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Consumers' Choices for Crucial Firewood in Saudi Arabia and Banning the Use of Local Types

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Abstract

Environmental laws in Saudi Arabia ban the using of local firewood, restricting consumers to only imported types. Hence, the study aims to investigate the factors affecting consumers' choices of imported firewood.[0] To obtain variations in consumers' choices of firewood, in the absence of local firewood, the study employed the stated preference approach to estimate the probability of choosing imported firewood using Logistic regression. The results pose that environmental attitudes and knowledge positively affect imported firewood choices while the aroma and country of origin negatively influence the imported firewood selection. Shopping from stores of recreational supplies and supermarkets increases the likelihood of selecting imported firewood. The collection available in the bagged logs shows a positive effect in selecting imported firewood. The essential of findings supply to shift preferences toward imported firewood comprise increasing environmental awareness, importing logs with a similar aroma to that of local types, and providing labels for the exporter countries. As local firewood is illegal, the latter insight might stimulate the selection mentality among only imported types of firewood.

Keywords: Firewood, Environmental Laws, Stated Preferences, Social Welfare, Logistic Regression, Saudi Arabia

1. Introduction

Firewood extraction dramatically increases environmental risks in a poor forest country such as Saudi Arabia, having only 5% forest land (The World Bank, 2021). Environmental risks related to firewood extraction include soil infertility, soil erosion, air pollution, biodiversity loss, desertification, sand encroachment, and climate change (The Ministry of Environment, Water and Agriculture, 2016)[1]. The Saudi Government bans the extraction, transportation, promotion, and sale of local firewood under the Environmental Laws and the Implementing Regulations of Firewood Extraction to prevent environmental risks. Violators must pay a monetary penalty, and fines of cutting down trees could also lead to jail time (not more than ten years) if violations repeat within a year (Umm Al-Qura Newspaper, 2021).

In addition to the stringent regulations, a division under the Ministry of Interior named the Special Forces for Environmental Security (Hereafter "the environmental police") deals with various sorts of environmental violations, including illegal firewood. Their efforts to prevent illicit extractions, transportation, and selling of local firewood are ubiquitously published using different means such as government websites, daily press, and governments' official accounts on social media (e.g., Twitter).

Banning local firewood suggests that consumers move away from their status quo entitlements to select among imported and local firewood types and select only imported firewood. However, this could have negative social welfare if environmental gains due to the ban do not cover the losses. But, this regulations approach could enhance social welfare if complemented with effective measures and policies to stimulate the utilization of imported firewood (Van Kempen et al., 2009). This study aims to evaluate the factors associated with consumers' choices of imported firewood and provide insights for the design of alternative policies and measures.

Many studies have addressed the use or extraction of firewood. Al-Subaiee (2016), Danlami (2019), and de Arruda et al. (2019) researched the impact of socioeconomic factors on firewood use. For instance, Al-Subaiee (2016) reported that education and living in modern houses (villas and apartments) negatively affected consumption. Other studies addressed the demand for firewood along with other energy sources (Guta, 2012; Olabisi et al., 2019; Ur Rahman, 2021). Ur Rahman (2021) jointly estimated the demand for firewood and other

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[1] Indirect socioeconomic risks include reduced tourism and increased unemployment in rural areas (The Ministry of Environment, Water and Agriculture 2016).

energy sources like natural gas through a system of demand equations among consumers in Khyber Pakhtunkhwa, Pakistan. About firewood regulations (Van Kempen et al., 2009; Latham et al., 2017; Nascimento et al., 2019, Van Kempen et al., 2009) estimated the probability that consumers would choose legal firewood in rural Guatemala. Their results included that being informed about legal procedures for firewood extraction and welfare positively increased the probability of consumers replacing legal firewood with illegal counterparts. Furthermore, other studies have centered on imported and domestic firewood. Palmieri et al.[5] (2020b) evoked consumer preferences for domestic eucalyptus firewood in Italy as a better firewood type for the environment. They found a positive correlation between willingness to pay and environmental attitudes; but, firewood species and packaging were negatively correlated with willingness to pay. Additionally, Palmieri et al. (2020a) researched the desire of Italian consumers to buy domestic eucalyptus firewood. Familiarity with the eucalyptus energy source, the supply method, attitudes toward newness, origin, and energetic density influenced the desire of consumers to utilize domestic eucalyptus firewood.

