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Empowering Women for Environmental Stewardship: Curriculum Integration for Water Conservation in Women Universities of Pakistan

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Abstract

Water scarcity and environmental degradation present formidable global challenges, necessitating immediate attention and the pursuit of sustainable solutions. Recognizing the pivotal role of women's empowerment in fostering and advancing the environmental stewardship, this research focuses on the unique contribution of Pakistan's women universities as substantial higher educational institutions. These women universities can play a distinctive role in shaping the perspectives, behaviors and actions of their female students, particularly in the crucial domain of water conservation. This research article delves into the specific role of women universities of Pakistan in addressing the water scarcity concerns due to climate change and serious initiatives taken by administration to prepare the graduates for imminent environmental challenges. The research further explores the measures taken by these higher education institutions to assimilate water conservation awareness among female apprentices. The emphasis is on accepting a feminist approach to examine and improve the structure of environmental education at university level. This study rigorously examines the influence of academic initiatives, empowerment strategies and institutional policies and in imparting a sense of responsibility toward better water conservation among women. By using a qualitative analysis framework that deliberates experiences, observations, and educational practices, and perceptions, the article seeks to contribute meaningfully to the connection of climate change, water conservation, gender education, and environmental sustainability. The results aim to augment our understanding of operative plans to energize environmental consciousness among women, mainly within the setting of water conservation.

Keywords: *Environmental Stewardship, Global Challenges, Institutional Policies, Water Conservation, Water Scarcity, Women Empowerment, Women Universities.*

Introduction

Climate change has internationally arisen striking issues by altering the ecosystems and influencing the accessibility of critical natural resources, especially water. The multifaceted connection between climate change and water scarcity has extensive consequences for ecosystems, societies, and global sustainability. Irregularities in precipitation patterns, exacerbated by global warming, have increased the occurrence and strength of extreme unpredictable weather events, disturbing the water cycle and triggering water scarcity in erratic precipitation zones (Ahmed et al., 2020) The changing climatic conditions increased the demand for water resources, predominantly in dry climate areas, affecting both surface water and soil moisture (Fahad & Wang, 2020). Asymmetrical melting of glaciers and polar ice caps contribute to increasing sea levels, which imperils coastal communities and upsets freshwater sources (Figueiredo & Perkins, 2013)Temperature and rainfall changes have an effect on agronomy, reducing output and requiring more irrigation, which strains water supplies (Fahad & Wang, 2020).

The complex association between climate change, food security, and water dearth underline the importance of multi structured research activities. Environment change have an additional impact on aquatic resources, affecting agriculture patterns, human needs, and natural ecosystems in surface and groundwater structures In the dynamic climatic structure and rapidly altering universal environmental concerns, the immersion of women in improving the intricate socio-environmental growth for sustainable development is getting important (Hussain et al., 2020). Females, as persuasive stakeholders, have a unique opportunity to encourage the positive change in environmental stewardship. Women's participation in global water conservation is critical to achieving the long-term environmental upgrading (Batool et al., 2020).

Women performs multiple responsibilities in growing communities, households, and societies. They can be involved as vivacious participants for successful water resource management at domestic and commercial level Recognizing and empowering the women for water conservation initiatives is essential for developing strong and sustainable communities around the world especially in water-scarce countries like Pakistan. The countries already handling the penalties of water scarcity are at critical juncture, where practical and proactive actions are required (Caruso et al., 2022). The young trained female generation, which are substantial demographic component, contains the ability to function as a catalyst for social change and can direct the trajectory towards more sustainable behaviors (Batool et al., 2020).

In Pakistan women are commonly responsible for handling everyday domestic chores so utilize more water, for household activities including cooking, washing, cleaning, and personal hygiene. Their decisions and approach about water usage contains a considerable influence on overall consumption patterns. Women, as main custodians and educators in their families, can pay an important role in molding the attitudes and behaviors regarding water use (Samiullah et al., 2018) . Women often produce ingenious solutions to domestic water shortage while serving as community leaders and influencer. Educating females with technical knowledge about effective water usage by adopting the conservation techniques at home is important for reducing waste production. Empowering the women to value water conservation, sustainable practices, and the mitigating the consequences of overconsumption can bring in more conscientious and controlled water habits in families (Patel et al., 2021).

