Chapter 8
Issues on Palm Oil Shipment with Regard to the Revised MARPOL Annex II: A Review

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Abstract Issues connected with the discharge of high-viscosity and persistent floating products from tankers and cargo ships have been reported by countries affected by the discharge. This concern prompted the International Maritime Organization (IMO) to amend Annex II of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), which came into force on 1st January 2021. This new amendment, however, has a negative impact on the shipping business particularly in the transport of palm oil. The aim of this study is to underline the weaknesses in the policy process of MARPOL Annex II amendment as well as to examine articles and journals about issues involving palm oil, which ended in a misleading view of palm oil among public. The study has involved literature review of published and unpublished materials relating to MARPOL Annex II and vegetable oils, particularly palm oil. The findings revealed flaws in the policy framework of the MARPOL Annex II revision and the perception issues that are working against palm oil are linked with the lack of scientific research, which may serve as proof to indicate that palm oil is not harmful to marine life and living things. The public perception of palm oil and its products has also been proven to be influenced by media.

Keywords MAPROL Annex II · Palm oil · Vegetable oils · GESAMP

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8.1 Introduction

Each year, large volumes of fully refined or unrefined (slack) vegetable oil such as palm oil, soybean oil, sunflower oil, and olive oil are transported in bulk by tankers and cargo ships around the world. Certain products, like palm oil, must be stored at temperatures above their melting point in order to be filled or discharged in liquid form, and ships are often fitted with cargo heating coils to facilitate this. Following unloading, residuals known as "stripping" frequently stay at the bottom of cargo tanks or crystallise against bulkheads and interior machinery. The crew cleans the tanks manually or automatically with rotary-jet cleaning devices that use steam, hot water or chemical solvents [1]. The residuals can then be treated by port reception facilities or be discharged at sea under certain conditions.

Operational practices for this are regulated by the Annex II of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) issued by the International Maritime Organization (IMO), which contains regulations for the control of pollution by noxious liquid substances (NLS) transported in bulk, defining the standards and principles, which must be adopted to discharge harmful substances at sea, as well the standards for controlling such releases. According to the revised MARPOL Annex II, which entered into force in 2007, palm oil that was previously categorised as unrestricted has been classified as "high-viscosity and solidifying substances" that fall within the intermediate pollution category. Category Y of the NLS comprised substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a hazard to either marine resources or human health or cause harm to amenities or other legitimate uses of the sea. Therefore, it justifies a limitation on the quality and quantity of the discharge into the marine environment [2]. However, chemicals, such as vegetable oils, were still permitted to be discharged into the ocean based on the revised MARPOL Annex II and the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) as regulated by the IMO, as long as the shipowner follows the guidelines for the discharge procedure and does not violate the regulation.

In response to years of extensive pollution of the coastlines in Northern Europe as a result of cleaning residues after carriage of vegetable oils and waxes commonly known as persistent floaters, the IMO has amended the IBC Code and MARPOL Annex II on 17 May 2019 under "Cargo residues and tank washings of persistent floating products" that entered into force in North West European Waters, Baltic Sea, Norwegian Sea and Western European Waters on 1 January 2021. According to this amendment, when discharging category Y high-viscosity or solidifying substances (e.g. with a viscosity equal to or greater than 50 mPa s at 20 °C and/or a melting point greater than or equal to 0 °C), the ship tanks should be stripped to the greatest degree feasible, followed by a tank pre-wash operation, with the residue/water combination formed during the pre-wash being discharged to a receiving facility at the port of unloading.

8.2 Background of the Study

This new amendment undoubtedly has negative impacts on the shipping industry, especially in the transport of palm oil. There is a range of concerns to address when dealing with this new provision, such as the shortage of port reception facilities (PRF) to dispose the residue, which is still lacking since not every port has this facility. Inadequate facilities can cause port congestion and will increase demurrage charges as a result of longer waiting times. The commercial washing takes at least one hour, but with certain cargoes, the whole cleaning process that includes flushing and steaming will take up to four to six hours [3]. As the world's most traded vegetable oil, any changes to regulations governing the transport of vegetable oils would have a huge impact on the palm oil business. Shipping palm oil to the Port of Rotterdam now costs between USD 40 and USD 70 per tonne. The cost of a pre-wash procedure for a vessel transporting 35,000 tonnes of palm oil to the Port of Rotterdam will rise to USD 68,600, or USD 1.96 per tonne of palm oil, due to the possibility of a longer wait at the port. The present shipping cost of palm oil from Malaysia to the Port of Rotterdam may rise by 2.5–7.1% as a result of this. Exporting palm oil will cost between USD 16 million and USD 20 million more for exporters. This increased expense would have to be passed on to customers, thus making it less competitive. Apart from the increased costs due to higher charter rate, it has been a major concern that negative perception about palm oil will be heightened. There is also a possibility that further efforts may be in the pipeline to extend this regulation to other geographical areas outside Europe, such as India and China; the two biggest palm oil consumers in the world.