The results found in other countries about firewood may not apply to Saudi Arabia because of two reasons. The roles of the explanatory factors differ among countries due to varying cultures, environmental preferences, and experimental settings (Van Kempen et al., 2009). Additionally, the ban on local firewood is unusual, as it contrasts with the common use of market-based policies such as certification for logs in compliance with regulations (Conway, 2012; Lavin et al., 2020; Álvarez et al., 2021) or the execution of forest management plans restricting the amount and days for extraction (Latham et al., 2017; Nascimento et al., 2019).

[90] To the best of our knowledge, no research has addressed the factors influencing the Saudis' choices of local or imported firewood in the context of the unusual firewood ban situation that currently exists. This study will fill this gap in the existing literature.

Empirical research of consumer economics covers revealed or stated preference approaches to comprehend consumers' choices. The former method utilizes observational data (Anderson and Hansen, 2004; Arnot et al., 2006), while the latter asks consumers to state their preferences using questionnaires (Loureiro et al., 2002; Sriwaranun et al., 2015; Palmieri et al., 2020a). The revealed preference method is unrealistic because of the unavailability of

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local firewood and the absence of historical transactional data.[2] We adopted the stated preference method, enabling us to study variations of choices among local and imported firewood. Our results will offer insights to formalize better and more effective policies and measures to reinforce the command and control approach, improving economic welfare.

The remaining of this paper consists of three sections. The first section represents the materials and methods. The second section discusses the results and implications, and the final section concludes.

2. Materials and Methods

Prohibiting local firewood for a better environment could reduce economic welfare if the environmental gains for environmental improvement offset the losses from preventing consumers from buying their preferred local firewood. The following presents the conceptual framework and the underlined assumptions, the econometrics application, and the data used for our investigation.

2.1. Theoretical Framework of Welfare Measures

We follow Mitchell and Carson (2013) to explain the conceptual framework for welfare measures. A given policy assessment would incorporate the Pareto improvement criterion, implying that improving some individuals does not harm others. Realistically, we encounter policies with mixed outcomes for better-off and worse-off individuals. Banning the use of local firewood in Saudi Arabia is no exception. The Pareto improvement criterion is still applicable as long as it allows the beneficiaries to compensate for the harmed individuals. Figure 1 indicates the underlined assumptions of both gainers and losers. The gainers are assumed to be environmentally cautious and voluntarily choose to buy imported firewood. The losers are those with preferences for local firewood exceeding that for environmental benefits and involuntarily buy imported firewood.

Figure 1: Type of Consumers and the Underlined Assumptions
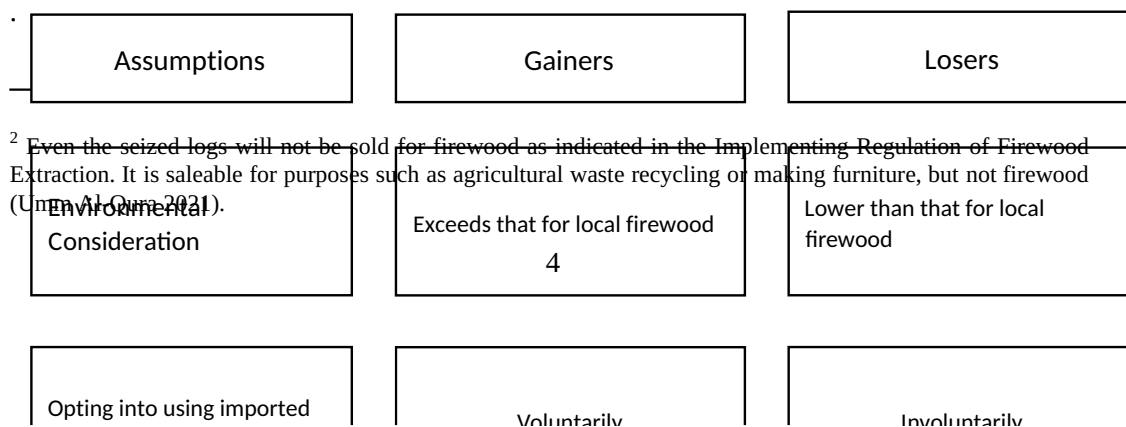
Assumptions	Gainers	Losers
Environmental Consideration	Exceeds that for local firewood	Lower than that for local firewood
Opting into using imported	Voluntarily	Involuntarily

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Environmental quality is a public good; individuals do not select the amount consumed, and all enjoy its fixed level. Improving the environment aims to prohibit local firewood. Accordingly, the framework considers the change in welfare as environmental quality improves due to banning local firewood.

