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Original Article

Effect of Financial Incentives on Water Saving Behaviour amongst Teenagers in Ahmedabad

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Abstract *- Water conservation is preserving water and preventing its usage. Freshwater is a scarce resource, and roughly 4 billion people face water scarcity for at least a month every year. Even though water covers most of the Earth's surface, only a small amount is freshwater that people can use for drinking, farming, and daily activities. As the population increases and cities grow bigger, the need for clean and safe water increases. Teenagers are the next generation to inherit the planet, and teens need to conserve freshwater. By saving water in simple ways, young people can help protect this valuable resource. It is also important for teenagers to spread awareness about water conservation. This paper presents an experiment where students were given rewards to complete and submit tasks related to water conservation to measure the effect of financial incentives on water-saving behavior in teenagers. The water-saving behaviour was measured using a Likert scale before and after the experiment. The results concluded that financial incentives increased water-saving behaviours in teens as measured by the General Attitude Towards Water Conservation (GAWC), Perceived Moral Obligation (PMO) and Behavioural Intentions (BI) subscales of the Likert scale.*

Keywords *- Financial Incentives, Water saving behaviours, Teenagers, Ahmedabad, Water scarcity.*

1. Introduction

Water is a scarce resource that is essential for sustaining any and all life on Earth. Water conservation is using water efficiently to prevent its wastage and ensure its availability for future generations. Only 3% of the Earth's water is freshwater, of which only 1% is readily available for human consumption. With around 4 billion people facing water scarcity for at least a month every year, the need to conserve water has become more urgent. [1] Currently, agriculture is responsible for roughly 70% of water consumption globally, and with increasing population, agricultural use of water is projected to increase by a factor of 1.9 by 2050. [2] Countries are implementing rainwater harvesting, irrigation, and greywater recycling plants to save and reuse water.

India is the world's most populous country, and water consumption is estimated to increase from 761 billion cubic metres in 2010 to 1180-1447 billion cubic metres (low demand and high demand) in 2050. [3] Apart from agriculture, another reason for water consumption in India is urbanisation and increasing population, especially in the metros. India has been trying to combat groundwater depletion by offering farmers financial incentives. In Punjab, the government has launched a scheme that offers farmers financial rewards on the basis of electricity conservation, which effectively means less water has been used. This reduced consumption by 6% to 25%. [4] In Gujarat, the government has subsidised micro-irrigation systems such as drip and sprinkler irrigation, which minimise wastage.

[5] However, these incentives are not proving to be enough for farmers, due to the subsidies given for agricultural goods. [6] Ahmedabad is also facing a severe water scarcity crisis as the city is utilising 152% of its groundwater. [7] The Ahmedabad Municipal Corporation should offer incentives to households, promote water harvesting technologies and spread awareness. [8] A community in Ahmedabad actively reduced its water consumption by 62% daily after installing meters to count usage. [9] An experiment in the Mediterranean region concluded that financial incentives promoted water-saving behavior amongst farmers.

However, the study discovered that of 259 farmers, 75% believed that 100-120 per hectare was not enough to decrease water usage. The farmers believed that a significantly higher incentive of 360 per hectare was necessary for them to reduce water consumption by 10%. [10]

1.1. Literature Review

Engagement of healthy behaviours is far from optimal, and financial incentives remain a popular way to promote

healthy behaviour, such as vaccination, between governments around the world. Non-systematic reviews have found that financial incentives are more effective for one-off activities. In contrast, systematic reviews have found that the effect of financial incentives is greater in deprived groups. Still, concerns arise regarding financial incentives, claiming they are socially divisive or manipulative.

Additionally, ethical concerns arise around using financial incentives to promote healthy behaviour, as there is a lack of clarity on what is acceptable and what is not. Studies have shown that people prefer flexible incentives (ones that can be spent anywhere, e.g., cash) to non-flexible incentives (coupons that can be used at specific stores).

The study was conducted on UK residents over 18 to assess their preferences for financial incentives promoting healthy behaviour. The survey asked for four healthy behaviours - smoking cessation, regular physical activity, disease screening and vaccination, and four types of incentives - no reward, cash, vouchers and lottery tickets. [11]

2. Methodology

2.1. Research Aim and Hypotheses

This paper aims to establish a link between financial incentives and water-saving behaviour in teenagers based in Ahmedabad, Gujarat.