The decision by IMO to stringent condition for vegetable oil through the amendment of MARPOL Annex II may be seen as an attempt to further discredit palm oil to its use and transport. Besides that, it is seen to be another attempt of putting a non-tariff barrier against palm oil. Although other vegetable oils will be impacted by the new law, they will not be as severe as palm oil. Most of the domestically produced vegetable oils such as sunflower oil, rapeseed oil and olive oil are transported internally using land transport such as trains or cargo trucks, and the MARPOL regulations will not apply on such mode of transport. The decision taken at the IMO level to impose stricter requirements on Category Y product is debatable since there is no observational and literature analysis on palm oil to prove that it is hazardous to marine life and living things. Indeed, scientific research has revealed that most of the vegetable oil-including palm oil is biodegradable and non-toxic. This state of fact leads the researchers to wonder why public opinion is polarised in terms of viewpoints that palm oil can threaten marine life and other living things even though it has not been proven so. This is the question that prompted the researchers to embark on this study; to conduct an analytical and literary evaluation of palm oil in order to refresh people's mind but also draw the attention to the characteristics of palm oil that people seem to take less attention to. This paper aims to:

(a) Underline the weaknesses in the policy process of MARPOL Annex II;
(b) Examine articles/journals on issues involving palm oil that ended in a misleading view of palm oil among the public;
(c) Highlight the behaviour and characteristics of palm oil; and
(d) Propose the future field of study, this study might serve as a starting point for further research on the feasibility of shifting the palm oil category in MARPOL Annex II from Y to Z.

The study has involved literature research of published and unpublished materials relating to MARPOL Annex II and vegetable oils, particularly palm oil. This includes an analytical review of the policy process of MARPOL Annex II, people's perception towards palm oil and behaviour and characteristics of palm oil.

8.3 MARPOL Annex II

8.3.1 The Policy Process

As early as 1994, the IMO circulated to all member states guidance and warnings concerning the transport of vegetable oils and their effect on birds after discharge [4]. Despite the lack of particular legislation, the organisation asked governments and port state administrations to bring the information to the attention of all ship operators in order to limit the discharge or emission of such compounds. The IMO's specialists engaged in the creation of the Globally Harmonised System (GHS) have to coordinate with the Organisation for Economic Cooperation and Development (OECD) and United Nations (UN) expert sessions from 1993 to 2003. During this period, scientists collected all safety data for bulk liquids mentioned or derogated in the IMO standard and created particular hazard categorization criteria in accordance with continuing discussions at the OECD and UN levels, using a flexible methodology. For a number of years, however, the hazard assessment of vegetable oils was excluded [5].

In the 1970s and 1980s, scientists published scientific publications regarding environmental concerns before any political or regulatory discussion. In 1989, however, there were complaints from coast guards and beach patrol agents concerning incidences of pollution and oiled birds that sparked national political action. Incidents involving the deaths of dogs and seabirds in 2013 triggered national political action once again [5]. Following this, in 2016, Norway and Sweden have proposed amendments towards MARPOL Annex II to further reduce the impact on the environment of tank washings containing high-viscosity and persistent floating products during Marine Environment Protection Committee (MEPC) meeting under IMO [6]. Among the recommendations made, include requiring the vessel to go through a pre-washing procedure before releasing the cargo residues to the port's reception facilities, as well as revising the definitions of solidifying and high-viscosity chemicals. In addition, Norway and Sweden proposed reclassifying the discharge material as a high-viscosity material: a substance in category X or Y with a viscosity of 50 mPa s or greater at

20 °C; and a solidifying agent is a noxious liquid with a freezing point of 0 °C or higher.

When the discussion at the international level began, the majority of IMO members, including the major vegetable oil importers, agreed towards the proposals and choosing for editorial work on the current treaty [6]. There was a final political debate with just minor resistance orchestrated by Malaysia, the world's top exporter of palm oil. Malaysia, speaking on behalf of certain other vegetable oil producing countries, questioned the hazards of floating oils for some products (such as palm oil), claiming that the liquids would solidify and hence not harm marine life. Furthermore, Malaysia identified a shortage of suitable tanker tonnage, thus leading to a shortage of renewable oils after 2006 [7]. Between the lines of the papers presented throughout the years, the producing agricultural industry made it clear that tighter transportation laws might have a severe impact on the competitive position of these renewable raw products and have an impact on developing nations in the south.

