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Tobacco's social and economic issues in Indonesia from 1992 to 2023 – a review to address product development

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Abstract

Indonesia has a distinct problem related to tobacco control because of its unique conditions and internal opposing interests. The tobacco industry is often seen as bringing substantial benefits to Indonesia, as well as having inherent cultural and heritage values. On the other hand, high and increasing tobacco use creates an economic burden from preventable diseases, threats to the demographic bonus, and other social hazards. The presence of electronic cigarettes (ECs) and various novel tobacco derivatives adds complexity to the existing problem. This study aims to gather and analyze published studies on the social and economic aspects of tobacco products from 1992 to 2023 to propose recommendations that contribute to the development of future regulations. Qualitative methods were used in this study. Specific search keywords were employed for collecting papers, which were processed for inclusion and exclusion; the selected papers were then subjected to content analysis. The findings are clustered into eight social aspects and five economic aspects. The differences between conventional and EC cigarette conditions are displayed in the MPOWER matrix, and the corresponding synthesis was then compared with proposals from existing studies and reports to produce enhanced recommendations. The conclusions emphasize the need for a tobacco master plan, efforts to diversify tobacco derivative products, voluntary initiatives from the industry to create a system that supports more responsible tobacco use, and the importance of conducting research and monitoring supported by independent funding, standards, and testing facilities to address problems and formulate appropriate policies.

Keywords: E-cigarettes, Economics, Indonesia, Social issues, Tobacco.

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1. Introduction

According to WHO's key facts, in 2020, 22.3% of the world's population used tobacco. From that population, around 80% of the world's 1.3 billion tobacco users live in low- and middle-income countries [1]. Indonesia has a population of 60.8 million adult male smokers and 3.7 million adult female smokers. This puts Indonesia among the nations with the greatest prevalence of tobacco consumption globally. Moreover, the 2013 and 2018 Indonesia national health surveys revealed that the incidence of smoking among teenagers aged 10-19 years increased from 7.2% in 2013 to 9.1% in 2018 [2].

Tobacco products must be governed because they have impacts on health, social issues, and the economy. A new challenge emerged from novel tobacco products that follow modern trends, like e-cigarettes (ECs) or other electronic nicotine delivery systems (ENDS). ECs[1] were first introduced to the Indonesian market around 2009 [3]. The 2018 excise tax regulation made the new tobacco products considered legal in Indonesia [3-5]. It was a starting point in regulating ECs because excisable goods become less affordable, the products are subject to consumption control, and their circulation is monitored [3]. The second and third milestones are the new health law (No. 17/2023) that was passed in August 2023 [6] and the 28/2024 government regulation for the implementation of the new health law. The new health law categorized all tobacco products as addictive substances.

Creating regulations for tobacco products in general, or ECs that want to be focused on in this study, is a challenging task. From a health perspective, ECs face pros and cons. The results of toxicological content analyses indicate that ECs are safer than conventional cigarettes, although the harmful effects of short-term EC use have been described [7]. From the direction of changing the use of conventional cigarettes to ECs, positive results have been observed in the form of safer chemical content, thereby reducing the risk. Cunningham, et al. [8]; Margham, et al. [9]; Goniewicz, et al. [10]. Goniewicz, et al. [10] found from their testing on 12 EC brands compared to cigarette smoke that the amounts of toxicants were 9–450 times lower. Margham, et al. [9] stated that the EC's aerosol has far lower amounts of toxicants and a less complex chemical makeup than tobacco smoke. They looked at 150 chemical emissions and found that emissions from e-cigarettes versus reference conventional cigarette (Ky3R4F) showed that the emissions of toxicants designated for regulation ranged from 82 to >99% lower per puff. Similarly, Cunningham, et al. [8] found that the nine WHO TobReg priority cigarette smoke toxicants were found to be more than 99% lower in the aerosols of e-cigarettes when compared to tobacco cigarettes.

However, ECs are not free of risk; the risks that will always exist are mainly related to nicotine, which is considered to be addictive and may potentially have other consequences [11]. Moreover, the health concerns associated with long-term use of ECs cannot be eliminated because the inhaled vapor contains hundreds of chemical substances [12]. WHO has expressed concerns about the presence of certain harmful substances, including glycidol, pyridine, dimethyl trisulfide, acetoin, and methylglyoxal [1]. Even a good result from a 3.5-year study still cannot eliminate the concerns regarding the risk of longer periods of use [13].

From an economic perspective, the tobacco industry is generally considered to contribute significant benefits for Indonesia as one of the tobacco-producing countries [14]. The revenue in the EC market in Indonesia is projected to reach US$0.5 billion in 2025. It is anticipated that the market will experience an annual growth rate of 1.63% for CAGR 2025-2029 [15]. Beyond the economic aspect, the tobacco industry in Indonesia is considered a national heritage [16]. The Indonesian tobacco industry is an indigenous sector that provides advantages to small cultivators, factory workers, and home industries and is still regarded as an industry of pride [17].[2]

From a social perspective, an update from the Global Adult Tobacco Survey (GATS) 2021 shows the prevalence of current use of ECs in Indonesia significantly increased from 0.3% in 2011 to 3.0% in the Ministry of Health Republic of Indonesia [18]. This means around a 100% increase in EC users per year since the GATS 2011 report. Demographic data (as of October 2023) shows that nearly 70% of users are aged 18 to 34 years, 44% have a high income, 38% have a middle income, and the composition of male-female users is 75% and 25%, respectively [15]. From the perspective that ECs attract the younger generation to use them, this is a cause for concern [19, 20].

While the health aspects of tobacco products are a global concern, the social and economic aspects are unique and complex issues in the case of Indonesia. The government regulations need to be made wisely to achieve optimum benefits for the nation. Despite the presence of various directions for Indonesia from the World Health Organization (WHO) and other organizations[3], the stakeholders in the nation need to understand each other about the existing different interests, endeavoring to look from different perspectives, and then take the best middle way. To provide insights and inputs for the new policy and its implementation regarding tobacco product development, especially ECs, the basis of scientific research is important. This scientific research is generally acknowledged to be lacking and necessary [7, 19].

Intending to provide inputs for future government regulation related to ECs, this study aims to compile and review social and economic aspects of tobacco products published in papers within the year range of 1992 to 2023. A study using 30 years of publication on the socio-economics of tobacco products related to Indonesia is expected to give a broad picture from different findings, highlighting the differences between conventional cigarettes and ECs and suggesting how to handle them. It becomes an urgency since Indonesia is preparing a new regulation. Furthermore, insights and inputs are needed for the implementation.

[1] To simplify, the term of e-cigarettes (ECs) is used throughout the article, which includes any type of ENDS and heated tobacco products (HTP) in general. Except a particular topic of ENDS or HTP is being discussed.
[2] The main topic discussed by Welker is about kretek cigarette.
[3] The example is from WHO [2]; Kosen, Thabrany, and Kusumawardani [21] and Tobacconomics.org [22] .

The review can be used to create formulations using MPOWER[4] from the WHO Framework Convention on Tobacco Control (FCTC)[5]. From that foundation, the distinct contribution as the novelty of this study is made by providing improved recommendations that strike a balance between different perspectives and offer valuable insights upon existing proposals for various stakeholders, including the industry. This study can complement other publications or reports that have a similar objective. Although focused on Indonesia, this study can be useful in addressing the global trend of new tobacco products in other countries.

2. Method

Using the qualitative method, the study was carried out descriptively with content analysis from related published papers. To gather published papers related to the social and economic aspects of tobacco in Indonesia, the Scopus website was initially used with simple keywords, namely "tobacco" and "Indonesia." These two keywords are very general, aimed at 'sweeping' all related publication papers. The result of the CSV file was then processed using VOSviewer, which can generate richer keywords that can later be used to obtain more specific published papers related to social and economic issues. The process in VOSviewer was also intended to identify the clusters of topics that appeared in the results.

The first-generation keywords were then shortlisted using comparable results from a thesaurus and 'related words' to social and economic topics. The list of keywords to regenerate intended published papers is shown in Table 1. From there, the input of keywords for the second query that were inserted into the Scopus search field is provided in Table 2, including the narrowing down filters. In the second search, the keyword "nicotine" was added in addition to "tobacco" because they were considered general words that may exist in any papers on the topics of tobacco cigarettes or electronic cigarettes (ECs).

Table 1.
Keywords to generate published papers in Scopus.

Social		**Economy**	
Social*	Religion	Econom*	Industr*
Commun*	Islam	Trade	Income
Socie*	Poverty	Commerce*	Expense
Attitude	Knowledge	Profit*	Capita
Behavio*	Budget	Fiscal	Occupation
Civil	Adult	Production	Consumption
Habit	Adolescent youth	Tax	employment
Perception	Juvenile	Export	GDP
Culture	Household	Import	Market
	Neighborhood	Investment	Growth
	Family		Financ*

From the search results, manual screening was carried out by inspecting the title and abstract. The next step in this method is content analysis. Issues are grouped into subtopics and then analyzed descriptively. The formulation of MPOWER was used as an approach to advancing parties' interests by taking into account relevant knowledge from findings on social and economic aspects, as well as consideration of health aspects. The last step is suggesting more intensive or enhanced 'middle-way' recommendations for the parties that are capable of setting agendas endogenously on matters of common interest, in addition to suggestions from existing published studies or reports. The flow of steps for the review method is visualized in Figure 1.

Table 2.
Implementation of keywords in Scopus query and narrowing down filters.

Remarks	**Query**
Input in Scopus search fields	Specific social keywords Social OR Commun* OR Socie* OR Attitude OR Behavio* OR Civil OR habit OR Perception OR Culture OR Religion OR Poverty OR Knowledge OR Islam OR Budget OR adolescen* OR youth OR Juvenile OR household OR neighbourhood OR family **AND**
	Specific economic keywords Econom* OR Trade OR Commerc* OR Profit* OR Fiscal OR Production OR Tax OR Export OR import OR Investment OR Industr* OR Income OR Expense OR Capita OR Occupation OR Consumption OR employment OR GDP OR Market OR Growth OR Financ* **AND**
	General keywords Tobacco OR nicotine **AND**
	General keywords

[4] MPOWER is a policy package of measures from the WHO FCTC, consisting of: MPOWER [23] .
[5] Indonesia is not a member of WHO FCTC Wibawa, Rifawan, Kharisma, and Amaliya [16] but applying the recommended MPOWER measures Ministry of Health Republic of Indonesia [18] and Tobacco Economic Ecosystem in Indonesia [24] .

Remarks	Query
	Indonesia
Narrowing filters / inclusion-exclusion rules	Language: English
	Source type: Journal Article
	Publication year: 1993 to 2023
	Re-filtered: conference papers, Notes, letters, editorials, short surveys, and papers that lean towards discussing health impacts are not included. Biology or life science, agriculture, climate, and experiments-related topics are not included.

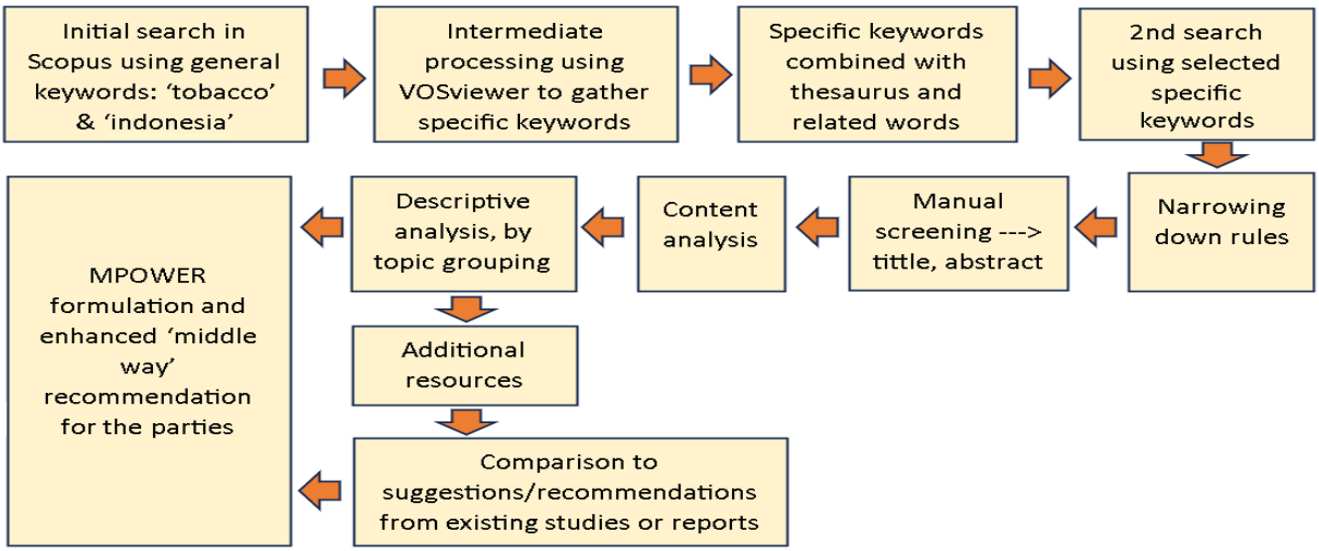

Figure 1.
Review method.

