Relative Awareness of United States and Saudi Arabian Business Managers with Respect to Carbon Market Issues

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This study focuses on the awareness level of American and Saudi Arabian managers in the private sector with respect to a set of study-defined awareness variables associated with the carbon market and carbon management policies. A questionnaire was distributed to randomly sampled middle-level managers. A total of 126 and 51 usable responses were collected from the American and Saudi Arabian sample groups, respectively. In 14 out of the 18 awareness variables contained in the survey, the American managers scored statistically significantly higher than their Saudi Arabian counterparts. In the four variables where Saudi Arabian managers scored higher, two were statistically significant (i.e., Pollution Problems and Green Investing) while the two were not.

Keywords: carbon emissions, awareness level, Saudi Arabia, USA, environmental education

INTRODUCTION

Sustainability and carbon management practices are gaining attention in the formulation of business strategies in most private sector enterprises across the globe, including the United States (U.S.) and Saudi Arabia (INDC, 2019). The main catalysts of these trends are growing awareness of carbon emission risks, legislative pressure from informed citizenry, and cases of international cooperation (e.g., the Kyoto Protocol). The Kyoto Protocol—an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC)—was adopted in Kyoto, Japan, on December 11, 1997, becoming effective on February 16, 2005 (UNFCCC, 2019).

Former U.S. President Bill Clinton signed the Kyoto Protocol in 1997, a crucial step considering the U.S.'s role in greenhouse gas emissions: in 2017, the total greenhouse gases emitted by the U.S. was 6.7 billion metric tons of carbon dioxide equivalent (CO2e). Carbon dioxide accounted for the largest percentage of greenhouse gases emitted by the U.S. (82%), followed by methane (10%), nitrous oxide (6%), and other greenhouse gases (3%). All sectors of the economy contribute to greenhouse gas emission, including electric power (28% of the total), transportation (29%), industry (22%), residential and commercial (12%), and agriculture (9%). (List of Countries…, 2019). However, the U.S. Senate refused to ratify the Kyoto Protocol, and in 2011, former President George W. Bush withdrew the U.S. from the Protocol.

In 2015, the Paris Agreement was adopted by most countries, including the U.S., but in 2017, the U.S. government withdrew from the Paris Agreement, as well. Despite the U.S. government's reluctance to be part of global environmental treaties, several steps were taken to reduce greenhouse gas emissions, with states and municipalities adopting aggressive policies to mitigate emissions (USA Climate Action

Tracker, 2019). In the private sector, the renewable energy and electric vehicle industries are making a dent in the CO2e emissions rate. Notwithstanding the U.S. government's decision to pull out of the Paris Agreement, if the private sector's low-carbon policies and subnational targets are implemented, a 17–24% reduction in CO2e by 2025 below the 2005 levels is expected, which will approximate the U.S.' originally established Paris Agreement commitment (USA Climate Action Tracker, 2019).

Saudi Arabia, a signatory of the Kyoto Protocol, ratified the Kyoto Protocol in May 2005, and, in September 2006, held its first regional Clean Development Mechanism conference in Riyadh. In 2017, the total greenhouse gas emitted by Saudi Arabia was 0.55 billion metric tons of CO2e. The fossil fuel industry including the power-generation and transportation sectors are the two most significant contributors of CO2e (List of Countries…, 2019).

Saudi Arabia's progress in mitigating CO2e emissions is promising. Under its "Vision 2030," Saudi Arabia plans to phase out subsidies to the fossil fuel industry, a source blamed for most of its greenhouse gas emissions (Saudi Arabia Climate Action Tracker, 2019). In March 2018, Saudi Arabia and the SoftBank Group executed a memorandum of understanding to build a solar energy plant with a capacity of 200 GW, the world's largest single solar project, which could dramatically lower the emission outlook for the Kingdom and move Saudi Arabia away from total dependence on fossil fuels (Saudi Arabia Climate Action Tracker, 2019). By 2030, Saudi Arabia seeks to reduce its annual emissions by up to 0.13 billion CO2e, a 25% reduction compared to its 2017 emissions level. In December 2017, however, the Saudi government announced it would slow down the reduction of fossil fuel subsidies, raising questions on the ambitious plans outlined in "Vision 2030." There is now considerable backtracking regarding the country's targeted emissions level (INDC, 2019).

