



Muslim's mega-event pilgrimage in Mina, city of Makkah, Saudi Arabia: Hajj's pilgrims recycling intention and behaviour

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School of Civil Engineering

Core research institutes



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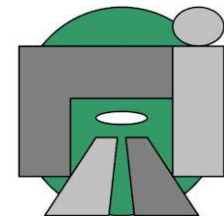


Pathogen Control
Engineering
Institute



water@
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iRI-Institute for
Resilient
Infrastructure



Other research Institutes / entities with SWM and resource efficiency portfolios



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ERI

Energy Research Institute



CIER

Centre for Integrated Energy Research



SRI

Sustainability Research Institute

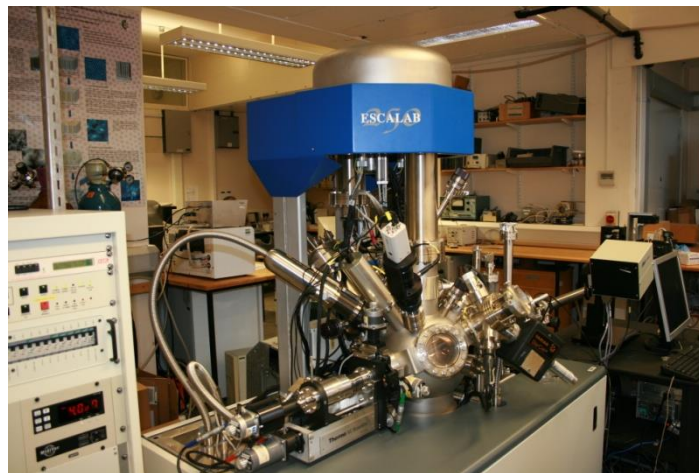
Energy Resources Institute - Experimental facilities



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- Thermal conversion of biomass
- Small scale laboratory rigs
- Large analytical laboratory
- Water analysis
- Environmental analysis



A preview...



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Hajj: A mega event for Muslims around the world



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- Hajj: world's biggest pilgrimage event for Muslims
- Annually in Makkah city, Saudi Arabia
- 2011 pilgrims: 2.8 million legal + about 1 million illegal
- Pilgrims from 181 countries
- Seven Twafah Companies serve the pilgrims

Mina: main place in Hajj



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Part of Mina camps



Mina: is massive...



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723 camps

**Each camp has
a different
number of tents
(6m² - 96m²)**

+ toilets

+ kitchen

**+ waste
compactor box
(8 tonnes)**

Pilgrims...



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And their waste....



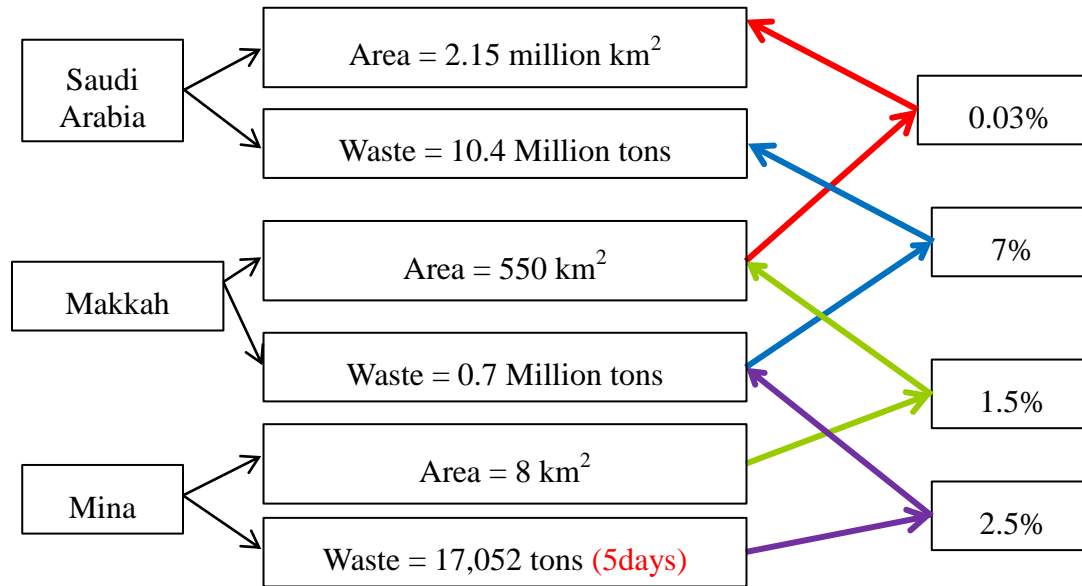
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Solid waste management in Mina



