Charting Ways for Environmentally Sound Management of Chemicals and Waste in ASEAN

Abstract *The rapid urbanization, industrialization, and strong economic growth experienced by ASEAN countries have driven a gradual but substantial rise in material production and consumption, leading to the increasing usage of chemicals and generation of both municipal and hazardous wastes [1]. Despite the rigorous efforts made by ASEAN countries, the rapid growth of waste generation, the complexities of waste composition and emerging new waste streams such as e-waste, plastic waste, and food waste remain a challenge to be addressed. To address these issues, ASEAN has put Sustainable Consumption and Production (SCP) as a high agenda, such as through The ASEAN Economic Community Blueprint and the ASEAN Socio-Cultural Community Blueprint, to minimize the generation of chemical and waste [2]. Furthermore, ASEAN member states' active involvements in various Multilateral Environmental Agreements (MEAs) such as the Basel Convention, Rotterdam Convention, Stockholm Convention, and Minamata Convention may provide incentives for enhancing ASEAN's regional cooperation in addressing the issue of environmentally sound management of chemicals and waste in the region.*

Key words*: Multilateral Environmental Agreements, Chemical and Waste, Circular Economy, Environmentally Sound Management, Chemical and Waste, Plastic Waste*

Environmentally sound management of chemicals & waste in ASEAN

The rapid urbanization, industrialization, and strong economic growth experienced by ASEAN countries have driven a gradual but substantial rise in material production and consumption, leading to the increasing usage of chemicals and generation of both municipal and hazardous wastes [1]. This increasing amount of waste generated by ASEAN countries need to be properly addressed, since without proper technical and institutional capacity for promoting solid waste management and material recycling in an environmentally sound manner, it is likely to result in increasing risk of harm to human health and the environment.

Since the establishment of ASEAN in 1967, ASEAN's total population has grown by 242.7% while the urban population has also increased from 21.5% to 49.0% in 2017 [3]. ASEAN's economic performance since 2007 to 2014 has grown to 4.6 % in 2014 and is expected to reach 4.9% in 2016 and 5.5% in 2017 [1]. As a consequence, AMS also observed a surge in waste generation, especially in Municipal Solid Waste (MSW), beside other types of waste such as chemicals and hazardous waste, as shown in Table 1:

Table 1 Amount of Waste Generation

No.	Countries	Per Capita MSW Generation (kg/capita/day)	Annual MSW Generation (In ton)
1	Brunei Darussalam	1.4	210,480
2	Cambodia	0.55	1,089,429
3	Indonesia	0.70	64,000,000

4	Lao PDR	0.69	77,380
5	Malaysia	1.17	12,840,000
6	Myanmar	0.53	841,508
7	Philippines	0.69	14,660,000
8	Singapore	3.763	7,514,500
9	Thailand	1.05	26,770,000
10	Viet Nam	0.84	22,020,000
	Total	11.38	150,023,297

Source: Jain (2017)

Table 1 shows that Indonesia is generating the highest quantity of MSW with 64,000,000 tonnes per year, followed by Thailand (26,770,000 tonnes), Viet Nam (22,020,000 tonnes), Philippines (14,660,000 tonnes), Malaysia (12,840,000 tonnes) and Myanmar (841,508), while Lao PDR is generating the lowest quantity of municipal solid waste (77,380 tonnes). In total, AMS generates 150,023,297 ton of MSW yet it does not necessarily provide accurate number in reality due to challenges faced by AMS such as the inadequate infrastructure and capabilities to monitor, different standards and regulations between AMS, the lack of standardized data collection and accessibility to existing data [1,4,5]. This also contributes to the complicated task faced by AMS in addressing and the environmental challenges, specifically the environmentally sound management of chemical and waste which was mainly due to the market differences, varying economic developments and diverse cultures [6].