Saudi Arabia and the U.S. are among the top per capita greenhouse gas emitting countries. In 2017, Saudi Arabia produced approximately 19 tons of CO2e per person, accounting for about 1.22% of global emissions despite representing only 0.4% of the world's population. Meanwhile, the U.S. per capita share of CO2e emissions was about 20%, accounting for 14.75% of global emissions while representing only 4.27% of the world's population (UNFCC, 2019; Greenhouse Gas Emissions, 2019). Thus, the U.S. and Saudi Arabia should focus on enhancing awareness levels among their citizens about the dangers of inaction and make efforts to reduce per capita carbon emissions.

LITERATURE REVIEW

People everywhere need to understand the cause of global warming, how climate change is going to affect them, what can they do to cope, and to find out and implement solutions to the best of their ability (UNCCC, 2019). Therefore, education and awareness are vital for public engagement to effectively induce governments to make difficult choices now, to avoid catastrophic consequences in the future. This includes addition of global warming issues in educational curricula at every level.

Lorenzoni, et al. (2007) investigated and compared the "global warming" and "climate change" opinions and awareness levels in the United Kingdom (U.K.) and U.S. In the U.S. study, conducted from November 2002 to February 2003 in collaboration with the University of Oregon Survey Research Laboratory, a survey was mailed to a representative sample of the American population. A total of 673 completed surveys were returned, implying an overall response rate of 55.4%. In the U.K., a face-to-face, quota-based survey was conducted in July 2002 by the Centre for Environmental Risk, University of East Anglia, resulting in 1,547 responses. Respondents were asked about their a) cultural and environmental values, b) perceptions of risk and benefit, c) risk regulation, d) acceptability, and e) trust in and evaluation of government policy. This study confirms a strong relation between citizens' opinion and governmental policies in the U.K., but does not establish any strong relationship between American citizens' opinions on climate change and carbon-related variables, and the U.S. government's lackluster response to climate change. The comparison of two comprehensive studies in the U.K. and U.S. reveal similar "global warming" and "climate change" related views among citizens of these two countries. Notably, after more than a decade of publication of the research, the U.S. government has been antagonistic to any global climate treaty and several administrations have vocally challenged the need for carbon mitigation policies.

Thus, we can infer that citizens' awareness level alone may not be enough to alter governments' response to carbon mitigation policies; multiple powerful stakeholders often play a role too.

Jia, et al. (2018) collected personal transportation-related data through a self-administrated survey from residents of three major Chinese cities (Beijing, Hangzhou, and Jinan). This study combines the widely applied attitudinal factors (i.e., affective, symbolic and instrumental factors) in conjunction with three low-carbon-related factors (i.e., low-carbon awareness, low-carbon knowledge and low-carbon habits), and then investigates the relationship between these factors and the behavior guiding the choice of commuting mode. The results of this survey confirmed that low-carbon knowledge and low-carbon habits have direct influence on commuting mode choice, while low-carbon knowledge and only one of the attitudinal factors (i.e., instrumental factors) are the strongest predictors of commuting mode. Greater appreciation of behavioral consequences and overall carbon awareness had a positive impact on transportation intent, although a great gap existed between behavior intention and actual choice. This is further research-based evidence relating awareness of carbon issues with the choices that citizens make.

