Article

Unchecked single-use persistence: Islamabad retailers' defiance of the plastic bag prohibition

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Abstract: Islamabad's 2019 ban on single-use plastic shopping bags aimed to reduce plastic waste, but compliance is limited. This study evaluates the effectiveness of the ban as well as other factors in curtailing plastic bag use in Islamabad. Regression modeling within a rational choice framework analyzed survey data from 406 retailers across 18 selected urban and rural markets. We found that the subjective belief that a fine was unlikely ($\beta = -16.10$; $t = -3.90$; $p < 0.001$), likely ($\beta = -24.99$; $t = -4.95$; $p < 0.001$), or very likely ($\beta = -43.84$; $t = -4.07$; $p < 0.001$) for selling bags versus very unlikely was significantly associated with lower usage. Additionally, older retailer age ($\beta = -0.25$; $p < 0.001$) and more education ($\beta = -0.77$; $p < 0.01$) were associated with lower plastic bag usage. Business registration ($\beta = -3.94$; $p < 0.10$) and trade membership ($\beta = -4.04$; $p < 0.05$) also decreased use. Rural location (zone II: $\beta = 13.28$; $p < 0.001$) and plastic bags stock availability ($\beta = 16.75$; $p < 0.001$) increased use. Awareness, viewing bags as "Good", unlikely fines and lack of substitutes lowered use. Results provide insights to inform more effective policies for reducing plastic waste.

Keywords: plastic bag ban; enforcement; retailer compliance; urban-rural differences; policy effectiveness

1. Introduction

Plastic pollution has become one of the most pressing environmental issues worldwide, with plastic waste estimated to cause billions of dollars in damage to marine ecosystems and losses to tourism and fisheries annually (MacArthur et al., 2016). A major contributor to plastic waste is single-use plastic bags, which grow exponentially, with trillions produced each year (UNEP, 2023a). Due to their lightweight nature and prevalence, plastic bags easily enter waterways and oceans, contributing significantly to the 8 million tons of plastic that flows into the seas each year (UNEP, 2023b). Single-use plastic bags, made from fossil fuels, contribute substantially to greenhouse gas emissions through their production, use, and disposal because the extraction, manufacture, and incineration or breakdown of the bags releases carbon dioxide and methane into the atmosphere, which are potent greenhouse gases that trap heat and cause climate change (Jankowska et al., 2022; Karimipour et al., 2019).

In response to the mounting plastic crisis, over 200 countries adopted a historic resolution at the 2017 UN Environment Assembly to eliminate plastic pollution in the oceans. More recently, in March 2022, the UN took the additional step of establishing a legally binding global instrument to end plastic pollution across oceans, rivers, and landscapes, demonstrating willingness for substantive action (UNEP, 2023a). At the national level, 127 countries have imposed bans, levies, or

other sanctions on the production and use of plastic shopping bags as a key strategy (Khan, 2023).

However, research suggests that plastic bag bans have frequently fallen short of their goals and proved ineffective, especially in the long term, largely due to poor enforcement and monitoring as well as public opposition (Bharadwaj et al., 2019). For instance, Nepal's ban in Kathmandu Valley in 1995 backfired within a year as plastic bag use returned to pre-ban levels. India's 2009 thin plastic bag ban also faded quickly and was undermined within 12 months. Similar challenges occurred in Bangladesh, where bans on plastic bag production and distribution have been regularly violated (Bharadwaj et al., 2019).

The lack of ban effectiveness highlights the critical need for improved enforcement and compliance mechanisms. While existing literature has identified strict enforcement as a key determinant of successful bans (Bharadwaj et al., 2019; Friesen, 2003), there has been limited measurement and analysis of specific enforcement approaches and their correlation to plastic waste reduction outcomes. Monitoring retail participation in reducing plastic bag distribution and evaluating the efficacy of oversight programs also remain understudied areas important for policy development (Bharadwaj et al., 2019). Therefore, assessing Pakistan's experience in enforcing bag bans can provide broader insights into policy options for enhancing enforcement to align outcomes with the significant global goals of curtailing plastic waste entering oceans.