Central to the issue of chemical and waste management is the principle of environmentally sound management (ESM), commonly defined as “taking all practicable steps to ensure that wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.” [7] In order to achieve this core principle, ASEAN member states (AMS) have ratified multiple Multilateral Environmental Agreements (MEAs) providing legal framework and international cooperation in technical and institutional capacity-building. At the same time, AMS have also begun formulating initiatives that include achieving Goal 12 of the United Nations’ Sustainable Development Goals (SDGs) and implementing effective mechanisms to achieve environmentally sound management.

MEAs and ASEAN regional initiatives on chemical and waste

The recent developments in MEAs related to chemicals and wastes provide incentives for ASEAN countries to implement and enhance best practices of environmentally sound management of those wastes throughout their life cycle, including the minimizing its generation through prevention, reduction, reuse, recycle, and recovery (3R) operations. These implementations are in line with AMS commitments in implementing provisions of the Basel Convention [7],[1] the Rotterdam Convention [8],[2] the Stockholm Convention [9],[3] and the Minamata Convention [10],[4] including the Strategic Approach to International Chemicals Management (SAICM). Such international instruments provide technical guidelines for environmentally sound management of chemicals and wastes. They have provided AMS with more elaborated and comprehensive policy and legal framework in addressing the generation and management of chemical and waste, since those agreements are closely related and

[1] All ASEAN member states are parties to the Basel Convention.
[2] Notwithstanding that all AMS are parties to the processes, Brunei and Myanmar have not ratified the Rotterdam Convention
[3] Notwithstanding that all AMS are parties to the processes, Brunei and Malaysia have not ratified the Stockholm Convention
[4] Notwithstanding that all AMS are parties to the processes, Brunei, Malaysia, and Myanmar have not ratified the Minamata Convention

often convened together (in case of Basel, Rotterdam, and Stockholm Convention) to provide better negotiations and information sharing between party members.

Regionally, AMS have reaffirmed their commitments on multiple occasions, *inter alia*, the 2017 ASEAN Joint Declaration on Hazardous Chemicals and Waste Management [11] and the 2019 Bangkok Declaration on Combating Marine Debris in ASEAN Region [12]. AMS have also formulated initiatives to achieve environmentally sound management, such as the 2013 Ha Noi 3R Declaration Sustainable 3R Goals for Asia and the Pacific for 2013-2023 [13] and the 2018 ASEAN+3 Marine Plastics Debris Cooperative Action Initiative [14]. AMS also established the ASEAN Working Group on Chemicals and Waste (AWGCW), a consultative platform among ASEAN Member States aiming to strengthen regional cooperation in addressing chemical and waste related issues under relevant multilateral environmental agreements such as the Basel Convention, Rotterdam Convention, Stockholm Convention, and Minamata Convention, as well as internationally agreed-upon systems such as the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), the 2020 Goal of Strategic Approach to International Chemicals Management (SAICM) and the UN 2030 Sustainable Development Goals [15].

AMS also cooperates with Japan as ASEAN partner in the region, establishing The Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes” in 2003 and the 3R Regional Forum in Asia and the Pacific in 2009 [16][17]. The Asian Network was proposed by Japan as an informal network among the Competent Authorities to the Basel Convention in Asia, aiming to facilitate information exchange and dissemination on transboundary movements of hazardous wastes and assisting countries in implementing the Basel Convention under each country's system. It includes other Parties to the Basel Convention from Asia region. Meanwhile, the 3R Regional Forum in Asia and the Pacific was established to serve as a platform for cooperation on promotion of the 3Rs in Asia and the Pacific.

Sustainable consumption and production of waste in ASEAN

Sustainable Consumption and Production (SCP) is United Nations’ SDGs Goal 12, involving shifting the consumption and production patterns to address global crises such as climate change, biodiversity loss and pollution, generation of hazardous and plastic wastes. There are three SDG 12 targets which are specifically for chemical and waste issues: 12.3 on food waste and food losses; 12.4 on achieving environmentally sound management of chemicals and all wastes throughout their lifecycle; and 12.5 on waste minimization through prevention and implementation of 3R (reduce, recycle, and re-use). SCP also implies a fundamental rethink of consumption culture which drive consumption and production process [18]. However, despite its universality, SCP patterns are basically based on human behaviors, thus regional and local characteristics play an important role in identifying SCP patterns and formulating SCP policies, specifically for ASEAN both as a region and for individual member states [19].