Women's role in domestic water consumption and conservation are solemn in tackling global water scarcity issues and maintaining sustainable resource management. Women perform several responsibilities in households, influencing the daily water consumption needs and acting as decision-makers and primary carers (Imran et al., 2021). Recognizing and empowering women in these roles is essential for effective water conservation measures. To deal with environmental uncertainties and a fast-changing climate, it is more important than ever to provide young girls with the knowledge and skills they need to live sustainable (Figueiredo & Perkins, 2013) To empower the female graduates, water conservation principles must be strategically integrated into educational curricula (Ali et al., 2021). The demand to reshape educational paradigms for the benefit of both the environment and future generations grows stronger by the day. The

inclusion of practical environmental education for sustainable water usage has become an absolute necessity for improving women's knowledge of forthcoming environmental concerns (Imran et al., 2021). Advanced and socially effective curriculum integration at the higher education level can help empower women to reduce water scarcity through residential and business water conservation activities. It will ultimately develop decisive attitudes and sense of responsibility for environmental restoration at both the micro and macro levels (Hablemitoglu & Ozmete, 2010).

In Pakistan water scarcity is a significant challenge, and the role of women's universities is pivotal in determining the mindset and approach of next generation of the female leaders (Memon et al., 2023). The demand of comprehensive and strategic approach about water conservation and management through curricular adaptation in women universities for preparing female graduates has been increasing for addressing water-related issues and fostering sustainability (Dakhan et al., 2020). With the help of water conservation and management-based course provision at university level, the female community can be facilitated through skill oriented physical and mental expertise. The universities can improve the socio-environmental role of young females for water resource management from sustainable practices (Arshad et al., 2020). The water conservation strategies and policies can thoroughly be adopted through practical training and mind building of community. The higher education institutions are best institutions to train community through knowledge and expertise. These institutions can empower the young community with skills, knowledge and expertise to become influencers and advocates of sustainable water management in their everyday life (Augustine & Hanafiah, 2019).

Objectives

1: To explore the role of women universities in training the young graduates about sustainable water conservations through formal educational activities.
2: To investigate the perception among female students of women universities of Pakistan about water resource conservation and management.

Review of Literature

Masood et al, (2023) (Frank, 2021) (Hussain et al., 2020) (Ahmed et al., 2020) (Frank, 2021) explores that a planned and sustainable water resource utilization is tactical and responsive slant that encourages water conservation for fair distribution and secure environment. Water resource training provides long-term solutions of social, economic, and environmental water concerns to manage water demand and supply balance without disturbing natural system of forthcoming generations. Technological adaptation prioritizes the environmental conservation, facilitates community engagement in decision making and implicates integrated planning that helps regulatory framework and climate resilience. Community awareness and training is essential to tackle water scarcity and environmental degradation for egalitarian, resilient and sustainable water future. Public approach and actions towards water resource usage for multiple chores are equally important to promote sustainable dimensions for integrated water resource system in an area. The role of young generation is not negligible in water sustainable resource utilization and storage.

Caruso et al, (2022) discussed that women make an important social contribution to sustainable water management and conservation, particularly in preserving and responsibly handling the water resources. Their multifarious engagement includes water collecting responsibilities, community initiative leadership, and creative water-related solutions. As key caregivers and educators, women determine attitudes towards water usage, and teaching them about sustainable techniques promotes responsible water habits. In rural areas, women's participation in agriculture underscores the significance of educating them about sustainable methods, effective irrigation, and crop selections for water conservation. Their participation in decision-making processes assures inclusive and operative solutions for water infrastructure development. Women's universities are imperative institutions that empower, educate, and nurture leadership qualities in women. They endorse confidence, address gender imbalances, and highlight women's accomplishments in all

sectors, shaping a more fair and progressive society. Their presence embraces sustainable development, with graduates making noteworthy contributions worldwide, consequently advancing the social growth.