3. Results and Discussions

Employing the aforementioned thorough paper search approach, this study considered 139 papers on social matters and 53 papers concerning economic matters. The objective was to gain knowledge about the period preceding and following the rapid growth of electronic cigarettes (ECs) in Indonesia, which began in 2009 [3]. Therefore, the two periods can be compared, analyzed, and then suggestions or recommendations can be given.

Until recently, there have still been ongoing discussions about conventional cigarettes, as revealed by this study. The utilization of GATS 2011 as the base of data persists even beyond 2020. Nevertheless, employing inductive investigation, supplementary articles were utilized to compare papers on conventional cigarettes with the social and economic dimensions of ECs.

The health implications of ECs remain a topic of extensive discussion. However, prevailing trends indicate a high level of consensus that ECs are comparatively less hazardous, albeit not entirely devoid of risk. The economic and social factors remain mostly unchanged compared to regular cigarettes. However, the user profile or social demography is changing. The primary issue at hand is the consumption of tobacco products by young individuals, and the delicate equilibrium between the economic benefits derived from the tobacco industry and the detrimental effects on health and society is being called into question. The significance of the culture and history of tobacco in Indonesia is equally noteworthy as a consideration in making recommendations.

3.1. Social Aspect

Below are the issues that can be captured from papers related to social aspects. The sub-aspects include socio-demographic characteristics, social hazards of tobacco use, issues related to tobacco promotion, advertising, and sponsorship (TAPS), smoking among school children and youth, the need for education, perceptions of cigarettes, addictive nicotine, tobacco use and religion, and tobacco use and health care providers (HCPs).

3.1.1. Socio-Demographic Characteristics

For kretek smoking[6], a study by Palipudi, et al. [25] found several factors as significant predictors, including being male, older, and having lower levels of education and wealth. However, the study did not find any significant association for domicile (urban vs. rural). Yen and Tan [26] observed a similar trend, utilizing the Asma [27] and data from the Southeast Asia region. They added that rural dwellers in Indonesia exhibit a higher propensity for smoking, and that non-government or self-employed individuals had a higher likelihood of smoking. Based on the same secondary data source, Asma [27] and Orlan, et al. [28] reported that individuals who smoke tobacco are predominantly male and fall within the age range of 25 to 44 years.

[6] A type of conventional cigarette.

In line with the findings of Yen and Tan [26] and Efendi, et al. [29] utilized the 2012 Indonesia Demographic and Health Survey – Adolescent Reproductive Health (IDHS-ARH) as an alternative data source. They determined that a considerable percentage of tobacco users in Indonesia are teenagers and young males residing in rural areas. Being exposed to media that likely contains cigarette advertising and having access to money through employment, particularly at lower socio-economic and education levels, increases the likelihood of smoking.

Meanwhile, for electronic cigarettes (ECs), the level of awareness of ECs in Indonesia is generally still poor (10.9%) according to Palipudi, et al. [30]. In contrast, conditions in other comparative countries in the paper [30], such as Malaysia, Qatar, and Greece, show that male, younger, more educated, and wealthier respondents exhibited greater levels of awareness. This fact can serve as a predictive indicator of the transition in socio-demographic characteristics from traditional to emerging economies in Indonesia. The condition regarding awareness and EC use in Indonesia is supported by a recent study from Kundu, et al. [31].

ECs attract more young people. According to the study by Palipudi, et al. [30], individuals who smoke cigarettes are highly likely to use ECs, as evidenced by findings in Qatar and Greece. Moreover, there is a 6-10% chance that those who have never smoked before would start using ECs. This suggests that cigarette smokers may also be EC users, and individuals who have never smoked may use ECs directly. A study by Fauzi and Areesantichai [32] investigated the factors related to the use of ECs among teenagers aged 15-19 in Jakarta, revealing that 6.3% of females and 29% of males reported having used ECs at least once. A field survey by Karsinah, et al. [33] in Yogyakarta, involving high school and university students, revealed that out of the 920 respondents who participated, around 98 individuals (10.68%) were current users of ECs, whereas around 530 individuals (57.61%) were experimental cigarette smokers. Approximately 570 respondents, accounting for 61.96% of the total, were male and had an average age ranging from 20 to 23 years. The majority of respondents (53.26%) possessed a university-level education.

It is worth examining the disparity in the number of women using ECs compared to men, which may be significantly greater than the proportion of women using conventional cigarettes. This fact is evident when comparing the data from GATS 2011 and 2021 in the female category regarding the prevalence of tobacco smoking and electronic cigarette use. The Indonesian GATS 2021 report [18] reveals that the overall prevalence of current use of ECs has increased dramatically from 0.3% in 2011 to 3.0% in 2021 (see Figure 2), which implies an approximate growth rate of 100% annually; with the female current EC use increasing from 0% to 0.3%. Women's consumption of tobacco products raises concerns regarding potential negative perinatal consequences during pregnancy [34].

These findings indicate that the tobacco control policy in Indonesia should be expanded to encompass the regulation of the marketing and usage of ECs and other anticipated novel tobacco products, with a focus on protecting the young generation, women, and also those who have never used tobacco.

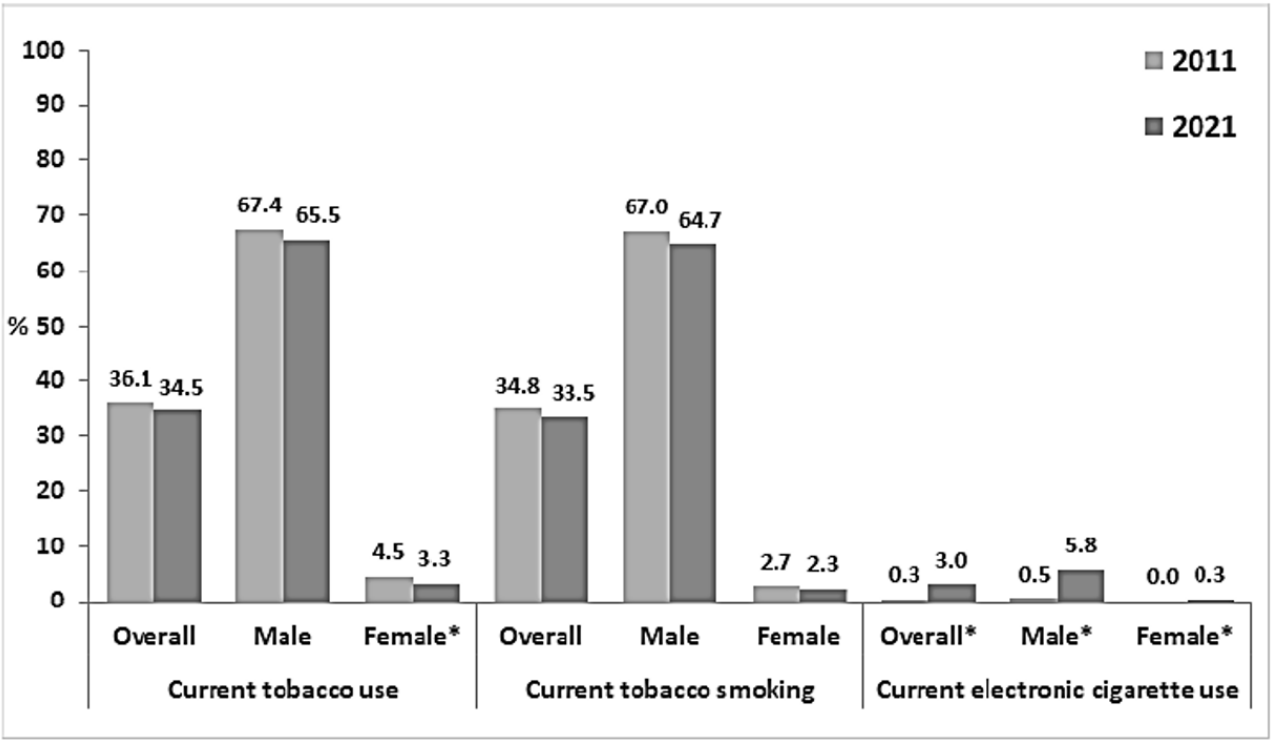

Figure 2.
GATS 2021: Prevalence of current tobacco use, current tobacco smoking, and current EC use, by gender in Indonesia. Comparison 2011 and 2021.
Source: Ministry of Health Republic of Indonesia [18]

3.1.2. Social Hazards of Tobacco use

As per the findings of Karsinah, et al. [33], individuals who smoked had noticeably inferior Health-Related Quality of Life (HRQoL) compared to those who had never smoked, and individuals with severe nicotine dependency exhibited greater

impairment in HRQoL compared to those with low and moderate levels of nicotine dependence. Several studies conducted by Peltzer and Pengpid [35] found that different psychological and social problems are associated with tobacco use, including depression Peltzer and Pengpid [35], engaging in sedentary activities for five or more hours during leisure time [36], experiencing loneliness [35], and the occurrence of undernourishment [37].

Semba, et al. [38] and Semba, et al. [39] found that among impoverished households residing in urban slums and rural areas of Indonesia, paternal smoking leads to the diversion of financial resources from food to tobacco, hence worsening child malnutrition. A more recent study showed that tobacco expenditure may be higher, reaching one-third of the regency minimum wage, according to Asyary and Veruswati [40]. Danal, et al. [41]; Djutaharta, et al. [42] and Bella, et al. [43] discovered similar findings. A recent research finding is even more concerning because young fathers use tactics to reconcile their function as caring parents with their status as smokers [44].

Exposure of children to environmental tobacco smoke in the household has been found to elevate the likelihood of developing acute lower respiratory infections, as reported by Suryadhi, et al. [45] and Puspitasari and Rahardja [46]. Even more, an investigation conducted by Wu, et al. [47] determined that the consumption of tobacco and alcohol is linked to the displacement of acute and preventive health-related actions while simultaneously encouraging the adoption of detrimental behaviors. Children living in households where both men and women use tobacco are considerably less likely to receive essential vaccinations and appropriate treatment for fever and diarrhea. Women are notably more prone to experiencing intimate partner violence when their husband or partner uses tobacco and/or alcohol.

The social impact of tobacco use on individuals and households is analyzed to remain the same between conventional and electronic cigarettes (ECs). This is due to factors that are independent of the type of tobacco products. From the products themselves, these factors include second-hand smoke, expense, and the effects of nicotine addiction, which will be discussed in another section. The external factors include level of education, knowledge, employment status, psychological condition, habits, and environmental conditions. To mitigate the impact of social hazards, the study conducted by Nichter, et al. [48] highlights the need for a well-publicized and agreed-upon community initiative for creating smoke-free households. Padmawati, et al. [49] created and assessed instructional resources about secondhand smoke and underscored the significance of collective dedication and knowledge-based interventions targeting individuals, households, and communities concerning the health, social, and economic risks associated with the use of tobacco products.