8.3.2 GESAMP Hazard Profile

Alongside the revision of MARPOL Annex II, the marine pollution hazards of thousands of chemicals have been evaluated by the Evaluation of Hazardous Substances (EHS) working group, giving a resultant of the joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) Hazard Profile, which indexes the substance according to its bio-accumulation; bio-degradation; acute toxicity; chronic toxicity; long-term health effects; and effects on marine wildlife and on benthic habitats. The hazard profile provides an alphanumerical fingerprint of each substance. The numerical scales start from 0 (no hazard), while higher numbers reflect increasing hazard. In this way, information on substances evaluated by GESAMP is made available to the widest possible audience in an instantly readable form. Hazard evaluation and categorisation or "classification" are thus the responsibility of separate bodies [8].

GESAMP, through its EHS working group, encourages industry involvement in the preparation of the hazard profiles. Of necessity, the sessions of the GESAMP EHS working group are closed meetings. However, representatives from chemical manufacturers, their branch associations or sector groups, as well as shipping agencies are frequently invited to provide statements or to comment on specific items under discussion. Such contributions are particularly welcomed by GESAMP in cases where the whole groups of substances are being reviewed or re-evaluated [8]. The results of the evaluation of chemical substances are published in the meeting reports of the GESAMP EHS working group and tabled at the next GESAMP session. Following approval by GESAMP, the hazard profiles are published periodically as circulars by IMO and distributed to IMO member states and observer organisations. In addition, a composite list is published annually by IMO containing the hazard profiles of all chemical substances evaluated during the last thirty years. Through MEPC, IMO is responsible for assigning bulk liquid substances to an appropriate pollution category on the basis of the GESAMP hazard profile as per Table 8.1 [8].

Table 8.1 GESAMP hazard profile [9]

GESAMP hazard profile May 2017 Product	Aquatic environment (score: 0–6)				Human health (score: 0–4)						Interference with other uses of the sea		
					Acute mammalian toxicity			Irritation, corrosion & long-term effect					
	A1 Bio-accumulation	A2 Bio-degradation	B1 Acute toxicity	B2 Chronic toxicity	C1 Oral toxicity	C2 Dermal toxicity	C3 Inhalation toxicity	D1 To skin	D2 To eye	D3 Long-term health	E1 Tainting	E2 Wildlife & benthic	E3 (0–3) Coastal amenities
Palm oil	0	R	0	NI	0	(0)	(0)	0	0			Fp	2
Soybean oil	0	R	0	NI	0	(0)	(1)	(0)	1			Fp	2
Sunflower oil	0	R	0	NI	(0)	(0)	(1)	(0)	(1)			Fp	2
Cotton seed oil	0	R	(2)	NI	(0)	(0)	(1)	0	1			Fp	2
Coconut oil	0	R	(1)	NI	0	(0)	(1)	0	(1)			Fp	2
Olive oil	0	R	(2)	NI	(0)	(0)	(1)	1	1			Fp	2

(continued)

Table 8.1 (continued)

GESAMP hazard profile May 2017 Product	Aquatic environment (score: 0–6)				Human health (score: 0–4)						Interference with other uses of the sea		
					Acute mammalian toxicity			Irritation, corrosion & long-term effect					
	A1 Bio-accumulation	A2 Bio-degradation	B1 Acute toxicity	B2 Chronic toxicity	C1 Oral toxicity	C2 Dermal toxicity	C3 Inhalation toxicity	D1 To skin	D2 To eye	D3 Long-term health	E1 Tainting	E2 Wildlife & benthic	E3 (0–3) Coastal amenities
Rapeseed oil	0	R	(2)	NI	(0)	(0)	(0)	(1)	(1)			Fp	2

- No concern over bio-accumulation
- Readily biodegradable
- No confirmed chronic toxicity
- No or low acute toxicity
- No acute mammalian toxicity (bracket of C3 valued in vapour form)
- No known long-term health concerns
- May be mildly irritant to eye and skin in direct contact
- Exists as persistent floater at sea
- Moderately affect coastal amenities, possibly lead to the closure of amenity