ASEAN has recognized the importance of SCP in addressing the chemical and waste challenges and has set it as a target under the ASEAN 2025: Forging Ahead Together work plan under the Socio-Cultural Community section [20]. SCP is included in section C.4 Sustainable Consumption and Production and has set the following strategic measures to be implemented [20]: 1) strengthen public-private partnerships to promote the adoption of

environmentally-sound technologies for maximizing resource efficiency; 2) promote environmental education (including eco-school practice), awareness, and capacity to adopt sustainable consumption and green lifestyle at all levels; 3) enhance capacity of relevant stakeholders to implement sound waste management and energy efficiency; and 4) promote the integration of Sustainable Consumption and Production strategy and best practices into national and regional policies or as part of CSR activities.

Plastic waste and opportunities towards circular economy in ASEAN with a view towards recent global discourse of a “new agreement” on plastic pollution

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Plastic waste is one of the most challenging issues related to waste management not only globally, but also in ASEAN. Globally, a research estimates that 8300 million metric tonnes (MMT) of plastic has been produced since 1950s, and 75% (6300 MMT) ended up as waste [21]. A great number of those wastes are inadequately managed, with one estimate that between 4.8 to 12.7 MMT of land-based plastic wastes entering oceans in 2015 alone [22]. The hazard potential of plastic waste are well-documented; the non-biodegradable nature of most plastic waste and its property to break down into smaller bits or commonly known as microplastic, especially those found and accumulated in environment led to serious environmental problems; such as the Great Pacific Garbage Patch [23], marine animals harmed by fishing nets [24,25], and microplastics found in fish catches and fish meals [26,27]. Yet the risk of plastic pollution to human health has not yet been fully understood [28,29]. The highly-persistent property of plastic in the environment allows it to accumulate in various types of ecosystems which may enter human body through inhalation or ingestion [30,31].

Nevertheless, plastic waste is also a global commodity in waste trade. In 2017, the global plastic waste trade was valued USD 4.5 billion for export and USD 6.1 billion for import, while the global total trade volume of plastic waste reached its peak during 2012-2017 period at 16.5 MMT [32,33]. The number of countries participating in the global waste trade networks grew tremendously, from 95 in the 1990s to 186 countries just before 2012, with movements from Southeast Asia to East Asia constituted the third highest with 1.3 MMT, just behind Western Europe to East Asia (3.1 MMT) and North America to East Asia (1.74 MMT) [32]. China, as a major importer of plastic waste, imported 5.83 MMT in 2017 alone, almost half of the global trade on plastic waste (13MMT) [32].

State of plastic waste in ASEAN

Asia has become a major region in the production and consumption of plastic within the past decade [34]. The region witnessed an increase of plastic production from 114 to 131 MMT between 2013-2015 alone [33], with China accounting for 28% of total plastic resin production and 64% synthetic fiber production in 2016 [35,36]. In ASEAN, the region’s plastic production accounts for about 20% of global production [37], and the production of single-use plastic is increasing with the rapidly growing packaging market; between 2014 and 2018, packaging market increased by an estimated 7.1% in Indonesia, 5.6% in Thailand, 4.2% in Singapore, 3.6% in Malaysia, and 3.3% in the Philippines [38]. A more general estimate on plastic waste generation in several of AMS can be observed on Table 2:

Table 2 Statistics on waste plastic generation in ASEAN countries (Mt)

AMS	MSW (2016)	ISW (2016)	Plastic ratio in MSW (%)	Plastic waste in MSW	Plastic waste in ISW	Total plastic waste (2016)	Total plastic waste (2017)	Total plastic waste (2018)
Thailand	27.5	37.2	17.6	5.38	0.5	5.85	5.88	5.96
Vietnam	22.0	51.1	10	2.64	0.6	3.28	3.29	3.30
Indonesia	6.1	141.0	14	0.98	1.8	2.74	2.95	3.01
Philippine	14.6	55.8	10.6	1.84	0.7	2.53	2.58	2.61
Malaysia	13.4	33.5	13.2	2.04	0.4	2.45	2.60	2.65
Singapore	7.7	11.4	11.7	1.05	0.1	1.19	1.22	1.24
Brunei Darussalam	0.2	0.9	13*	0.04	0.0	0.05	0.05	0.05