Following Mitchell and Carson (2013), the price for the public good is set at zero, and the compensating surplus measures the change in economic welfare responding to the environmental quality change. Figure 2 depicts the welfare changes of the presumed gainers (the left panel) and losers (the right panel). The downward sloping curves are the Hicksian demand holding the utility level constant, also known as the compensated curves.

The magnitude of the Hicksian demand shift for the beneficiaries is larger than for losers. For gainers, an increase in environmental quality from q_0 to q_1 shifts the Hicksian demand upwards from h_0 to h_1 providing a higher utility level. For the worsen-off consumers, the Hicksian demand moves downwards from h_0' to h_1', reducing the utility level. The latter group is assumed to benefit from environmental quality improvement, but their preferences for local firewood are rigid.

Figure 2: The Change in the Compensating Surplus

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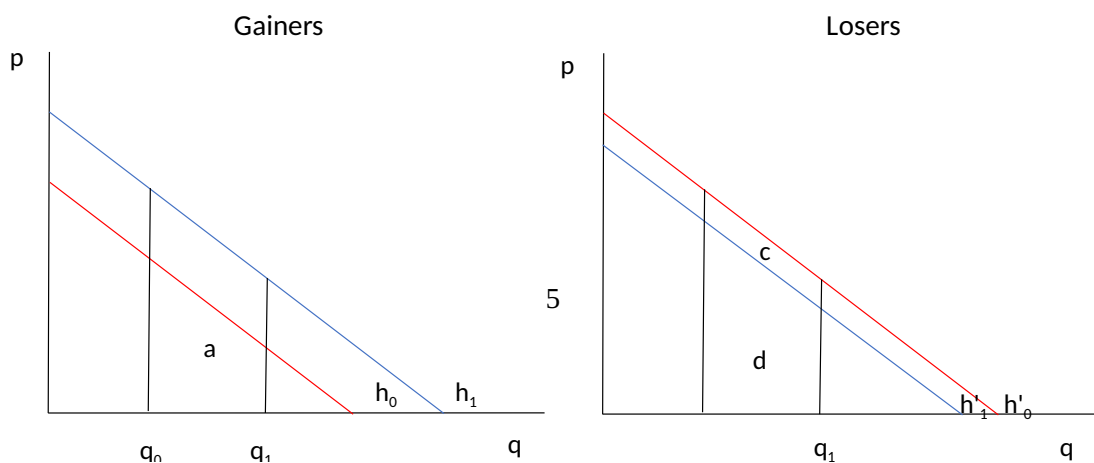
$$q$$

The area a defines the maximum amount the consumer is willing to pay to enjoy the quantity increase and maintain the initial utility level. However, the area c+d indicates the minimum amount the consumer is willing to accept the utility reduction. In mathematical notation, consider the inverse Hicksian demand function,

$$h\left(P, q, T, U_0\right), \tag{1}$$

where P denotes a vector of prices, q the environmental quality, T taste, and U_0 the initial utility level. The compensating surplus is the integral under the Hicksian demand curve as follows:

$$\int_{q_0}^{q_1} h\left(P, q, T, U_0\right) dq. \tag{2}$$

An issue in estimating equations 1 and 2 is the unknown T, the taste factor, and the functional form for h. Economists apply non-market valuation techniques to overcome this issue.[12]► One is the stated preference contingent valuation method, asking individuals to state their valuation of a given change in q (Mitchell and Carson, 2013).