The study's hypotheses are outlined as follows:

- H_{01}: Financial incentives have no impact on General Attitude towards Water Conservation (GAWC) amongst teenagers in Ahmedabad.
- H_{a1}: Financial incentives have an impact on General Attitude towards Water Conservation (GAWC) amongst teenagers in Ahmedabad.
- H_{02}: Financial incentives have no impact on the Perceived Moral Obligation (PMO) of saving water amongst teenagers in Ahmedabad.
- H_{a2}: Financial incentives have an impact on the Perceived Moral Obligation (PMO) of saving water amongst teenagers in Ahmedabad.
- H_{03}: Financial incentives have no impact on Behavioural Intentions (BI) of saving water amongst teenagers in Ahmedabad.
- H_{a3}: Financial incentives have no impact on the (BI) of saving water amongst teenagers in Ahmedabad.

2.2. Data Collection

The data was collected using a standardised scale to understand the attitude of the respondents towards water conservation. [12] The following sub-scales were used to understand the attitude.

2.2.1. The General Attitude towards Water Conservation (GAWC)

People's knowledge of water scarcity and their perception of the growing need for water conservation were assessed by the 11 items under this aspect. The questions were taken from the Water Conservation Attitudes and Behaviours of Australians. [12]

2.2.2. Past Experience and Behavior (PE)

This subscale's three items focus on the participant's past experiences with water scarcity and their water conservation initiatives, both past and present. [12]

2.2.3. Perceived Moral Obligation (PMO)

Moral ethics can often impact behaviour. The PMO items evaluate how much a person feels compelled to practice water conservation. [12]

2.2.4. Behavioral Intentions (BI)

The components of this factor assess the degree to which an individual's attitude is manifested in their actions. [12]

2.2.5. Perceived Water Rights (PWR)

Depending on an individual's perspective regarding their rights to natural resources, their attitude towards the depletion of these resources may differ. PWR Lam assesses the degree to which individuals perceive access to water as a fundamental right. [12]

2.3. Financial Game

A financial incentive game was created for the respondents to encourage water-saving behaviour. The responses were graded daily, and a Rs 500 Amazon voucher was awarded to the winner of the day. The game was conducted over a 5-day period, and the respondents were given the following questions and tasks to record.

Tasks were given more weightage compared to questions as they enabled respondents to delve deeper and think about innovative ways to conserve water. Moreover, it is very easy for respondents to answer socially desirable questions. The tasks require the respondents to put in effort and hence have more weightage.

Tasks

1. Leaky faucets dripping once per second can waste upto 11000 litres of water in a year. Check your house for leaky faucets and upload a pic.
2. Convince a member of your family to make changes and save more water. Share the text message or voice recording.
3. Share an innovative way you saved water today.

Tasks 1 and 2 held a weightage of 5 points each, whereas Task 3 held a weightage of 7 points.

Questions

1. The average shower head uses 15 litres per minute. Cutting your shower time from 10 to 5 minutes can save up to 25000 litres of water per year. Did you take a shower for under 5 minutes today?
2. Watering plants during the day can waste upto 50% of the water due to evaporation. Did you water your plants early in the morning or late evening?
3. Leaving the tap running while brushing can waste upto 10 litres per minute. Did you turn off the tap in intervals?

All the questions held a weightage of 1 point each.

2.4. Demography

The study's students included males and females in the age group 14-17. The table below describes the gender distribution of the respondent sample for the five-point Likert scale of attitude towards water conservation in India.

Table 1. Gender distribution of participants for pre (N=32), post control group (N=16) and post test group (N=16)

	Pre	Post (Control Group)	Post (Test Group)
Male	16	8	8
Female	16	8	8

2.5. Data Analysis

Data was converted from Google Forms into a spreadsheet. Then, averages were calculated for each question, the sub-category of questions, and the overall average. A paired sample t-test was used because the study involved repeated measures on the same participants' responses before and after the intervention. The test was conducted on GAWC, PMO and BI. The sample size N=16 was used for all three hypotheses (H1, H2 and H3) for consistency with post-study measurement since 16 participants were conveniently selected to participate in the post-study. SocialScienceStatistics.com was used to conduct the t-test.

2.6. Ethical Considerations and Informed Consent

This study was conducted in accordance with standard ethical practices. All participants were teenagers aged 14-17 who voluntarily took part in the survey. In the introduction of the form, it was clearly stated that their participation was absolutely voluntary and that digital consent was obtained. The form disclosed that their identities would remain completely confidential and their responses would be used solely for the purpose of this research paper. The participants were also aware that they could leave the study at any given moment without any adverse effects.

3. Results

3.1. Game Results

This section compares the responses given by the participants to the financial game on Day 1 with the responses given by the participants to the financial game on Day 5.