This study aims to help address these gaps by examining the enforcement of and compliance with plastic bag bans in Pakistan, where single-use plastic consumption has continued despite bans in some jurisdictions (Jehangir et al., 2022). Specifically, this study quantitatively measures enforcement factors, including perceived punitive risks, frequency of inspections, and monetary fines, and relates these statistically to retailer compliance and plastic bag distribution. It analyzes these enforcement metrics alongside other potential influences on retailer behaviors, like awareness, attitudes, and bag availability, when predicting plastic bag usage. The findings can provide insights into designing oversight techniques to improve the enforcement and effectiveness of plastic bag bans. Additional research building on this study by further quantifying enforcement mechanisms and impacts can continue strengthening the evidence base in this important policy area.

2. Literature review

The effectiveness of regulatory measures such as bans, taxes, and mixed policies in reducing single-use plastic bags has been the subject of various studies. In China, the introduction of a nationwide regulation that required retailers to charge for plastic shopping bags resulted in a significant 49% reduction in the use of new bags (Schnurr et al., 2018). However, the impact varied among consumer groups, regions, and shopping occasions, indicating success can be influenced by local factors and attitudes (Schnurr et al., 2018). In Armenia, a controlled trial found financial bonuses were substantially more effective than environmental nudges in reducing disposable plastic bag purchase, regardless of reusable bag presence (He, 2012). A systematic review revealed regulations based solely on bag thickness do

not reduce consumption, while bans and taxes significantly reduce use, with taxes being the most effective (Adeyanju et al., 2021). The review highlighted the importance of public policy in influencing attitudes and behaviors toward climate-friendly options, although the effects may be short-lived (Adeyanju et al., 2021). Studies of international legislative strategies reported effectiveness ranging from 33-96% in reducing bag use (Xanthos and Walker, 2017), emphasizing the need for multi-jurisdictional interventions and policy effectiveness evaluations (Xanthos and Walker, 2017).

While these studies have provided important insights into the impacts of different policy options for reducing plastic bags, there remains a significant gap in research focused specifically on quantitatively evaluating enforcement approaches for plastic bag bans and relating the strength of enforcement to outcomes. Prior qualitative work has highlighted enforcement and oversight as critical factors influencing the success of bag bans (Bharadwaj et al., 2019; Friesen, 2003). However, there is limited quantitative analysis of the relationship between specific enforcement mechanisms, such as the intensity of monitoring and penalties, and reductions in plastic bag usage.

For instance, Bharadwaj et al. (2019) noted the importance of the perceived likelihood of punishment in enforcing bans, emphasizing municipalities' capacity for oversight and sanctions. However, no known studies have quantitatively measured factors like inspection rates or fines and examined how these correlate statistically with decreased retail distribution of bags. While strict enforcement is frequently cited as essential for effective bans (Bharadwaj et al., 2019; Friesen, 2003), minimal research has quantified enforcement actions through metrics like citations issued and connected this numerically to decreases in plastic waste.

A few studies have analyzed predictors of retailer participation in reducing plastic bags, though not with a focus on enforcement. Bharadwaj et al. (2019) found older, registered, and more educated retailers were more compliant, alongside location and social norms. However, they did not include quantitative measurement of enforcement. There remains a lack of research quantitatively connecting enforcement approaches, including perceived risks of penalties, monitoring intensity, and actual fines, with plastic bag usage behaviors and waste reductions.

While bans have been frequently adopted, their success depends heavily on enforcement, which has been understudied. For example, within the U.S., California was the first state to implement a statewide ban on single-use plastic bags in 2016. However, data suggests usage reductions have been modest and varied based on monitoring, indicating a need for improved enforcement (Wagner, 2017). In contrast, stricter bans in cities like San Jose that prohibit bags at checkout entirely have shown significant effectiveness, pointing to enforcement strength's importance (Wagner, 2017). Studies in countries like South Africa have similarly found highly variable results from plastic bag bans depending on the locality and enforcement (Dikgang and Visser, 2012). Comparing enforcement approaches in countries with more versus less effective policies could provide useful insights.

Beyond bans, taxes and charges have also been widely adopted but depend on enforcement to ensure retailer participation. For instance, charges introduced in England led to an 85% reduction in use (Rivers et al., 2017). However, data found

avoidance was still substantial in smaller stores, highlighting the need for consistent monitoring and penalties regardless of business size to maximize compliance (Rivers et al., 2017). Understanding real-world enforcement gaps can help target improved oversight. Further, research on how pricing levels correlate quantitatively with enforcement approaches and usage declines could inform effective tax designs.