2.2. Econometric Model

This paper aims to determine the effect of the influencing factor on consumers' choices for imported firewood, contributing to designing better and more effective measures and policies to sufficiently align consumers' preferences for commanding the control policy to ban local firewood. From the random utility model (McFadden 1974), two firewood alternatives exist, $j=1 \wedge 2$ for imported and local firewood, respectively. For N consumers, the utility of the individual i corresponding to the alternative j is U_{ij}, $i=1,2,\ldots,N$. U_{ij} is a function of observable, V_{ij}, and unobservable, ε_{ij}, factors written as $U_{ij}=V_{ij}+\varepsilon_{ij}$. The individual i selects the choice j providing the highest utility. Its mathematical expression is $U_{ij}=\max\left(U_{i1}, U_{i2}\right)$.

The stated preference contingent valuation method involves surveying individuals to state their preferences. We asked them to select between local and imported firewood in our case. The response outcome variable, Y, was coded as a binary variable equaling 1 if the consumer favored imported firewood and 0 otherwise. Given the influencing variables, we used Logistic regression (Greene 2012) to estimate the probability of selecting imported firewood. The model follows:

$$P(Y=1 \vee X) = \frac{e^{X'\beta}}{1+e^{X'\beta}} = L(X'\beta) \tag{3}$$

where $L(.)$ is the Logistic Cumulative Distribution Function (CDF), X is a vector of exploratory variables, and β is a vector of the estimated coefficients. The marginal effect is calculated as follows:

$$\frac{\partial P}{\partial X_j} = \frac{e^{X'\beta}}{(1+e^{X'\beta})^2} = L(X'\beta)[1-L(X'\beta)]. \tag{4}$$

Survey Design

The designed questionnaire directs individuals with alternatives to state the highest utility and to obtain observable characteristics. The questionnaire was written in Arabic and pretested before participants' recruitment.

The sample was collected through days of relatively lower temperatures and higher firewood consumption (from January 30 to February 22, 2021). As the weather cools down, many individuals do recreational activities involving spending time outdoors in deserted areas, thus increasing the demand for firewood.

The sample comprises consumers of firewood, aged at least 18 years old, and said to use firewood within a year. Our questionnaire is web-based, and the snowball method has chosen consumers through emails and varying social media platforms. An online survey would

provide higher attendance promptly compared to other survey methods; specifically during the pandemic of Covid19, because health recommendations included taking preventive measures of wearing a mask and limiting gatherings in crowded closed areas, and unnecessary contacts with other people. Although a snowball survey may not provide a representative sample, it is prevalent in consumer behavior studies (Testa et al. 2019; Palmieri et al. 2020a, 2020b).

Local firewood is supposedly absent due to the ban on its extraction, transportation, promotion, and sale. The environmental police actively enforce this ban. Some of the enforcement measures are in Table 1. A revealed preference approach is unavailable to test the factors affecting consumers' choices for imported vs. local firewood due to the absence of observational data. Instead, a stated preference method allows for variations of local and imported firewood choices by utilizing a hypothetical scenario. What follows are the details of the factors influencing choices and the hypothetical scenario.

Table 1: Examples of Law Enforcement Efforts to Compact the Use of Firewood in Saudi Arabia

The Headline in the News	Date	Source
"90 tons of firewood seized in Riyadh"	27 December (2020)	Arab News
"Local firewood sellers arrested in Riyadh."	22 February (2021)	Arab News
"Saudi authorities arrest 44 people in Riyadh area selling illegal firewood."	23 May (2021)	Alarabia News

Factor Influencing Choices of Imported Firewood

The influencing factors fall into four categories. The first group considers environmental attitudes and knowledge. Following (Loureiro et al.,[49] 2002), we used a tradeoff scenario to measure attitudes ranging from saving the environment to gaining economic returns and asked the participants to position themselves on a scale in the range of 1 to 7, where 1 indicated preferring financial returns irrespective of saving the environment, and 7 implied otherwise. This point of reference assured variations within the environmental attitudes metrics (Loureiro et al., 2002).[9] To determine the environmental knowledge, we developed a dummy variable, taking the value of 1 if the consumer considered firewood extraction to pose a risk to the environment and 0 otherwise.[3]

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[3] We have five categories to measure environmental knowledge (high risk, medium risk, low risk, no risk, and do not know). We constructed a dummy variable, where the value of 1 indicated the chance (high risk), and 0