3.1.3. Tobacco Advertising, Promotion, and Sponsorship (TAPS)

TAPS are regarded as closely linked to the consumption of tobacco products [50]. Advertising refers to the strategic use of various media channels to establish favorable perceptions or connections with a product. Meanwhile, promotion or marketing encompasses a range of activities aimed at boosting sales, including sponsorship and corporate social responsibility (CSR) efforts by tobacco firms. CSR is included because it helps to foster positive perceptions of the tobacco industry, particularly among current smokers [51].

A study conducted by Prabandari and Dewi [52] found a consistent association between smoking status and perceptions of cigarette advertisements aimed at young people, as well as having smoking friends and family. Lovato, et al. [53] examined the impact of TAPS on the promotion of teenage smoking behaviors. They compiled nineteen longitudinal studies that tracked a combined total of more than 29,000 individuals who did not smoke at the beginning of the study. Their research consistently indicates that the presence of tobacco advertising and promotion increases the probability of teenagers initiating smoking. The study conducted by Wulan, et al. [54] revealed a strong correlation between the participants' frequent usage of ECs and their exposure to advertising on social media platforms. As many as 84% of participants reported being exposed to EC advertisements or promotions on various social media platforms. Harkati, et al. [55] identified the promotion of ECs on social media platforms such as YouTube as a novel obstacle to tobacco control efforts in Indonesia.

A study conducted by Tjandra, et al. [56] examined how the general public assesses the ethical aspects of selling tobacco products in Indonesia. The majority of participants held the view that tobacco marketing techniques in Indonesia are morally wrong. Bigwanto, et al. [57] conducted a study that examined 27 vape outlets and 35 retail stores following the implementation of the 2018 excise tax. The majority of vape stores (92.6%) indicated that they sold products with cartoon pictures or public figures, while a large proportion (96.3%) allowed consumers to utilize these products within the premises. Five vape outlets and four retail establishments indicated that they did not mandate clients to complete an identity-verification process for purchasing items. A majority of the vape businesses (55.6%) and a significant portion of the retail stores (46.6%) indicated that their proximity to a school was within a distance of less than 500 meters.

The GATS 2021 study by the Ministry of Health Republic of Indonesia [18] reveals a substantial elevenfold rise in the detection of cigarette advertising on the internet compared to 2011 (refer to Figure 3). From the evidence, TAPS indeed need to be regulated and strictly implemented, especially to avoid the use of tobacco products by youth. The industry needs to understand and show goodwill for this. It is already difficult to face challenges from peers and smoking adults, and further encouragement should be prevented. Counter-TAPS measures can also be continuously applied, as shown in a study by Swatan, et al. [58], indicating a substantial association between heightened awareness of health risks, effective social control, and mass media coverage of the dangers of tobacco smoking, and a decrease in addiction rates in rural regions. A study by Faisal and Suryati [59] showed that pictorial health warnings on conventional cigarette packs have a significant association with the intention to quit smoking among students. A tighter system to prevent selling without ID for age verification can be adopted. An application for this purpose will be discussed in another section.

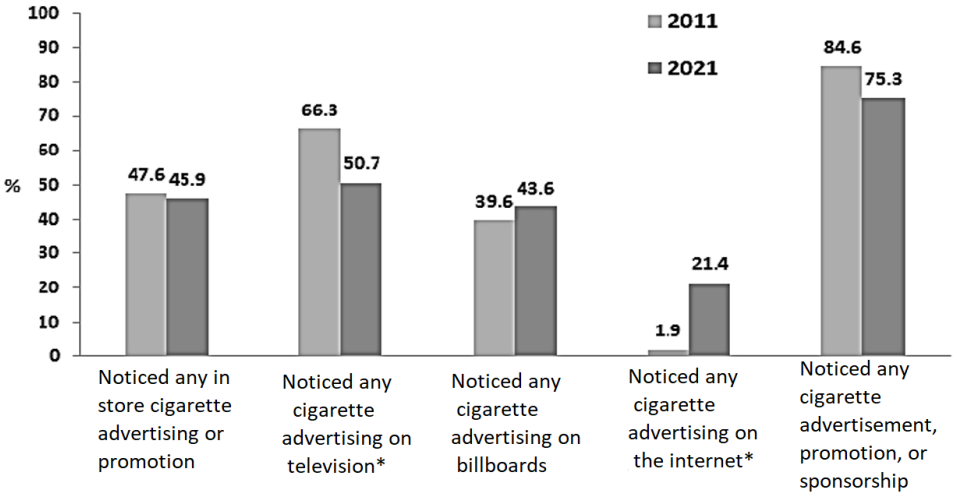

Figure 3.
GATS 2021: Noticing TAPS during the past 30 days. Comparison 2011 and 202.
Source: Ministry of Health Republic of Indonesia [18].

3.1.4. Smoking in School Children/Youth

A study conducted by Haryanto, et al. [60] revealed that approximately 28.6% of early adolescents in elementary school (aged 10-12 years) in West Java, Indonesia, were actively smoking. A majority of their family members (56%) are currently smokers, while 41.7% of their friends also smoke. Prior to that, an investigation conducted by Smet, et al. [61], encompassing individuals aged 11 to 17 years (spanning from elementary to high school) in Semarang, Central Java, revealed that the smoking habits of one's closest companions exerted the greatest influence on their smoking behavior.

Bigwanto, et al. [57] specifically examined smoking habits among high school students in Jakarta, with a particular emphasis on electronic cigarettes (ECs). Out of 767 pupils, the survey participants consisted of 54.1% males, with an average age of 16 years. Within this sample, 32.2% of students reported having used ECs at some point, whereas 11.8% of students were identified as current EC users. This evidence corroborates the previous discourse on the use of ECs by those who had never smoked. Several quantified variables show a positive correlation with the use of ECs, including the current use of traditional cigarettes, a belief that ECs are less habit-forming than traditional cigarettes, a belief that ECs do not contribute to the development of cancer, parental approval of EC use, and sufficient financial resources to purchase ECs.

The studies conducted by Haryanto, et al. [60] on smoking children in elementary school and by Bigwanto, Nurmansyah, et al. [62] on smoking children in high school highlight the importance of implementing interventions in schools to discourage tobacco use among all stakeholders, including students, parents, and teachers. Education plays a crucial role in correcting misconceptions about the absence of risks associated with the use of ECs, as highlighted by Intihan, et al. [63]. Furthermore, the acquisition of knowledge and information is essential for attaining greater financial opportunities [29].

A study conducted by Satpathy, et al. [64] revealed that students in Southeast Asia were able to obtain cigarettes from sellers, despite the existence of legislative constraints on sales to minors. Nevertheless, it has been noted that the majority of young individuals in Indonesia face restricted financial access. To safeguard minors from using tobacco products and to address several other concerns, it is imperative to implement a stringent sales system that encompasses all points of sale in the market, notwithstanding the limited financial resources available, along with efforts to provide education and knowledge.

It is imperative to provide boys with intensive attention and support to prevent tobacco usage. In a previous study conducted by Ng, et al. [65], the authors explored the association between tobacco use and the construction of masculinity. The study found that some individuals believed that smoking was necessary to be considered a true man. This is supported by a recent study by Rohmah, et al. [44] that examined smoking young fathers. Kodriati, et al. [66] discovered that individuals with a masculine inclination tend to downplay the health risks associated with smoking. The concept of 'masculinity' also has a positive correlation with popularity, violence, and tobacco consumption [67]. This finding highlights that educational efforts should focus on combating the perceived notions of smoking and the significance of gender-specific interventions.

Peers, teachers, and parents should provide examples of non-smoking behavior. The lack of examples or role models creates a significant challenge, as found in the study by Setyowati, et al. [68]. According to Reitsma, et al. [69], the number of smokers aged 15 to 24 years in 2019 was around 155 million, accounting for 20.1% of young males and 5.0% of young females. Furthermore, a staggering 83% of individuals who smoke initiated this habit between the ages of 14 and 25. Hence, the age range of 14-25 years is a crucial period that requires timely intervention. A more recent study by Ayuningrum and Sudaryanto [70], using the 2019 Global Youth Tobacco Survey (GYTS), even showed that children can start smoking at the age of 12-13 years, obtaining information and ECs from their peers.

3.1.5. Perception

A study conducted by Nurmansyah, et al. [62] on senior secondary school students in Depok revealed a statistically significant correlation between perception and actual smoking behavior. The study found that both smokers and non-smokers perceived smoking as a behavior that enhances confidence, coolness, socialization, stress relief, and symbolizes adulthood

and masculinity. Although the majority of students, both smokers and non-smokers, were cognizant of the fact that cigarette smoking leads to health issues, the study emphasizes the significance of altering young people's perception of cigarette smoking rather than solely educating pupils about the health risks of smoking, especially when they already have a strong understanding of those matters.

Intihan, et al. [63] in Yogyakarta examined the impact of tobacco product usage on school children. The study utilized surveys and found that the majority of tobacco smokers and vape users in the Yogyakarta province hold a strong perception regarding the risk-benefit of electronic cigarettes (ECs). A study by Franchyeda and Sinaga [71] in Medan found that 51% of respondents had a favorable perception of ECs, and the majority of respondents (88%) reported using ECs due to social influence.

Regarding perspectives toward the industry, the kretek industry in Indonesia is viewed as a source of pride that benefits individuals such as growers and manufacturing workers [17]. According to Nichter, et al. [48], smoking is deeply rooted among men in Indonesia. Women who have household rules find it uncomfortable to enforce smoking restrictions when guests visit their homes, as smoking is considered a normal part of Indonesian male culture. Kretek and smoking are prevalent in Indonesia and are deeply ingrained in the sociocultural fabric of the nation.

From this and earlier sections, we can understand that perception is a significant driver for smoking. The perception of smoking relates to the image of masculinity, being cool, confident, and grown-up. Meanwhile, the perceived image of the tobacco industry is that it supports the economy and is part of the culture. For ECs, the perception is that they are less addictive and do not cause cancer. Educating or providing knowledge is important in this matter, as well as collective commitment in the community and providing examples of good behavior. Moreover, imparting knowledge on the socio-economic impacts of tobacco use may also provide stronger reasoning[7].

3.1.6. Tobacco Products Contain Nicotine and Nicotine is Addictive

Hidayat and Surjono [73] demonstrated through a sociological approach that cigarettes are addictive products. They propose that an escalation in the cost of cigarettes may result in a substantial decline in cigarette usage over an extended period. From a medical perspective, nicotine addiction occurs when nicotine acts on nicotinic cholinergic receptors (also known as nicotinic acetylcholine receptors - nAChRs) that are found throughout the central nervous system of mammals. This action stimulates the release of dopamine and other neurotransmitters that play a crucial role in the development of nicotine dependence. Nicotine addiction arises when individuals develop a dependence on smoking to regulate their emotional state and level of alertness, alleviate symptoms of withdrawal, enhance hunger and focus, manage feelings of anxiety and despair, or reinforce pleasurable behaviors [74-76].

McGrath-Morrow, et al. [11] conducted a thorough examination of the impact of nicotine on development, especially in ECs that are capable of administering concentrated amounts of nicotine rapidly. They concluded that nicotine exposure alone has the potential to cause developmental defects, impair childhood health, and create addiction in adolescents and young adults, as shown by preclinical and clinical investigations. This study suggests that behavioral variations and increased dopamine release in response to nicotine contribute to the higher susceptibility of adolescents to addiction compared to adults. They proposed the implementation of public health initiatives to restrict the production, distribution, and utilization of these novel nicotine-delivery systems. The aim is to minimize the exposure of teenagers and young people, who are more susceptible to enduring health problems, to these products.

It is an established truth, based on sociological and medical studies, that tobacco products containing nicotine are addictive. It is crucial to acknowledge that nicotine alone has health impacts and that addiction has social consequences. From the earlier section, it is evident that the social implications include the influence on household economy, adequacy of nutrition, quality of health, and detrimental behaviors. Individuals may experience emotional disturbances, withdrawal symptoms, decreased focus, anxiety, and depression as a result of addiction. To lessen the effect, it is necessary to establish a specific threshold for nicotine consumption for those who are allowed to consume it. Moreover, it is necessary to establish a system that guarantees strict compliance with the thresholds. The method should also serve to deter sales to minors and curb the distribution of illicit tobacco products, which will be further elaborated upon in another section.