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Residual from the distribution of charity meals

Compactor Box

Camp waste disposed of in street

Solid waste Management in Mina



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Present Mina waste management in Mina

Mina camps waste

Camp cleaners collect waste

They dispose collected waste in camp bins

They collect waste bags from camp bins

Dispose of all bags (or part of them) in the camp compactor box

Throw bags (or part of them) in the street (illegal)

Mina Streets Waste

Municipality cleaners sweep streets

They collect the swept waste in big bags and gathered them in a pile

They collect the bags in platform trolley

Municipality cleaners dispose collected bags into street compactor boxes or underground storage boxes (50 tons)

Transfer all waste from Mina to the landfill after the end of the Hajj event
(collected waste in 2011 = 17,000 tons generated in five days)

Aim: Study pilgrims' recycling behaviour



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Recycling behaviour

**Pilgrims' recycling
intention**

**Pilgrims' actual
recycling behaviour**

**Pilgrims'
questionnaire:
Use Multinomial
Logistic Regressions**

**Exemplar project:
optional sorting
project**

Methodology: Pilgrims' intentions (by questionnaire)



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Two cases: “**optional**” vs. “**compulsory**” recycling scheme

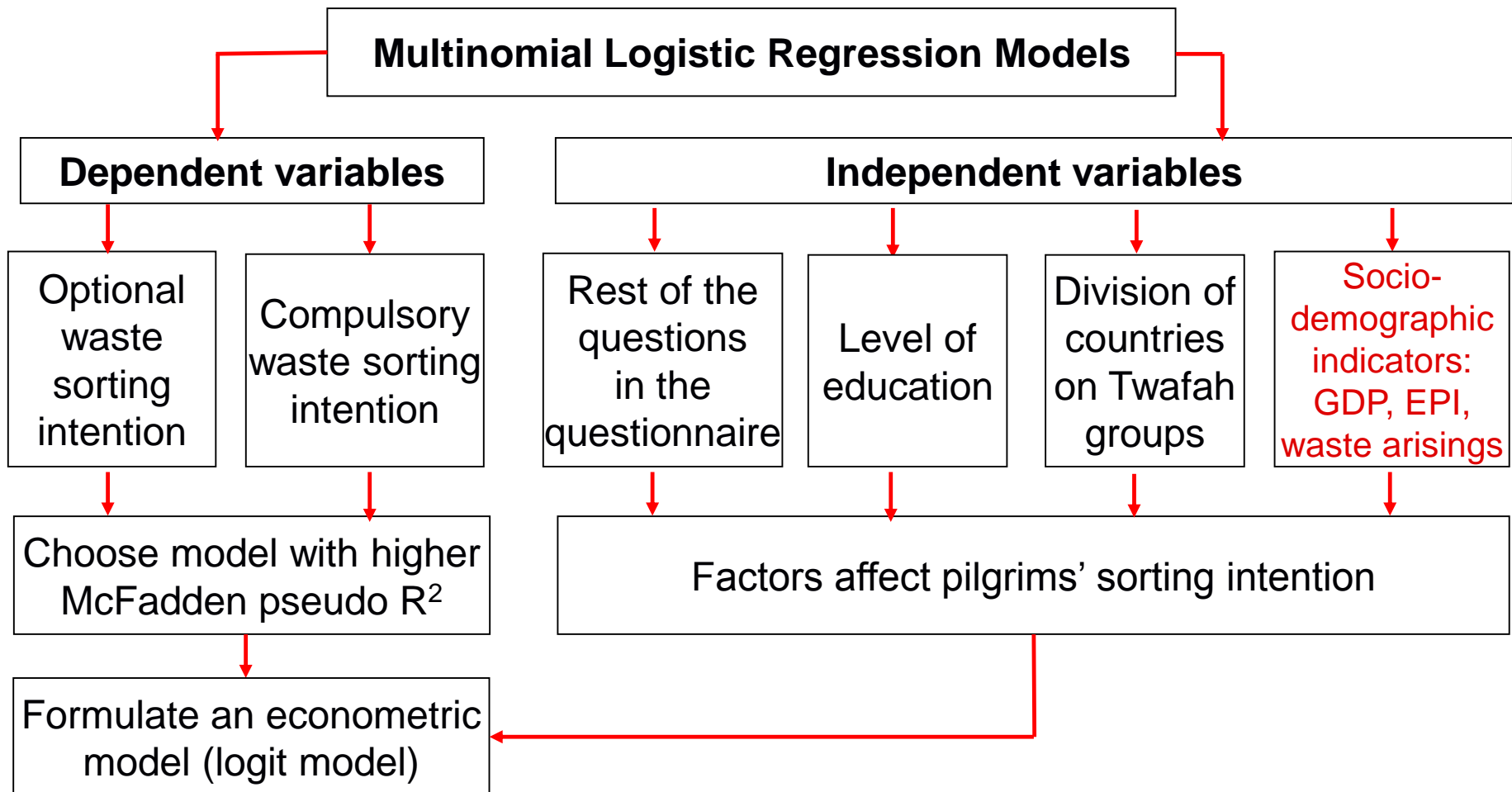
Education level	No degree	School degree	Bachelor Degree	Post-graduate degree
What is your nationality			
Questions	Answers			
	1	2	3	4
1- Do you eat in your Mina camp?	Always	Sometimes	Rarely	
2- From where do you get your food?	From the camp catering	I buy it from outside the camp	Both	
3- Did you hear anything about waste sorting and recycling?	Yes	No		
4- After you read the definitions, do you think you can sort your solid waste?	Yes	No		
5- Do you sort your solid waste at your home in your country?	Yes	No		
6-1 If it is optional, Do you think you will sort your solid waste in your camp during Hajj in Mina?	Yes	Maybe	No	
6-2 If it is compulsory, Do you think you will sort your solid waste in your camp during Hajj in Mina?	Yes	Maybe	No	
7- Are you satisfied about the level of cleanliness in Mina steers during Hajj?	Very unsatisfied	Unsatisfied	Satisfied	Very satisfied
8- Are you satisfied about the level of cleanliness in your Mina camp during Hajj?	Very unsatisfied	Unsatisfied	Satisfied	Very satisfied