Any change in habits, including living low-carbon, requires a change in lifestyle. Researchers have defined a short psychological measure (Low Carbon Readiness Index, or LCRI) that predicts a wide range of diverse low-carbon behaviors in the household, and that can index general willingness to transition to a low-carbon lifestyle. O'Brien, et al. (2018) selected 102 Australians to test the validity of the LCRI in predicting a low-carbon life style. The index measures citizens' awareness level in relation to carbon emissions and environmental issues. The findings of this study also confirm those of other researches that awareness is the precursor of behavioral change and influences public policy. One of the related conclusions of this study is that LCRI can be used by governments to help develop low-carbon policies and monitor their implementation.

Abubaker, Al-Shihri, and Ahmed (2016) provided one of the earliest research papers on the level of understanding of sustainability and CO2e mitigation in Saudi Arabian youths. This may be the first study of its kind conducted at a Saudi Arabian university. In 2014, they surveyed 152 students at the College of Architecture and Planning, University of Dammam. This college has a mission that focuses on a) curriculum and research, b) campus operations, and c) community involvement. Their findings were mixed. Students were very aware of sustainability related issues, but they were not willing to make personal changes to reduce their carbon footprint in campus life, such as by reducing water consumption, energy use, and use of personal transportation. The study also observed that the projects and courses in the architecture program did not place much emphasis on sustainability topics. The study findings may be unique to Saudi Arabian culture, as they are contradictory to other studies from Europe and Asia where awareness of carbon related topics lead to positive lifestyle changes to reduce carbon emissions and move towards a sustainable economy. The authors recommended future research covering other universities and institutions, including business entities. While this study only looked at perceptions of students from a single college, it helped policy-makers understand Saudi youths' awareness level and desire for sustainable changes. There is definitely a need to examine other campuses and business organizations, where the first step could focus on gauging the awareness of university administrators and mid-level business managers. Next, their awareness could be correlated to decision-making, including lifestyle changes.

Freije, et al. (2016) surveyed first- and fourth-year science major students at the University of Bahrain to examine the impact of college-level science education on student awareness of climate change topics. A total of 143 students responded to the questionnaire, with a statistically significant difference observed in the awareness level between the first-year and fourth-year groups; confirming the author's hypothesis that relevant education can change a student's perception and help these students appreciate the effects of climate change. This research is highly significant as it is one of only two studies conducted on college students in any of the Gulf Cooperation Council member countries. As previously noted, this region leads the world in per capita CO2e emissions and where the fossil fuel industry is key to their survival.

In most countries, younger generations are more willing to support low-carbon policies than older generations are, because they are the ones to face the negative consequences of status quo policies. It is further argued that college curricula should focus much more on the dangers of not mitigating carbon

emissions and not following sustainable economic policies. For example, Bowser, Gretzel, and Brown (2014) focused on the college curriculum in providing multidisciplinary knowledge to a diverse workforce. This exploratory study concluded that curricula across all disciplines must reflect current environmental realities, making students aware of the dangers of inaction and transforming younger generations into responsible citizens. Students should also have access to environmental internships and field experiences (Bowser, Gretzel, and Brown, 2014). It is further argued that college curricula should focus much more on the dangers of not mitigating carbon emissions and not following sustainable economic policies.

Rickinson (2001) performed a critical review of the education process and environmental knowledge of primary and secondary school students. The author studied over a hundred journal articles, books, and reports published between 1993 and 1999. Among other findings, his analysis underscored the importance of television news and educational programming to appropriately educate young populations on carbon and environmental issues. Conversely, it was noted that mass media can also be a source of disinformation. The study further found that an informed citizenry is the strongest driver of environmentally friendly policy initiatives. Without an educated society, the governments may not seek to reduce greenhouse gases.

Carberry, et al. (2019) analyzed the role of environmental activism on green information systems (green IS) and its influence on d environmentally friendly decision-making by corporations. This was a landmark study based on a web-based survey of 400 U.S. firms located domestically. A total of 744 managers responded, of which 425 responses were considered complete and included in the analysis. Among the respondents, 12% were CEOs, 57% senior managers, and 21% mid-level managers. Statistical analysis confirmed the positive role of environmental activism (educating and persuading) in creation of green IS and steering low-carbon, policy adoption by these corporations. The indirect impact of social activism and making corporations aware of various options was more profound than that of direct pressure on corporate managers.

