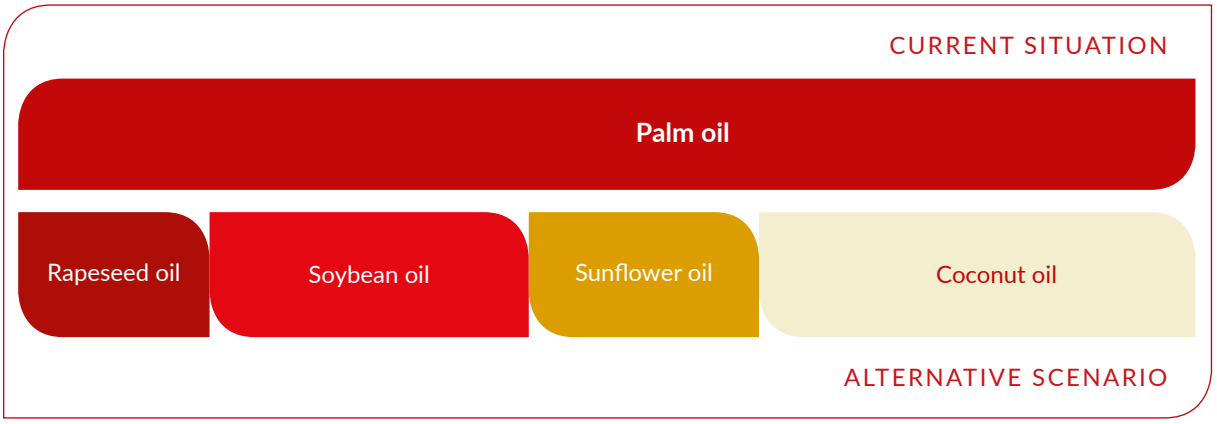
In the next step of the analysis, the values from Table 9 were converted to the mass of other oils necessary for substituting palm oil. It has been assumed that the mass ratio is 1:1, i.e. each kilogram of palm oil can be substituted with a kilogram of other vegetable oil. This assumption may not be completely accurate, especially in the case of the production of fried snacks, in which case it is caused by the differences in melting points. The amount of palm oil used in this product segment, however, is relatively low, and, additionally, it is assumed that the manufacturers using the new oil would optimise their processes to obtain similar amount of oil required for the process. The calculations are presented in Table 10.

Application	Palm oil (tonnes)	Rapeseed oil	Soybean oil	Sunflower oil	Coconut oil
Margarines, spreads	-48 950	12 237,5	12 237,5	12 237,5	12 237,5
Chocolate, chocolate products	-8 900	0	0	0	8 900,0
Ice cream	-13 350	3 337,5	3 337,5	3 337,5	3 337,5
Cookies	-44 500	11 125,0	11 125,0	11 125,0	11 125,0
Fried snacks	-13 350	0	0	13 350,0	0
Bread	-22 250	5 562,5	5 562,5	5 562,5	5 562,5
Soap, surfactants	-146 850	0	0	0	146 850,0
Biofuels	-8 900	2 225,0	2 225,0	2 225,0	2 225,0
Feed	-133 500	66 750,0	33 375,0	33 375,0	0
Other (undetermined)	4 450	0	0	0	0
TOTAL	**-440 550**	**101 237,5**	**67 862,5**	**81 212,5**	**190 237,5**

Table 10. *Scenario of replacing palm oil, expressed in mass units*

The data from the above table are visualised in Chart 19. In the suggested scenario, coconut oil would have to substitute as much as 43% of the currently used palm oil, whereas for rapeseed oil it would be 23%, for soybean oil 15%, and for sunflower oil 18%. The remaining 1% is the palm oil, the applications of which were assumed as other (undetermined).

Chart 19. *Visualisation of the scenario of replacing palm oil from mass perspective*

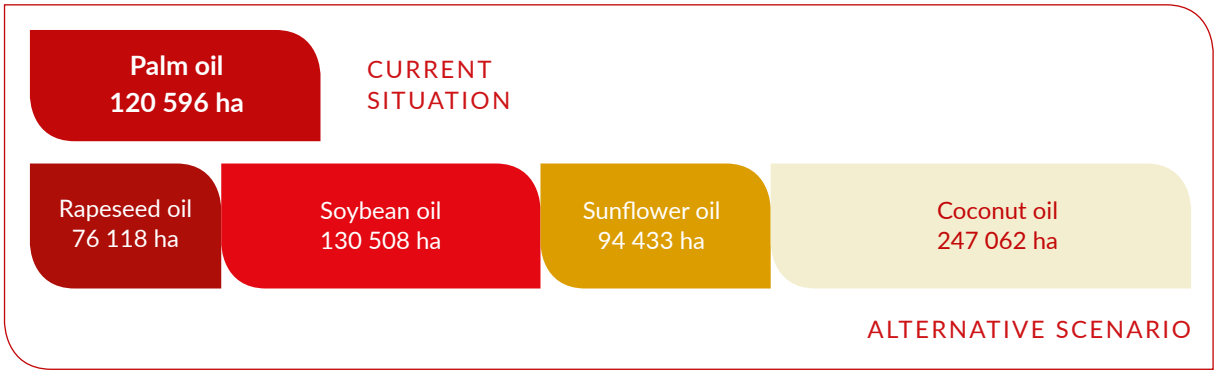


In order to calculate the changes in land use, the following assumptions have been made for the average annual productivity of the analysed oils: palm oil 3.69 tonnes/ha, rapeseed oil 1.33 tonnes/ha, soybean oil 0.52 tonnes/ha, sunflower oil 0.86 tonnes/ha, coconut oil 0.77 tonnes/ha[3].

The scenario of complete replacement of palm oil in Poland would enable freeing 119,390 hectares of the lands used for growing palm oil in Indonesia, Malaysia and other countries, from which it is imported to Poland (indirectly and directly). The great advantage of palm oil over other vegetable oils is its productivity per area unit. With the above assumptions in mind, replacing palm oil would create enormous demand for land for the production of other vegetable oils, which is

visualised in Chart 20. 548,118 hectares of new, unused land would be needed to meet Poland's demand for all four types of vegetable oils. A unique example of the differences in productivity is soybean oil, the relatively low required amount of which (67,862.5 tonnes) would require using 130,505 hectares of land. To sum up, the production of four palm oil substitutes would require over four times bigger production area.

Chart 20. *Visualisation of the scenario of replacing palm oil in the context of arable land surface*



Changes in land use would also be of regional significance. According to the assumptions of Virtual Agricultural Trade, the newly created demand for vegetable oils alternative to palm oil would generate production on all continents[103]. Table 11 presents the assumed local changes in land use. Substituting palm oil in Poland with alternative vegetable oils would generate the need to use over 428 thousand hectares of land, as much as 185 thousand hectares of which is located in Asia. What is interesting, changes in oil consumption in Poland would be connected to the necessity of using the land for plantations on every continent. For Latin America it would be 76,870 hectares, for Africa 64,656 hectares, and for Oceania 18,007 hectares. Due to the significant amounts of rapeseed oil and sunflower oil in the suggested scenario, also in Europe over 81 thousand hectares would have to be used for the new crops. The positive value for Europe in the column with palm oil results from the assumptions of methodology[103], according to which complete replacing of palm oil in Poland would generate, in a short period of time, re-exporting this raw material from Poland and changes in the intra-European palm oil trade structure.