Multinomial logistic regression



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Formulated two models: (1) optional and (2) compulsory sorting



Model for pilgrims' intention



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An Econometric Model (logit model) was formulated for the chosen model

$$P_i = \frac{1}{1 + e^{-Z_i}}$$

Where P_i : represents the probability of pilgrims' positive sorting intention

$$Z_i = \beta_1 + \beta_2 X_i$$

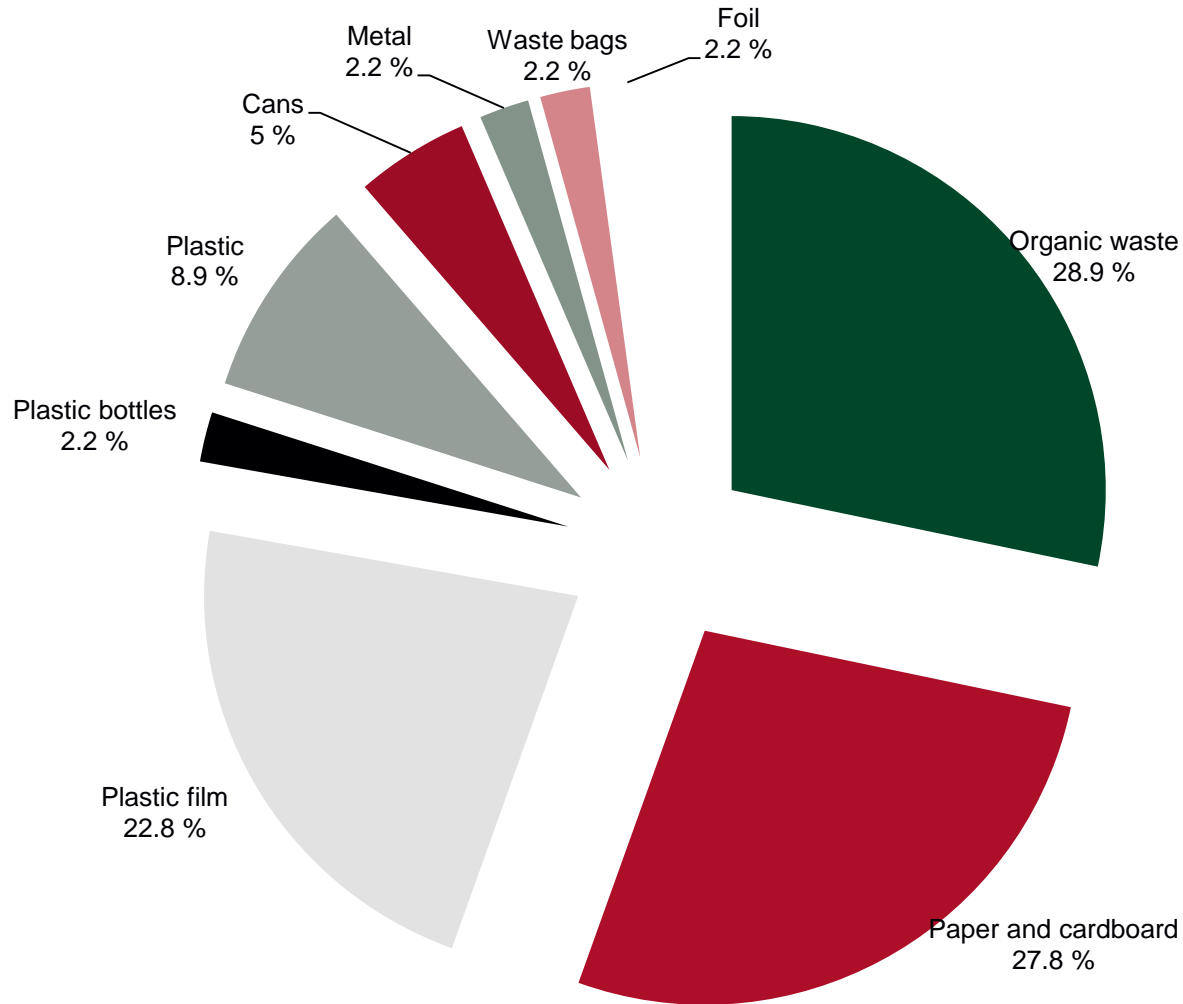
β_1 = the intercept

β_2 = slope coefficients (the value of the variable effect based on the reference point)

Mina's camps waste composition: e.g. “western” camps



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Recycling exemplar / intervention project



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- Plastic was chosen to be sorted in the green bins (the most prevalent of non-organics organic component in Mina camps)