With newly approved environmental laws assuming less comprehension of the regulations among consumers is sensible. On July 10, 2020, the Royal Decree (M/165) approved the new Environmental Laws, and on February 2, 2021 (the fourth day of our data collection), the Ministry of Environment, Water, and Agriculture approved the new Implanting Regulations for Firewood Extraction (Umm Al-Qura Newspaper, 2021). Instead of directly asking about the familiarity with regulations, we used a proxy as a dummy variable that equaled 1 if participants have seen environmental police efforts to compact local firewood and 0 otherwise. This measure better reflects familiarity with the new regulations because the enforcement news is widespread on various media platforms such as daily press, official governmental websites, and official governmental accounts on social media.

We assumed that environmental attitudes and knowledge would positively affect the demand for imported firewood. So would familiarity with regulations, indicated by the proxy of the environmental police. Although the environmental police are conceptually endogenous (Levitt 2002), they crucially affect consumers' choices in the short run due to the momentum of the force. The endogeneity is still of great concern, but perhaps in the long run, beyond the course of our investigation.

The second category determines the firewood attributes of aroma, flame color, burning duration, and country of origin, employing a scale ranging from 1 to 3, where 1, 2, and 3, respectively means, not important, less important, and important. The third category refers to consumers' behavioral habits about consumption purpose, supply method, and primary source of firewood. We used a dummy variable to investigate whether the primary goal was recreational vs. personal (for heating or cocking). The recreational purpose is expected to affect the demand for imported firewood positively. Arguably, leisure time in open places and deserted areas in a country like Saudi Arabia having limited forest coverage is more likely to inflate the marginal value for environmental conservation, thus increasing the demand for imported firewood.

The primary sources of purchasing firewood in the country are traditional firewood markets, stores of recreational supplies, supermarkets, and other sources, including street vendors in recreational areas. The traditional markets are mostly located at or adjacent to livestock

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otherwise due to low variations. The proportion of those who chose the option (no risk) was 1.60%, and the proportion of those who chose the option (do not know) was 4.53%.

markets. Before the prohibition, these markets were associated with local firewood compared to supermarkets and stores of recreational supplies. Accordingly, buying logs from traditional markets is expected to negatively influence imported firewood. Contrarily, buying logs from supermarkets and stores of recreational supplies is expected to positively affect imported firewood.

The supply method is also critical for consumers' choices (Palmieri et al. 2020a). We asked consumers in what form (strapped, bagged, or full pickup truck-load) they buy firewood. The strapped and bagged forms supposedly affect imported firewood positively, but the opposite is true when purchasing a full pickup truck-load of firewood.

The fourth category was about demographics and we added dummy variables for males, with a college degree or above, living in the Riyadh province, and having a high income (monthly household income above (SAR 18,000 [US$ 4,800]), [4] and two more dummies for age between 26 and 40 years old, and age of 41 years or older. Our reference groups had females, education levels below college, low income, and consumers younger than 26 years old. Table 2 depicts the definitions and descriptive statistics of our influencing factors.

Table 2: Definitions and Descriptive Statistics of Variables to Analyze Consumers' Choices for Imported Firewood

Variables	Label	Frequency	%
Consumer's choice of firewood	Imported		
Local firewood		191	50.93
Imported firewood		184	
			49.07
	Total	375	
			100.00 [8]
A measure of environmental attitudes asks about a tradeoff between saving the environment and economic returns	Environmental Attitudes		
1= Valuing economic returns at the cost of the environment		13	
			3.47
2			
		4	1.07
3			
		19	5.07
4			
		69	18.40
5			
		77	20.53

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[4] One $US to Saudi Riyal (SAR) exchange rate is 3.75 (https://www.sama.gov.sa/ar-sa/FinExc/ExchangeRatesHijri/2021-2.xls).