Table 11. *Regional changes in land use resulting from the replacement of palm oil. Values are expressed in hectares*

Region	Palm oil	Rapeseed oil	Soybean oil	Sunflower oil	Coconut oil	Balance
Asia	-88 229	31 297	3 223	3 782	235 593	185 665
– Indonesia	-57 912	83	0	0	133 028	75 199
– Malaysia	-18 946	0	0	846	7 013	-11 086
Latin America	-11 088	3 194	70 325	14 439	0	76 870
Africa	-3 517	4 527	55 382	8 118	146	64 656
Oceania	-23 124	750	1 528	28 005	10 848	18 007
Europe	4 872	36 351	48	40 090	475	81 836
Total	**-119 390**	**76 118**	**130 505**	**94 433**	**247 062**	**428 728**

IMPACT ON THE ENVIRONMENT

Complete replacement of palm oil in Poland would be connected with very unfavourable changes regarding land use, carbon dioxide emissions, and loss of biodiversity.

5.2. Impact on Global Emissions of Greenhouse Gases

Climate change is currently one of the greatest problems of our planet. Excessive carbon dioxide emission is considered the main factor impacting the changing climate[106, 107, 108].

In the case of oils, carbon dioxide emission is connected to every stage of production cycle, from the preparation of soil for growing, through the stage of production (agriculture), to the final transport of the product to stores. Comparing the application of oils in this project, mainly the first stage was taken into account, i.e. the preparation of soil for growing. It has been also assumed that the further stages in the delivery chain generate emissions of similar amounts of carbon dioxide, regardless of the type of oil. This assumption seems reasonable, taking into consideration earlier studies[13]. In order to estimate additional emissions related to cutting tropical rainforests to make place for plantations, the so-called *Carbon Release Factors* have been employed. It is the carbon dioxide value released to the atmosphere as a result of cutting one hectare of forest in a given country. E.g. for Europe, this factor is on average 168 tonnes of CO2/ha, while for Asia it is 296 tonnes CO2/ha[106]. The earlier calculated values of the changes in land use were multiplied by the factor for a given geographic region, taking into consideration the countries these changes affect the most. Table 12 presents data on estimate additional carbon dioxide emissions to the atmosphere related to removing natural plants for growing oil plants.

IN THE CASE OF OILS, CARBON DIOXIDE EMISSION IS CONNECTED TO EVERY STAGE OF PRODUCTION CYCLE, FROM THE PREPARATION OF SOIL FOR GROWING, THROUGH THE STAGE OF PRODUCTION (AGRICULTURE), TO THE FINAL TRANSPORT OF THE PRODUCT TO STORES

Additional carbon dioxide emissions related to expanding arable land					
Region	Asia	Latin America	Africa	Oceania	Europe
CO2 emissions (million tonnes	54,9	11,5	12,5	1,9	13,7

Table 12. *Summary of regional changes in the emissions of CO2, due to changes in land use*

Emissions connected to the expansion of additional arable lands for growing rapeseed oil, soybean oil, sunflower oil, and coconut oil would amount to **94.6 million tonnes of carbon dioxide**. In comparison, Poland generated in 2016 a total of 296.6 million tonnes of carbon dioxide[107], which would mean that substituting palm oil with other vegetable oils would generate globally almost 32% of the total carbon dioxide emission in Poland. Globally, that is approximately 0.25% of the total carbon dioxide emissions in 2017.

Apart from carbon dioxide emissions related to the destruction of natural forests and peat bogs for growing oil plants, additional emissions result from removing the plants that absorbed carbon dioxide emissions. This loss is partially compensated by the plant grown for the production of oils, however, the difference is significant. E.g. natural tropical rainforest in Indonesia is able to absorb annually 254-390 tonnes of CO2, while palm oil plantation absorbs only 31-101 tonnes of CO2. Table 13 presents the results of calculations, assuming different values of photosynthetic abilities for different world regions[108]. The presented calculations are estimates.

Table 13. *Annual difference in the absorption of dioxide, due to changes in land use*

Additional carbon dioxide emissions related to the removal of plants absorbing CO2					
Region	Asia	Latin America	Africa	Oceania	Europe
CO2 emissions (million tonnes/year)	43,8	6,9	8,6	0,8	8,8

This analysis shows that apart from the emission of 94.6 million tonnes of carbon dioxide as a result of land use, approximately 69 million tonnes of carbon dioxide produced around the world will not be absorbed. The analysis skipped stages like producing oils or transporting them, as small differences are assumed in the production processes of the individual oil types.

5.3. Impact on Biodiversity

PALM OIL IS PRODUCED IN REGIONS WITH SIGNIFICANT BIODIVERSITY. DUE TO THIS FACT, SUBSTITUTING PALM OIL WITH OTHER VEGETABLE OILS MUST BE ANALYSED WITH A VIEW ON BIODIVERSITY CHANGES

Palm oil is produced in regions with significant biodiversity. Due to this fact, substituting palm oil with other vegetable oils must be analysed with a view on biodiversity changes. Contrary to the analysis of land use and greenhouse gas emissions, the studies on biodiversity indices are still at preliminary stage, and there is not unequivocal criterion of assessment of this factor. Therefore, the analysis in this section is performed on the basis of several indices and compared in order to reveal a trend.

GEF BIO is an index, which was one of the first created[109] and it is approved by various institutions[13]. It is based on classifying the value of land of a given country in a scale from 0 to 100. Brazil, as the country with the greatest biodiversity, has the value of 100, while Nauru has the value of 0. One hectare of land unused for agriculture is the basis for comparison. Another index often used when performing analyses on biodiversity is NBI, i.e. *National Biodiversity Index*[110]. This factor is based on similar assumptions as GEF BIO, and its scale is 0 to 1. In the case of NBI, Indonesia is considered a country with the greatest biodiversity, therefore, one hectare of land in this country is described with the value of 1, and all the other countries have lower values.

The calculations revealed that the total substitution of palm oil in Poland with other oils would cause the loss of equivalent of **195 thousand hectares, according to the calculation method employing the GEF BIO factor, or 259 thousand hectares employing the NBI factor**. Both methods differ from one another with their assumptions, which are especially visible in the context of factors for European countries. E.g. the biodiversity factor for Poland is only 0.6 (in 0-100 scale) according to the GEF BIO method, and as much as 0.367 (in 0-1 scale) according to the NBI method. For the other continents, the values have maximum differences of 12% (standard deviation). A detailed division into world regions is presented in Table 14.

Changes in biodiversity with division into regions (thousand hectares)					
Region	Asia	Latin America	Africa	Oceania	Europe
GEFBIO	122,1	28,9	19,5	15,1	9,9
NBI	145,8	39,9	23,1	14,9	35,9

Table 14. *Changes in biodiversity with division into world regions*

In order to evaluate the real impact of the above values, one should refer them to the total value of biodiversity in the world. According to the GEF BIO method, it is 289 billion points, i.e. the equivalent of 2.89 billion hectares of tropical rainforest in Brazil. Substitution of palm oil in Poland with alternative vegetable oils would be connected to losing 0.0067% of global biodiversity. The total global value of biodiversity according to the NBI index is 4.75 billion points, which is theoretically equal to 4.75 billion hectares of ecosystem of tropical rainforest in Indonesia. As a result of substituting palm oil in Poland with other vegetable oils in accordance with this scenario, the loss of of global biodiversity would be 0.0055%. A good reference point seem to be the changes in biodiversity resulting from the current palm oil plantations in the world. The total substitution of palm oil in Poland with other vegetable oils would cause loss of biodiversity equal to approximately 1.7% of the losses caused by all the current palm oil plantation in the world. It is worth noting again that the methodology of investigating biodiversity changes is still a subject of studies, therefore, the above results are theoretical and do not provide a definite answer on the issue of the impact of the substitution investigated in this report.