3.1.7. Tobacco use and Religion

Some of the collected research examined the correlation between tobacco use and religion, particularly focusing on Islam. In a study conducted by Byron, et al. [77] using semi-structured focus group discussions, it was revealed that in the majority of the focus groups, smoking was considered a discouraged behavior for Muslims, although not explicitly prohibited; the decision to adhere to religious statements was viewed as a matter of personal choice. Several participants expressed the view that the religious group's ability to speak out against smoking was compromised because numerous religious leaders themselves engaged in smoking.

The discovery made by Byron, et al. [77] aligns with the findings of Jamil and Al Qurtuby [78], which highlight the prevalence of smoking among several religious notables and influential members of Islamic organizations in Indonesia. This inconsistency hinders the realization of efforts to quit smoking. The more current study conducted by Jamil and Al Qurtuby [78] has already incorporated the utilization of Jamil and Al Qurtuby [78] additional analysis of the government's comparable conduct. The government's implementation of several regulations and policies fails to effectively enforce penalties and treat offenders with the necessary seriousness. Moreover, numerous government officials have been avid

[7] Even though, the study is regarding compliance of TAPS at the point of sale Suarjana, Mulyawan, Eka Putra, Duana, and Astuti [72] .

smokers. Greater commitment and role models are necessary to address tobacco use issues, including religious or government leaders, as also put forward by Ahsan, et al. [79], stating that a regulation will not be effective without a tangible example.

Moving to another topic related to religion, the Hajj pilgrimage is suggested as an opportunity for smoking cessation by Aldahash, et al. [80]. During the Hajj pilgrimage, a significant reduction in cigarette consumption was observed among smokers. This study can be utilized as a basis for formalizing a program aimed at initiating smoking cessation during the pilgrimage. The pilgrims who share the same purpose can be organized into groups and placed under the supervision of healthcare practitioners. From that initiative, another idea can be offered for smoking cessation programs: a place that supports smoking cessation, adopting the immersive experience concept of 'kampung inggris' (English village) at Pare, East Java[8]. The concept can be designed so that the entire population of the village does not smoke, has a collective commitment, and the village has facilities to support the program. In the era of smartphones, technology can also be used for smoking cessation [82, 83]. A study by Wibowo, et al. [84] examined the use of mobile phone apps for smoking cessation. They found that the respondents perceived a mobile phone smoking cessation intervention as useful.

3.1.8. Tobacco use and Health Care Providers (HCPs)

The findings of a study conducted by Ramadhani, et al. [85] among dentists indicate that a significant proportion of the participants (75.5%) expressed confidence in the efficacy of combining nicotine replacement therapy (NRT) with counseling for achieving successful smoking cessation. They acknowledged that dentists also have the responsibility to engage in tobacco control activities (69.5%) and that their dental practice is an optimal setting to carry out such initiatives (72.0%). Meanwhile, a study by Lorensia, et al. [86] among pharmacists revealed that the most extensive understanding of the hazards associated with electronic cigarettes (ECs) is mostly focused on nicotine. Regarding the adverse effects of ECs on lung and cardiovascular health, there are differing opinions on the risks associated with passive smoking. For medical students, Kendrich and Magdalena Sinaga [87] showed a 16% smoking prevalence; only 22% have good knowledge about tobacco, and one-third of them have a negative attitude toward tobacco avoidance as well as smoking behavior.

Health care practitioners (HCPs), including dentists, chemists, physicians, and others, must possess uniform comprehension. Therefore, they must possess knowledge and receive training on tobacco usage. Moreover, the differences among chemists regarding the impact of secondhand smoke from electronic cigarettes highlight the need for further research. Conducting a study is crucial for identifying the causal risk factors [88]. Research related to tobacco is necessary to expand the knowledge base, allowing for the subsequent dissemination of findings and conclusions to healthcare professionals (HCPs) and other stakeholders. The research must be conducted by a reputable and dependable research institution, funded either by the government or other sources with no conflicting interests. Moreover, regular and ongoing monitoring of tobacco usage is crucial for assessing the efficacy of tobacco control efforts, with the data on conventional cigarettes and ECs needing to be separated.

Regarding the advantage of having data on tobacco use in Indonesia, a compelling example arises when comparing a study conducted by Tarigan, et al. [89] with previously cited studies about socio-demographic factors. The attributes commonly observed in Indonesian smokers, as identified in different research, include being male, of advanced age, and self-employed. These traits are associated with an increased risk of developing lung cancer, as demonstrated in a study conducted at Adam Malik Hospital in Medan by Tarigan, et al. [89], which utilized medical records spanning from 2012 to 2015. The findings indicate that a significant proportion of males diagnosed with lung cancer fall within the age range of 51-60 years (43.5%) and are employed in entrepreneurial roles. An analogous connection can be employed to assess the influence of EC usage in Indonesia if the data is separated from conventional cigarettes.

A study on formaldehyde concentrations in EC vapor in Indonesia has also been published by Lestari, et al. [90], and they recommended that further research be carried out regarding the chemical contents of ECs. This is significant for Indonesia, as Wu, et al. [91] indicated that the chemical composition of a similar tobacco product can vary across different countries. This suggests that the components of a cigarette can be arranged or adjusted as desired. Hence, it presents a greater risk, particularly for ECs whose components are blended in e-liquid.

The government of Indonesia needs to provide regulations and standards[9], establish testing laboratories capable of evaluating tobacco products and devices, and conduct regular market surveillance to assess the ECs available in the market. Meanwhile, the manufacturers should comply with the regulations and standards, incorporate security measures to deter tampering, and establish a strict, responsible, and traceable selling system.

3.2. Economic Aspect

According to the 2021 survey, China, India, Brazil, Indonesia, and the USA are the top five countries in terms of tobacco cultivation (refer to Figure 4). Production trends in four countries from 1961 to 2021 are generally on the rise, except for the USA. While production in China has experienced a decline from 3.41 million tonnes in 2012 to 2.13 million tonnes in 2021 (refer to Figure 5). Indonesia's production in 2021 amounted to 237,115 tonnes, which is one-tenth of the output of the top producer (refer to Figure 6).

The revenue generated by tobacco excise in Indonesia, also known as Cukai Hasil Tembakau (CHT), has shown a consistent annual increase from IDR 73 trillion to IDR 188 trillion between 2011 and 2021, as depicted in Figure 7 [92]. On

[8] A non-native English environment that offers an alternate means for learners to enhance their speaking skills outside of official education Sari and Rozimela [81] .
[9] Existing Indonesia national standards (SNI) for end tobacco products in Indonesia: SNI 8946-2021 Heated tobacco, SNI 9070-2022 e-cigarette liquid, SNI 01-0765-1999 White cigarette, and SNI 01-0766-1989 Kretek cigarette. There are other SNIs for material, raw and intermediate tobacco derivatives.

average, this represents a growth rate of almost 10% per year. Analysis of excise tax revenue statistics from 2019 to 2021 [93] reveals that the CHT makes up around 95% of the total contributions. Meanwhile, according to data from databoks.katadata.co.id in 2018, the contribution of CHT to GDP from 2011 to 2017 was consistently around 1.1%. After the social aspect, it is important to understand the economic aspect of the tobacco industry in Indonesia. This section discusses issues related to economic aspects. The sub-aspects that can be grouped from findings in the published papers are the tobacco industry in Indonesia, taxation and price of cigarettes, illicit cigarettes, the impact of smoking burden on the economy, and substitute crops and alternative tobacco utilization.

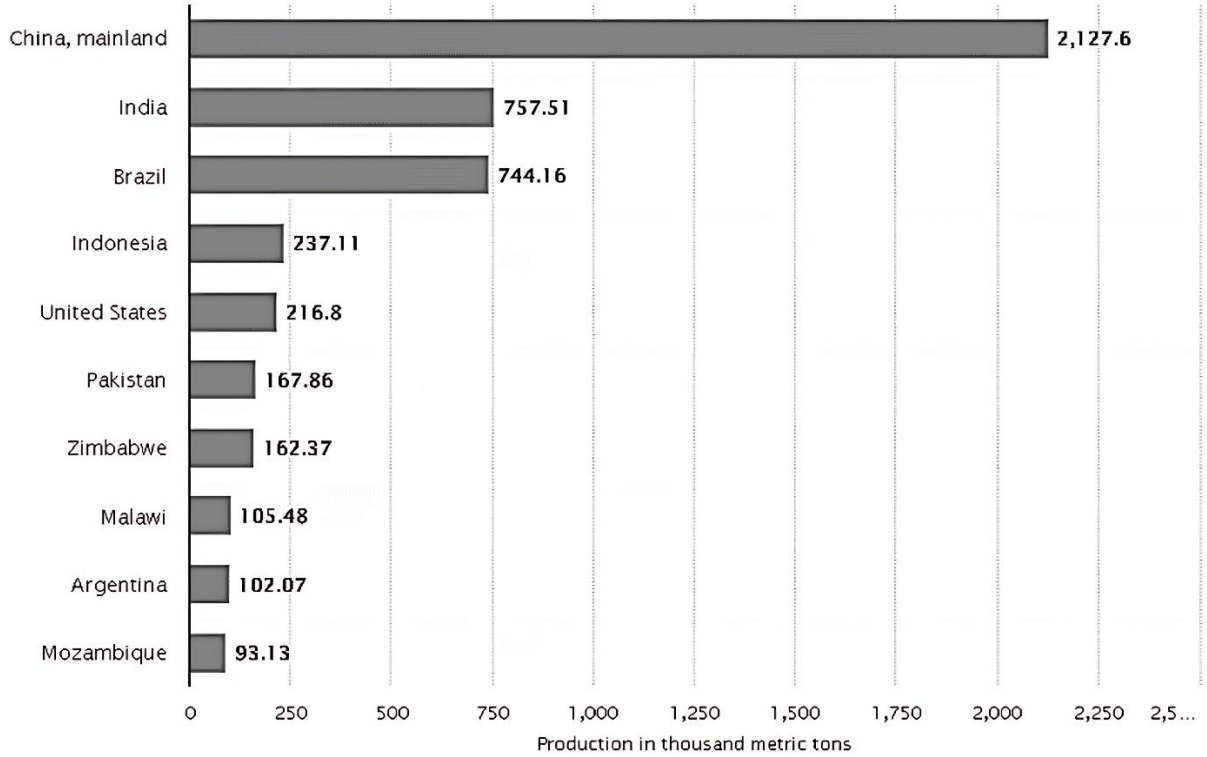

Figure 4.
Top tobacco producer countries 2021.
Source: Statista [94].