Based on Table 8.1, it is found that vegetable oil including palm oil is non-hazardous to aquatic environment and human. Thus, it exists as persistent floater at sea and moderately affects coastal amenities. This evaluation process done by International Tanker Owners Pollution Federation (ITOPF) was based on the GESAMP Hazard Evaluation Procedure. This state of fact leads the researchers to wonder why palm oil has been categorised under Category Y and condition under this category has been stringent even though scientific study has proven it to be as non-hazardous. This might be due to the fact that in instances of accidental poisoning, GESAMP will also take into account of human experience [8]. All available information is considered together by the experts, and ratings are given on the basis of the total weight of evidence, in order to evaluate the hazard produced by the substances. However, where experimental data on bio-accumulation or acute aquatic toxicity are not available, then GESAMP generally accepted estimation techniques. In this case, quantitative structure–activity relationships (QSARs) for the chemical group in question is acceptable. Besides that, estimation techniques for biodegradation also could be accepted by GESAMP to show that a substance is not readily biodegradable, in order to avoid further and often pointless testing [8].

8.4 Excerpts from Media About Palm Oil Harmfulness

8.4.1 The Death of Zanzi the Dog

One of the first cases happened in Cornwall, England, near the Strait of Dover, on the dog-friendly beach of Long Rock. This is also, coincidentally, the world's busiest shipping channel. Zanzi, a black-haired mini-schnauzer, went out on a stroll with his owners in October 2013. He had wandered off and was shortly munching on something, which was claimed to be white, waxy, and smelled a bit like diesel. Zanzi became agitated minutes after biting and swallowing the gluey material. The stuff became entangled, and the dog was having difficulty breathing. Zanzi was sent to the nearest vet, Mounts Bay, where he had an emergency operation. Zanzi died that day, despite his best attempts [9]. That year, news of Zanzi's oil-related death spun through the news cycle. It appeared that palm oil, a substance formerly connected with rainforest devastation, had also killed a beloved pet. Following this case, further complaints of the oil sickening and killing dogs began to appear in online news, with the majority of articles going back to Zanzi himself. Zanzi's death has spurring anxiety to owners up and down the coasts. Cornwall Council and other governments scrubbed their beaches of washed-ashore fats, posted "Be wary of palm oil" signs on the sand, and set up a government website as a warning to safeguard local pets [9].

With this bad connotation, palm oil has penetrated the public mind. Back at Mounts Bay, where Zanzi died, it was discovered that there had never been a proven dog fatality caused by palm oil. In reality, despite the fact that this substance kills a dog every day, none of the canine deaths have been verified to be the effect of this component. Long pointed out that no one seems to be completely sure what exactly in the blobs of floating fat it is that was sickening and killing dogs [10]. The stomach contents of one dog that became really unwell after consuming something on the beach were found to contain not just palm oil, but also substantial amounts of germs. Therefore, it is probable that these dogs are becoming seriously ill as a result of bacterial infection. According to her, dogs do not break down fats properly, so if they consume enough of it—even if it is not enough for a person to metabolise—they might get pancreatitis.

Cudmore claimed that the initial Cornishman article that revealed the "deadly palm oil" was confirmed by the national body, Public Health England, as a cause of Zanzi's death was incorrect [11]. According to Cudmore, based on her communication with one of that agency press officer, she has been informed that Zanzi's case was actually not in Public Health's hand but in those of the Maritime Coastguard's. Andrew also responded that they did not analyse the substance, and there had never been proof or cause to believe that palm oil itself is responsible for the dog's death. Apart from this, the Poisons Information Service in UK investigated how 30 surviving dogs who had eaten various "palm oil blobs" on various beaches in the country reacted to the substance. While many dogs exhibited no signs of illness, one did have a minor cough that lasted three days, and another recovered from aspiration pneumonia after seven days. Eleven of them vomited, which was the most prevalent adverse effect, and a few of them also had diarrhoea. Both of these are signs of petroleum toxicity in dogs [11].

It is fully aware that cargo ships or tankers also discharge chemicals, such as diesel fuel residue into the sea as it is permitted by MARPOL Annex II and IBC Code, as long as the shipowner follows the guidelines for the discharge procedure and does not violate the regulation. Therefore, the water is contaminated not only by palm oil waste but also by other chemicals like petroleum. As a result, the ship waste and palm oil residue mix to produce a gelatinous form with a petrol-like odour, attracting dogs to sniff and even swallow the oil. This petrol mixture could cause major health risks to both humans and dogs. See Table 8.2 for the list of articles and journals regarding the death of the dogs.