THE TOTAL SUBSTITUTION OF PALM OIL IN POLAND WITH OTHER VEGETABLE OILS WOULD CAUSE LOSS OF BIODIVERSITY EQUAL TO APPROXIMATELY 1.7% OF THE LOSSES CAUSED BY ALL THE CURRENT PALM OIL PLANTATION IN THE WORLD

5.4. 100% Certified Palm Oil Scenario

An alternative solution could be also substituting the uncertified palm oil, the share of which in the total import of palm oil to Poland is estimated at 31% (137,950 tonnes annually), with certified palm oil. For the sake of calculations it has been assumed that such a scenario would require creating new plantations, which would meet eight basic criteria necessary for obtaining certification: production process transparency, conformity with local law, obligation to ensure financial liquidity, applying high standards in the production process, responsibility in relation to protecting the environment and natural resources, respecting the rights of employees, responsible approach to the growth of plantation, and obligation to constantly improve the process[18]. This assumption is an extreme one, and it is aimed at showing the maximum possible changes in land use, CO2 emissions and biodiversity changes. In practice, part of certified oil could come from the already existing plantations, which meet or can meet in future the criteria of producing certified palm oil. Thus, this analysis presents an extreme case, in which all of the produced certified oil would require preparing new areas for growing.

Producing the additional amount of certified palm oil would require creating plantations on the maximum area of 37,385 hectares. It is slightly more difficult to estimate the changes in CO2 emissions and biodiversity, as certified plantations would be created in places without tropical rainforest and where biodiversity is lower than in the local *bio-*

diversity hotspots. One can only assume that these changes will not exceed the values calculated with the previously employed methodology. Taking such assumption into account, the additional carbon dioxide emissions would be not more than 11 million tonnes of CO2, and biodiversity changes would be lesser than 24.7 thousand hectares (GEF BIO) or 29.5 thousand hectares (NBI).

5.5. Scenario of Substituting Palm Oil with Locally Produced Rapeseed Oil

This scenario takes into account only industry branches in which such substitution is possible. It is worth noting that the assumption that the whole rapeseed oil could be produced only in Poland or in the European Union is wrong, which can be proven e.g. by the assumed theory of *Virtual Agricultural Trade*, which indicates that the supply would be distributed uniformly in all geographic regions. From 445,000 tonnes of palm oil consumed in Poland as much as 271,450 tonnes could be discontinued, while 173,550 tonnes would stay in circulation. This change would require delivering 271,450 tonnes of rapeseed oil to the Polish market (from local or foreign production). A detailed division into applications is presented in Table 15.

Table 15. *Substituting palm oil with rapeseed oil in sectors, in which it is possible*

Application	Palm oil	Rapeseed oil
Margarines, spreads	0	48 950
Chocolate, chocolate products	8 900	0
Ice cream	0	13 350
Cookies	0	44 500
Fried snacks	13 350	0
Bread	0	22 250
Soap, surfactants	146 850	0
Biofuels	0	8 900
Feed	0	133 500
Other (undetermined)	4 450	0
TOTAL	**173 550**	**271 450**

Taking into consideration the conversion factors employed earlier, the production of local rapeseed oil would require 204,098 hectares of arable land for growing, while it would free up 43,826 hectares previously used for the production of palm oil. To sum up, in the global scale 160,272 hectares of new arable land would have to be created for the purpose of production. Additionally, 46.7 million tonnes of carbon dioxide would be generated as a result of the changes in land use. Changes in biodiversity would be the equivalent of 83,406 hectares according to the GEF-BIO method and 124,190 hectares according to the NBI method, respectively. Data summary is presented in Table 16.

	Scenario – 4 vegetable oils	Scenario – certified palm oil	Scenario – rapeseed oil
Land use changes	428 728 ha	< 37 385 ha	160 272 ha
CO2 emission changes	94,6 million tonnes	< 11,0 million tonnes	46,7 million tonnes
Biodiversity changes (GEF-BIO)	195 000 ha	< 24 700 ha	83 406 ha
biodiversity changes (NBI)	259 000 ha	< 29 500 ha	124 190 ha
Reduction of demand for palm oil	99%	-	61%

Table 16. *Summary of environmental changes related to substitution of palm oil with other vegetable oils*

204 thousand hectares required for growing rapeseed oil is an area equal to 0.6% of the area of Poland and 1.2% of arable land in Poland. Rapeseed oil in Poland is produced on the area of approximately 860-900 thousand hectares[15]. Therefore, implementing the above scenario would require increasing the arable land used for growing rapeseed by approximately 24%. It should be again noted that the substitution of palm oil with rapeseed oil (as determined in the scenario) would generate rapeseed production in other parts of the world.

Substituting uncertified palm oil by certified palm oil seems to be the right step in fighting the negative effects of growing this raw material on the environment. This change could be introduced with a relatively small influence on land use changes, carbon dioxide emissions and changes in biodiversity. Also, it would not require drastic changes in production processes on part of the manufacturers. The positive effect of such a change would be also very significant for the environment and for the people of the manufacturing countries.

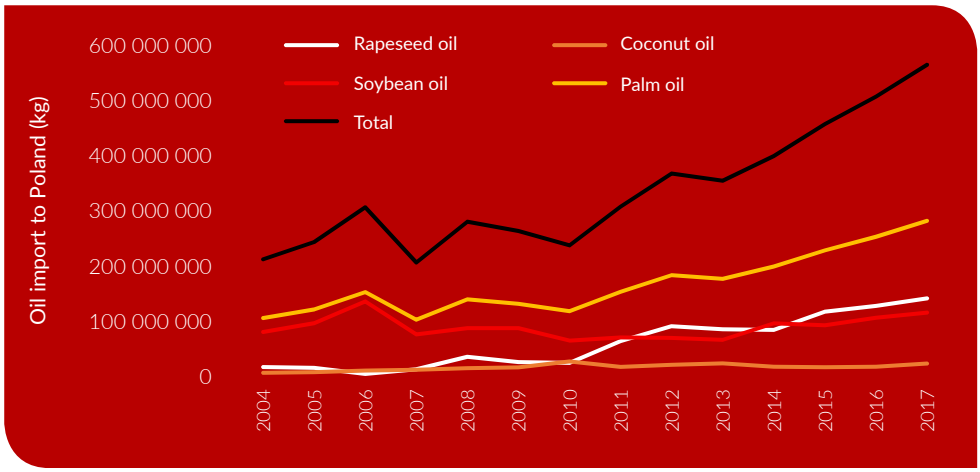
SUBSTITUTING UNCERTIFIED PALM OIL BY CERTIFIED PALM OIL SEEMS TO BE THE RIGHT STEP IN FIGHTING THE NEGATIVE EFFECTS OF GROWING THIS RAW MATERIAL ON THE ENVIRONMENT

6. SUMMARY AND RECOMMENDATIONS

Poland has an important place in the world consumption of palm oil, which has been shown by the analysis of the consumption per capita and per GDP unit. Palm oil import to Poland as raw material has increased since 2004 by over 150%. What is interesting, this increase is proportional to the increase of the import of rapeseed oil, coconut oil, and soybean oil together. Therefore, it can be concluded that the demand for palm oil was most probably the result of increased needs for oils in general, and it did not stem from an increased need for this specific type of oil. The data on the import of selected oils to Poland in years 2004-2017 is presented in Chart 21.

Chart 21. *Import of selected vegetable oils to Poland in years 2004-2017*

Source: Central Statistical Office.