There are also opportunities to expand the study of enforcement for bans beyond retailers to producers and distributors. Much research focuses on retailer compliance, but oversight further up the supply chain also plays a critical role in restricting supply and availability. One study in Greece found targeting enforcement at plastic bag importers rather than end retailers improved the reduction impacts of a ban (Elliott et al., 2020). Quantitative analysis of factory inspections, import monitoring, and penalties could provide insights into strengthening enforcement across the full production and distribution system. While existing research provides a foundation, quantitative studies focused specifically on measuring enforcement approaches for plastic bag policies and connecting these statistically to usage reductions are still lacking. This study helps address these evidence gaps.

3. Methods

3.1. Study area and data collection

The study was undertaken in the Pakistani capital city, Islamabad, Pakistan's most diverse and planned city. The Federal Ministry of Climate Change has banned single-use plastic shopping bags in Islamabad since August 2019. Although few other cities are also subject to the ban in Pakistan, Islamabad may be the right starting point with regard to the maximum probability of success of plastic bag management policies. The reason is that capital cities are generally pivotal in addressing regional and global environmental issues due to their urbanization processes and activities that have impacts beyond their boundaries, necessitating the integration of environmental concerns into urban policy and governance (Bengston et al., 2004). Therefore, we selected Islamabad for the study. The city's population is 2 million (PBS, 2017). Islamabad has five zones (Capital Development Authority, Islamabad, 2017). Zone I and zone II comprise urban areas, whereas zones IV and V are rural areas. Zone III comprises Margalla Hills National Park (**Figure 1**).
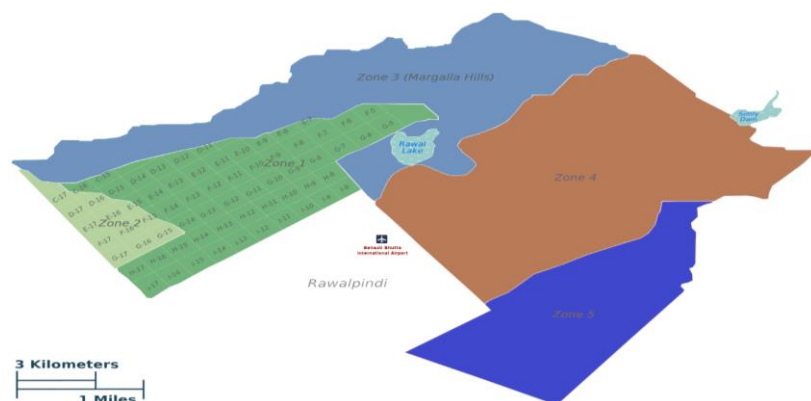

Figure 1. Islamabad capital territory map.

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We surveyed 18 markets from both urban and rural markets to observe the effectiveness of the plastic bag ban policy. The urban area of Islamabad is divided into small sectors. Each sector has a significant commercial center, commonly known as Markaz. The people of respective sectors usually buy their groceries and other necessities from these "marakiz". The rural area of Islamabad is divided into villages and small towns, and typically, each town has its market where people purchase goods for daily use. We collected urban and rural area market data from the Islamabad Capital Authority (CDA). To ensure population representation from every zone, we short-listed markets by zone. We then started the randomization process to select the desired data. Therefore, using the "=RAND ()" command in Excel Spreadsheet, 11 markets from urban areas and seven markets from rural areas were randomly selected for the study. After selecting the markets, 15 to 30 retail shops were purposively selected for data collection from each market based on the market size.

3.2. Conceptual framework

The economic theory of crime explains that an individual would choose to commit a crime if the net expected gains from committing the crime are more than the subjective expectations about the probability of punishment (Becker, 1968). For example, if an individual commits a criminal act, he gets some benefits from it but also faces a risk of being caught, held accountable, and sanctioned. The penalty may be a fine, imprisonment, or a combination. The calculation of expected utility from the act determines whether a person chooses to take a harmful action. The person will act if it increases the potential gains he derives from the act compared to the likelihood of being caught and sanctioned.

We followed the rational choice model of crime as a conceptual framework in this study. The framework posits that plastic bag compliance behavior may be determined by the probability of being caught and the penalty amount (Bharadwaj et al., 2020). The fine for breach of plastic bag regulations will work effectively only if there is sufficient monitoring to make the probability of being caught high. With the increased subjective probability of being caught, the offender's chances of being caught and fined will increase (Bharadwaj et al., 2020). If the environmental regulatory body fails to implement its policy of banning or imposing a fine on the violator, the subjective expected fine will equal zero. Given the above reasoning, we expect that as the probability of being caught and fined increases, the use of plastic bags decreases.