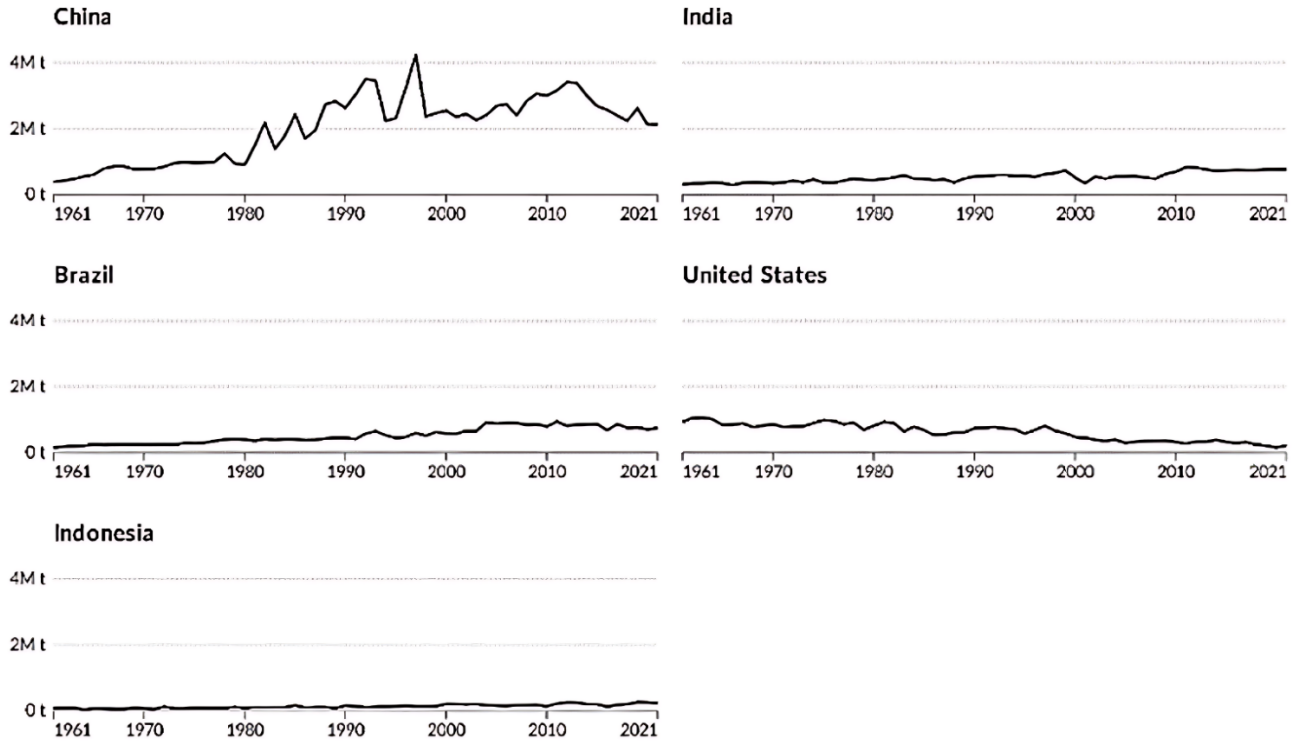

Figure 5.
Tobacco production (top five) from 1961 to 2021.
Source: Food and agriculture organization of the United Nations. OurWorldData.org/agricultural-production | CC BY Our World in Data [95]

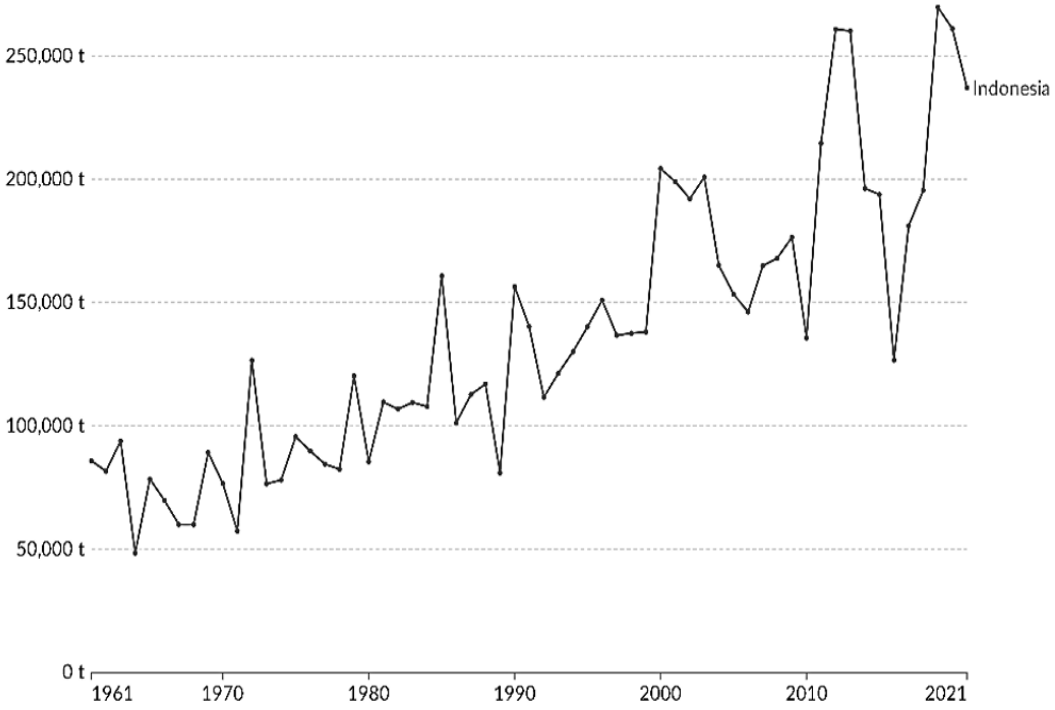

Figure 6.
Indonesia's tobacco production, 1961-2021.
Source: Food and agriculture organization of the United Nations. OurWorldData.org/agricultural-production | CC BY Our World in Data [95].

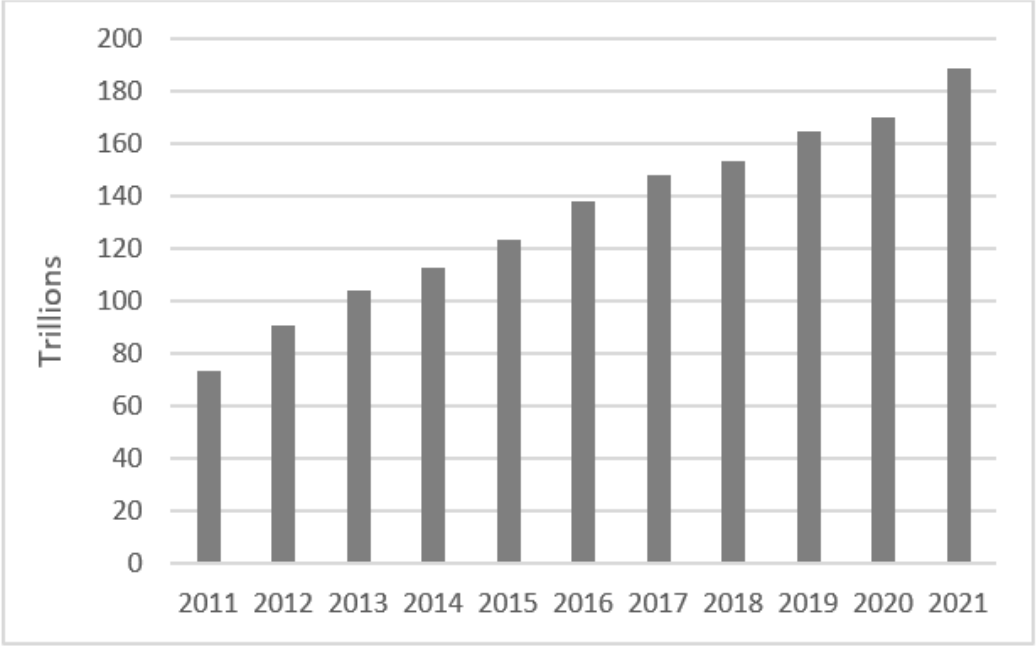

Figure 7.
Indonesia's realization of tobacco excise (CHT) from 2011 to 2021.
Source: Adi Ahdiat [92].

3.2.1. Tobacco Industry in Indonesia

Tobacco is a yearly plant that has its leaves collected throughout 3 to 4 months and is thereafter subjected to drying. The combined planting area in Indonesia is 236,500 hectares based on 2019 data, with the islands of Java and Nusa Tenggara having the greatest plantations of 188,550 hectares and 37,834 hectares, respectively. Figure 8 illustrates the distribution of plantation areas, indicating that a significant number of individuals engaged in the tobacco industry are located in Central and East Java (refer to Figure 9). This suggests that employment in the tobacco industry plays a crucial role in certain districts. Those plantations yield over 270,000 tonnes of tobacco leaves. The extent of tobacco cultivation varies in response to market prices, exhibiting an average annual growth rate of 3.3% to 3.5% between 1980 and 2021. Tobacco output is contingent upon climate conditions, with an average annual growth rate ranging from 6.4% to 8.5% since 1980 [96].

According to a report by Sahadewo [97] the average proportion of tobacco growers in the agricultural sector is 1.6%, whereas the proportion of total workers in the economy from 1990 to 2011 is 0.7%. In 2014, the tobacco manufacturing sector employed around 692,000 individuals. These workers were primarily involved in the processes of drying, curing, cutting, and rolling tobacco leaves with paper to produce cigarettes. However, the tobacco manufacturing sector has a lower contribution to employment compared to the food, apparel, and textile industries.

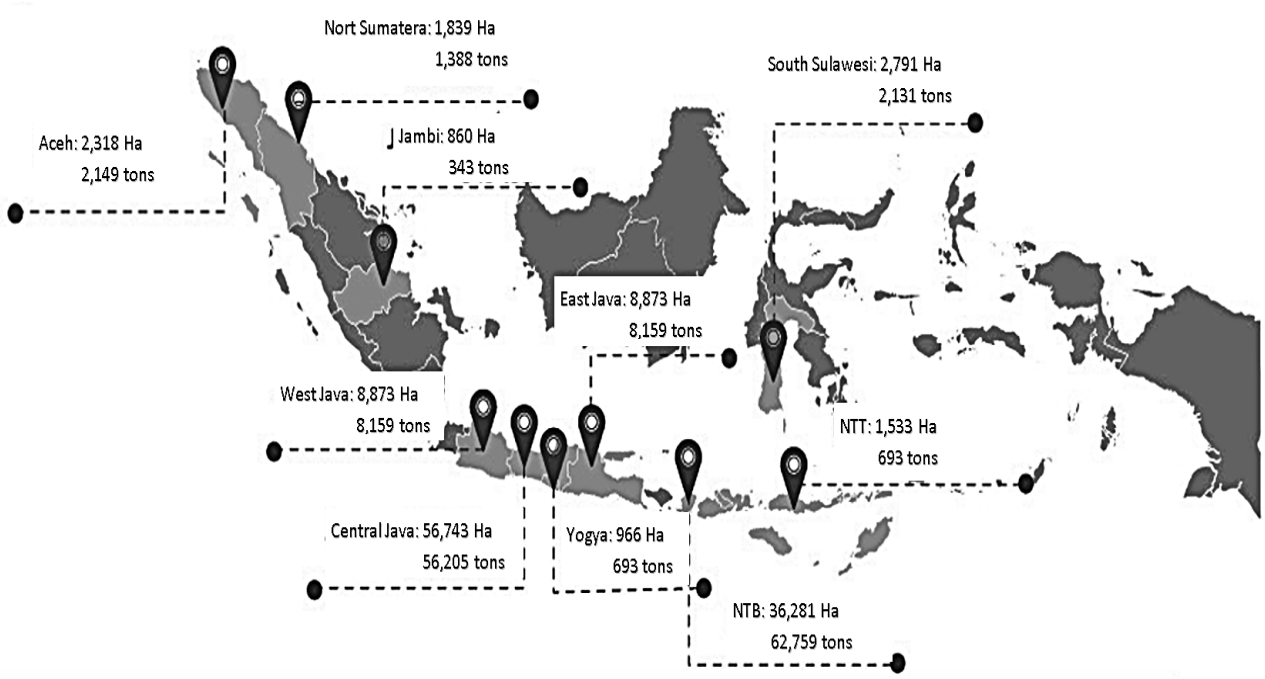

Figure 8.
Distribution of tobacco plantations in Indonesia.
Source: Directorate General of Estate Crops Ministry of Agriculture [96].