Table 8.2 Articles and journals regarding the death of the dogs [12–16]

Article/journal	Title
Mail Online https://www.dailymail.co.uk/news/article-2571647/Toxic-waste-killing-dogs-beaches-Poisoned-pets-left-writhing-agony-palm-oil-dumped-sea.html	Toxic waste killing dogs on beaches: poisoned pets left writhing in agony by palm oil dumped at sea (2 March 2014)
Shoreham Herard https://www.shorehamherald.co.uk/news/washed-palm-oil-dangerous-dogs-beach-2301467	Washed-up palm oil dangerous to dogs on beach (24 Feb 2014)
The Westmorland Gazette https://www.thewestmorlandgazette.co.uk/news/14208063.warning-issued-to-dog-walkers-after-dog-eats-deadly-palm-oil-on-beach-at-silverdale/	Warning issued to dog walkers after dog eats deadly palm oil on beach at Silverdale (15 Jan 2016)
Daily Post UK https://www.dailypost.co.uk/news/north-wales-news/toxic-palm-oil-deadly-dogs-13847250	Toxic palm oil deadly to dogs could be washing up from killer wreck again (2 Nov 2017)
Metro https://metro.co.uk/2018/03/23/dog-owners-warned-deadly-palm-oil-washing-uk-beaches-7410402/	Dog owners warned of deadly palm oil washing up on UK beaches (23 March 2018)

8.4.2 The Deaths of Seabirds

In January 2013, it was reported that about 100 birds were found on Chesil Beach in Dorset, UK, 60 a little further west at Brixham and many other individual birds and smaller groups elsewhere along the coast. The birds, mostly guillemots, were covered in the waxy film. Morris stated that the tests by the Environment Agency have established that the problem has been caused by some sort of refined mineral oil, not palm oil as had been suspected [17].

According to [18], forensic specialists determined that the unexplained waxy material coating more than 100 seabirds found up on Southern English beaches was a mineral-based oil. United Kingdom's Maritime and Coastguard Agency (MCA) officials also said the initial findings indicate that the substance is not palm oil, as had been suggested by at least one scientist [19]. That means it might have been anything from hydraulic fluid to Vaseline, but it was clearly not the palm oil that had been linked to the deaths of birds from Cornwall to Sussex. However, the West Sussex Gazette alleged that palm oil was a primary cause of eleven seabird deaths in Worthing [20]. According to senior animal rescue officer at the Worthing, if palm oil makes dogs ill it is certainly not going to be good for birds [21]. More and more articles about palm oil washing up on beaches and killing seabirds have recently appeared on the online news as listed in Table 8.3, causing public distress. Despite

Table 8.3 Articles and journals regarding the death of the seabirds [22–25]

Article/journals	Title
The Free Library https://www.thefreelibrary.com/SLAUGHTER+OF+THE+SEABIRDS%3B+Hundreds+covered+in+palm+oil+washed+up+on+...-a0317122822	SLAUGHTER OF THE SEABIRDS; hundreds covered in palm oil washed up on British beaches (1 Feb 2013)
BBC https://www.bbc.com/news/uk-england-dorset-26313284	Chesil Beach: dead and oil-covered birds still washing up (23 Feb 2014)
West Sussex Gazette https://www.westsussextoday.co.uk/news/seabirds-die-after-ingesting-deadly-palm-oil-1285258	Seabirds die after ingesting deadly palm oil (28 Feb 2014)
Dorset Echo https://www.dorsetecho.co.uk/news/11030832.update-tide-of-dead-seabirds-keeps-rolling-in/	UPDATE: tide of dead seabirds keeps rolling in (25 Feb 2014)

the fact that none of the seabird deaths were caused by this component, such news has heightened the public's negative perception of palm oil.

8.5 Vegetable Oil Behaviour and Characteristics: Palm Oil

8.5.1 Increase in Palm Oil Production in Response to Increased Demand for Vegetable Oils

Vegetable oils have been used by man for many decades in various ways [26]. Vegetable oils' unique characteristics and chemical composition have allowed them to be used as food, lubricants and fuels, as well as in the production of agrochemicals, plasticisers, inks and coatings. Palm oil remains the largest vegetable oil consumed globally for food and industrial use. Higher production and lower prices support expanded global palm oil demand from China, the European Union and many other countries. Despite global production outpacing consumption, ending stocks continue to fall as stock levels recover from 2020/21 consumption exceeding production levels [27]:

i. Indonesia consumption is up 220,000 tonnes to 15.3 million on higher demand for food use.
ii. China consumption is up 400,000 tonnes to 7.2 million mostly on higher demand for food use.
iii. Thailand consumption is up 450,000 tonnes to 2.7 million on higher industrial and food use.

iv. India consumption is down 205,000 tonnes to 8.6 million as consumer preferences shift to other vegetable oils, driving lower food use [28].