The rational choice model also suggests that the choice of committing a crime is also affected by other factors. For example, many people may not choose to commit a crime even if net expected gains from the crime are more significant than the subjective expectations about the probability of punishment because of high moral value. They may be making a rational choice as they may still feel better (their utility is higher) than the expected gains from committing the crime. So, the rational choice framework can be easily extended to incorporate other relevant personal and social factors (Becker, 1968). The rational choice framework posits that plastic bag compliance behavior may also be determined by environmental awareness, market

characteristics, and personal and social factors.

Given the above, we expect that the retailer's demographic and market-related characteristics are strongly correlated with their plastic bag distribution behavior. Additionally, we also anticipate that awareness and acceptance of the plastic bag ban, social involvement, availability of plastic bags, and the perceived risk of penalties contribute significantly to variations in retailers' plastic bag distribution practices.

3.3. Estimation methods

To identify the key factors influencing plastic bag use, we employed a multiple regression model with quantity of plastic bags used Q_{PB} as the dependent variable and several explanatory variables related to retailer demographics, shop characteristics, and awareness. Since the dependent variable is continuous, multiple linear regression is used to investigate the effect of the interventions. The following econometric model will be estimated:

$$Q_{\mathrm{PB}} = \beta_0 + \beta_1 P_{\mathrm{fine}} + \beta_2 Age + \beta_3 M_{\mathrm{income}} + \beta_4 Edu + \beta_5 T_{\mathrm{shop}} + \beta_6 T_{\mathrm{goods}} + \beta_7 N_{\mathrm{retail}} + \beta_8 L_{\mathrm{awareness}} + \epsilon$$

where Q_{PB} represents the quantity of plastic bag use, β_0 is the intercept, $\beta_1, \beta_2, \ldots, \beta_8$ are the coefficients for the respective variables, indicating how much the dependent variable changes with a one-unit change in each independent variable. P_{fine} is the probability of getting fined. Age is the age of the retailer or respondent. M_{income} is the monthly income. Edu stands for the level of education. T_{shop} represents the type of shop. T_{goods} denotes the type of goods sold. N_{retail} is the nature of the retail (e.g., small, medium, large). $L_{\mathrm{awareness}}$ measures the level of awareness about plastic bag use and its impact. ϵ is the error term, capturing all other factors that influence the quantity of plastic bag use but are not included in the model.

4. Results

4.1. Descriptive statistics

The summary statistics of the distribution of variables across different categories reveal insightful trends about retailers' demographic and market-related characteristics, acceptance and awareness of the ban on plastic bags, social involvement, bags availability, and the effectiveness of the ban (**Table 1**).

In terms of retailers' characteristics, the majority (51.90%) are classified as medium-sized, followed by small (26.33%) and large (21.77%) retailers. A significant majority (77.22%) have their business registered with relevant authorities, with only a small fraction (18.73%) not registered. The shop locations are predominantly in the Markaz area (73.67%), with the remaining 26.33% in other locations. Urban areas dominate the zone distribution, with 61.01% in zone I (urban) and smaller percentages in zones II (urban) at 6.58%, IV (rural) at 15.44%, and V (rural) at 16.96%.

Awareness and acceptance of the plastic bag ban are high, with 97.47% knowing that plastic bags are unsuitable and 97.22% aware of the ban. The majority view the ban positively (93.92%), yet a vast majority (97.72%) find it hard to

comply with the ban. Compliance is reflected in the fact that 71.39% have never been caught providing a plastic bag, and of those who have, 83.04% did not pay a fine.

Table 1. Summary statistics of different correlates of plastic bag usage.

Variable	Category	Percent
Retailers' demographic and market-related characteristics		
Nature of retail (our imputation)	Small	26.33
	Medium	51.90
	Large	21.77
Is your business registered with the relevant authority?	No	18.73
	Yes	77.22
	Don't know	4.05
Location of the shop	Markaz	73.67
	Other	26.33
Zone	I (Urban)	61.01
	II (Urban)	6.58
	IV (Rural)	15.44
	V (Rural)	16.96
Acceptance and awareness of the ban on plastic bags in ICT		
Do you know that plastic bag is not suitable for environment?	No	2.53
	Yes	97.47
Do you know that plastic bags are banned now?	No	2.78
	Yes	97.22
How do you see the ban on plastic bags?	Bad	6.08
	Good	93.92
Is it hard to comply with the ban?	No	2.28
	Yes	97.72
Have you ever been caught providing a plastic bag?	No	71.39
	Yes	28.61
Did you pay a fine?	No	83.04
	Yes	16.96
Social involvement		
Are you a member of a trade union/trade body?	No	67.09
	Yes	32.91
Did PAK-EPA (government) consult you before/after ban?	No	89.37
	Yes	10.63
Do you feel that there is a need for a plastic bag ban?	No	13.67
	Yes	86.33

Table 1. (*Continued*).