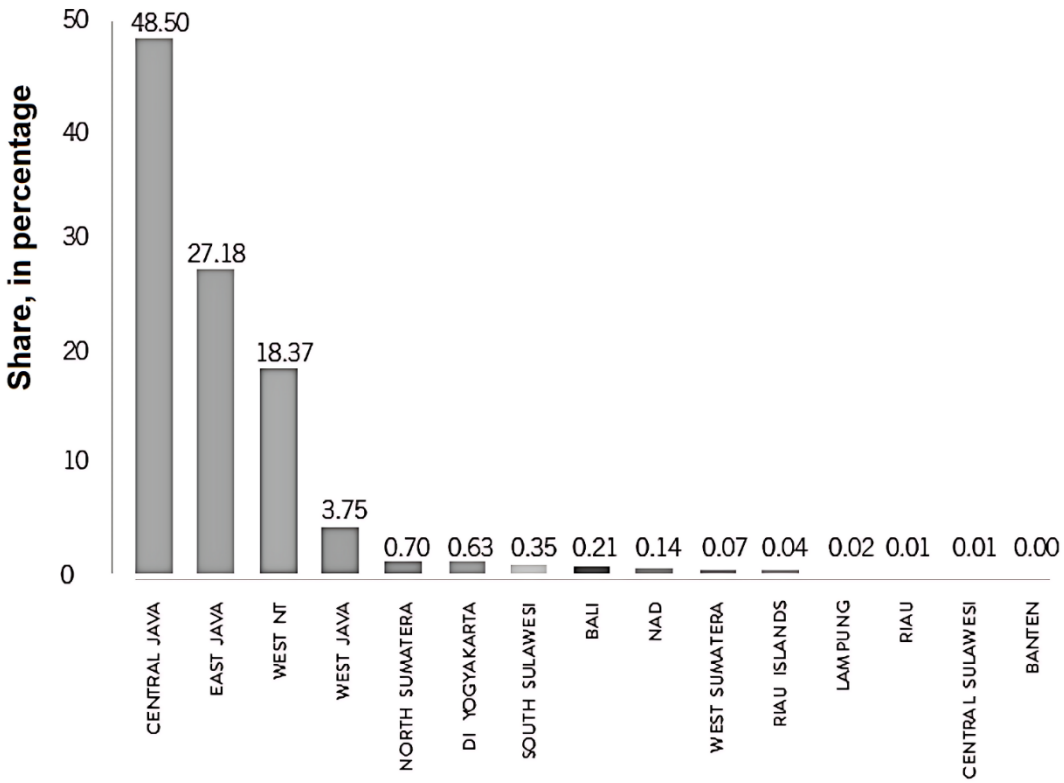

Figure 9.
Concentration of tobacco manufacturing workers, 2014.
Source: Sahadewo [97].

If looking into the largest plantation areas, a study conducted by Karsinah, et al. [33] revealed that tobacco manufacturing is one of the prominent export sectors in Central Java. The RCA indexes of these industries are greater than 1, indicating a high level of competitiveness. The proposed future plans in that study include expanding the export market, improving the

quality and quantity of export products, enhancing labor skills, and strengthening technological capabilities. Concerning the proposal, if we consider the current advancements in the industry, specifically ECs, it would be advantageous for the Indonesian tobacco business to have the capability to manufacture extracted nicotine from tobacco leaves. This extracted nicotine can serve as a key component in e-liquids and other tobacco derivative goods. It is then necessary to establish national standards for quality references.

Jember is another region in Java that is known for its production of tobacco. The tobacco sector's average contribution to Jember Regency's GDP, compared to the plantation commodities in Jember from 2013 to 2017, was 24.40% (Rp.1,122.76 million), indicating a strong contribution of tobacco commodities (>20%). In 2016, tobacco emerged as the most valuable commodity in Jember Regency, constituting around 81.09 percent of the overall exports. The export value of tobacco amounted to US$ 113,516,671, equivalent to 17,908 tonnes [98].

However, Ahsan, et al. [99] express disapproval of the economic impact of the tobacco industry on Indonesia. They dispute the assertion that Indonesia's tobacco industry makes a substantial contribution to the economy, contending that tobacco does not tend to foster economic growth in Indonesia. Their analysis utilized data and macroeconomic indicators sourced from Euromonitor International and World Bank Data, covering the period from 2006 to 2019. The topic of the economic burden of tobacco use is later discussed in another section.

3.2.2. Taxation and Price of Cigarettes

An analysis employing input-output methodology revealed that implementing a tobacco tax hike in Indonesia would result in a favorable overall effect on the economy. This would be achieved by augmenting economic output, household income, and employment. The primary driver of the positive impact is government expenditure resulting from supplementary revenue [43]. Indonesian citizens stand to gain if the government effectively allocates its revenue to encourage economic growth and development.

Mathematical models also suggest that cigarette demand is significantly influenced by factors such as selling price, income per capita, and population. When the selling price of cigarettes increased by 11% as a result of a 25% hike in the cigarette excise tax, the demand for cigarettes decreased by 4.31% [100]. The decreased demand after a price increase was also shown in the study conducted by Ramjani, et al. [101]. A paired t-test revealed a substantial decrease in the number of cigarettes consumed by adolescents, amounting to a reduction of two cigarettes per day following the implementation of an increase in cigarette excise tax. The study by Hidayat and Surjono [73] employed various estimation models suggesting that streamlining tariffs has a more significant effect on elevating cigarette prices, decreasing consumption, and augmenting government revenue compared to periodically boosting excise rates.

However, a study conducted by Santoso and Erlando [102] in Indonesia indicates that raising cigarette prices does not reduce individuals' inclination to smoke. This demonstrates that a significant number of Indonesians view cigarettes as necessities. Hence, the rise in tobacco excise tax results in an expansion of government revenue but also an increase in the quantity of illicitly marketed cigarettes.

For a study on a broader area, Ho, et al. [103] conducted a study to examine the impact of price hikes on cigarette use, tobacco tax revenues, and the decrease in smoking-related deaths in 22 low- and middle-income countries in the Asia-Pacific region, including Indonesia. Based on the conducted simulation, it is evident that implementing a yearly increase in cigarette prices by an average of 9.51% would result in a decrease of 3.56% in average annual cigarette use. Additionally, there would be a significant increase of 16.20% in average annual tobacco tax income.

Comparing neighboring nations in Southeast Asia, a study by Nguyen and Nguyen [104] in Vietnam yields compelling indications that individuals are more inclined to quit smoking when confronted with higher cigarette pricing. A recent study conducted in Malaysia by Koya, et al. [105] proposed that the government should uphold its tax policies while simultaneously enhancing its measures to combat the illegal trade of tobacco. In the Philippines, Lavares et al. determined that despite significant tax hikes imposed by the government between 2013 and 2018, the proportion of illicit activities in the market remained unchanged in 2018, accounting for 16% of the total market, consistent with the level observed in 1998. Their research concludes that there is no indication of a favorable correlation between tobacco taxes and the magnitude of the illicit cigarette market in the Philippines.

In 2018, the excise tax was imposed in Indonesia on Other Tobacco Processing Products (Hasil Pengolahan Tembakau Lainnya - HPTL), which includes ECs, at a rate of 57% of the selling price (the maximum allowed by law[10]). This is justified by the fact that these products are primarily consumed by the upper middle class [3]. Economic studies indicate that this tax may inadvertently lead to an increase in cigarette consumption among individuals who use both cigarettes and other tobacco products. The study confirmed the validity of their hypothesis by observing that the implementation of an e-liquid tax in Indonesia led to a marginal increase in e-liquid pricing. Additionally, there was a decrease in the use of ECs and traditional cigarettes. Notably, individuals who reported reducing their EC usage also reported an increase in their cigarette consumption [5].

Based on the findings from the Indonesian 2021 GATS report by the Ministry of Health Republic of Indonesia [18], it is observed that there is a notable difference in the price per pack of white and kretek cigarettes, which are IDR 24,090 and IDR 14,867 respectively. However, the monthly expenditure on both types of conventional cigarettes in Indonesia remains similar, amounting to approximately IDR 377,985 (refer to Figure 10). Using the average monthly spending as a benchmark, the approach can be extended to incorporate ECs. Cigarettes of all varieties are priced per unit or milliliter to allow for the determination of the quantity that can be purchased within one month. Subsequently, the data can be subjected to

[10] Law No. 39/2007 as amendments to Law No. 11/1995 about Excise.

comparison.A conversion number is also required to equalise the measurement of e-liquid in millilitres with the quantity of conventional cigarette sticks.

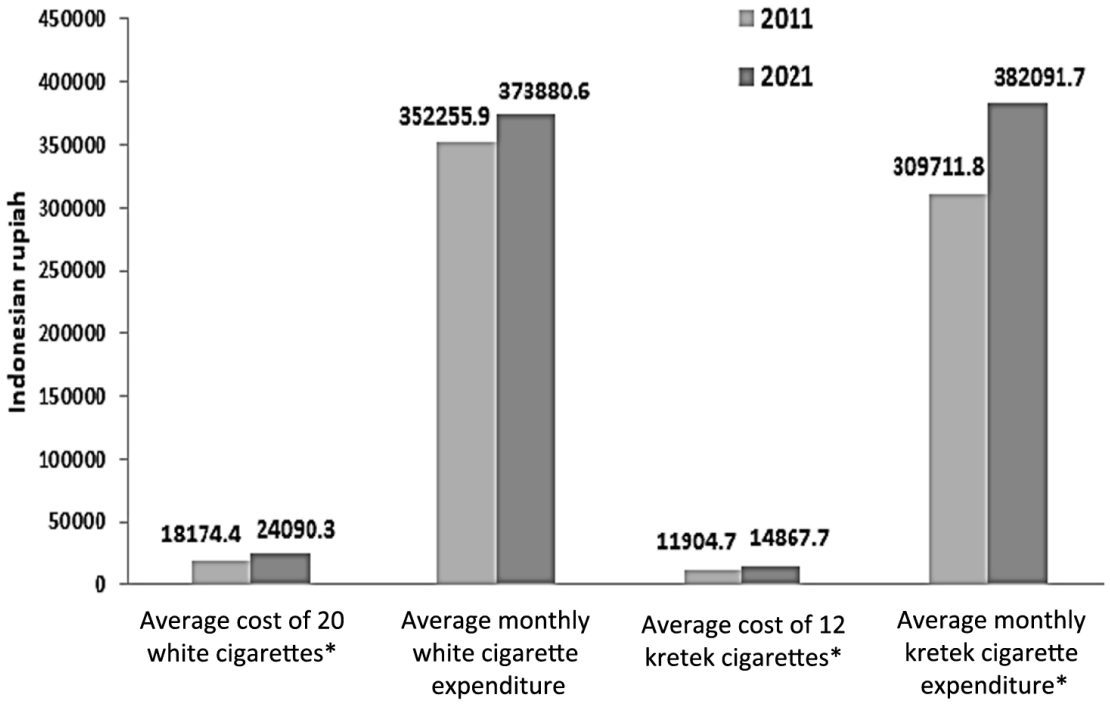

Figure 10.
GATS 2021: Average cost and monthly expenditure of manufactured white and kretek cigarettes in IDR. Comparison 2011 and 2021.
Source: Ministry of Health Republic of Indonesia [18].

Based on the GATS 2021 data and the prevailing prices of tobacco products in the Indonesian market, a straightforward estimate is presented in Table 3. Monthly spending on tobacco is lower when switching from other types of cigarettes to the EC-open system[11]. The EC-open system provides a smoker with the equivalent of 140 packs of regular cigarettes, which serves as a significant motivation for smoking. A suggestion can be made to raise the excise tax on e-liquids for ECs until it reaches the minimum average price of the lowest conventional cigarettes.

Table 3.
Calculation of the number of tobacco products that can be purchased in one month.

Tobacco products	Avg price (Rp.) per stick/ml	Qty of stick/ml as avg monthly expenditure[1]
Pack of kretek cigarettes (12/pack)	1,239/stick[1]	305 sticks / 25.4 packs
Pack of white cigarettes (20/pack)	1,205/stick[1]	314 sticks / 15.7 packs
EC - Pack of heat not burn (20/pack)	1,500/stick[2]	251 sticks / 12.5 packs
EC - closed system	34,659/ml[2]	11 ml (around 11 packs)[3]
EC - open system	2,693/ml[2]	140 ml (around 140 packs)[3]
Information: [1] according to GATS 2021 report; [2] average store price. [3] Using conversion of 1 ml equals around 1 pack of white cigarettes Indejuice [107] and Evapo [108]		

The political dynamics surrounding the adoption of tobacco taxation are more intricate compared to those surrounding alcoholic beverages and sugar-sweetened beverages [79]. Increasing excise tax impacts higher tobacco product selling prices. There is no doubt that it subsequently increases government revenue from excise. However, for the product user, the decision to reduce or stop smoking, switch to another type, or purchase illicit tobacco products is still not a definitive outcome among different factors or conditions (see Figure 11). A comprehensive measure needs to be implemented when increasing tobacco excise, along with providing knowledge and education, market surveillance, security/traceability features on the product, and a strict selling system. The strict selling system can serve various purposes.