The palm oil consumption is increasing since it is the most versatile of all vegetable oils. This is due to the fact that palm oil may be processed to produce a diverse spectrum of products with varying melting points, consistencies and characteristics. There are a couple of reasons why palm oil has been the favoured crop to meet growing demand for vegetable oils. Firstly, it has the lowest production costs. Secondly, its composition means it is versatile and can be used for food and non-food purposes. Some oils are not suited for cosmetic uses such as shampoos and detergents. Third, it gets incredibly high yields [29].

8.5.2 Oil Behaviour

Vegetable oils, including palm oil, have melting points above 0 °C that require heating during the voyage and while discharging. The viscosity and melting point of the substance, as well as its characteristics when discharged into the marine environment as tank washings, are the key physical properties at issue for these materials. The viscosity of oil and its displacement on the water surface are inversely proportional. The melting point of various vegetable oil is listed in Table 8.4. While the viscosity of the oil is high, it moves slowly; when the viscosity is low, the oil moves quickly, depending on the water temperature [30].

Vegetable oil such as palm oil, soybean oil, sunflower oil and olive oil are transported in bulk by tankers and cargo ships around the world. Following unloading, residuals frequently stay at the bottom of cargo tanks or crystallise against bulkheads and interior machinery. Tanks are either manually cleaned by the crew or automatically cleaned by rotary-jet cleaning systems that use steam, hot water or chemical

Table 8.4 Vegetable oil melting point temperature

Vegetable oil	Melting point temperature (°C)
Palm oil	30–37
Soybean oil	−20
Sunflower oil	−17
Palm Kernel oil	~24
Peanut oil	0–3
Cottonseed oil	~0
Coconut oil	24–26
Olive oil	−6
Sesame oil	−6
Corn oil	−11
Cocoa butter	34–38

solvents. When discharging tank washings, the majority of the tank washing will be water, with a final component being the cargo residues floating on the tank washing surface. Although the cargo residue may be a viscous liquid while in the slop tank, when it enters the sea, it will become solid because of the ambient sea temperature. Therefore, instead of being spread over a greater distance, it could be concentrated in one area. When cargo residue, which contains oil enters into the seawater, it begins a cycle of processes known as weathering, which alters the properties and behaviour of the oil. The key factors that influence oil behaviour are [30]: physical characteristics of the oil, in particular, specific gravity, viscosity and boiling range; composition and chemical characteristics of the oil; meteorological conditions (sea state, sunlight and air temperatures); and characteristics of the seawater (specific gravity, currents, temperature, presence of bacteria, nutrients and dissolved oxygen and suspended solids). Palm oil is classified into two types: solid fractions called palm stearin (PS) and liquid fractions called palm olein (PO). The separation of this fraction intends to improve the potential application of palm oil, particularly palm stearin, which offers flexible melting properties for a variety of food sectors [31].

Palm stearin, a palm product, solidified at 30 °C and according to a laboratory test conducted by the ITOPF, it is rapidly biodegradable. The result of the test has been evaluated based on GESAMP Hazard Evaluation Procedure. Based on the test result, it shows that palm stearin is non-hazardous, although it is discovered that it may have an impact on coastal amenity usage and wildlife. Table 8.5 shows that palm oil and palm nut have low viscosity in comparison to other vegetable oils [32].

Table 8.5 Bibliographical data of vegetable oil [33]

Oil type	Rapeseed	Palm	Palm nut	Castor
Synonyms	Rape oil, rapeseed oil, canola oil	Palm oil, palm butter	Palm nut oil, palm kernel oil	Castor oil, cosmetol, gold bond, phorbyol, neoloid, ricinus oil
Appearance (state at 20 °C)	Yellow liquid	Orange-red solid, light to dark	Light yellow liquid, hazelnut odour	Colourless/pale yellow liquid, slight odour
Density relative to seawater (at 20 °C)	0.91	0.895–0.95	0.899–0.913	0.96
Solubility in sea water (mg/l)	Insoluble	Insoluble	Insoluble	Insoluble
Viscosity (cSt at 20 °C)	72–82	25–31 (at 50 °C)	17–20 (at 50 °C)	600–1200 (at 840 °C)

8.5.3 Biodegradation at Sea

Vegetable oils are widely found in nature and consist mainly of glycerol esters particularly triacylglycerols (a major form of dietary lipid in fats and oils, whether derived from plants or animals). They are biodegradable, come from renewable sources and have low toxicity [34]. Biodegradation of a compound is often found as a result of the actions of multiple organisms. It is a process by which microorganisms alter or convert (through enzymatic or metabolic action) the chemical structure imported to a polluted environment to improve degradation through a process called bioaugmentation [35]. Several tests that were carried out indicated that vegetable oils, including palm oil undergo about 70–100% biodegradation in a period of 28 days. However, it was discovered that the vegetable oils did not biodegrade on the beach, but rather changed into a gum-like substance known as lump in the case of palm oil. Palm oil lump is formed at the European Union sea because the water temperature is about 20 to −2 °C with heavy waves [6]. Given the state of the ambient waters, palm oil residues do not have ample time to go through the process of biodegradation and have been taken by strong currents to the coastal and marine areas of the European Union.