Variable	Category	Percent	
Bags availability			
Plastic bag is available to buy in stock?	No	20.25	
	Yes	79.75	
Is PB supplied at your shop?	No	33.16	
	Yes	66.84	
Are PB substitutes easily available?	No	70.63	
	Yes	29.37	
Do you provide reusable bags to consumers?	No	87.59	
	Yes	12.41	
Effectiveness of ban			
	Very unlikely	30.89	
	Unlikely	43.54	
	Neutral	1.27	
What is the probability that you would be caught?	Likely	20.76	
	Very likely	3.29	
	Don't know	0.25	
	Very unlikely	31.14	
	Unlikely	49.62	
	Neutral	1.27	
What is the probability that you would be fined?	Likely	14.68	
	Very likely	3.04	
	Don't know	0.25	

Regarding social involvement, a significant number of retailers (67.09%) are not members of a trade union or trade body, and a large majority (89.37%) reported no consultation from the PAK-EPA (government) regarding the ban. However, there is strong support for the need for a plastic bag ban (86.33%). For bags availability, 79.75% of retailers have plastic bags available to buy in stock, with 66.84% supplying them in their shops. However, substitutes for plastic bags are not easily available, as indicated by 70.63% of the retailers. A large majority (87.59%) do not provide reusable bags to consumers. Finally, in terms of the effectiveness of the ban, perceptions of being caught or fined are low, with 30.89% seeing it as 'very unlikely' and 43.54% as 'unlikely' that they would be caught. Similarly, 31.14% and 49.62% see it as 'very unlikely' and 'unlikely', respectively, that they would be fined.

These statistics collectively suggest a scenario where there is high awareness and nominal support for the plastic bag ban among retailers, but challenges in compliance and availability of alternatives, coupled with a low perceived risk of enforcement, are notable.

4.2. Regression analysis

Table 2 shows the results of 6 regression models examining factors associated

with the percentage of customers given plastic bags by retailers. Model 1 looks at just retailer characteristics like age, size, registration status, education, location, and zone. Model 2 examines retailers' awareness and acceptance of the plastic bag ban. Model 3 looks at retailers' social involvement. Model 4 focuses on plastic bag availability factors. Model 5 examines the probability of being caught or fined for defying the ban. Finally, model 6 includes all factors from the previous models to analyze the association of all factors together with the outcome.

Table 2. Regression analysis.

Outcome variable:	(1)	(2)	(3)	(4)	(5)	(6)
Share of customers given plastic bags by retailers (%)	β	β	β	β	β	β
Retailers' demographic and market-related characteristics						
Age	−0.26**					−0.25***
	(−2.76)					(−3.78)
Retail size (Ref. Small)						
Medium	−1.70					
	(−0.67)					
Large	−4.24					
	(−1.36)					
Business registered? (Ref. No)						
Yes	−8.87**					−3.94+
	(−3.11)					(−1.94)
Don't know	−20.96***					−10.77**
	(−3.60)					(−2.62)
Education (years)	−1.42***					−0.77**
	(−4.29)					(−3.28)
Shop location (Ref. Markaz)						
Other	4.73					
	(1.27)					
Zone (Ref. Urban (I))						
II (Urban)	24.75***					13.28***
	(5.74)					(4.29)
IV (Rural)	22.79***					14.50***
	(6.19)					(6.48)
V (Rural)	17.94***					11.59***
	(3.97)					(5.10)
Acceptance and awareness of the ban on plastic bags in ICT						
Do you know PB not suitable? (Ref. No)						
Yes		−11.62				
		(−1.51)				
Do you know PB banned in ICT? (Ref. No)						
Yes		−13.36+				
		(−1.82)				

Table 2. (*Continued*).