Table 2. Comparison of responses to questions on Day 1 with Day 5

	Percentage of those who took a shower under 5 minutes	Percentage of those who watered plants early morning /evening	Percentage of those who turned off the tap during intervals
Day 1	50%	62.5%	100%
Day 5	66.7%	77.8%	88.9%

The comparison of the responses to the tasks is as follows.

3.1.1. Task 1: Check your house for leaky faucets and upload a pic

Day 1

Fig. 1 Response to task 1 on Day 1

Image response to task 1 on Day 1is given in Figure 1.

3.1.2. Task 2: Convince a Member of your Family to Save water

Day 1

"I see that we waste so much water without even meaning to do it, like the leaking tap or the running water while brushing. What about making a few changes, such as turning off the tap while brushing? It is simple, but could really make a big difference. Let us give it a try?"

Day 5

"We should challenge the whole family to finish their showers in under 5 minutes by creating a common playlist for everyone."

3.1.3. Task 3: Share an Innovative Way you Saved Water Today

Day 1

"Any excess water from my washing machine is filtered and used to water my plants and clean."

Day 5

"One innovative way I saved water at home was by setting up a simple system to collect the clean water that flows while waiting for the shower to heat up. I placed a bucket under the showerhead and used that water later for cleaning, watering plants, or even flushing the toilet.

3.2. Survey Results & Comparison

The following results were obtained after conducting pre- and post-surveys with the same participants.

Table 3. Average response of questions in the general attitude towards water conservation (GAWC) subscale for pre (N = 32) and post-intervention (N=16).

Question	Category	Pre	Post
More attention to water conservation is needed. [12]	GAWC	4.31	4.63
I am very positive about water conservation. [12]	GAWC	3.84	4.31
I could make more effort to conserve water. [12]	GAWC	3.84	4.31
I feel no pressure to conserve water at the moment. [12]	GAWC	2.88	3.06
Water shortage issues do not affect me. [12]	GAWC	3.44	3.38
I am not concerned at all with water conservation. [12]	GAWC	4.09	4.69
Water conservation is not my responsibility. [12]	GAWC	4.03	4.38
It is a challenge to convince others to conserve water. [12]	GAWC	2.16	2.13
The need for water conservation depends on location. [12]	GAWC	2.91	3.06
Water conservation is important. [12]	GAWC	4.47	4.94
Water conservation is necessary because of water scarcity. [12]	GAWC	4.09	4.19
Average General Attitude towards Water Conservation	-	3.64	3.91

Table 4. Average response of questions in the past behaviour and experience (PB/PE), nuanced analysis of water resource (NAWR) and perceived moral obligation (PMO) subscales for pre (N = 32) and post intervention (N=16)

Question	Category	Pre	Post
I conserve water whenever I can. [12]	PB	3.44	3.81
I advocate water conservation among my friends and family. [12]	PB	3.22	4.00
I have experienced a limited water supply before. [12]	PE	2.59	2.56
Water conservation alone can solve India's water problem. [12]	NAWR	2.59	2.69
Water is a natural resource; everybody is obliged to treasure it. [12]	PMO	3.84	4.00
Everybody should save water because water resources are limited. [12]	PMO	4.03	4.31
Average Perceived Moral Obligation	-	3.94	4.16

Table 5. Average response of questions in the perceived water right (PWR) and behavioural intentions (BI) subscales for pre (N = 32) and post intervention (N=16).

Question	Category	Pre	Post
Everybody has the right to use water according to his/her interest, and the government should satisfy everyone's demand. [12]	PWR	3.44	2.94
If circumstances allowed you, would you like to reduce water consumption at home? [12]	BI	3.66	4.19
If circumstances allowed you, would you like to change Or install some water-saving appliances? [12]	BI	4.00	4.38
Average Behavioural Intentions	-	3.64	4.28
Overall Average	-	3.54	3.80