		62	16.53
7= Valuing saving the environment at the cost of economic returns		131	34.93
	Total	375	100.00
A measure of environmental Knowledge asks if the consumer considers cutting trees poses a high risk to the environment	Knowledge		
Yes		271	72.27
No		104	27.73
	Total	375	100.00
The essential purpose of using firewood	Purpose		
Recreation		90	24
Others		285	76
	Total	375	100.00
The importance of aroma measured on a scale from 1 to 3	Aroma		
1= Not important		38	10.13
2= Less Important		121	32.27
3= Important		216	57.60
	Total	375	100.00
The importance of flame color measured on a scale from 1 to 3	Flame color		
1= Not important		164	43.73
2= Less Important		137	36.53
3= Important		74	19.73
	Total	375	100.00

Table 2: Continued

Variables	Label	Frequency	%
The importance of burning duration measured on a scale from 1 to 3	Burning duration		
1= Not important		19	5.07
2= Less Important		110	29.33
3= Important		246	65.60
	Total	375	100.00
The importance of country of origin measured on a scale from 1 to 3	Country of Origin		
1= Not important		127	33.87
2= Less Important		106	28.27
3= Important		142	37.87
	Total	375	100.00
The primary source of buying firewood			
Stores of recreational supplies	Supplier	88	23.47
Supermarkets	Supermarket	49	13.07
Other sources (including traditional markets and street vendors)	Other sources	238	63.47
	Total	375	100.00
A proxy for familiarity with regulations asks if the consumer has seen environmental police efforts in the media	Familiarity with Regulations		
Yes		299	79.73
No		76	20.27

	Total	375	100.00
The supply method			
Strapped firewood	Strapped	188	50.13
Bagged firewood	Bagged	85	22.67
Full pick truck-load		102	27.20
	Total	375	100.00
Gender			
Male	Male	249	66.40
Female		126	33.60
	Total	375	100.00
Live in Riyadh province	Riyadh		
Yes		306	81.60
No		69	18.40
	Total	375	100.00
Age			
Age is between 18 to 40 years old		216	57.60
Age is 41 years old or above	Age ≥ 41	159	42.40
	Total	375	100.00
Household monthly income is SR18,000 (US$4800) or above	Income		
Yes		114	30.40
No		261	69.60
	Total	375	100.00
A college degree or above	Education		
Yes		294	78.40
No		81	21.60
	Total	375	100.00

Source: The authors' elaboration on the data collected

Hypothetical Scenario

A well-designed survey produces reliable information (Arrow et al., 1993), but the ban on local firewood could stimulate bias. A hypothetical scenario facing consumers to express their choices between imported and local logs may lead to biased results if responses are on the perception of amending the recently approved jurisdictions. To avoid the potential bias the hypothetical scenario could trigger, we leveraged the published government materials explaining the rationale for banning local firewood and encouraging the use of imported firewood. Doing so would rule out the expectation that the analysis is an ex-ante examination of regulations and align the analysis with our aim to provide policymakers with insights to encourage the use of imported firewood to reinforce the command and control approach.

After perusing the comparisons between local and imported firewood, participants were asked to answer a question on firewood consumption objectively while considering income and other consumption expenditures. The question was the following:

If you bought firewood with the availability of local and imported types at a price of SAR15 (US$4) per bundle, what type of firewood would you buy?[5]

Participants could select among three options: local, imported, or indifferent. We excluded indifferent consumers (98 observations) to center the analysis on those favoring local or imported firewood, which decreased the sample size to 375 observations.

3. Results and Discussion

3.1. Descriptive Statistics

Table 2 presents descriptive statistics of the variables in the analysis. The sample revealed that the number of consumers choosing local or imported firewood was almost the same. About the environmental attitudes measure, its average is equal to 5.41, suggesting positive attitudes toward the environment. Consumers exhibited a comparatively high ecological knowledge and familiarity with environmental regulations. Seventy-two percent of participants were considering that cutting down trees for firewood posed a risk to the environment. The proxy of environmental police suggested familiarity with firewood regulations, in which 80% of individuals noted that environmental police tried to prevent extracting, transporting, and selling local firewood.

Save for flame color; all the remaining firewood traits are crucial for consumers. The proportions of those choosing number 3 (important) on our 1 to 3 Likert scale concerning the importance of aroma, flame color, burning duration, and country of origin are 57.60%, 19.73%, 65.60%, and 37.87%, respectively. Twenty-four percent of consumers purchased logs from stores of recreational supplies, whereas 13% bought them from supermarkets. About demographics of the surveyed sample, 30% were high-income, 78% obtained a college degree or above, 66% were male, 42% were aged at least 41 years old, and 82% lived in Riyadh.