As a result of the analysis, it has been concluded, that complete replacement of palm oil in Poland would be connected with very unfavourable changes regarding land use, carbon dioxide emissions, and loss of biodiversity. The suggested scenario would require creating plantations, which would take the area almost four times as big as currently used for the production of palm oil. Carbon dioxide released to the atmosphere exclusively as a result of cutting down forests for plantations would equal 32% of the total annual CO2 emissions in Poland. Assessment of the loss of biodiversity with the assumptions of the GEF BIO methodology, establishes that substitution of palm oil in Poland with other vegetable oils would cause losses of biodiversity equal to total destruction of 195 thousand hectares of Amazon jungle. The alternative scenario based on the use of rapeseed oil in all possible applications also does not seem favourable from the point of view of environment protection.

The increasingly growing demand for vegetable oils is undoubtedly problematic from the point of view of global economy and environment protection. Analysing the data in this report, it should be noted that the productivity of palm oil is its doubtless advantage, and the attempts at substituting it completely with other vegetable oils can have negative consequences for the environment. One of the conclusions of this analysis is the suggestion that more pressure should be put on seeking solutions, which do not require the use of oil. This is extremely difficult, as many sectors of economy are based on fats. An excellent example is the market of surfactants, in which compounds other than based on fats are very rare. The production of biosurfactants or plant extracts, such as saponin, is still in the development phase. In the area of biofuels, the production of algae fats, which theoretically can be grown in impoverished areas, is still highly unprofitable.

More and more food industry companies seek alternative solutions, which would allow for obtaining high-value, high-calorie, and also economically profitable food products, also by using alternative production methods. An excellent example are the aforementioned algae, which can be a great source of nutrients like proteins or omega-3 fatty acids both for people and for animals. Another solution, apart from the process of photosynthesis, is the production of biomass in the process of fermentation. This report suggests that complete substitution of palm oil with other vegetable oils is not the perfect solution. Industry representatives should focus on seeking alternative solutions, depending on application sectors, also by limiting the consumption of oils.

THE INCREASINGLY GROWING DEMAND FOR VEGETABLE OILS IS UNDOUBTEDLY PROBLEMATIC FROM THE POINT OF VIEW OF GLOBAL ECONOMY AND ENVIRONMENT PROTECTION. ANALYSING THE DATA IN THIS REPORT, IT SHOULD BE NOTED THAT THE PRODUCTIVITY OF PALM OIL IS ITS DOUBTLESS ADVANTAGE, AND THE ATTEMPTS AT SUBSTITUTING IT COMPLETELY WITH OTHER VEGETABLE OILS CAN HAVE NEGATIVE CONSEQUENCES FOR THE ENVIRONMENT

Authors of the report would also like to emphasise the necessity of paying attention to the origin of palm oil. CSPO palm oil, i.e. coming from certified plantations, cannot be treated equally as palm oil without this certification. Uncertified oil often comes from plantations created in place of tropical rainforests, which results in increasing carbon dioxide emissions and has negative impact on biodiversity.

Certified oil constitutes approximately 69% of the total palm oil imported to Europe for food industry. Due to the lack of accurate data, the consumption of certified CSPO palm oil in Poland has been estimated at the level of EU average for food. This assumption seems reasonable, taking into account the fact that most of palm oil as raw material reaches Poland via Germany, where the certification index is 72%, and the fact that food industry (including feed) has significant share in the palm oil market in Poland. The same oil, with the same physicochemical properties and the same applications has a decidedly less negative impact on global biodiversity, as well as climate change.

Manufacturers of products containing palm oil should take care about the delivery chain transparency. It is an obligation of the decisive bodies to enforce the obligation of following the transparency rules of obtaining raw materials like palm oil without the possibility of substituting certified oil with cheaper oils obtained with harm to the environment and the society.

Caring for delivery chain transparency also applies to companies intermediating in palm oil trade, as well as semi-product manufacturers. Palm oil should come from certified plantations, and corporations should now allow the possibility of replacing it with cheaper, uncertified substitutes. The obligation of following delivery chain transparency should be a priority for legislative and executive bodies of countries and EU institutions.

Another important aspect covered by this report is the amount of palm oil reaching Poland, including the consumption in hidden form. Thanks to the obligatory process of labelling products containing palm oil and its derivatives, more and more consumers are aware of palm oil content in the consumed products. However, this awareness is still too low[112].

It is the obligation of the manufacturers, organisations and authorities to inform consumers (e.g. via social campaigns) about the ingredients of foods, and to make them aware of the effects of excessive consumption of certain products. It should be noted again that the issue of using certified palm oil, which should be presented in these campaigns as the favoured alternative to oils coming from uncertified plantations.

To sum up, firstly the necessity of using oils in the respective branches of economy should be analysed. Taking into consideration the limitations in substituting palm oil with vegetable oils, the activities of governments and non-governmental organisations should focus on decreasing the consumptions of all oils, both of vegetable and animal origin, and also to impose on the manufacturers the obligation to use oil from certified sources, thereby increasing awareness of the consumers, especially regarding the consumption of products containing palm oil in hidden form.

PALM OIL SHOULD COME FROM CERTIFIED PLANTATIONS, AND CORPORATIONS SHOULD NOW ALLOW THE POSSIBILITY OF REPLACING IT WITH CHEAPER, UNCERTIFIED SUBSTITUTES. THE OBLIGATION OF FOLLOWING DELIVERY CHAIN TRANSPARENCY SHOULD BE A PRIORITY FOR LEGISLATIVE AND EXECUTIVE BODIES OF COUNTRIES AND EU INSTITUTIONS

REFERENCES

1 World Population Prospects: The 2017 Revision, United Nations, https://population.un.org/wpp/Publications/Files/WPP2017_Volume-I_Comprehensive-Tables.pdf 09/01/19

2 Dandekar A., Gutterson N.,*Genetic engineering to improve quality, productivity and value of crops*.Calif. Agr. 2000, 54(4):49–56. https://doi.org/10.3733/ca.v054n04p49

3 Forum Nachhaltiges Palmol, https://www.forumpalmoel.org/ 20/12/18

4 The International Union for Conservation of Nature (IUCN), https://www.iucn.org/resources/issues-briefs/palm-oil-and-biodiversity 02/12/19

5 Michael Reily, RekorTertinggi, EksporMinyakSawit 2017 Tembus US$ 22,9 Miliar, https://katadata.co.id/berita/2018/01/30/rekor-tertinggi-ekspor-minyak-sawit-2017-tembus-us-229-miliar 10/01/19

6 Sustainable Management of Peatland Forests in Southeast Asia, ASEAN Peatland Forests Project, http://www.aseanpeat.net/index.cfm?&menuid=68 02/12/19

7 Why is palm oil important?, Green Palm Sustainability, https://greenpalm.org/about-palm-oil/where-is-palm-oil-grown-2 02/01/19

8 Rietberg P., Wageningen University, 2016, *Costs and benefits of RSPO certification for independent smallholders* A science for policy paper for the RSPO

9 FGV withdraws RSPO Certificate, FGV Holdings, http://www.feldaglobal.com/fgv-withdraws-rspo-certification/ 20/12/18

10 Production volume of palm oil worldwide from 2012/13 to 2017/18 (in million metric tons), Statista, https://www.statista.com/statistics/613471/palm-oil-production-volume-worldwide/02/01/19

11 Palm Oil Production by Country in 1000 MT, Index Mundi, https://www.indexmundi.com/agriculture/?commodity=palm-oil02/01/19

12 Renewable Energy Directive, RED II, European Commission, https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive 02/01/19

13 WWF Deutschland , *Auf der Ölspur – Berechnungen zu einer palmölfreieren Welt2016*

14 Oil World ISTA Mielke GmbH, https://www.oilworld.biz/t/publications/annual 13/12/18

15 Główny Urząd Statystyczny, http://stat.gov.pl/ 02/01/19

16 European Sustainable Palm Oil, *Making Sustainable Palm Oil in Europe*, Progress Report on the import and use of sustainable palm oil in Europe November 2017