The oil biodegradation processes in seawater were found to be significantly stimulated by nutrient enrichment and by the presence of mixed microbial consortia found in wastewater. It was also observed that different oils responded in different rates and extents to biodegradation depending on their viscosity, structure and compositions. Auto-oxidation and biodegradation took place in the oil weathering process. The oxidation process either accelerates the biodegradation rates by producing much smaller and easier compounds to be biodegraded or inhibits the microbial attacks by producing antibacterial products [36]. Depending on the sea temperature, palm stearin will easily biodegrade in less than 5 days. The reason why palm oil did not biodegrade on the beach, but instead transformed into a gum-like material known as lump, has attracted researchers' interest. Other chemical residues, which also have been discharged to the sea, may have had a role in why palm oil solidified and did not go through the weathering process.

8.6 Qualitative Content Analysis on Published and Unpublished Materials

The content and meaning of the published and unpublished materials used in this study were examined using qualitative content analysis. The meaning unit has been coded, categorised and organised into themes. Then, graphs were created to provide a graphical representation of the results. According to the graphs in Tables 8.6 and 8.7, the major focus of the materials is on negative propagation of palm oil. Due to a lack of scientific research, palm oil has been propagated as dangerous and harmful

Table 8.6 Total of meaning unit based on theme (The Death of The Dogs)

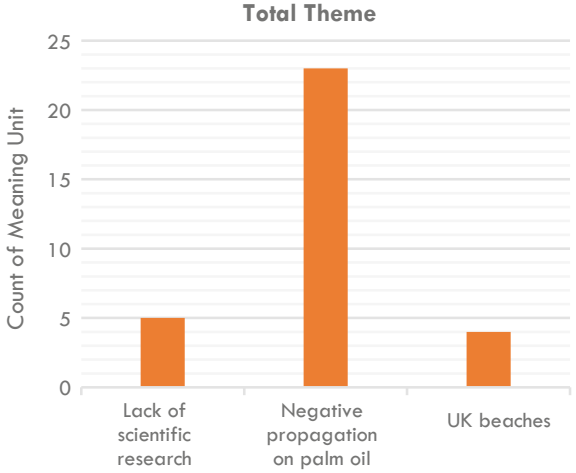
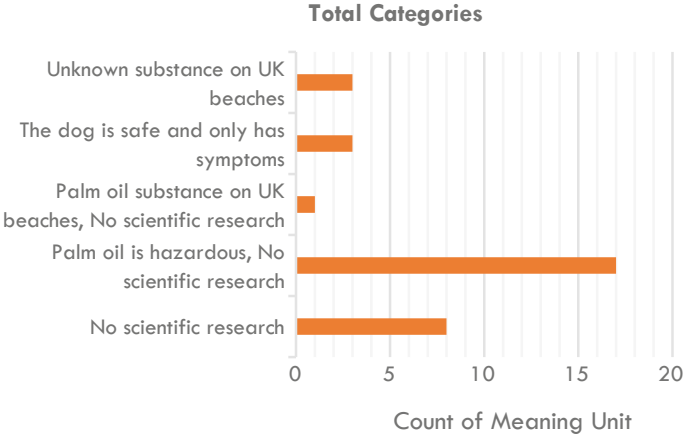


Table 8.7 Total of meaning unit based on categories (The Death of The Dogs)



to marine life and living things. Similarly, the content analysis of materials about seabird deaths in Tables 8.8 and 8.9 yielded the same result.