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[5] The SAR 15 price is an average of a sample of firewood bundles.

As suggested by the survey earlier, consumers' environmental attitudes and knowledge, and familiarity with regulations are real and addressable. Nevertheless, about 50% of consumers still choose local firewood over imported firewood, underlining this study's indispensability in evaluating the factors, affecting consumers' choices for imported firewood. These equal splits of preferences among imported and local firewood are also supporting the applicability of developed hypothetical scenario. With the restrictions on local firewood, consumers were selecting between imported firewood and local firewood.

3.2. Econometrics Results

Table 3 presents the Logistic regression model results. The model explained 32% of the variations (Nagelkerke R-square=0.322). The Nagelkerke R-square was calculated using the Stata command Spsot 13 of Long and Freese (2014). The model correctly predicted 71% of the probability values, and the overall model fit was statistically significant [$\chi^2(17)=103.65$, P 0.01].

Environmental attitudes $(P\ 0.01)$ and knowledge $(P\ 0.01)$ positively influenced the likelihood of choosing imported firewood. However, the importance of aroma $(P\ 0.05)$ and country of origin $(P\ 0.01)$ negatively affected the possibility of preferring imported firewood. Shopping from recreational supplies $(P\ 0.05)$ and supermarket stores $(P\ 0.05)$ positively increased the chance of selecting imported firewood. Instead of purchasing a full pickup truck-load of logs, buying bagged logs boosted the probability of preferring imported firewood $(P\ 0.01)$. Regarding demographics, education exerted a positive but marginal effect on choosing imported firewood $(P\ 0.1)$, while living in Riyadh reduced such likelihood $(P\ 0.05)$.

Column 3 in Table 3 reports the marginal effects at the means. Consumers are 8% more likely to select imported firewood given a unit increase in our measure of environmental attitudes. Environmentally knowledgeable consumers are 21% more likely to buy imported firewood. The chances of choosing imported firewood are likely to decrease by 11% and 16%, respectively and the importance of aroma and country of origin increase. Buying bagged logs is associated with 30% higher odds of selecting imported firewood than purchasing a full pickup truck-load of firewood. Individuals living in Riyadh are 18% less

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likely to buy imported firewood, while those with a college degree and beyond are 16% more likely to choose imported firewood.

The results are in line with our hypothesis. Environmental knowledge and attitudes boost the likelihood of buying imported firewood. These findings also agree with studies suggesting the consumption of environmentally friendly firewood. Palmieri et al. [18] (2020b) reported that ecologically conscious consumers were more likely to pay a higher premium for less polluting firewood. The message for the government as to encourage the use of imported firewood is thus increasing environmental awareness among consumers. [0] This would also require novel means to increase the efficacy of the educational efforts in stimulating the use of imported firewood. One example is leveraging the inconsistency between the high levels of ecological knowledge and imported firewood selection to induce cognitive dissonance that could potentially shift behavior toward saving the environment, by buying imported firewood (Dickerson et al., 1992).

The negative sign for the country of origin's coefficient shows the decreased probability of choosing imported firewood. One implication for the government to promote imported firewood is to establish the mentality to choose among different types of imported firewood, probably through mandating the provision of labels. Perhaps when brands inform about the export origin, it could form choices on the perception that local logs are no longer an option.

Table 3: Logistic Regression Results

The dependent variable is consumers' choices of firewood	Logistic Regression		
	Coefficients	P-values	Marginal Effects
	(1)	(2)	(3)
Environmental Attitudes	0.302	0.001	0.076
Knowledge	0.845	0.005	0.211
Recreational Purpose	0.258	0.368	0.064
Aroma	-0.444	0.023	-0.111
Flame	-0.144	0.417	-0.036
Burning Duration	0.157	0.468	0.039
Origin	-0.628	0.001	-0.157
Supplier	0.611	0.045	0.153
Supermarket	0.858	0.024	0.214
Familiarity with Regulations	-0.156	0.625	-0.039
Strapped	0.141	0.646	0.035
Bagged	1.189	0.001	0.297