*The number is the average of the known data. Countries with MSW of less than 0.2 Mt are not counted.
Source: Y. Liang, Q. Tan, Q. Song, J. Li, An analysis of the plastic waste trade and management in Asia, Waste Management. 119 (2021) 242–253.

Table 2 indicates a growing trend of plastic waste generation in ASEAN countries with generation of Municipal Solid Waste (MSW) more than 0.2 Mt. MSW needs to be considered since the majority of plastic waste comes mixed with solid waste in Southeast Asia due to low collection rate of solid waste and treatment facilities that effectively prevent environmental leakage [34,39]. This trend corresponds to a report from United Nations Centre for Regional Development (UNCRD) which estimates that Asia and Southeast Asia region in particular will continue to observe an increase in resource consumption despite a decline in resource efficiency, leading up to a continuous increase in waste generation, including plastic waste [40,41]. Due to the inconsistency between increasing consumption of plastic and the general lack of infrastructure for environmentally sound management of plastic waste has consequently contributed to the increasing plastic waste in Southeast Asia [39].

Other source of the plastic waste in Asia is the global trade in plastic waste which was abruptly disrupted after China, as the biggest importer of plastic waste in the region, fully implemented the 2013 Green Fence Policy through the implementation of the 2017 National Sword Policy. The policy bans a comprehensive list of 24 categories of recyclables and solid waste, including majority types of plastic waste, effectively closed its border from any import of plastic waste, displacing 111 MMT of plastic waste projected to be imported by China and resulting in a decrease of global total trade volume with China to almost half of the previous year [32,42,43]. Consequently, many plastic exporting states, mostly high-income countries such as Germany, Japan, the United Kingdom and the United States, either reduced their waste export or diverted their export to other importing states in developing countries, including in ASEAN [32,44,45]. The latter development contributed to the increasing import of plastic waste, both legally and illegally, to ASEAN countries such as Indonesia, Malaysia, Vietnam, and the Philippines [4,33].

Table 3 Imports of Plastic Waste (HS 3915) to AMS, 2016-2020 (in tons)

No.	Country	2016	2017	2018	2019	2020
1	Brunei	29.97	115.69	124.76	442.28	292.94
2	Cambodia	646.80	639.46	584.79	71.52	2.37
3	Indonesia	120,978.86	128,951.34	320,451.81	249,618.39	181,733.48
4	Lao	1,180.63	3,909.16	7,880.96	98,533.41	63,777.51

5	Malaysia	287,673.30	549,786.28	872,530.65	333,499.82	478,091.61
6	Myanmar	687.81	1,854.93	3,299.23	2,691.78	10,275.20
7	Philippines	4,650.16	0.00	11,760.79	16,330.38	9,978.18
8	Singapore	3,354.38	9,226.08	9,049.27	4,222.86	5,648.77
9	Thailand	69,507.07	152,737.88	552,726.63	141,783.04	150,872.29
10	Viet Nam	101,906.90	149,927.67	190,966.52	279,717.68	328,875.18
	Total	590,615.86	997,148.50	1,969,375.40	1,126,911.15	1,229,547.52

Source: compiled from https://comtrade.un.org/

Table 3 indicates that the ASEAN region observed a huge surge of plastic waste imports from 590,615 tons in 2016 to 1,969,375 tons in 2018, indicating a shift of plastic waste stream to ASEAN countries. Malaysia was the biggest importer in the region, with 872,530 tons in 2018, followed by Thailand (552,726 tons), Indonesia (320,451 tons) and Viet Nam (190,966 tons). Prior to China’s ban on plastic waste imports, a number of AMS were net exporter of plastic waste, but have since become net importer of plastic waste, such as Indonesia (USD 58 million) and Viet Nam (USD 30 million) [44]. The destabilized plastic waste market has prompted a sharp increase of illegal transboundary movement of plastic waste into Southeast Asia [46,47].