- Educational campaign in the three camps: 30 poster and banner and 10,000 brochures
- To motivate pilgrims to participate: project profit was given to charity

Recycling Project



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Exemplar project: camps selection criteria
(Based on pilgrims only)

Level of education

High

Medium

Low

Egyptian
camp

Western
Europe
camp

Pakistani
camp

Role in the society
and the affluence

High

Medium

Low

Egyptian
camp

Western
Europe
camp

Pakistani
camp

Waste recycling
habits

Yes

No

Egyptian
camp

Western
Europe
camp

Pakistani
camp

Results for Pilgrims' intentions questionnaire



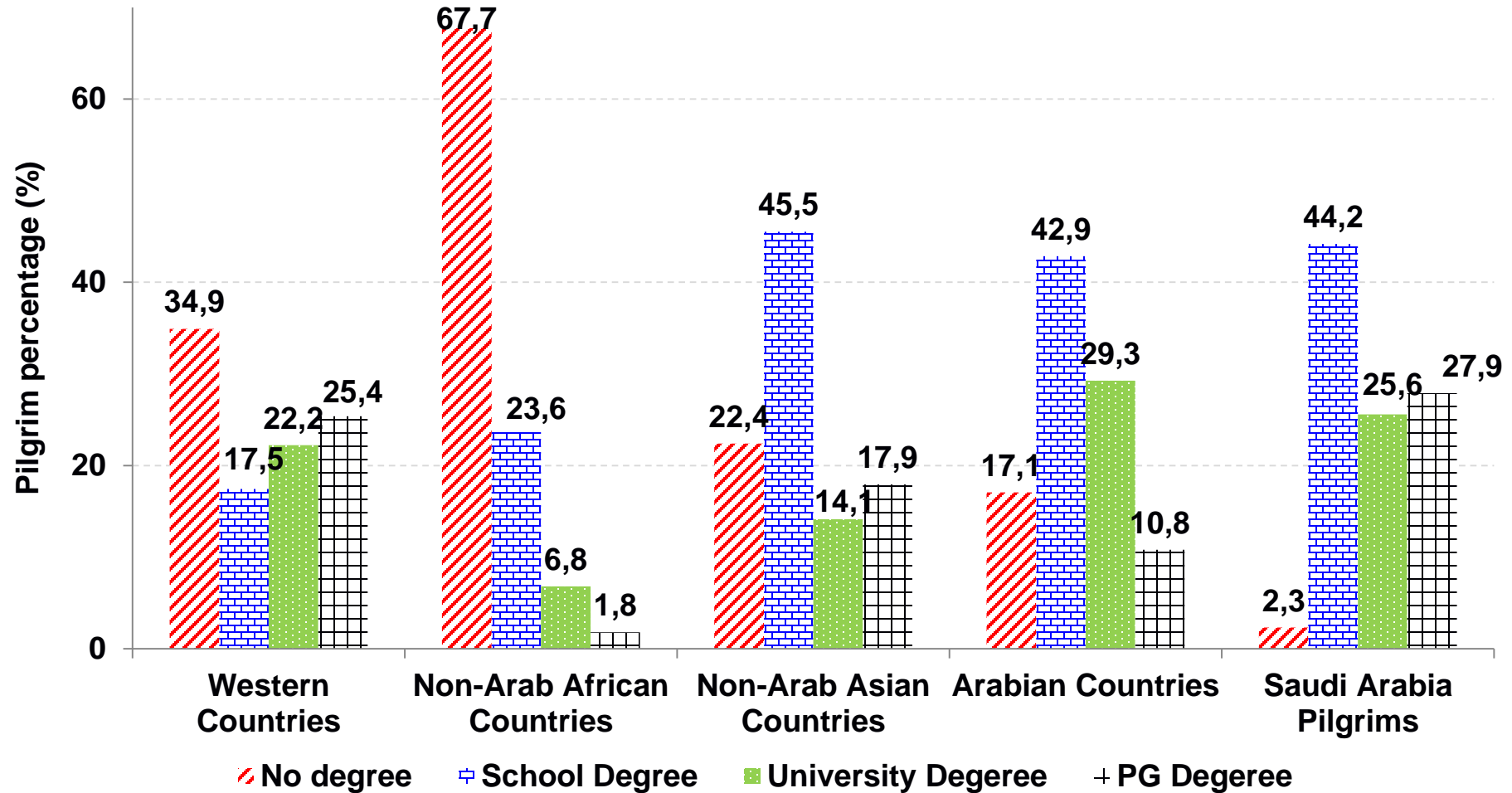
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- 903 pilgrims from 60 countries were interviewed randomly in Mina
- Only 817 forms were used due the elimination of the forms that contain conflicted answers between optional and compulsory sorting
- The 817 pilgrims were served by six Twafah companies (regrouped into five groups)