Table 8.8 Total of meaning unit based on theme (The Death of The Seabirds)

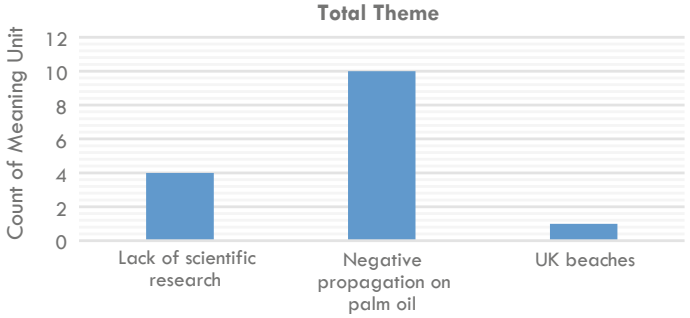
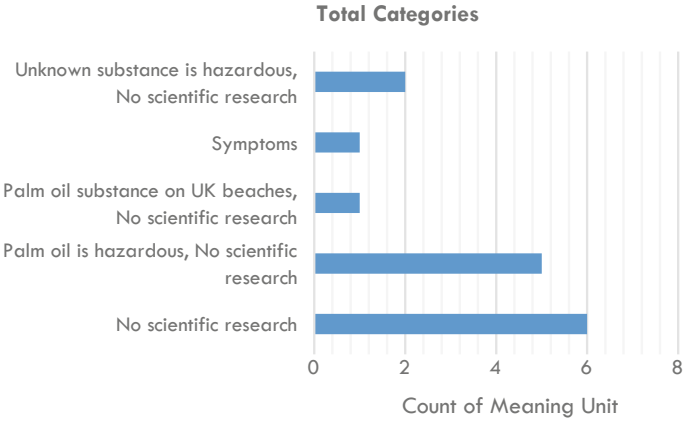


Table 8.9 Total of meaning unit based on categories (The Death of The Seabirds)



8.7 Discussion

According to the analytical review, the decision on palm oil categorisation made at the IMO forum is debatable. Scientific studies confirming that palm oil is non-hazardous have been recognised as one of the few elements supporting this claim. Furthermore, no scientific analysis has been undertaken to verify that palm oil killed Zanzi or other dogs, as well as the seabirds. Apart from that, human experience and estimating techniques have been acknowledged as flaws in the GESAMP Hazard Evaluation Process, which might lead to inaccurate palm oil categorization at the MEPC at the IMO. This is because data derived from human experience is very subjective and must be supported by solid proofs. However, there have been instances in the past where manufacturers, representatives, and trade organisations have questioned hazard profiles. MEPC has previously advised GESAMP to do research on big chemical groups such as polyether polyols and vegetable/animal oils. GESAMP

reviews individual and groupings of chemicals on a regular basis, based on the availability of new data. Therefore, the researchers are of the opinion that there are strong reasons for palm oil categorisation in MARPOL Annex II to be revised. Palm oil major exporters should propose to IMO for the revision of GESAMP Hazard Profile, so that a new categorisation for palm oil can be determined.

The fact that palm oil exists as persistent floater at sea and moderately affects coastal amenities could be among the issues, which should be further analysed. A further research might be needed to find the best solution in order to cater for this issue. Besides that, the qualitative content analysis performed produced several salient observations:

i. The key perception propagated by the media is that palm oil is harmful to the marine ecosystem and living things.
ii. The perception issues that are working against palm oil are linked with the lack of scientific research.
iii. The propagation of negative sentiment towards palm oil started in European countries.
iv. The results of experimental studies and laboratory experiments proved that palm oil's behaviour and characteristics are safe for marine life and other living things.

8.8 Conclusion and Recommendation

News posted on social media has a ripple-like effect, allowing the post to reach a larger audience. This is not the first time that the palm oil industry has faced backlash. In fact, it began in the late 1980s, and misinformation about palm oil continues to exist since then. Palm oil has long been overlooked in the West, despite scientific evidence showing it is both more environmentally friendly and safer than other oils. The perceptions of people and the media impact the acceptability of palm oil and its products. Due to the obvious gap between what the public perceives and what is currently needed for the palm oil industry's long-term survival, all stakeholders must continue to put in efforts to raise their awareness. If there is a biased media narrative, it can be corrected by proactive discussion at international level and should involve political outreach.

The decision by IMO to enforce a more stringent condition for vegetable oil through the amendments of MARPOL Annex II and IBC has negative impacts on the shipping industry, especially in the transport of palm oil. Although other vegetable oils will also be impacted by the new regulation, they will not be as severe as palm oil. Most of the European-produced vegetable oils such as sunflower oil, rapeseed oil and olive oil are transported internally using land transport such as trains or cargo trucks and the MARPOL regulations will not apply on such mode of transport. Besides that, there is still lack of research on assessing the impact of current amendments. Rather than bickering, global industry leaders, particularly major palm oil exporters, should engage one another through dialogues and collaboration to improve the palm

oil industry. There is a possibility for a future revision of the palm oil categorization in MARPOL Annex II and IBC. Therefore, a thorough analysis should be undertaken for this reason.

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