The strict selling system verifies age and data on the national ID database, which is integrated with the cashier system or by using applications on smartphones for small shops, serving the purpose of protecting the youth. On top of that, the different manufacturers and brands should agree on a single data platform to serve the purpose so that the purchase of tobacco products can be aggregated and the consumption limit per person per certain period can be maintained (preventing health and

[11] A 'closed-system' is marketed as a pre-assembled, ready-to-use unit, comprising components that are not easily modifiable and containing liquids that are difficult to access. In contrast, an 'open-system' provides users with the flexibility to alter nearly all of its components and/or to fill them with any desired liquid Eissenberg, Soule, and Shihadeh [106] .

social hazards regarding overuse and irresponsible use). However, to prevent leaks in the supply system, all shops selling cigarettes must be registered, and sales need to be traceable and correspond with stock availability. Moreover, minimum security features on cigarette product packaging also need to be improved to make tampering difficult. Production serial numbers and QR codes can also be applied to verify product authenticity with the manufacturer. Thus, this effort can serve the purposes of health, economy, social monitoring, and research, as well as create hindrances for illicit tobacco products.

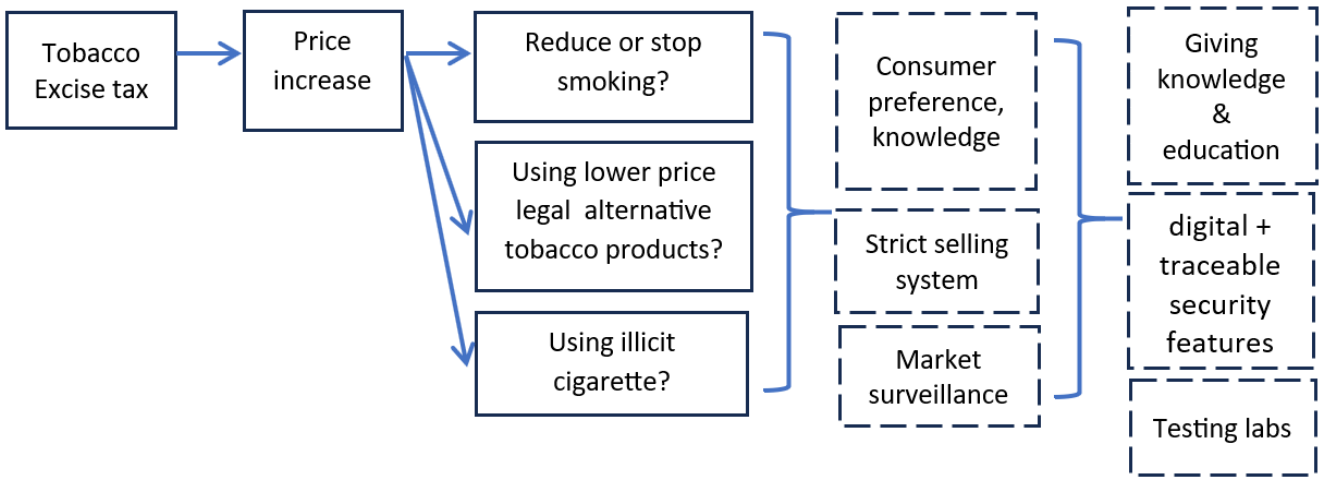

Figure 11.
Connection between tobacco excise tax, price, impacts, and control measures.

3.2.3. Illicit Cigarettes Issues

Kasri, et al. [109] propose that the affordability of illicit cigarettes may lead to a rise in smoking prevalence, particularly among young individuals. Additionally, they result in significant government revenue depletion. By analyzing data from the Basic Health Research Survey, Global Adult Tobacco Survey, and National Socioeconomic Survey, researchers discovered that illicit cigarette consumption in Indonesia is both prevalent and on the rise. This has resulted in a significant loss of government revenue, accounting for nearly one-third of the tobacco excise tax revenue. The consumption of illegal cigarettes reached its greatest point in 2018, making up 19% of total consumption. The projected decline in government revenue varied from IDR 24.2 to 42.0 trillion (equivalent to US$ 1,668 to 2,897 million), representing 15.8% to 27.5% of the cigarette excise revenue in 2018. Despite the concerning portrayal of illicit cigarettes in Indonesia mentioned earlier, a study conducted by Brown, et al. [110] on illicit cigarettes worldwide revealed that Indonesia is one of the five low-middle-income countries (LMICs) with a relatively low prevalence of illicit cigarettes. In the study, the packs were classified as either 'legal' or 'illicit' based on the inclusion of a health warning label from the nation of purchase and the presence of a tax stamp.

Illegal products, meaning they are not registered and unmonitored, may contain dangerous ingredients. Furthermore, not paying excise tax means the manufacturers are not contributing to efforts to overcome health and social impacts. The highest prosecution (47.5%) carried out by the government of Indonesia on illegal products was on cigarettes [111]. For consideration, WHO has had The Protocol to Eliminate Illicit Trade in Tobacco Products since 2012, which is the first protocol adopted under the WHO FCTC. Even though Indonesia has not ratified the FCTC, best practices from the protocol can still be adopted.

3.2.4. Impact of Smoking Burden on the Economy

In a study conducted by Kristina, et al. [112], it was determined that the number of cancer fatalities in Indonesia attributed to smoking was 30.6% of all cancer-related deaths. Among these deaths, 95% were males and 5% were females. Smoking-related cancers also caused a total of 1,207,845 Years of Potential Life Lost (YPLL). The economic burden of cancer deaths attributed to smoking amounted to USD 1,309 million in 2013. Lung cancer is the primary cause of both mortality and financial burden among all types of cancer. Another study by Kristina, et al. [112] showed that smoking-related disorders were responsible for approximately 21.6% of the total cases of chronic diseases in Indonesia. The most prevalent diseases were hypertension, chronic obstructive pulmonary disorders, and ischemic heart disease. The projected cost of treating smoking-related illnesses in Indonesia was at least USD 2,177 million, which accounted for nearly 2.5% of the country's GDP in 2015.

Satyana, et al. [113] quantified the effects of smoking on the Indonesian working-age population, specifically in terms of economic costs, years of life lost, quality-adjusted life years (QALYs) lost, and productivity-adjusted life years (PALYs) lost. The prevalence of smoking among working-age men in Indonesia was 67.2%, while among women it was 2.16%. According to this study, smoking was responsible for a loss of 2.9 million years of life (0.40% of the total), 41.6 million QALYs lost (5.9% of the total), and 15.6 million PALYs lost (2.3% of the total). The cumulative economic impact of reduced productivity resulting from smoking reached USD 183.7 billion among individuals of working age who were monitored until their retirement. The projected healthcare expenditure was estimated at USD 1.8 trillion. Within one year, the Gross Domestic Product (GDP) saw a loss of USD 10.2 billion, while healthcare costs incurred a loss of USD 117 billion.

The book authored by Kosen, et al. [21] provides an estimation of Indonesia's macroeconomic loss in 2015 resulting from tobacco consumption, which amounted to IDR 596.61 trillion or approximately USD 45.9 billion. The total amount includes IDR 208.8 trillion for cigarette purchases, IDR 376 trillion for the loss of productive years, and IDR 13.67 trillion and IDR 53.44 billion for inpatient and outpatient medical costs, respectively. Furthermore, they expressed concerns regarding the imminent threat presented by the increasing population of young adult smokers. This will not only have economic repercussions but also endanger the well-being of future generations and undermine the anticipated demographic advantage in Indonesia. Nevertheless, the calculation pertains to traditional cigarettes.

Implications from tobacco use include direct and indirect costs, which are all later calculated into economic numbers. The direct cost is medical, which burdens the national health insurance or Jaminan Kesehatan Nasional (JKN). The indirect costs include Years of Potential Life Lost (YPLL), quality-adjusted life years (QALYs), productivity-adjusted life years (PALYs), and threats to the future demographic bonus. In Kosen, et al. [21], cigarette purchases are also calculated as a cost. Various studies regarding the economic costs of tobacco products all show higher expenditures due to direct and indirect costs related to health and reduced productivity compared to the revenue and benefits to the plantation and industry locations, as discussed previously. Thus, Indonesia, which means the government and industry, really needs to make efforts to optimize revenue and prevent loss from tobacco products. This includes increasing sin taxes on products that have negative impacts, defining and implementing limits on the consumption of tobacco products, fighting illicit tobacco, and diversifying tobacco derivative products (discussed in the next section). It should also be kept in mind that there is currently no study available for calculating the economic cost of electronic cigarettes (EC) alone. Separate monitoring must be conducted, and tobacco control measures must distinguish between conventional cigarettes and ECs during the time that the two products are offered side by side on the market.

3.2.5. Substitute Crops and Alternative Tobacco Utilization

Various solutions have been proposed to address tobacco issues, including cultivating alternative crops and exploring different options for tobacco use [114]. These solutions are necessary to tackle the tobacco-related issues concerning the extensive job-generating business, which encompasses individuals engaged in agricultural operations, manufacturing, and sales and marketing. Research is lacking on the constraints and practical methods that can help farmers sustainably transition to other crops. This remains a significant challenge, even though there are some existing programs aimed at addressing the economic difficulties that farmers may encounter through subsidies. Experience from India indicates that blending other crops depending on local characteristics does not yield the same level of profitability as tobacco unless accompanied by improvements in infrastructure. A successful shift to alternative crops must be carried out through an incremental method.

Manoharlal and Saiprasad [114] final suggestion is to replace tobacco with tobacco itself, which means still cultivating tobacco, but the crops are made into alternative derivative products other than cigarettes. For non-cigarette applications, the plant density can be much higher, and mechanical harvesting can be implemented. The different uses of tobacco crops include medicinal applications, seed oil, biofuel, essential oil, and edible protein; pulping, which can later be made into paper, particle board, briquettes, and fiber-cement; and bioactives such as nicotine, insecticide, pharmaceuticals, solanesol, and polyphenols. Similar to these suggestions, Darmayanti, et al. [115] suggested tobacco stalks for biobutanol and bioethanol, while Prabowo, et al. [116] suggested tobacco stems for botanical pesticides. The active ingredients in nicotine, through the pyrolysis process, result in bio-oil that has many benefits, including antimicrobial, antifungal, insecticidal, and insect-repellent properties.

In the effort towards tobacco control, the path for this measure needs to be initiated. Lowering tobacco use cannot be done instantly. Educating people and the smoking cessation process also require time. On the other hand, the tobacco industry must prepare itself to move to substitute crops and/or other tobacco derivative products, creating other "egg baskets." Moreover, a timeline or master plan needs to be created and agreed upon among stakeholders. Studies are also needed to provide guidance or practical ways, distinct for conditions in Indonesia, that lead to sustainability for farmers transitioning to other crops.

3.3. Further Discussion

Stubbs [117] stated that Indonesia, a major global tobacco producer, was the sole Southeast Asian nation that had not yet ratified the WHO FCTC. It was said that the tobacco sector exerted pressure on the government to refrain from signing the agreement, expressing worry about the potential negative impact on the livelihoods of its 600,000 workers and 3.5 million farmers. In recent research, Wibawa, et al. [16] outlined that the primary rationale behind Indonesia's opposition to the FCTC agenda also lies in its historical ties to national heritage. Issues regarding tobacco in Indonesia are not merely a matter of health concerns but also of economic and cultural significance. Indonesia has a deep-rooted connection with cigarettes, which is inextricably linked to its rich history and cultural identity.