Level of education by Twafah groups



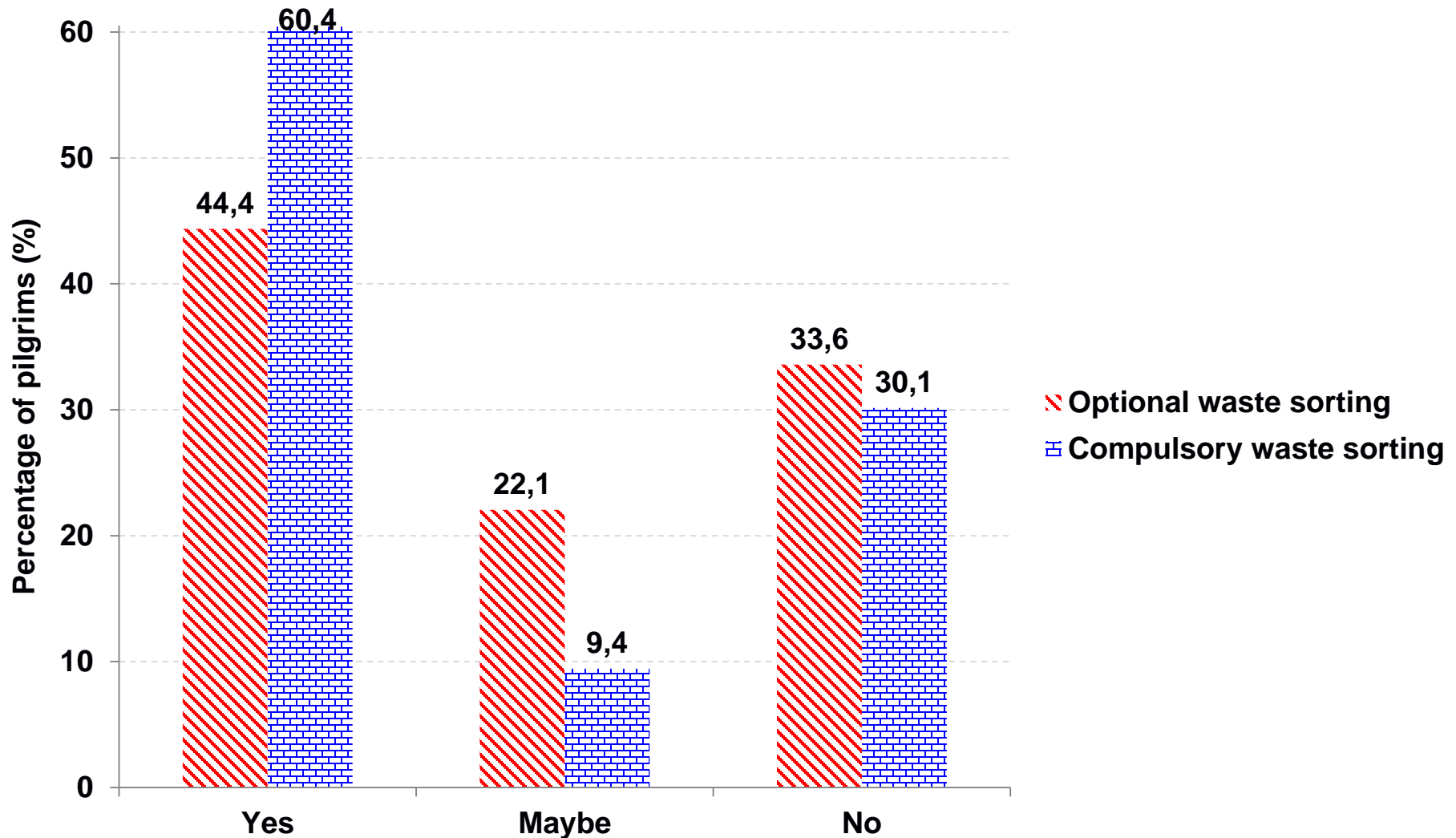
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Pilgrims' recycling intention Optional vs. Compulsory