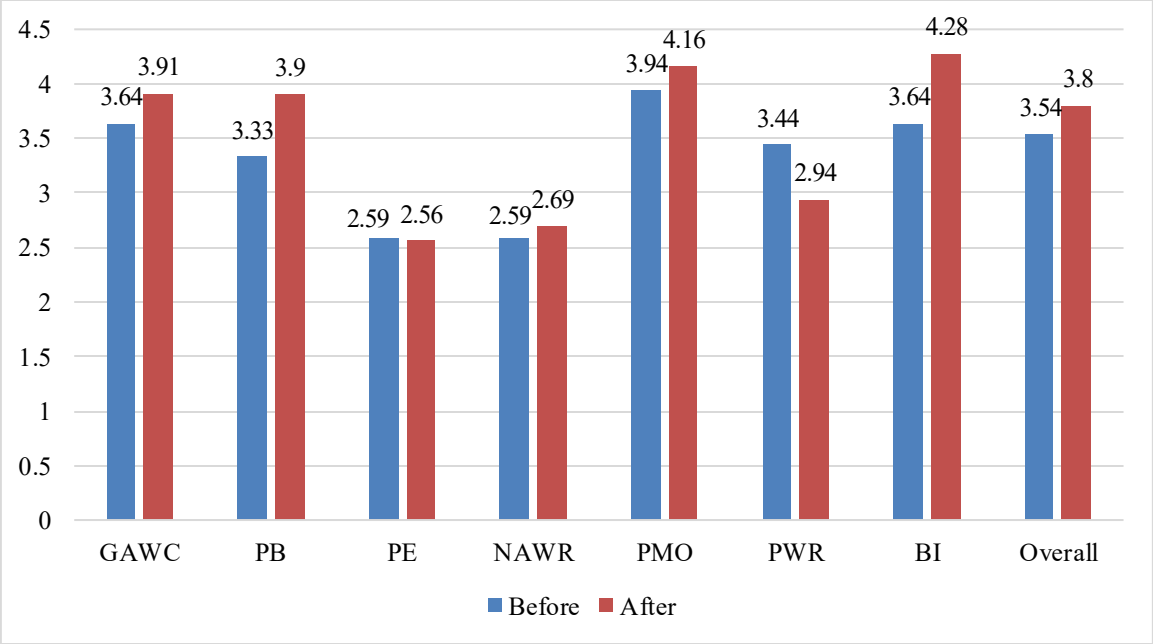

Fig. 2 Comparison of the averages of each subscale before and after the game was conducted

In Table 3, the responses to the GAWC (General Attitudes towards Water Conservation) scale are presented. Prior to the game, respondents strongly agreed on the importance of water conservation, indicated by an average response of 4.47 on a 5-point scale. When asked about the difficulty of convincing others to conserve water (a negatively scored item), the average response was 2.16, suggesting that respondents found it quite difficult to persuade others. Additionally, respondents remained neutral towards the statement *"I feel no pressure to conserve water at the moment"*, with an average score of 2.88.

Post-game responses in Table 3 showed a positive shift. The average score for the importance of water conservation increased to 4.91, demonstrating even stronger agreement. Respondents also showed a generally positive attitude towards water conservation following the game experience.

In Table 4, the responses to the Past Behavior (PB), Experience (PE) and Nuanced Analysis of Water Resource (NAWR), and Perceived Moral Obligation (PMO) scales are present. Before the game, participants showed neutral behavior regarding advocating water conservation, with an average score of 3.22. They somewhat agreed that they personally tried to conserve water wherever possible, reflected in a score of 3.44. Their past experience with limited water supply was relatively weak/neutral, with an average response of 2.59, and their understanding of India's water resources showed a similar weak/neutral pattern. In terms of moral obligation, respondents demonstrated a strong sense of responsibility towards water conservation, with average scores of 3.84 and 4.03.

After the game, Table 4 responses reported more positive past behaviors advocating water conservation, with an average score of 4.0, and stronger agreement regarding their mindfulness about saving water, with a score of 3.81. While their past experience with water scarcity remained relatively unchanged at 2.56, perceived moral Obligation increased, with average scores rising to 4.0 and 4.31, indicating an increased sense of personal responsibility for water conservation.

Table 5 presents the Perceived Water Right (PWR) and Behavioral Intentions (BI) scales. Pre-game responses reflected a somewhat neutral stance towards the statement *"Everyone has the right to use water to his or her own interest"*, with an average of 3.44. Respondents also showed a strong willingness to engage in water-saving behavior when circumstances allowed, with average scores of 3.66 and 4.0.

Post-game, while the statement about water rights dropped to a more neutral 2.94, behavioral intentions to conserve water strengthened significantly, with scores rising to 4.19 and 4.38, reflecting a very strong willingness to adopt water-saving behaviors.

Figure 2 presents each subscale's pre- and post-average responses. There is an increase in average score for the majority of the sections, with the largest one in behavioural intentions, from 3.64 to 4.28. There was also a decrease in perceived water right from 3.44 to 2.94. The average score increased from 3.54 before the game to 3 after. A t-test was conducted to understand the statistical significance of the results.