17 The Observatory of Economic Complexity: OEC https://atlas.media.mit.edu/en/ 18/12/18

18 Impact Report 2018, Roundtable on Sustainable Palm Oil, https://rspo.org/key-documents/impact-reports 20/12/18

19 Essential Palm Oil Statistics 2017, Palm Oil Analytics, http://www.palmoilanalytics.com/files/epos-final-59.pdf

[20] The Official Portal of Malaysian Palm Oil Board, http://www.mpob.gov.my/

[21] Indonesian Palm Oil Producers Association (Gapki) & Indonesian Ministry of Agriculture

[22] DEFRA (Department for Environment, Food and Rural Affairs) (2011): *Mapping and understanding the UK palm oil supply chain*. London: DEFRA

[23] Zielone Wiadomości, *Niemal 50% oleju palmowego w Europie jest spalana przez pojazdy*, http://zielonewiadomosci.pl/tematy/energetyka/niemal-50-oleju-palmowego-w-europie-jest-spalana-przez-pojazdy/ 20/12/18

[24] Palm Oil Uses, European Palm Oil Alliance, https://www.palmoilandfood.eu/en/palm-oil-uses 06/12/18

[25] John J. Musa, Department of Agriculture and Bio-Resource Engineering, Federal University of Technology, Minna. *Nigeria*,2009,*Evaluation of the Lubricating Properties of Palm Kernel Oil*. http://lejpt.academicdirect.org/A14/107_114.html 29/11/18

[26] Ademola Rabiu, Samya Elias and Oluwaseun Oyekola (July 18th 2018). *Oleochemicals from Palm Oil for the Petroleum Industry*, IntechOpen, DOI: 10.5772/intechopen.76771. https://www.intechopen.com/books/palm-oil/oleochemicals-from-palm-oil-for-the-petroleum-industry

[27] Departament Informacji Gospodarczej, Polska Agencja Informacji i Inwestycji Zagranicznych SA 2013, *Sektor spożywczy w Polsce, Profil sektorowy*, https://www.paih.gov.pl/files/?id_plik=21744 09/01/19

[28] Portal Dla Handlu, *Raport: Polska to ósmy rynek handlu artykułami spożywczymi w Europie*, http://www.dlahandlu.pl/detal-hurt/wiadomosci/raport-polska-to-osmy-rynek-handlu-artykulami-spozywczymi-w-europie,73478.html 09/01/19

[29] Portal Dla Handlu, *Food Show 2017: Sektor spożywczy jest obecnie w kluczowym momencie rozwoju*, http://www.dlahandlu.pl/detal-hurt/wiadomosci/food-show-2017-sektor-spozywczy-jest-obecnie-w-kluczowym-momencie-rozwoju,59635.html 09/01/19

[30] Mba, Ogan & Dumont, Marie-Josée & Ngadi, Michael (2015). *Palm Oil: Processing, Characterization and Utilization in the Food Industry – A Review*. Food Bioscience. 10. 10.1016/j.fbio.2015.01.003

[31] Mukherjee S. &Analava M.(2009). *Health Effects of Palm Oil*. J Hum Ecol. 26. 197–203. 10.1080/09709274.2009.11906182

[32] Kruszwica, Kampania Poznaj się na tłuszczach, *Choroby cywilizacyjne a tłuszcze*, https://poznajsienatluszczach.pl/2016/09/28/tluszcze-a-choroby-cywilizacyjne/ 21/12/18

[33] WassellP.& Young N., *Food applications of trans fatty acid substitutes*, International Journal of Food Science and Technology, 42, 503-517, 2007

[34] World Health Organization, *WHO plan to eliminate industrially-produced trans-fatty acids from global food supply*, https://www.who.int/news-room/detail/14-05-2018-who-plan-to-eliminate-industrially-produced-trans-fatty-acids-from-global-food-supply 17/12/18

[35] Aleksandra Ptak-Iglewska, Rzeczpospolita,*Ponura przyszłość margaryn. Zyskuje masło*, https://www.rp.pl/Przemysl-spozywczy/310039926-Ponura-przyszlosc-margaryn-Zyskuje-maslo.html 18/12/18

[36] RSPO Annual Communications of Progress 2017, Unilever https://www.rspo.org/file/acop2017/submissions/unilever-ACOP2017.pdf 11/01/19

[37] Kruszwica, http://www.olek.pl/pl/kruszwica/zrownowazony-rozwoj/zrownowazony-rozwoj 11/01/19

[38] Lipp M., AnklamE., *Review of cocoa butter and alternative fats for use in chocolate – Part A. Compositional data*,Food Chemistry Volume 62, Issue 1, May 1998, Pages 73-97 10/12/18

[39] USDA Food Composition Databases https://ndb.nal.usda.gov/ndb/search/list?home=true 20/12/18

[40] Johari Minal, MPOB Washington, DC,2014 *‚An Introduction to Production, Processing,and Applications of Palm and Palm Kernel Oils*http://www.natuoil.com/wp-content/uploads/2014/09/Introduction-to-Palm-Oil-Sep-2014-final1.pdf 20/12/18

[41] Dyrektywa 2000/36/WE Parlamentu Europejskiegoi Radyz dnia 23 czerwca 2000 r. http://orka.sejm.gov.pl/Drektywy.nsf/all/32000L0036/$File/32000L0036.pdf

[42] Gunneral J.,*Perspektywy rynku czekolady*. Przegl. Piek. Cuk., 2000, 48 (10), 56

[43] Mondelez International, https://www.mondelezinternational.com/impact/sustainable-resources-and-agriculture/~/media/mondelezcorporate/uploads/downloads/PO_Action_Plan_Update_Nov_2016.pdf 11/01/19

[44] Greenpeace, Palm oil: Oreo and Cadbury linked to destruction of orangutan habitat, https://www.greenpeace.org.uk/press-releases/palm-oil-oreo-cadbury-linked-destruction-orangutan-habitat/ 12/12/18

[45] Meo Carbon Solutions GmbH (2015): *Analyse des Palmöl sektors in Deutschland: Ergebnispräsentation*. Köln: Meo Carbon Solutions GmbH.

[46] Euromonitor International,https://www.euromonitor.com/ dane z 2015r 28/11/18

[47] Nestle, *Nestlé wspiera zapobieganie globalnemu wylesianiu. Wdraża system satelitarny pozwalający na 100% monitoring swojego łańcucha dostaw oleju palmowego*,https://nestle.media.pl/pr/403272/nestle-wspiera-zapobieganie-globalnemu-wylesianiu-wdraza-system-sateli 28/11/18

[48] Portal Spożywczy, *Rynek ciast i wyrobów cukierniczych w Polsce wart 3,6 mld zł,*http://www.portalspozywczy.pl/slodycze-przekaski/wiadomosci/rynek-ciast-i-wyrobow-cukierniczych-w-polsce--wart-3-6-mld-zl,141014.html 14/12/18

[49] Statista, Cookies & Crackers in Poland, https://www.statista.com/outlook/40100300/146/cookies-crackers/poland 02/01/19

[50] Statista, Preserved pastry goods and cakes in Poland, https://www.statista.com/outlook/40050200/146/preserved-pastry-goods-cakes/poland 02/01/19

[51] Portal Spożywczy, *Słodki biznes: rynek słodyczy zwiększy wartość do 14 mld zł,* http://www.portalspozywczy.pl/slodycze-przekaski/wiadomosci/slodki-biznes-rynek-slodyczy-zwiekszy-wartosc--do-14-mld-zl,140467.html 21/12/18