Male	-0.379	0.159	-0.095
Riyadh	-0.733	0.027	-0.183
Age $\geq$ 41	0.212	0.400	0.053
High income	0.367	0.195	0.092
Education	0.639	0.051	0.159
Constant	-0.474	0.617	---

	Predicted Firewood Choice		
Imported	Imported	Local	Correctly classified
Local	130	56	69.89%
	54	135	71.43%
Overall			70.67%
N=375			
Nagelkerke R-square =0.322			

The aroma result suggests exciting implications. Although some attributes of imported firewood, such as burning duration, were better than those of local firewood, the aroma coefficient had a negative sign, reducing the likelihood of purchasing imported firewood. Consumers may not risk buying imported logs with unfamiliar aroma because the aroma attribute is not predetermined by physical sensations such as the attribute of dryness or by using labels. The solutions offered are through a market-based policy to compensate consumers for losing the aroma attributes or a marketing strategy to provide types of foreign firewood with similar aroma.

Obtaining firewood from the primary source presents the expected patterns. Purchasing from recreational supplies and supermarket stores positively increased the likelihood of choosing imported firewood compared to the reference group, comprising buying firewood from traditional firewood markets, street vendors, and others. Before the local firewood ban, the traditional markets and street vendors used to sell local firewood, essentially available in uneven and unorganized logs per unit. However, the imported firewood is mostly available in evenly put together pieces, enabling retailers to display them on their store shelves.

Instead of purchasing a full pickup truck-load of logs, buying bagged or strapped logs, though the latter is statistically insignificant, positively influenced the likelihood of imported firewood consumption. This result underlined the relevance of the supply method to stimulate the utilization of imported firewood. Likewise, using a multilevel Logistic regression model, Palmieri et al. (2020a) revealed that, the willingness to consume the eucalyptus firewood

analysis by consumers caring about the supply method were 2.2 times more likely to purchase eucalyptus logs.

The negative coefficient of living in Riyadh lacks a solid justification. Although preferring a region in deterring activities of illegal firewood could form an externality in displacing choices to other areas (Gonzalez-Navarro, 2013; Latham et al., 2017). This locational-based pattern of Riyadh is also worth scrutinizing to reduce any negative spillovers across different locations (Romanach and Frederiks, 2021).

The results are intuitive and robust among different specifications. Column 2 shows that the estimated coefficients from the Logistic regression model with their robust standard errors are almost identical to that of column 1. However, the coefficients for education and buying from recreational supplies became marginally significant at 10%.

This study is explanatory, and we are cautious about the generalization of our interpretations for two reasons. First, our data collection was during the prime time of the Covid19 pandemic. Second, we could not cross-validate the results with - previous research. As per our knowledge, our study was the first to center on the consumers' choices of local vs. imported firewood based on the new environmental rules in Saudi Arabia, giving insights to policymakers to encourage the use of imported firewood.

4. Conclusion

The study evaluated factors influencing consumers' choices of imported firewood, as environmental regulations in Saudi Arabia ban the extraction, transportation, promotion, and the sale of local firewood. The results discovered are that environmental attitudes and knowledge increased the likelihood of choosing imported firewood. Aroma and country of origin reduced the probability of selecting imported firewood. The primary source for purchasing firewood influences consumers' choices. Buying from supermarkets and recreational supplies stores influences the likelihood of choosing imported firewood. Moreover, the supply method in bagged logs positively affected the probability of selecting

imported firewood. Education boosted the likelihood of preferring imported firewood, while living in Riyadh exerted the opposite effect.

Although our study is exploratory, the results are still fruitful in fostering a better understanding of consumers' choices of firewood to design better and more effective measures and policies, considering the ban for local firewood. For example, the aroma negatively affected the choice of imported firewood. Thus, supplying imported logs having a similar aroma to local firewood might lead consumers to favor imported firewood. Increasing environmental knowledge among consumers results in shifting consumers' choices toward imported firewood.

The main caveat of our analysis is that the hypothetical scenario was developed based on the assumption of uniformity within imported and within local firewood types, while attributes vary from type to type among both imported and local firewood. Further research should detail the individual attributes of firewood logs by origin and type.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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