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Results and discussion

Pilgrims' questionnaire



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- Based on McFadden pseudo R^2 : **the compulsory recycling is better than the optional**
- If the level of education increases, compulsory recycling intention increases (they follow the rules)
- The logit model for the compulsory model equals to:

$$Z_i = \{-4.029 + 0.04X_2 + 0.005X_3 + 2.175X_4 - 1.58X_5 \\ + 1.359X_6 - 0.838X_7 + 1.373X_8 + 0.806X_9 + 0.68X_{10} \\ - 1.153X_{11}\}$$

$$P_i = \frac{1}{1 + e^{-Z_i}}$$

Model variables



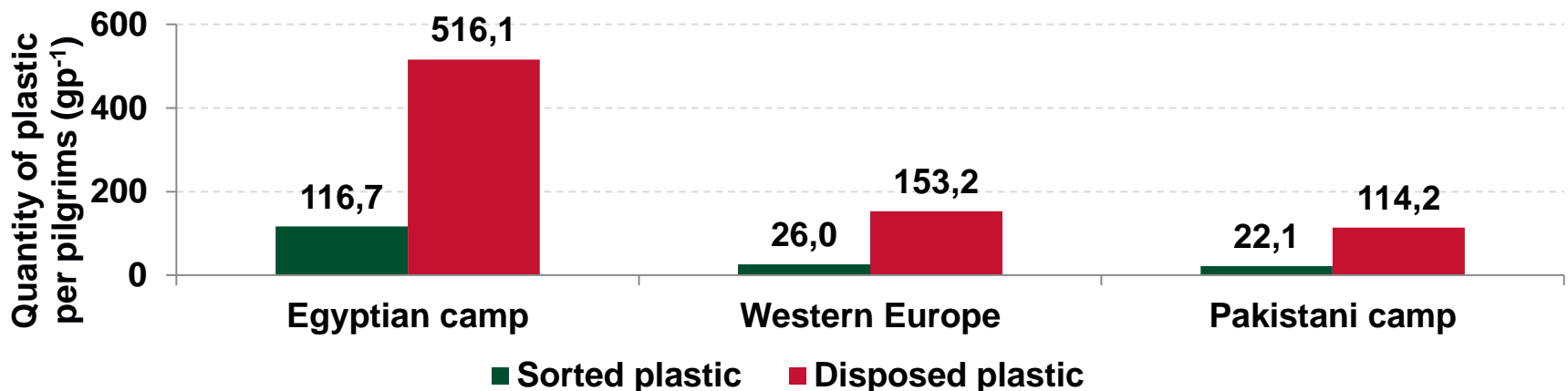
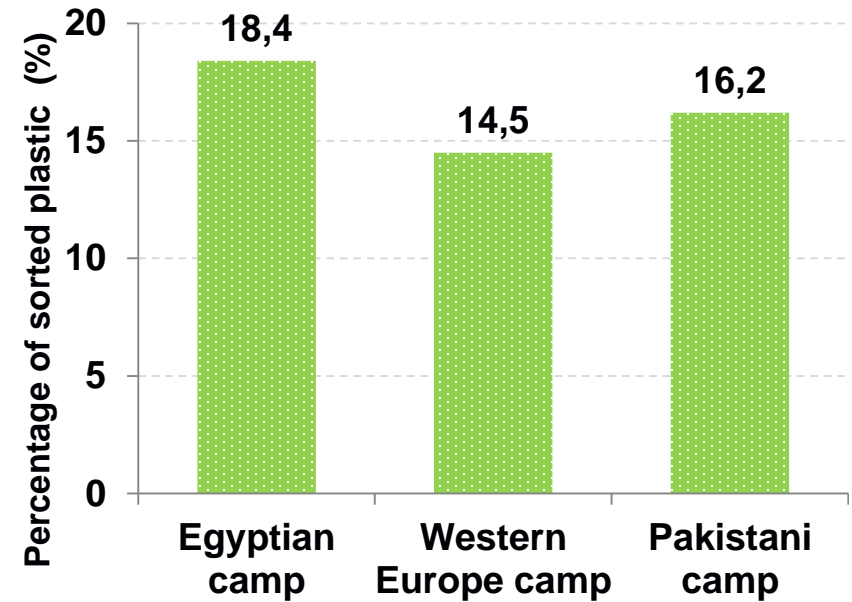
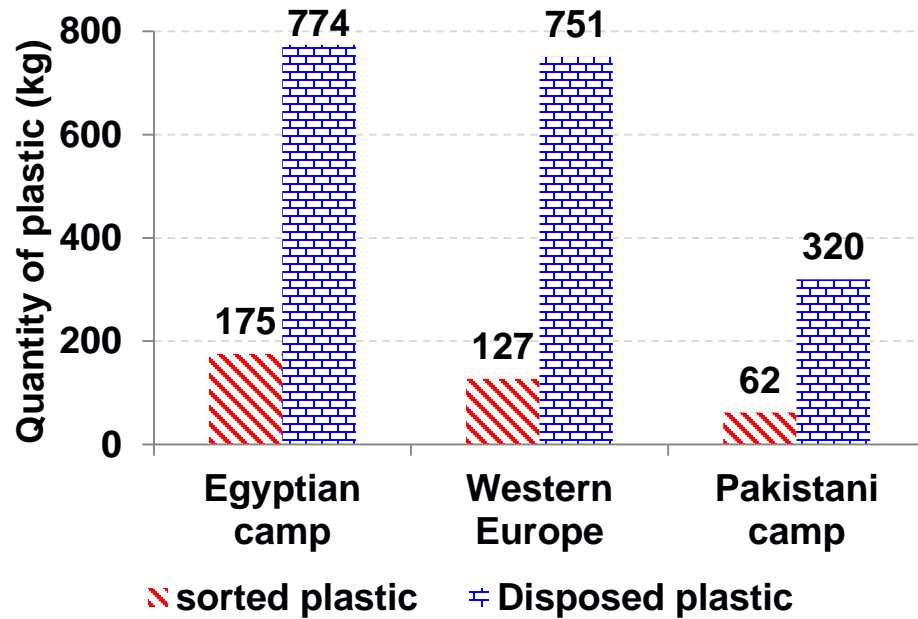
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Variable symbol	Variables represent
X_2	EPI (Environmental Performance Index of the country)
X_3	Waste generation rate per capita
X_4	Level of education based on no degree group (reference)
X_5	Twafah Company based on Saudi Arabia group (reference)
X_6	First question based on the answer Rarely
X_7	Second question based on the answers buy it + both
X_8	Third question based on the answer No
X_9	Fourth question based on the answer No
X_{10}	Fifth question based on the answer No
X_{11}	Seventh question based on the answers Satisfied + very Satisfied

Quantity of sorted and disposed plastic in the three camps



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Factors affecting pilgrim behaviour