Outcome variable:	(1)	(2)	(3)	(4)	(5)	(6)
Your opinion about PB (Ref. Bad)						
Good		−17.48***				
		(−3.51)				
Compliance with ban is hard? (Ref. No)						
Yes		62.51***				32.02***
		(7.86)				(6.41)
Ever caught defying PB ban? (Ref. No)						
Yes		−9.76**				−3.48*
		(−3.14)				(−2.01)
Ever fined defying PB ban? (Ref. No)						
Yes		−6.40+				
		(−1.71)				
Social involvement						
Member of trade body? (Ref. No)						
Yes			−17.50***			−4.04*
			(−6.45)			(−2.31)
Did PAK-EPA consult you about PB ban (Ref. No)						
Yes			−12.79**			
			(−3.17)			
Do you think PB ban is needed? (Ref. No)						
Yes			−17.23***			
			(−4.86)			
Bags availability						
PB can be bought from stock? (Ref. No)						
Yes				16.41*		16.75***
				(2.44)		(7.39)
PB supplied at shop? (Ref. No)						
Yes				19.80**		17.56***
				(2.75)		(8.31)
PB substitute available? (Ref. No)						
Yes				−10.52+		−6.58***
				(−1.76)		(−4.12)
Do you give reusable bags? (Ref. No)						
Yes				−33.85***		
				(−5.43)		
Price of reusable bag per KG (PKR)				0.04*		
				(2.30)		
Charged customer per reusable bag (PKR)				−0.14		
				(−0.45)		

Table 2. (*Continued*).

Outcome variable:	(1)	(2)	(3)	(4)	(5)	(6)
Effectiveness of ban						
Probability of being caught for selling PB (Ref. V. Unlikely)						
Unlikely					2.67	
					(0.63)	
Neutral					−3.07	
					(−0.22)	
Likely					−3.64	
					(−0.79)	
Very likely					13.04	
					(1.26)	
Don't know					7.22	
					(0.29)	
Probability of being fined for selling PB (Ref. V. Unlikely)						
Unlikely					−16.10***	
					(−3.90)	
Neutral					−27.47+	
					(−1.92)	
Likely					−24.99***	
					(−4.95)	
Very likely					−43.84***	
					(−4.07)	
Don't know					0.00	
					(.)	
Constant	104.00***	63.78***	102.24***	37.62*	92.78***	43.22***
	(18.77)	(4.85)	(31.68)	(2.68)	(39.04)	(7.17)
N	395.00	395.00	395.00	43.00	395.00	395.00
R^2	0.44	0.24	0.23	0.80	0.15	0.73
F	30.41	20.02	37.93	24.36	7.82	79.55
p	0.00	0.00	0.00	0.00	0.00	0.00

t statistics in parentheses; $+ p < 0.10$, $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$.

Model 1 examined demographic and market-related retailer characteristics. Older retailer age ($\beta = -0.26$; $t = -2.76$; $p < 0.01$) and more years of education ($\beta = -1.42$; $t = -4.29$; $p < 0.001$) were significantly associated with lower percentages of customers receiving plastic bags. Being a registered business ($\beta = -8.87$; $t = -3.11$; $p < 0.01$) and rural locations (zone II: $\beta = 24.75$; $t = 5.74$; $p < 0.001$; zone IV: $\beta = 22.79$; $t = 6.19$; $p < 0.001$; zone V: $\beta = 17.94$; $t = 3.97$; $p < 0.001$) compared to unregistered businesses and urban locations were associated with significantly higher percentages.

Model 2 focused on retailer awareness and acceptance. Retailers who viewed plastic bags as "Good" ($\beta = -17.48$; $t = -3.51$; $p < 0.001$) and those aware of the ban in Islamabad ($\beta = -13.36$; $t = -1.82$; $p < 0.10$) gave significantly fewer bags compared to those who viewed them as "Bad" and weren't aware. Retailers who said

complying was hard ($\beta = 62.51$; $t = 7.86$; $p < 0.001$) gave significantly more bags. Model 3 examined retailers' social involvement. Being a member of a trade body ($\beta = -17.50$; $t = -6.45$; $p < 0.001$) and being consulted about the ban ($\beta = -12.79$; $t = -3.17$; $p < 0.01$) were significantly associated with lower plastic bag use.