Land-based activities are considered to be the major contributors to marine plastic pollution in ASEAN, such as Illegal dumping, tourism, and release of untreated sewage waste by local villages or factories, according to some estimates [21,48,49]. Considering that a number of AMS are also considered as one of the major polluter of marine plastic waste and the challenges they face in managing MSW in an environmentally sound manner, it may correlate with the fact that the East Asian seas are considered to have one of the greatest levels of plastic pollution in the world [22,44,50].

Circular economy of plastic in ASEAN

The state of plastic waste in ASEAN, as elaborated above, requires it to be addressed through concerted actions at multiple channels and also changes in business model and behavior [51]. The linear take–make–consume–dispose economic model, including for plastic, that currently predominates industrial production systems in Asia has been widely deemed as outmoded despite unprecedented economic growth and welfare it has brought. This consideration is increasing in the face of global challenges of climate changes, depleting resources and increasing waste generation, and circular economy starts to emerge as a response to the challenges [52]. The circular economy is an umbrella term to capture industrial and business models that instead of practicing the business-as-usual approach to production, aim to minimize waste generation and keep non-renewable resources in permanent use through establishing technical and economic cycle, minimizing energy loss and de-materializing production and consumption [53]. Thus, at its core, the circular business model is about economics and competitiveness.

Figure 1 Flows of plastic materials in a circular economy



Source: Akenji, L. et al. (2019), Circular Economy and Plastics: A Gap-Analysis in ASEAN Member States, Brussels & Jakarta.

The emergence of circular economy represents a fundamental and necessary alternative to achieve ASEAN’s long-term economic resilience which depends on achieving sustainable and inclusive growth [39]. In regard to plastics, implementing the circular economy model on plastics should not be focused *only* towards recycling practices, despite its significant potential for reducing waste and for limiting the need for natural resources, because: 1) recycling can indeed save resources, but the whole cycle of recycling also uses energy and other resource; 2) the quality of recycled plastics is currently inferior to that of virgin plastics; 3) current waste management makes it unfeasible to collect and recycle all post-consumer plastics; 4) there may be dissipative losses of plastics to the environment overtime such as microfibers and microplastics; and 5) some types of plastics are costly to be recycled [51].

Thus, overcoming the plastic-related challenges in ASEAN requires multilevel approaches and strategies, from minimizing the production of plastic, redesigning plastic usage so as to reduce the needs for plastic and making plastic easily reusable or recycled, ensuring plastics produced are free from hazardous chemicals, and protecting the health, safety, and rights of all people involved with all life-cycle of plastics. Thus, a holistic policy intervention to current practices and business model are required at all supply chain stages of plastics.

Towards a global plastic treaty

Current international legal instruments related to plastic waste are fragmented; most of the established international legal instruments focus on plastic as a waste after its generation (such as Plastic Waste Amendment of Basel Convention) and do not touch the whole life cycle of plastic nor its land-to-sea pollution. Other regulatory and management frameworks

addressing plastic waste, marine litter and microplastic, such as UNCLOS [54] and Annex V of MARPOL 73/78 [55] only cover pollution at sea and ocean discharge/dumping while the 1997 UN Watercourse Convention [56], the Convention on Biological Diversity (CBD) [57], and the 2001 UN Fish Stocks Agreement [58] only provide general obligation to protect the marine environment. Thus, the lack of a comprehensive legal and policy framework addressing the whole life-cycle of plastic may become a challenge in tackling the increasing problem of plastic waste, marine litter, and microplastic worldwide.