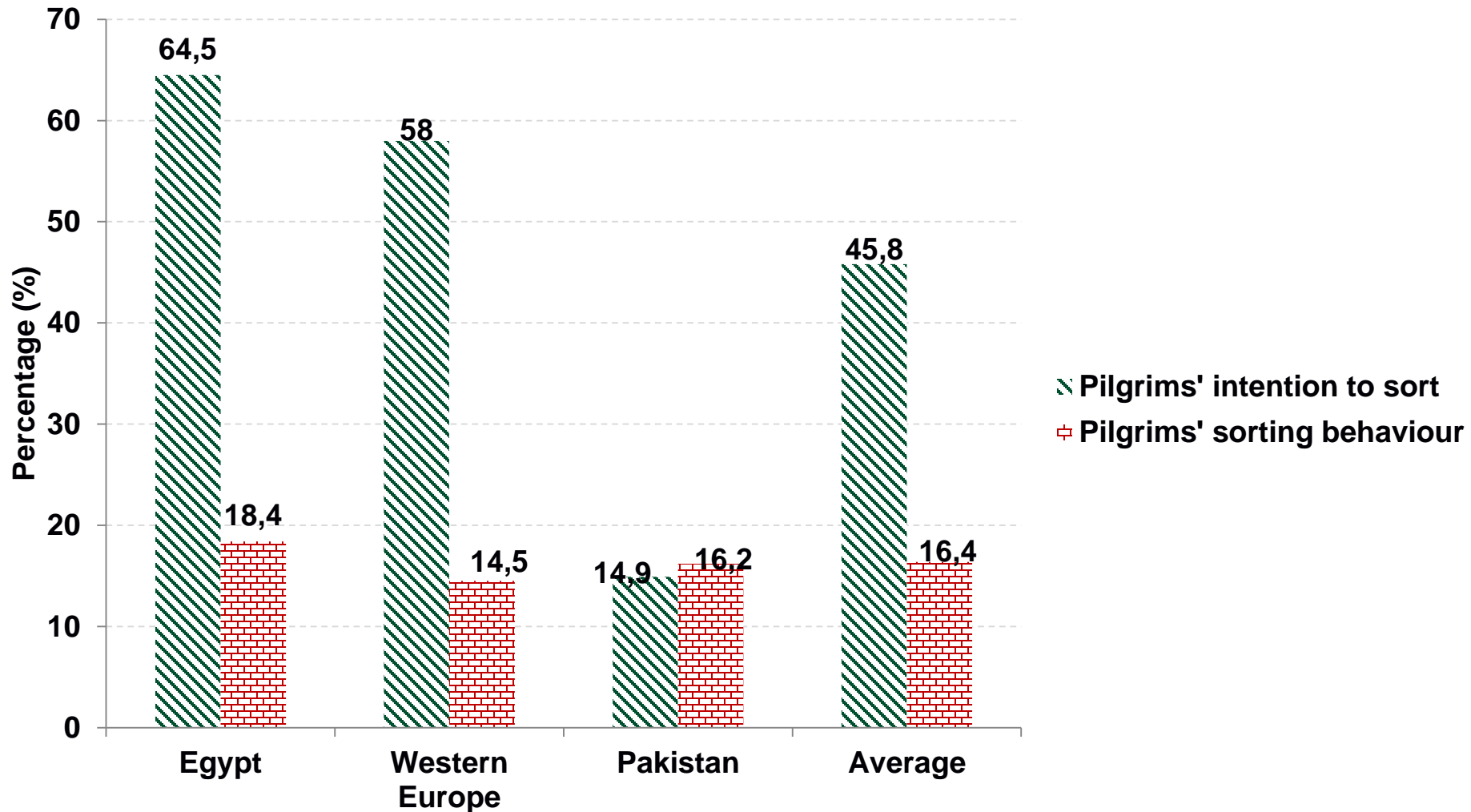
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- Pilgrims' background about recycling
- Pilgrims' level of education and social level
- Their interest in the project
- Camp waste bins capacity
- Camps cleaning workers were not trained to participate in this project
- Quantity of generated plastic
- Level of disturbance during pilgrims arrival to their camp and departure
- Limited time to educate pilgrims about the project before the event
- Existence of free plastic bottled drinks refrigerators
- Difficulty in communication (pilgrims' spoken languages)
- The method of food catering inside the camp

Pilgrims' recycling Intention vs. actual behaviour



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Performance Limiting factors (in implementing intentions)



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- Ignorance of the essence of waste sorting and recycling might lower pilgrims recycling willingness (Pakistan)
- Some pilgrims from developed countries might not have the recycling habits such as of the majority of the citizens (they originally from developing countries - immigrants)
- **Difficulties caused the gap between recycling intention and behaviour are:**
- Camps cleaning workers were not trained to participate in this project
- Camps general waste bins capacity
- Great diversity in the food catering method between camps
- Difficulty in communication because of the multilingualism

Key factors to consider when introducing recycling in Mina – hajj:



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Factors effect pilgrims intention to participate in recycling:

- **Whether the system is optional or compulsory by the law**
- **Ethnicity**
- **Level of education**
- **Social “level” (socio-demographic: GDP, EPI, waste arising)**
- **The method of food catering in Mina camps**
- **Information campaigns and educational programmes**
- **Pilgrims’ satisfaction about the level of Mina streets cleanness**
- **Ignorance of the essence of waste sorting and recycling**

In order to make this project occurs, financial and moral supports were obtained from five different organizations:

- ❖ The Custodian of the Tow Holy Mosques Institute of Hajj Research
- ❖ Ma'aden Mining Company
- ❖ Haji and Mu'tamer's Gift Charity Association
- ❖ Environmentalist for Studying and Consulting
- ❖ Global for Food Hygiene and Safety

Thank you!



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