[52] Rzeczpospolita, *Podwójna jakość żywności – UOKiK zbadał produkty oferowane konsumentom w Polsce i na Zachodzie*, https://www.rp.pl/Konsumenci/310099963-Podwojna-jakosc-zywnosci---UOKiK-zbadal-produkty-oferowane-konsumentom-w-Polsce-i--na-Zachodzie.html 21/12/18

53 Amnesty International, *The Great Palm Oil Scandal*, https://www.amnesty.org.uk/files/the_great_palm_oil_scandal_lr.pdf 21/12/18

54 Portal Handel Extra, *PepsiCo: Rynek słonych przekąsek w Polsce stabilny*, https://handelextra.pl/artykuly/182359,pepsico-rynek-slonych-przekasek-w-polsce-stabilny 14/12/18

55 Lidl, A Better Tomorrow, https://www.abettertomorrow-lidl-ni.co.uk/sourcing/#fruit-vegetables 14/12/18

56 Salimon, Jumat&Salih, Nadia &Yousif, Emad. (2010). *Industrial development and applications of plant oils and their biobasedoleochemicals*. Arabian Journal of Chemistry. 5. 10.1016/j.arabjc.2010.08.007

57 Detergents & Soaps, Bar Soaps Manufacturing Process, http://www.detergentsandsoaps.com/bar-soaps.html 13/12/18

58 PMR Ltd, Rynek artykułów kosmetycznych w Polsce wzrósł o 6.2% w 2017 roku, https://www.ceeretail.com/analysis/1517/rynek-artykulow-kosmetycznych-w-polsce-wzrosl-o-6-2-w-2017-roku 12/12/18

59 Euromonitor International, Bath and Shower in Poland, https://www.euromonitor.com/bath-and-shower-in-poland/report 02/01/19

60 The Roundtable on Sustainable Palm Oil (RSPO), https://rspo.org/members/all 02/01/19

61 Schuster Institute for Investigative Journalism at Brandeis University, Outline of Production: Palm Fruit to Product, http://www.schusterinstituteinvestigations.org/products-with-palm-oil 13/12/18

62 Prospector, Then and Now: Shampoo Formulations through the Years, https://knowledge.ulprospector.com/6253/pcc-shampoo-formulations-through-the-years/ 02/12/18

63 Portal Biotechnologia.pl, Formulacje: Szampon, kosmetyk do mycia i pielęgnacji włosów, https://biotechnologia.pl/kosmetologia/formulacje-szampon-kosmetyk-do-mycia-i-pielegnacji-wlosow,325 06/12/18

64 Katarzyna Błaszczyk, Katarzyna Teleżyńska, Rynek Kosmetyków Pielęgnacyjnych, http://poradnikhandlowca.com.pl/archiwum/archiwum/06-2008,Raport---Rynek-kosmetykow-pielegnacyjnych,Rok-2008,13,176.html 06/12/18

65 Portal Chemia i Biznes, Rynek produktów do profesjonalnej pielęgnacji włosów rozwija się stabilnie, https://www.chemiaibiznes.com.pl/aktualnosc/rynek-produktow-do-profesjonalnej-pielegnacji-wlosow-rozwija-sie-stabilnie 20/12/18

66 Portal Zielone Wiadomości, *Kierowcy muszą spalić więcej lasów deszczowych, aby spełnić cele UE dla OŹE*, http://zielonewiadomosci.pl/tematy/energetyka/kierowcy-musza-spalic-wiecej-lasow-deszczowych-aby-spelnic-cele-ue-dla-oze/ 19/12/18

67 Puls Biznesu, *Biopaliwa będą coraz bardziej eko*, https://www.pb.pl/biopaliwa-beda-coraz-bardziej-eko-910265 19/12/18

68 Portal Odnawialne Źródła Energii, *Rynek biopaliw w Polsce czekają duże zmiany*, http://odnawialnezrodlaenergii.pl/biomasa-aktualnosci/item/2610-rynek-biopaliw-w-polsce-czekaja-duze-zmiany 18/12/18

69 Polskie Stowarzyszenie Producentów Oleju, *Pakiet przewozowy wszedł w życie*, https://www.pspo.com.pl/publications/e7672ee476e0ecad866eed372f7702fb5c1cb238.pdf 18/12/18

[70] Rajczyk R., Magazyn Biomasa, *Egzotyczna biomasa zdobywa polski rynek,*https://www.cire.pl/pliki/2/egzotyczna_biomasa.pdf 02/12/18

[71] Transport & Environment, *7 facts about palm oil biodiesel*, https://www.transportenvironment.org/sites/te/files/Fact-sheet%20palm%20oil%20biofuels%20TE%20May%202018.pdf 12/12/18

[72] Rynek Pasz: stan i perspektywy, wrzesień 2017, ISSN 1428-1228. NR. 39

[73] Portal Rynkometr.pl, *Produkcja gotowych paszy i karmy dla zwierząt*, https://www.rynkometr.pl/pkd/10.9/ranking-firm, 28/01/19

[74] Dubois V., Breton S.,*Fatty acid profiles of 80 vegetable oils with regard to their nutritional potential*, Eur. J. Lipid Sci. Technol. 109 (2007) 710–732

[75] Vladimir Pekic, Confectionery News, Shea-ring the benefits: Confectionery industry rallies behind affordable, sustainable and quality ingredient, https://www.confectionerynews.com/Article/2015/05/13/Shea-ring-the-benefits-Confectionery-industry-rallies-behind-affordable-sustainable-and-quality-ingredient 17/12/18

[76] Lin, B.-F., Huang, J.-H., Huang, D.-Y., Effects of Biodiesel from Palm Kernel Oil on the Engine Performance, Exhaust Emissions, and Combustion Characteristics of a Direct Injection Diesel Engine, Energy & Fuels, 2008, 22 (6), pp 4229-4234, doi: 10.1021/ef800338j

[77] Polska Federacja Producentów Żywności, Jak powstaje margaryna? http://dobretluszcze.pl/jak-powstaje-margaryna/ 10/12/18

[78] Frank D. Gunstone, Vegetable Oils in Food Technology: Composition, Properties and Uses, Second Edition, 2011

[79] CBI Ministry of Foreign Affairs, *Exporting palm oil alternatives to Europe*, https://www.cbi.eu/market-information/natural-ingredients-cosmetics/palm-oil-alternatives 17/12/18

[80] Portal Biotechnologia.pl, *Dzikie masło, czyli masło shea – w czym tkwi tajemnica jego różnorodnych właściwości kosmetycznych?,* https://biotechnologia.pl/kosmetologia/artykuly/dzikie-maslo-czyli-maslo-shea-w-czym-tkwi-tajemnica-jego-roznorodnych-wlasciwosci-kosmetycznych,12527 10/12/18

[81] Portal Manufaktura Kosmetyczna, *Olej jojoba*, https://www.manufakturakosmetyczna.pl/surowce/8-surowce/18-olej-jojoba 10/12/18

[82] Hinrichsen N.,*Commercially available alternatives to palm oil*, Lipid Technol. 2016 ; 28(3-4),https://doi.org/10.1002/lite.201600018

[83] Fratini F., Cilia G., Turchi B., Felicioli A., Beeswax: A minireview of its antimicrobial activity and its application in medicine, Asian Pacific Journal of Tropical Medicine, 2016, 9 (9), pp 839-843, doi:10.1016/j.apjtm.2016.07.003