Sepehri et al, (2021) (Gulraiz & Ali, 2021) (Qasim et al., 2018) (Sultan et al., 2016) (Sepehri et al., 2021) mentioned that universally higher education institutions perform an imperative role in educating the graduate students about water conservation using targeted tactics imparting responsible behaviors for environmental sustainability. This involves integrating water conservation modules into the academic curriculum in all disciplines, making a compact basis for all students. Hands-on training and internships with relevant organizations provides practical experience to students, that allows them to apply theoretical knowledge in real-world settings. Encouraging the research initiatives on novel water preservation technologies and strategies promotes an inquiry-based and inventive culture.

Arshad et al, (2020); Burridge et al., (2016); Patel et al., (2021) explored that younger communal participation can enhance the publicly beneficial initiatives in local water conservation projects. It augments the functionality of projects and encourages the community towards civic responsibility and environmental stewardship. Awareness campaigns in the academic environment and beyond edify the need of responsible water use. Guest lectures, expert interactions, discussions, seminars, and networking events connect graduating students to individuals and organizations in the water conservation business, providing them valuable insights and employment chances.

Specialized career coaching emphases on job potentials and research prospects in water-related fields. Adopting student-based initiatives promotes active engagement in environmental activities whereas establishing a good instance for future cohorts. With these measures, women's institutions equip graduates to be activists, leaders, and professionals committed to addressing global water shortages and promoting sustainable water practices.

Methodology

The recent research focused on both descriptive and statistical methods to inspect the environmental stewardship and awareness about water conservation among young female students of women universities of Pakistan. Secondary data was collected from official website of all fifteen women universities of Pakistan. For primary data collection field survey was conducted from students of different faculties of four women universities of Pakistan through instrumental survey utilizing research questionnaire. For pilot survey data was collected from twenty participants of Government College Women University Faisalabad (GCWUF) and analyzed to check the reliability of items.

Stratified random sampling technique was used to collect data from four universities including GCWUF, Lahore College for Women University (LCWU), Women university Multan (WUM), and Rawalpindi Women University (RWU). Total 150 samples were obtained from selected universities. Four universities were selected for data collection on the basis of accessibility and convenience.

The data was systematically digitized and analyzed using the Statistical Package for Social Sciences (SPSS) version 21 and STATA version 15 analytical software tools. Univariate analysis was first conducted to calculate descriptive summary statistics like frequencies, means and percentages for the demographic variables and water conservation indicators. This provided insights into the socioeconomic attributes and awareness for water saving behaviors of the sampled students. Bivariate analysis was then performed to assess correlations between demographic factors and reported water conservation awareness. Cross-tabulations of age, education, and institutes, against the awareness frequencies indicated preliminary relationships.