In a concerted effort to address this issue, a global discussion on the establishment of a global treaty on plastic throughout its whole life-cycle and to end plastic pollution is ongoing and recently reached a historic moment. The second round of 5th United Nations Environment Assembly (UNEA-5.2), held in 28 February–2 March 2022, adopted a resolution which establishes an Intergovernmental Negotiating Committee (INC) with a mandate to draft an international legally binding instrument on plastic pollution, including in the marine environment [59]. The deliberation will start commencing from the second half of 2002, with the aim of convening the draft instrument by the end of 2024. The resolution promotes comprehensive approach to be adopted into the instrument which may employ both binding and voluntary approaches that addresses the full life cycle of plastics, taking into account, *inter alia*, principles of Rio Declaration and national circumstances and capabilities. As a result of contentious discussions on how to properly address the issue of plastic pollution, the resolution also proposes to incorporate several ideas into the provisions, *inter alia*, the sustainable consumption and production of plastics, to promote national and international cooperative measures to reduce plastic pollution in the marine environment, including existing plastic pollution, and to promote national action plans to work towards the prevention, reduction and elimination of plastic pollution, and to support regional and international cooperation [59].

Policy Recommendations

A concerted action by Southeast Asian countries under ASEAN to respond to the outlined issues above are critical for the region. ASEAN member states should leverage their long-established association and to further strengthen AMS’ cooperation with ASEAN Dialogue Partners, especially in the region. Such endeavors should be pursued through ASEAN Community (especially Socio-Cultural) since it is the most relevant platform and cooperation with East Asian countries as Dialogue Partners are well embedded in the Community blueprints.

Encourage the speedy ratification of international instruments related to of chemical and waste management by ASEAN Member States who have yet to ratify those instruments. Ratifications to MEAs such as such as the Ban Amendment of Basel Convention [60],[5] Stockholm Convention on POPs, Rotterdam Convention, and Minamata Convention may provide incentives toward a more comprehensive regional regime on chemical and waste management in ASEAN.

[5] Notwithstanding that all AMS participated in the process, only Brunei Darussalam, Indonesia, and Malaysia have ratified the Ban Amendment to the Basel Convention. See http://www.basel.int/Countries/StatusofRatifications/BanAmendment/tabid/1344/Default.aspx

Encourage further clarity in chemicals and waste under national definition in ASEAN Member states, taking into consideration the recent development in related international instruments. A more consistent national definition between AMS may further incentivize chemical and waste data collection in the region, thus providing basis for strengthening waste management and monitoring process.

Adoption of the technical guidelines into national policy and legal framework, such as provided by the Basel Convention, the Rotterdam Convention, the Stockholm Convention, and the Minamata Convention, taking into consideration the available technological, social, and economic aspects. Technical guidelines of relevant international instruments (such as Basel Convention for hazardous and recently plastic waste) offer tailored recommendation on policy and legal framework for certain types of waste, thus providing more specific and gradual implementation stages.

Enhance cooperation with BCRC-SCRC Regional Center SEA to establish a regional framework/action plan to address the issue of transboundary movement of waste, including hazardous and plastic waste to and between ASEAN Member States for better monitoring and coordination. Regional Center may serve as hub for cooperation not only between ASEAN member states, but also between ASEAN and other partners under the same convention (such as Basel Convention or Stockholm Convention).

The management of plastic waste in ASEAN is mostly handled as a mix of solid waste and happens in the informal sector [61,62]. Thus, is it important **to strengthen the implementation of Framework for Circular Economy for the ASEAN Economic Community specifically for plastics**, *inter alia*, through establishing an ASEAN regional guidelines on circularity in plastics use, research and innovation on plastics, ASEAN technical standards for plastic products and recycled plastics, and ASEAN regional approach to phasing out harmful additives in plastics [51].

Shifting the predominant narrative to the governance of plastics as end-of-pipe issue to a holistic approach, since it’s not only related to waste management. Governance for plastics would need to be more systematized and deliberate among ASEAN countries and businesses.

In anticipating developments on the convening of a global plastic treaty, ASEAN should take an active role in shaping the international instrument at the right level, serving the interest of ASEAN Member States and the region at large, especially to navigate the posture, type, and possible provisions of the international instrument. Recent Framework for Circular Economy for the ASEAN Economic Community [39] should be disseminated to global community and contribute to the discourse.

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