In Europe, Duarte, et al. (2018) researched the process of transformation of Spanish citizens to a low-carbon lifestyle as a result of strict environmental targets imposed after the 2015 Paris Agreement and the 2016 EU Climate Strategy. The objective of this study was to assess the medium-term, environmental impact of several consumer-oriented measures, using a dynamic Computable General Equilibrium (CGE) model. The crux of the study measured changes in the lifestyle of Spanish consumers and analyzed the dynamic impact of those changes. Prior to making the lifestyle changes, consumers were educated and made aware of environmental challenges. Duarte, et al. (2018) confirmed that consumer-oriented changes can help the Spanish government achieve their targeted reduction of greenhouse gases. Generally, citizens are willing to adopt new habits once they fully understand their role and impact in solving this issue.

The above-mentioned studies emphasize the role of citizen awareness and knowledge regarding carbon issues as the foundation for them to make low-carbon lifestyle changes and lobby policy-makers for regulations mitigating greenhouse gasses. Therefore, the purpose of this study is to gauge and compare the awareness level of American and Saudi Arabian private sector managers regarding the carbon market, environmental variables, and carbon management policies. From the literature, this awareness level can be considered a proxy for the propensity of these managers to adopt low-carbon policies in their respective organizations and become advocates for other public sector, low-carbon policies.

RESEARCH HYPOTHESIS

H1: *American private-sector manager's awareness level of carbon market and carbon management policies is higher than the Saudi Arabian managers.*

RESEARCH METHODOLOGY

After conducting a literature review, the author was unable to find any study that establishes or compares carbon market awareness variables between American and Saudi Arabian private sector managers. Following separate detailed discussions with a group of three Saudi Arabian and four American managers, a list of carbon market awareness variables was compiled. The list was kept simple to ensure Saudi Arabian managers, whose English proficiency is low, easily understood it. The sample region is limited to two metropolitan cities in Saudi Arabia and one U.S. state.

A questionnaire, based on the aforementioned compiled variables, was designed to assess personal awareness and knowledge by American and Saudi Arabian, mid-level, private-sector managers regarding the carbon market, environmental topics, and carbon management policies, collectively described as *Awareness Variables*. A seven-point Likert scale was used, whereby a score of one indicated "very little awareness" and a score of seven indicated "strong awareness" in each of these topic areas. The study sample was based on 75 randomly selected, mid-level, Saudi Arabian managers, primarily in the Jeddah and Riyadh metropolitan regions of Saudi Arabia. A total of 51 completed questionnaires were collected over a span of two months from the participating managers. Following collection of the Saudi Arabian data, 175 mid-level, American managers in Minnesota were also randomly selected for the same questionnaire and a total of 126 usable U.S. responses were collected and included for data analysis. The data were analyzed by tabulating mean importance scores and employing two-tailed t-tests along with MANOVA. SPSS Statistics-25 software was used for this analysis.