3.3. t-Test Results

Table 6. Paired Samples T-Test for General Attitude Towards Water Conservation Before and After Financial Incentive Game

Variable	M	SD	t	df	p
GAWC Pre	3.64	0.49			
GAWC Post	3.91	0.61	2.192	16	0.043

Note. N = 17. M = Mean, SD = Standard Deviation, t = t-statistic, df = degrees of freedom, p = two-tailed p-value. The table compares GAWC scores before and after a financial incentive game conducted with teenagers in Ahmedabad. Means and standard deviations are rounded to two decimal places.

Table 7. Paired Samples T-Test for Perceived Moral Obligation Before and After Financial Incentive Game

Variable	M	SD	t	df	p
PMO Pre	3.25	0.97			
PMO Post	4.16	0.78	3.107	15	0.007

Note. N = 17. M = Mean, SD = Standard Deviation, t = t-statistic, df = degrees of freedom, p = two-tailed p-value. The table compares PMO scores before and after a financial incentive game conducted with teenagers in Ahmedabad. Means and standard deviations are rounded to two decimal places.

Table 8. Paired Samples T-Test for Behavioural Intentions Before and After Financial Incentive Game

Variable	M	SD	t	df	p
BI Pre	3.57	0.52			
BI Post	4.28	0.52	3.405	15	0.004

Note. N = 17. M = Mean, SD = Standard Deviation, t = t-statistic, df = degrees of freedom, p = two-tailed p-value. The table compares BI scores before and after a financial incentive game conducted with teenagers in Ahmedabad. Means and standard deviations are rounded to two decimal places.

All three alternative hypotheses, H_{a1}, H_{a2}, and H_{a3}, are accepted.

4. Discussion

The findings of this study indicate that financial incentives significantly enhance water-saving behaviours among teenagers in Ahmedabad, as demonstrated by statistically significant increase in General Attitude towards Water Conservation (GAWC), Perceived Moral Obligation (PMO), and Behavioral Intentions (BI) subscales ($p<0.05$ for all three, as shown in Table 6-8). These results are consistent with prior research demonstrating the efficacy of financial incentives in promoting pro-environmental behaviors across various contexts, including Tokyo, Gujarat, Zambia and Australia.

This study uniquely extends these findings to a younger demographic, highlighting the potential of financial incentives as a tool to engage teenagers in water conservation efforts.

The results corroborate findings from diverse geographical and demographic contexts. A study conducted in households in the metropolitan area of Tokyo also reported an increase in water-saving behaviour when financial incentives were given, in low consumption households. [13] However, the paper reported that the same was not statistically significant for households with high consumption. A study in Gujarat, India, has also proven to be effective for farmers who use large amounts of water for agricultural purposes. [14] When the farmers were offered direct conservation payments (rupees 50-100 per hour of reduced pumping), the groundwater usage declined by 24%. In Zambia, Africa, where 4% of the median household's income is used to pay water bills, a study reported that lottery-based financial incentives, along with price information, led to water conservation. In contrast, price information alone had no significant impact. [15] An Australian study reported that financial incentives worked best when combined with some form of social nudge. [16] A Reno, Nevada study also reported similar results, concluding that social incentives aid financial incentives in creating a positive water-saving behaviour. [17] This study provides compelling evidence that financial incentives, delivered through a gamified intervention, can enhance water-saving behaviours among teenagers in Ahmedabad.

5. Conclusion

After the game, the students reported a better general attitude toward water consumption. The students' past behaviour improved, which can be attributed to playing the game. The past experience and nuanced analysis of water resources remained the same with nominal differences. The perceived moral obligation of the students changed as playing the game made them realise how much water can be saved with small actions. The perceived water rights of the students decreased, and the behavioural intentions improved. Overall, students' attitudes towards water conservation have improved after playing the game. The t-tests showed that the results were statistically significant at the 5% significance level, and the overall attitude towards water consumption has increased. This data can be used to encourage water saving among households and conserve water for future generations.

While the t-tests were conducted accurately, to further generalise the findings of this paper to a greater population, a larger study must be conducted with people of diverse demographic backgrounds across India. Moreover, the results of the experiment may vary due to income background. Participants with a higher socio-economic background may still not actively conserve water when offered financial incentives, while people from lower socio-economic backgrounds may drastically reduce water wastage.

While the results of the experiment can be used to create a financial incentive-based scheme to promote water conservation in the short run, offering incentives over a long period of time may not be feasible in the long run. For the

long run, financial incentives can be used alongside social nudges to promote water-saving behaviours worldwide. Alternatively, a progressive water tax can be set up to promote less wastage of water in households with higher consumption.

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