Model 4 looked at plastic bag availability. Having bags that could be bought from stock ($\beta = 16.41$; $t = 2.44$; $p < 0.05$) and supplied at the shop ($\beta = 19.80$; $t = 2.75$; $p < 0.01$) were positively and significantly associated while having substitutes available ($\beta = -10.52$; $t = -1.76$; $p < 0.10$) was negatively associated with usage. Model 5 analyzed enforcement factors. Believing a fine was unlikely ($\beta = -16.10$; $t = -3.90$; $p < 0.001$), likely ($\beta = -24.99$; $t = -4.95$; $p < 0.001$), or very likely ($\beta = -43.84$; $t = -4.07$; $p < 0.001$) for selling bags versus very unlikely was significantly associated with lower usage.

Finally, model 6 combined all factors. Older retailer age ($\beta = -0.25$; $t = -3.78$; $p < 0.001$), more education ($\beta = -0.77$; $t = -3.28$; $p < 0.01$), business registration ($\beta = -3.94$; $t = -1.94$; $p < 0.10$), and trade membership ($\beta = -4.04$; $t = -2.31$; $p < 0.05$) remained significant and in the same direction. Rural location (zone II: $\beta = 13.28$; $t = 4.29$; $p < 0.001$) and stock availability ($\beta = 16.75$; $t = 7.39$; $p < 0.001$) also stayed significant. The model explained 73% of the variation ($R^2 = 0.73$; $F = 79.55$; $p < 0.001$).

5. Discussion

The findings of this study suggest that the ban was ineffective in preventing retailers from reducing plastic bag consumption in Islamabad. Given the Pakistan Environmental Protection Agency's (Pak-EPA) deficient administrative capacity, limited monitoring, the lengthy legal procedure for imposing fines for noncompliance, and the large number of retailers in the jurisdiction, there was little chance that the ban was effective. The ineffectiveness of the ban phenomenon is also observed in other cities around the world. For example, Macintosh et al. (2020) presented the results of a study on the impact of the ban on single-use plastic bags introduced in the Australian Capital Territory in 2011. The study assessed whether the ban reduced the consumption of plastic bags and litter and whether there was public support for the ban was sustainable. The result shows that the ban was not particularly effective in reducing the consumption of plastic bags or rubbish. Similar results are found in other developing countries, such as India and Nepal (Bharadwaj et al., 2019; Gupta, 2011).

Bharadwaj et al. (2019) identified perceived punishment or expectation of fines as a critical determinant of plastic bag use. They showed that the likelihood of detection played a significant role in the effectiveness of ban enforcement. We now turn to a specific law enforcement measure, namely the likelihood of detection and the amount of expected fines violators will pay if discovered. Our results show that as retailers' probability of getting caught increases, the use of plastic bags decreases, and that of reusable increases. For instance, if retailers perceive the probability of getting caught as "likely," they tend to reduce their distribution of plastic bags by 3.64 percentage points. A surge is observed for those who are "very likely" to be caught or are uncertain ("don't know"), increasing the share by 13.04 and 7.22

percentage points, respectively, with both effects being statistically significant. Turning to the perceived sanction by a retailer, the results suggest that the perceived probability of being fined significantly discourages the use of plastic bags and promotes reusable bags.

Bharadwaj et al. (2019) used the size of city police as a proxy for the probability of being caught. They noted that the per capita size of the police in a municipality is strongly correlated with the use of plastic bags. Interestingly, they found that the probability of being monitored and caught for retailers plays a much more critical role than the amount of the fine for violating the ban. Hence, they found that it is not so much the amount of fine that matters but the presence of ban enforcement personnel (city police). In contrast to Bharadwaj et al. (2019), our result suggests that the probability of being sanctioned is more intensely (in magnitude) associated with discouraging the use of plastic bags. The result does not undermine the role of monitoring and detection. Of course, the probability of sanction has no meaning without the probability of detection. Further, an association of compliance with the probability of detection is consistent and sizeable across the probability of detection categories. Hence, unlike common belief which states that regular and effective monitoring mechanisms and stringent enforcement should be in place to ensure compliance with the ban, our results imply that it is not actual monitoring and stringent enforcement that matters to deter retailers from distributing plastic bags rather the perceived probability of detection and perceived probability of sanction.

However, in our sample, the average perceived probability of detection and perceived probability of sanction is 20% and 15%, respectively. Therefore, increasing the perceived probability of detection and the perceived probability of sanction can significantly drop plastic bag use in Islamabad. However, for this to happen, more strict monitoring and enforcement is needed, which seems very difficult with the current level of the PAK-EPA staff for monitoring and enforcement. Hiring more staff for monitoring and enforcement incurs huge fixed and recurrent costs. Further, the implementation of the monitoring and enforcement is also costly. The limited budget of the PAK-EPA explains its inability to maintain ban enforcement. The PAK-EPA could explore collaborative opportunities with environmental NGOs, community groups, media outlets, and social media influencers to raise awareness of environmental regulations and inspire voluntary compliance.