[84] European Palm Oil Alliance, Banning palm oil is not the solution – sustainable palm oil is – EPOA response to Iceland's ban on palm oil,https://www.palmoilandfood.eu/en/news/banning-palm-oil-not-solution-sustainable-palm-oil-epoa-response-%E2%80%98iceland%E2%80%99s-ban-palm-oil 04/01/2019

[85] Sandha, G.K., Swami, V.K., *Jojoba oil as an organic, shelf stable standard oil-phase base for cosmetic industry*, Rasayan J. Chem, 2009, 2 (2), pp 300-306, ISSN: 0974-1496

86 Anushree S., André M., *Stearic sunflower oil as a sustainable and healthy alternative to palm oil,A review*, Agron. Sustain. Dev. (2017) 37

87 Portal Ekologiczny, *Wosk pszczeli: właściwości, działanie i zastosowanie wosku pszczelego*, https://www.ekologia.pl/kobieta/zdrowie/wosk-pszczeli-wlasciwosci-dzialanie-i-zastosowanie-wosku-pszczelego,24609.html 13/12/18

88 Polskie Stowarzyszenie Producentów Oleju, *Natłuszczanie pasz dla trzody chlewnej*, http://www.paszerzepakowe.pl/plik,19.pdf 14/12/18

89 Orlen, *PKN Orlen bada produkcję biokomponentów z glonów*, https://www.orlen.pl/PL/BiuroPrasowe/Strony/PKN-ORLEN-bada-produkcj%C4%99-biokomponent%C3%B3w-z-glon%C3%B3w.aspx 10/12/18

90 Demirbas A. and Demirbas F.,*Importance of Algae Oil as a Source of Biodiesel. Energy Conversion and Management*, (2011), 53, 163-170.http://dx.doi.org/10.1016/

91 Rodolfi L.,ChiniZittelli G., Bassi N., *Microalgae for Oil: Strain Selection, Induction of Lipid Synthesis and Outdoor Mass Cultivation in a Low-Cost Photobioreactor*(2009),Biotechnology and bioengineering 102. 100-12. 10.1002/bit.22033

92 Mata T.M., *Microalgae for biodiesel production and other applications: A review. Renew Sustain Energy Rev* (2009), doi:10.1016/j.rser.2009.07.020

93 Rahman K., Mashud M.,*Biodiesel from Jatropha Oil as an Alternative Fuel for Diesel Engine*, 2010 http://ijens.org/103103-0707%20IJMME-IJENS.pdf 17/12/18

94 Gradziuk P., Instytut Rozwoju Wsi i Rolnictwa PAN, *Możliwości i bariery rozwoju zaawansowanych biopaliw w Polsce*, http://biblio.modr.mazowsze.pl/Biblioteka/Ekonomia/biopaliwa_gradziuk.pdf 14/12/18

95 Zamorowska K., *Biopaliwa – czyli jak skomercjalizować ideę?,* Portal Teraz Środowisko, https://www.teraz-srodowisko.pl/aktualnosci/biopaliwa-czyli-jak-skomercjalizowac-idee-5515.html 20/12/18

96 Portal Gospodarczy wnp, *PKN Orlen kontynuuje badania nad produkcją biopaliw z glonów*, https://nafta.wnp.pl/pkn-orlen-kontynuuje-badania-nad-produkcja-biopaliw-z-glonow,311516_1_0_0.html 20/12/18

97 Portal Infor.pl Sektor Publiczny, *Ustawa o biopaliwach już od 1 stycznia 2018 r.*,https://samorzad.infor.pl/wiadomosci/768556,Ustawa-o-biopaliwach-juz-od-1-stycznia-2018-r.html 10/01/19

98 Kuryłek Z.,*Wpływ zmian regulacyjnych na kształtowanie rynku biokomponentów w Polsce*, Finanse, Rynki Finansowe, Ubezpieczenia nr 1/2017 (85), s. 659-669, doi: 10.18276/frfu.2017.1.85-52 https://wnus.edu.pl/frfu/file/article/view/6961.pdf 10/01/19

99 KeatingD., Palm oil to be phased out in EU by 2030, Euractiv, 14 July 2018, https://www.euractiv.com/section/future-of-mobility/news/palm-oil-to-be-phased-out-in-eu-by-2030

100 KPMG, *Sustainable Insight: A roadmap to responsible soy*, http://www.gentechnikfrei.at/downloads/roadmap-responsible-soy-v2.pdf

101 Round Table Responsible Soy, http://www.responsiblesoy.org/

[102] WWF – World Wide Find For Nature, http://wwf.panda.org/our_work/markets/mti_solutions/certification/agriculture/soy/

[103] Noleppa S., Cartsburg M.,*The agricultural trade of the European Union: Consequences for virtual land trade and self-sufficiency*. HFFA Research Paper 03/2015. Berlin: HFFA Research GmbH

[104] FAO (Food and Agriculture Organization), 2012: *Technical conversion factors for agricultural commodities*. Rome: FAO

[105] Eurostat, 2014: *Statistics by theme: International trade: International trade detailed data: EU trade since 1988 by SITC*. Luxembourg: Eurostat

[106] IPCC, 2014. *Fifth Assessment Report*, http://ar5-syr.ipcc.ch/ipcc/ipcc/resources/pdf/IPCC SynthesisReport.pdf 14/01/19

[107] NASA, 2018. *Scientific Consensus: Earth's climate is warming*, https://climate.nasa.gov/scientific-consensus/, 14/01/19

[108] Union of Concerned Scientists, 2018. *Scientists Agree: Global Warming is Happening and Humans are the Primary Cause*, https://www.ucsusa.org/global-warming/science-and-impacts/science/scientists-agree-global-warming-happening-humans-primary-cause#.WxVaP0iFOUk, 14/01/19

[109] TynerW.E.,Taheripour F., Zhuang Q., Birur D., Baldos U., *Land use changes and consequent CO2 emissions due to US corn ethanol production: a comprehensive analysis*, 2010, West Lafayette, IL: Purdue University

[110] Fossil CO_2& GHG emissions of all world countries, 2017, European Commission – Joint Research Centre, EDGAR, http://edgar.jrc.ec.europa.eu/overview.php?v=CO2andGHG1970-2016&sort=des8

[111] Union of Concerned Scientists, Palm Oil and Global Warming, https://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/palm-oil-and-global-warming.pdf 12/01/19

[112] Dev Pandey K., Buys P., Chomitz K., Wheeler D.,*New tools for priority setting at the global environment facility*. World Bank Development Research Group Working Paper, 2006, Washington D.C.: World Bank

[113] CBD (Convention on Biological Diversity),*Global Biodiversity Outlook 1*. 2001, Montreal: CBD.

[114] Control Union, *RSPO Roadshow – perspektywy wykorzystania oleju palmowego w Polsce*, https://controlunion.pl/rspo-roadshow-perspektywy-wykorzystania-oleju-palmowego-w-polsce/ 28/01/19

APPENDIX. CHAPTER 2
Definitions and bases for calculations, additional charts and data not included in the report

Definitions of product segments, chapter 2, palm oil as product ingredient

Data: Foreign trade, 2017, source: Central Statistical Office				
Group of products	**Type of product**	**Import [kg]**	**Estimated content of palm oil**	**Estimated amount of palm oil in products imported to Poland [kg]**
Foodstuffs	Margarine	100 483 052	24%	24 115 932
Foodstuffs	Baked goods	81 969 104	1%	819 691
Foodstuffs	Cookies	83 128 104	10%	8 312 810
Foodstuffs	Chocolate	187 724 600	5,15%	9 667 817
Foodstuffs	Ice cream	22 433 221	10%	2 243 322
Foodstuffs	Potato chips	17 977 923	2%	359 558
Foodstuffs	Crisps	12 326 360	5%	616 318
Feed	Feed	706 592 861	1%	7 065 929
Chemicals and cosmetics	Soaps	51 702 665	55%	28 436466
Chemicals and cosmetics	Surfactants	477 036 791	20%	95 407 358
Chemicals and cosmetics	Shampoos	56 107 454	5%	2 805 373
Biofuels	Biofuels	269 039 878	3%	8 071 196
Total				**187 921 771**

CN code definition (Combined Nomenclature)

Combined Nomenclature is a basis for reporting goods:
- on importing or exporting, or
- when it is subject to intra-EU trade statistics.