DATA ANALYSES

Data from both samples were analyzed; descriptive statistics for each Awareness Variable is provided in Table 1. The Saudi Arabian sample size is smaller (n=51) compared to the American sample size (n=126) and the Saudi Arabian sample exhibits a higher standard deviation than American managers', suggesting wider gap of the awareness of these topics among Saudi Arabian managers, perhaps based on their education level and the industry in which they were employed. The null hypothesis is tested by comparing mean scores of the two samples for each Awareness Variable and an overall mean score using two-tailed t-tests; the results are tabulated in Table 2. Mean score for fourteen out of eighteen variables are statistically significant with a positive t-value confirming that the American sample has statistically significant higher mean scores. In all but four carbon market awareness related topics, American managers scored higher than their Saudi Arabian counterparts. Mean scores were higher in four Awareness Variables for the Saudi sample, with two out of the four being statistically significant (i.e., environmental pollution and green investing). One possible explanation for the statistical significance of these two scores is that the Saudi survey participants were from two major cities (Jeddah and Riyadh) and poor air quality in these cities make the respondents fully aware of pollution issues. The significance of green investing can be attributed to the open, top-down strategy of the Saudi Arabian government to reduce carbon emissions by allocating funds for green projects. The other two variable's (carbon tax and carbon risk) score were higher in Saudi Arabian sample but not statistically significant. It appears that Saudi Arabian and American managers' awareness of increasing costs as a result of carbon tax and hidden carbon risk is essentially equal. Notably, in both samples, these two variables scored very low in awareness.

TABLE 1
MEAN AND STANDARD DEVIATION SCORES FOR AMERICAN AND SAUDI ARABIAN MANAGERS' AWARENESS LEVEL OF CARBON MARKET VARIABLES

	Awareness Variables*	U.S.** Mean	U.S. Std. Deviation	Saudi*** Mean	Saudi Std. Deviation
1	Global Warning	5.31	1.552	3.84	2.072
2	The Kyoto Protocol	5.62	1.457	1.55	1.922
3	Carbon Footprint	5.18	1.455	1.92	1.861
4	Carbon Market Functions	5.51	1.446	2.28	2.090
5	Greenhouse Gases	5.16	1.690	3.27	2.289
6	Cap-and-Trade Mechanism	5.37	1.506	1.78	2.013
7	Carbon Credits	5.50	1.325	1.74	1.850
8	Pollution Problems	4.66	1.827	5.31	1.772
9	Global Climate Exchanges	4.77	1.560	3.92	2.098
10	Carbon Neutrality	4.91	1.550	1.62	1.806
11	Carbon Labels	3.67	2.007	1.72	1.773
12	Carbon Beta	3.57	1.978	1.24	1.680
13	Carbon Disclosure	3.50	1.888	1.20	1.666
14	Carbon Tax	2.77	1.781	2.78	2.501
15	Voluntary Carbon Market	5.52	1.643	1.28	1.727
16	Carbon Risk	2.40	1.139	3.92	2.230
17	Green Investing	1.79	0.771	2.82	2.164
18	Carbon Offset	2.06	0.601	1.16	1.811

Note: *Mean scores are calculated from a seven-point Likert scale where "1" represents "very little awareness" and "7" represents "strong awareness."
**U.S. sample size = 126
*** Saudi Arabian sample size = 51

TABLE 2
MEAN t-SCORE DIFFERENCES OF AWARENESS VARIABLES BETWEEN AMERICAN AND SAUDI ARABIAN MANAGERS

	Awareness Variables	t-Test Value*	Significance Level
1	Global Warning	4.562	0.000
2	The Kyoto Protocol	13.629	0.000
3	Carbon Footprint	11.121	0.000
4	Carbon Market Functions	10.010	0.000
5	Greenhouse Gases	5.259	0.000
6	Cape-and-Trade Mechanism	11.393	0.000
7	Carbon Credits	13.102	0.000
8	Pollution Problems	-2.187	0.000
9	Global Climate Exchanges	2.594	0.000
10	Carbon Neutrality	11.329	0.000
11	Carbon Labels	6.346	0.000
12	Carbon Beta	7.948	0.000
13	Carbon Disclosure	7.945	0.000
14	Carbon Tax	-0.038	0.965
15	Voluntary Carbon Market	14.879	0.000
16	Carbon Risk	-1.579	0.120
17	Green Investing	-3.287	0.002
18	Carbon Offset	3.431	0.001

*Two-tailed T-Test.