Furthermore, according to Wibawa, et al. [16], there is concern that the FCTC regulations may be more rigorous and susceptible to manipulation by foreign entities. One of the criticisms directed towards the FCTC is the potential utilization of the treaty as a means for certain countries to exert control or intervention over others. The Ministry of Industry argues that the ratification of the FCTC is deemed superfluous due to the existence of Indonesia's previous health legislation, specifically PP No. 109/2012[12]. Although Indonesia is not a signatory of the FCTC, the Indonesian government actively participated in the discussions of the FCTC as a drafting member. In addition, Indonesia actively participates in the GATS, utilizing the MPOWER methodology from the FCTC to determine the indicators in the report. A study by Aryani and Yusa [119] also

[12] Other related regulations are Minister of Health Decree No. 28/2013, Minister of Health Decree No. 56 /2017, and Ministry of Education and Culture issued Decree No. 64/2015 Ministry of Health Republic of Indonesia [18]. New regulations that regulate ECs are Minister of Finance decree No. 156/PMK.010/2018 and Health Law No 17/2023. Warouw *et al.* [118]. reported, Smoke-Free Areas (SFAs) have been implemented by 84% of Indonesian local governments.

concluded that Indonesia has been found to possess the capacity to formulate domestic regulatory frameworks aimed at addressing and diminishing tobacco consumption, despite the significant influence exerted by tobacco industries and markets.

The tobacco companies and the Ministry of Finance are considered to well recognize the tobacco issues, and they have shown a proactive response to address the public's concerns. As an illustration, one of the four pillars[13] of the tobacco excise policy (CHT) is to decrease the occurrence of tobacco use among young people [111]. In addition, the Indonesian government has implemented an average rise of 11-12 percent in the tobacco excise duty for conventional cigarettes of SKM and SPM[14] for the years 2023 and 2024. However, for SKT, the increase is set at 5 percent. Concurrently, there is a 15 percent rise in ECs, which will subsequently be incrementally enhanced by the same proportion over the next five years [120].

Meanwhile, the industry that developed ECs and other innovative tobacco products that carry a lower risk suggests that they actually share the same concern. Those efforts must be appreciated; all parties should think prudently because a change needs to be carried out gradually, and all parties need to be treated fairly. Thus, a middle way is always important. Even though it is probably eventually agreed to completely ban tobacco products in Indonesia, a timeline needs to be discussed and agreed upon among stakeholders.

Discussing further on CHT, it is used for the Revenue Sharing Fund (Dana Bagi Hasil, abbreviated as DBH), which is regulated through Minister of Finance Regulation number 222/PMK.07/2017. DBH CHT is used for five programs, namely: improving the quality of raw materials, industrial development, social environment development, socialization of provisions in the excise sector, and/or eradication of illegal excisable goods, with priority on the health sector to support the national health insurance program. A minimum of 50% of DBH CHT is used to support the national health insurance or Jaminan Kesehatan Nasional (JKN)[15]. A recent study by Ahsan, et al. [121] concluded that the DBH CHT mission aligns with FCTC article 17, which promotes economically viable alternatives for tobacco farmers, even though there are some obstacles in the implementation and Indonesia has not ratified the FCTC.

With the limited papers on social and economic topics on EC, important insights can still be obtained from the discussion of conventional cigarettes put in the context of EC. This is later given as a difference of MPOWER (see Table 4) between conventional cigarettes and EC that can advocate the direction of policy-making related to ECs or other novel tobacco products. With the main concerns among the stakeholders addressed equally, it is expected to lead the way to a win-win solution and sustainability of the industry itself while maintaining the optimal economic benefit to the nation that has the tobacco industry as a part of its culture and long history.

The recommendations given later are with consideration on the side of the industry, which cannot be denied that they are one of the key stakeholders in the circle. By persuasion and reasoning, voluntary action from the tobacco companies is mentioned, considering the surrounding multi-spectrum critics and severe actions that could be taken against them, such as completely banning tobacco products[16]. Other more complex ‘middle-way’ mandatory top-down measures can be considered by the government; this is similar to the use of prescriptions for tobacco product use in Australia and comprehensive pre-market assessment (PMTA) in the USA [123].

Table 4.
MPOWER formulation – conventional cigarettes vs ECs (case of Indonesia).

MPOWER measures	Conventional	ECs
Monitoring Use and prevention policies	Product monitored: Kretek cigarettes, white cigarettes, chewing tobacco/betel quid.	Product monitored: heated tobacco products, open system electronic cigarettes, closed system electronic cigarettes, and other types of electronic cigarettes or novel tobacco products.
	User profile monitored: Gender, age, income (poor/wealthy), expenditure, education, environment (rural, city, school, household), and job types. Separate monitoring between conventional and ECs.	
Protect People from tobacco smoke	Restaurants, homes, public transportation, government buildings, workplaces, healthcare facilities, and schools. Smoking areas need to be separated between conventional cigarettes and electronic cigarettes.	
Offer Help To quit tobacco use	Curriculum, programs, initiatives, education, and training in schools, households, workplaces, and communities in rural areas and cities. The program can be a smartphone application for smoking cessation during Hajj, called Free of Smoke Kampong. Keys: 1. Stop smoking behavior needs to be well-publicized and agreed upon at the community level. 2. the importance of changing youths' image of cigarette smoking rather than only educating students regarding the health hazards	

[13] The 4 pillars of Tobacco Excise (*Cukai Hasil Tembakau* abbreviated as *CHT*) Policy are: Consumption control, with target of reducing smoking prevalence to be 8.7% in 2024 on those aged 10-18 years; labour sustainability, regarding the impact on tobacco farmers, workers, and industries; revenue improvement, to support national development programs; and supervision of illegal cigarettes Ministry of Finance [111] .
[14] The explanation for the abbreviations is: machine-rolled kretek cigarette (*Sigaret Kretek Mesin-SKM*), machine-rolled white cigarette (*Sigaret Putih Mesin-SPM*) and hand-rolled cigarettes (*Sigaret Kretek Tangan*-SKT).
[15] However, this provision does not appear in the new regulation, namely 206/PMK.07/2020.
[16] 34 countries have banned ECs WHO [122] .

MPOWER measures	Conventional	ECs
	3. Parents, teachers, leaders (religion and government), peers, spouses, HCPs, and influencers/popular persons should give a good example (not smoking) to youth.	
Warn About the dangers of tobacco	Inform real data on health impacts from research and medical records of health facilities. Focus: male (especially head of household), less wealthy/poor, less educated, rural, self-employed/entrepreneur.	Inform or warn that ECs are not free of risk. Never a smoker, youth prevented from trying e-cigarettes or any type of tobacco products. Focus: younger individuals, more educated, more affluent, male and female, urban areas.
	Possible nicotine addiction --> unresponsible use could lead to an impact on health, household's social economy, and behavior.	
Enforce Bans on tobacco advertising, promotion, and sponsorship (TAPS)	Restriction of TAPS on conventional media (radio, TV, magazines, billboards), CSR programs from tobacco companies, the internet, and social media. Prevent tobacco product use posted on social media by individuals, peers, and influencers. Bans on selling to youth need to be enforced across all parties in the selling chain, including small shops and street vendors. A digital single platform for shop registration, age verification (at the cash register or tills), monitoring of aggregate tobacco purchases (per person per day/week), and stock monitoring is essential. Security features in the product should be traceable to the manufacturer. Eradicate illicit/unregistered/untaxed tobacco products	
Raise Taxes on tobacco	Maximum tax according to the law, lowering the price gap between kretek and white cigarettes.	Raise taxes on open systems.

Recommendations below are thought to support middle-ground approaches, considering existing suggestions from published studies and reports. Therefore, the recommendations regarding the increase of excise tax, providing education/knowledge/training, countering TAPS, establishing well-publicized and agreed-upon community-level initiatives to stop smoking behavior, implementing smoking cessation programs during the Hajj season, developing a smoking cessation application, preparing for other tobacco derivatives or crops, and providing support for farmers in crop transition are not included. The recommendations that can be made from this study are as follows.

1. For the industry

a. The tobacco industry in Indonesia needs to act voluntarily. They must demonstrate goodwill and propose satisfactory social and health measures as part of their responsibility to mitigate the multidimensional impact of the products they produce. This also pertains to the long-term sustainability of their industry.
b. Implementation from point 'a': Obeying TAPS regulations, creating a system to restrict access to conventional cigarettes and electronic cigarettes for youth, and ensuring that nicotine addiction is prevented for adult users. The implementation needs to include attention to small shops or street vendors. A traceable, electronic-based, single database platform agreed upon among industry players and a verified strict selling system is suggested by this study.
c. Working towards the production of nicotine extract in Indonesia and starting a tobacco derivatives industry.

2. For the government

a. Having a shared collective understanding among various related institutions is essential to obtain optimal benefits from tobacco while the industry and trade are still allowed to operate, all while mitigating health, economic, and social impacts.
b. Creating the tobacco policy needs to be done in a wise manner and with a careful long-term plan.
c. Separating tobacco control measures and monitoring between conventional cigarettes and e-cigarettes.
d. Establishing novel and more creative smoking cessation programs. This study suggested a smoke-free Kampong.
e. Creating national standards for extracted nicotine and other tobacco product derivatives in accordance with the future tobacco master plan.
f. Establishing testing laboratories to support standards implementation and market surveillance.
g. Conducting research to provide a scientific basis and secure research funding is essential for supporting tobacco control policy formulation. Independent funding and research are crucial. Recommended research topics include testing for EC substances circulating in Indonesia, establishing a nicotine intake limit, developing a strict selling system using a single platform and an application on smartphones for small shops, long-term monitoring of EC impacts, providing guidance on practical ways to facilitate crop transition according to conditions in Indonesia, and analyzing the economic costs of ECs, among others.

3. Both the government and the industry create a future tobacco master plan and timeline.

4. Conclusions

Tobacco product use can have various impacts, mainly in terms of social and health aspects. Smoking behavior is primarily initiated and established during adolescence; in Indonesia, it can jeopardize the demographic bonus. It cannot be ruled out that smoking is a part of culture and ritual that aids in social activities, but its use needs to be made more responsible.

From a health perspective, even though electronic cigarettes (ECs) are less risky compared to conventional cigarettes, it must be understood that the authorities in charge of health need to be careful in setting up regulations involving tobacco products. From an economic perspective, outcomes from the excise tax and the use of the fund should be optimal for the nation's development, rather than experiencing a loss of productivity and covering health costs due to preventable smoking-related illnesses. The sustained operation of the industries is still important but should be carried out more responsibly and directed toward a long-term plan, creating other 'egg baskets,' such as crop substitution or producing new derivatives.

Meanwhile, for conventional cigarettes, even though they have historical and socio-cultural values and support the economy, the nation should rethink its long-term strategy regarding the economic gain versus the cost burden. From a social perspective, the negative impact should be reduced, mainly the negative impact on households and adolescents.

Even though the social hazards are still similar to those of conventional cigarettes, the health impact of ECs is still under debate. However, the risk is certainly lower. Hence, the calculation of economic costs is different from that of conventional cigarettes. The study for health monitoring of ECs is not yet available, nor is the economic cost calculation for ECs, which should be lower (or not?). In line with that, stakeholders are still influenced by the concerns regarding conventional cigarettes, which have a higher risk and perceived higher economic cost. During the period when both products are available on the market side by side, tobacco control measures and monitoring need to be differentiated between conventional cigarettes and ECs. Research is important to open the Pandora's box.

Comprehensive measures need to be implemented to prevent EC or any tobacco product use or effects (like second-hand smoke) among youth/adolescents and non-smokers. A strict selling system using a digital platform that can serve multiple purposes, voluntarily implemented by the industry, may provide a solution. The selling system should accommodate age verification, record tobacco product purchase aggregates to adhere to the nicotine intake limit, and establish a tracing system in the supply chain. The data can be helpful for monitoring and research purposes.

For the government, imposing optimal excise taxes, implementing control for tobacco advertising, promotion, and sponsorship (TAPS), providing education and knowledge, conducting market surveillance, and offering inclusive programs for tobacco cessation must continue.

To optimize the economic benefit of tobacco for Indonesia, extracted nicotine as the ECs' liquid ingredient needs to be manufactured locally. The extracted nicotine can also be used in other tobacco derivative products, which can provide another source of economic income with a smaller health impact. Accordingly, related standards need to be created, as well as the establishment of testing laboratories, which are also important to support market surveillance. Moreover, research is crucial to provide a scientific basis for educating, imparting knowledge, and formulating policy. Funding and research need to be provided by the government or other independent parties to avoid conflicts of interest. With the importance of research emphasized, several research topics are recommended.

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