1. **Food**:

1.1. **Margarine**
data for CN1517 – Margarine; edible mixtures or preparations of animal or vegetable fats or oils or their fractions, other than edible fats or oils or their fractions of heading 1516

1.2. **Baked goods**
CN 1905 10 Crispbread
CN 1905 40 Rusks, toasted bread and similar toasted products
CN 1905 9030 Bread and rolls not containing >5% of sugar and fat
CN 1905 9080 Other baked goods
CN 1905 9090 Remaining baked goods

1.3. **Cookies**
CN 1905 20 Gingerbread and the like
CN 1905 31 Sweet biscuits
CN 1905 32 Waffles and wafers
CN 1905 9045 Biscuits
CN 1905 9060 Baked goods with added sweetening matter
CN 1905 9070 Baked goods containing >5% of sugar

1.4. **Chocolate**
CN 1704 9030 – White chocolate
CN 1806 20 Food preparations containing cocoa in blocks, slabs or bars weighing >2 kg or in liquid, paste, powder, granular or other bulk form in containers or immediate packings, of a content >2 kg
CN 1806 31– Food preparations containing cocoa in blocks, slabs or bars, other than listed in headings 18062010 to 18062095, filled
CN 1806 32- Food preparations containing cocoa in blocks, slabs or bars, other than listed in headings 18062010 to 18062095, not filled
CN 1806 90 – Chocolate and foodstuffs containing cocoa, other than listed in headings 18061015-18063290
Only the products containing cocoa beans, cocoa paste, or cocoa powder are considered to be containing cocoa, pursuant to item 1806.

1.5. **Ice cream**
CN 2105 – Ice cream and other edible ice, whether or not containing cocoa

1.6. **Crisps and chips**
CN 2005 2020 – Potatoes in the form of thin slices, fried or baked, whether or not salted or flavoured, in airtight packings, suitable for immediate consumption, not frozen
CN 2004 1099 – Potatoes other than cooked, in other form than: flour, meal or flakes, frozen

2.0. **Animal feed**
CN 2309 – Preparations of a kind used in animal feeding: 230910 dog or cat food, put up for retail sale, 230990 food for animals other than dogs and cats, put up for retail sale

3.0. **Chemicals and cosmetics**

3.1. **Soap – data for**:
Soap 340111 Soap etc. Products for toilet use (including medicated products) 340119 Soap etc. Products other than for toilet use 340120 soap in other forms than shaped pieces

3.1.1. **Surfactants**
CN 3402 – Organic surface-active agents (other than soap); surface-active preparations, washing preparations, whether or not containing soap, other than those of heading 3401

3.2. **Hair care products**
CN 3305 10 – Shampoos (preparations for use on the hair)

4.0. **Biodiesel**
CN3826 – Biodiesel and mixtures thereof, not containing or containing less than 70% by weight of petroleum oils or oils obtained from bituminous minerals

APPENDIX TO CHAPTER 3
Consumption estimation methodology

1. Data on production for 2017 based on the report on production of industrial products for 2017 by Central Statistical Office: due to the possible term discrepancies, definitions of each category are provided below.
2. Values of import and export: database Foreign trade in Central Statistical Office: CN codes in Appendix No. 1.
3. Comparison with values from previous years' reports per capita and Statista data.
4. Calculation based on: proportional content of the consumed oil volume (data from DEFRA 2011, WWF 2016, and own calculations in an Excel file).

Appendix No. 1: Number of people in Poland 38,422,000
(Central Statistical Office 2019 http://stat.gov.pl/podstawowe-dane/ 09/01/19)

Ad 1:
DEFINITIONS OF CATEGORIES OF PRODUCTS TAKEN INTO CONSIDERATIONS.

The bread category includes data from report:
PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017. Diagram 1
- Fresh bread
- Rye bread
- Wheat bread
- Frozen bread
- Mixes and doughs for making baked goods
- Bread made of mixed wheat and rye flours

Chocolate:
PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017. Diagram 1
- Chocolate and other food preparations containing cocoa with weight over 2 kg, containing 18% and more cocoa butter and milk fat by mass
- Chocolate and other food preparations containing cocoa, filled
- Chocolate and other food preparations containing cocoa, not filled, with added cereal, fruit or nuts
- Chocolate-covered candies
- Chocolate-covered dragees
- White chocolate

Cookies:
DIAGRAM 3. SOLD PRODUCTION OF MORE IMPORTANT PRODUCTS ACCORDING TO PRODCOM IN 2017
- Confectionery and cookies, fresh
- Gingerbread and the like
- Sweet biscuits; waffles and wafers, completely or partially coated or covered with chocolate or other preparations containing cocoa
- Sweet biscuits, including double biscuits with filling, without completely or partially coated or covered with chocolate or other preparations containing cocoa
- Waffles and wafers containing water exceeding 10% of mass of end product, without ice cream cones, double waffles with filling, and the like
- Wafers and waffles, including salted and filled, without coated or covered completely or partially with chocolate or other preparations containing cocoa

The calculated data comply with the per capita values from Statista database for 2017, which proves the calculations to be reliable. In comparison to the available data on palm oil content in cookies and the figures from British DEFRA 2011 report, the average content in this category was estimated at 10%. This value is much lower than the value assumed in the British report, because in this report this category also takes into consideration the consumption of sweet baked goods, in which the consumption of palm oil during production is lower. Another issue is the use of margarines for baking cookies, which lowers palm oil content in the end product.

Margarine:
DIAGRAM 1. PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017

Feed:
DIAGRAM 1. PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017
- Ready-made feed for livestock

Crisps:
DIAGRAM 1. PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017

Ice cream:
DIAGRAM 1. PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017
Ice cream density was taken into account in calculations (assumed 0.6 g/cm3)

Soaps:
DIAGRAM 1. PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017
- Soap, surfactants and products used as soap

Surfactants:
DIAGRAM 1. PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017
- Surfactants, whether or not including soap, not put up for retail sale

Shampoos:
DIAGRAM 1. PRODUCTION OF INDUSTRIAL PRODUCTS IN 2017
- Hair care products

Biofuels:
- Only import is taken into account, due to the fact that biodiesel in Poland is made of rapeseed oil
- 32% of all biofuels is palm oil, and the maximum content is 10% – the estimated content has been designated at the level of 3% of biodiesel import

Summary:

Based on the comparison of the values estimated on the basis of the data from the reports on the production and foreign trade for 2017 by Central Statistical Office with source data (Statista, data from Eurostat reports for previous years and the report on deliveries to domestic market for 2017 by Central Statistical Office) it can be concluded that the obtained values are reliable, as there are no significant difference from the estimated and source data. For comparison, based on the report on deliveries to domestic market for 2017 by Central Statistical Office, which includes precise values for the consumption of chocolate and margarines, the estimated values are at similar level, which confirms the accuracy of the estimates.
Export and import in the case of the majority of food products is much lower than production, and in the majority of cases the production volume is significant.

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CONSUMPTION

Import of palm oil to Poland has increased since 2004 by 150%

THREATS

Overexploitation and agriculture are the biggest drivers of current biodiversity loss

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