Furthermore, aggregate mean scores of all 18 variables from both samples are compared by a two-tailed t-test. The results are presented in Table 3. The American managers' aggregate mean score of 4.204 compares to the Saudi Arabian managers' aggregate mean score of 2.282. The difference between these two scores is statistically significant ($p < .001$), concluding that the American middle-level manager's overall awareness level of carbon market issues is greater than the awareness of Saudi Arabian middle-level managers and further confirms the research hypothesis. As noted, the standard deviation for the Saudi Arabian sample was almost double that of the American sample, confirming higher variability in the awareness level among Saudi Arabian managers regarding carbon market issues.

TABLE 3
AGGREGATE AWARENESS DATA FOR AMERICAN AND SAUDI ARABIAN MANAGERS

U.S. Aggregate Mean**	U.S. Std. Dev.	U.S. Aggregate Mean***	Saudi Std. Dev.	t-Test Value*	Significance Level
4.204	0.700	2.282	1.327	9.808	0.000

*Two-tailed T-Test.
** U.S. sample size n = 126
*** Saudi Arabian sample size n = 51

Multivariate analysis of variance (MANOVA) was employed to examine statistical differences on one continuous dependent variable by an independent grouping variable. The MANOVA compares whether

the newly created composite differs by different groups, or levels, of the independent variables. For this purpose, Pillai's trace test, the most robust test, was selected, despite its departure from the assumptions (Statistics How To, 2016). The F-value of 25.33 is statistically significant, confirming that a linear model is more compatible with these data than a constant average model, and hence, both samples are derived from different populations.

CONCLUSIONS

Based on the literature review, countries with higher knowledge and awareness of environmental issues have implemented aggressive policies to mitigate the negative effects of greenhouse gas emissions, with the notable exception being the U. S. Generally, policy-makers and governments are responsive to the needs and wishes of their citizens; therefore, the level of awareness regarding the carbon market and related issues may be an important predictor of future environmental policies.

American managers' awareness level, in 14 out of 18 listed variables, is higher than the Saudi Arabian managers' awareness levels and therefore, these managers are considered to be more likely to make proactive decisions to reduce their organization's carbon footprint and even lobby to their local and federal governments to implement low-carbon policies. Extrapolating from the literature, the higher score, and hence greater awareness, may be attributed to increased emphasis on carbon related issues in the American education system and media outlets. In Saudi Arabia, where the fossil fuel industry is vital to the economy, the education system and media may not be devoting the same level of resources to issues related to the carbon market. Accordingly, these factors are not likely to garner the same focus in business decision-making conversations. The education system and media is unquestionably influencing citizens and managers' decisions related to carbon emissions and sustainability, and the direct impact of education system and media can be further explored in a future study.

The Saudi Arabian sample group has a higher awareness score than the American sample in a total of four variables (i.e., pollution, carbon tax, carbon risk, and green investing) and only two of those variables (i.e., pollution and green investing) are statistically significant. Pollution is a serious problem in major Saudi Arabian cities, and the government is championing green investment in future projects. The increased emphasis within Saudi Arabia on these two factors may account for their higher scores and reinforces the premise that public awareness is the key to change. Since there is no significant difference in the variable factors of carbon tax and carbon risk, it might be concluded that the relative awareness of these factors in both countries is similar. The reasons behind the differences in scores of these variables as well as potential similar surveys undertaken in greener countries could form the focus of future studies to inform effective policy-making.

The awareness scores for future Saudi Arabian managers may be improved if these environmental issues are included in high school and college curricula. More currently, civic organizations and mass media can play a vital role in citizen awareness campaigns. Without higher awareness of carbon market issues, the implementation of carbon abatement policies is likely not possible.

Limited geographical representation in sample selection may be considered a limitation of this research project. Additionally, its validity may be questioned, as the awareness variables have been selected based on discussions with a small group of managers in both countries. This research project, however, has offered an interesting insight about the awareness level of American and Saudi Arabian managers with respect to carbon management issues.

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