Engaging Trade unions can potentially increase the effectiveness of the plastic bag ban. The analysis in model 3 indicated that when a retailer is a member of a trade body, the share of customers receiving plastic bags decreases by 17.5 percentage points ($p < 0.001$) compared to those who are not members, indicating a robust negative association and suggesting that membership in trade bodies might be instrumental in promoting adherence to the ban. This result may explain that trade unions can play a supportive role in implementing the plastic bag ban. The PAK-EPA should collaborate with trade unions to make this initiative successful. The engagement can also highlight the retailers' concerns and help policymakers ensure regulations are fair and consider the retailers' concerns.

The trade union platform can also be used to increase awareness among retailers. The unions can encourage their members and other retailers to comply with

the ban by increasing awareness about the environmental impact of plastic bags and the reasons behind the ban. It is corroborated by the results where we found that the retailers who believe that a plastic bag ban is necessary to reduce waste and impact on the environment demonstrate a decrease in dispersing plastic bags to their customers compared to those who do not perceive the ban as necessary. This result emphasizes that engagement with trade unions is also essential for advocacy purposes and seeking support from the trade bodies to implement the ban effectively.

Apart from engaging trade bodies, policymakers also need to engage communities, NGOs, and the public to raise awareness about the environmental impact of plastic bag use. Increasing awareness about the environmental impact of plastic bag use can contribute significantly to the ban's success. The result of the study shows that the education of retailers can contribute significantly to compliance with the ban. Therefore, it is suggested that PAK-EPA and relevant institutions run awareness campaigns (preferably using local languages, social media, and other communication methods to educate retailers (and, more broadly, the residents) about the environmental impact of plastic bags and the benefits of the ban.

Two more results warrant attention: The nature of the business (registered and unregistered) and the region of the market (rural and urban). The result shows that implementing the ban in rural and urban markets should follow a tailored approach by considering the unique challenges and characteristics of these regions and the nature of the business. The policymakers must ensure that regulations accommodate the specific needs and circumstances of rural areas and the nature of the businesses; factors like limited access to recycling facilities, affordable alternatives, and population and density of business should be considered.

In conclusion, our findings indicate that Islamabad's 2019 plastic bag ban is not particularly effective in reducing the use of plastic bags and needs to be designed and implemented more carefully. As plastic bag bans are ineffective, another policy tool in this regard would be to implement a plastic levy on the use of plastic bags in retail outlets, as in Ireland and the UK (Convery et al., 2007; Rivers et al., 2017). However, the largely unregistered (informal) and regulated nature of Pakistan's retail sector presents a particular challenge to such a policy. In addition, there are challenges related to resistance and lack of cooperation from retailers to such a policy. Alternatively, as suggested in this study, the PAK-EPA could develop innovative monitoring strategies to enforce the ban. Such strategies could include involving trade groups and local stakeholders in decision-making to ensure they understand and support the ban.

6. Conclusion

Retailers are significant players in reducing plastic bag use, and understanding their decision factors would go a long way toward a better-designed policy. The present study analyzes retailers' participation level in the plastic bag ban policy in Islamabad Capital Territory (ICT) to reduce the sale of plastic bags. Mainly, we were interested in examining the effect of monitoring and enforcement on the level of compliance with the ban. The result shows that the ban was not particularly effective in reducing the consumption of plastic bags. The ban found no support from most

retailers, monitoring and enforcement were insufficient to deter retailers from dispersing plastic bags, and the location of the retailers and the informal and unregulated nature of the businesses were crucial factors for the limited success of the ban.

The findings suggest banning single-use plastic bags is not enough to change behavior. Instead, the success of a plastic bag ban would depend on the high probability of detection and imposition of fines, which in turn depends on the deployment of physical and financial resources (Bharadwaj et al., 2019). In addition, the ban's success also depends on communication to raise awareness and collaboration with trade bodies to seek support from the retailers for the ban. These results are helpful for policymakers to implement the ban more effectively. Further research building on this work can support the development of oversight programs and enforcement techniques to maximize the effectiveness of bans, taxes, and other measures in mitigating plastic pollution.

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