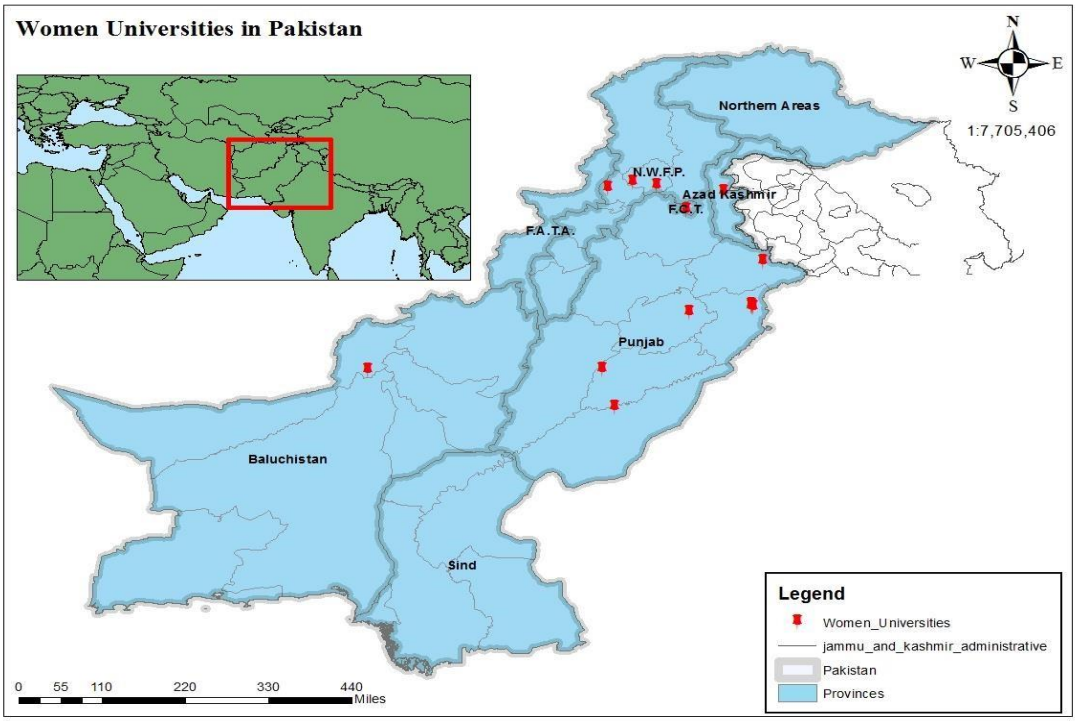

Figure 1: Location map of women universities of Pakistan.

The logit model was estimated with water conservation frequency as the ordinal dependent variable and key demographics as the predictors. Finally, an ordered logistic regression model was estimated with water conservation frequency as the ordinal dependent variable and key demographics as the predictors. This multivariate modeling approach identified the determinants with statistically significant impact on the likelihood of graduates aware about water saving behaviors, after controlling for confounding factors. The ordered logit model is suitable for ordinal outcome variables and avoids restrictive assumptions of normality and homoscedasticity required for linear regression. It is estimated using the following Equation.

Model for Simple linear regression

$$Y_{ij} = \beta_o + \beta_1 x + \sigma_{ij} ,$$

where y_{ij} represents the observed value, β_o is the effect of the intercept, β_1 is independent variables and σ_{ij} ~ N (0, σ^2) represent the effects of the uncontrolled factor of the experimental assay, with $i = 1,...I$ and $j = 1,...J$ In order to perform the analysis.

Multiple Linear Regression

Multiple regression works by considering the values of the available multiple independent variables and predicting the value of one dependent variable.

For Multiple Regression equation

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + ...(1)$$

y = A predicted value of y (which is your dependent variable)

α = the y Intercept

β_1 = the change in y for each 1 increment change in x_1 values

β_2 = the change in y for each unit increment change in the x_2 value

x =value of x (x is the Independent Variable) which can predict a value of y as dependent variable)

The ordinal Logit Models

Logistic (or sometimes called ordered logit models) are logistic regressions that model the change among the several ordered values of the dependent variable as a function of each unit increase in the predictor. (With a binary variable, the ordinal logistic model is the same as logistic regression.) the equation of ordinal logit models is:

$$p = \frac{e^{a+bx}}{1 + e^{a+bx}}$$

Results and Discussion

This study investigated the water conservation, environmental stewardship awareness among female university students and the role of their formal educational programs for better learning practices and improved knowledge. The information from official websites of all women universities of Pakistan reveals that almost all universities are incorporating courses regarding environmental studies in their degree programs but they have not included uniform courses about water conservation and management for all degree programs especially at bachelor level. Further only eight out of fifteen women universities are offering specialized degree programs relevant to environmental studies. Courses and degree programs about environmental studies offered in all women universities mainly emphasizes on scientific perspective and less relevant to socio-behavioral insights and requirements.

Primary data from questionnaire is summarized using charts, tables, and graphs. The data set is well-formatted and divided structurally and the result is shown in the frequency tables about demographic variables below:

Table1: Frequency distribution of participants.

Variables		**Frequency**	**Mean**	**Standard Deviation**
Age	18-20	43	0.28	15.88
	21-23	68	0.45	17.85
	>24	39	0.26	16.67
		Frequency	**Mean**	**Standard deviation**
Faculties	Basic Science	23	overall	overall
	Management Science	66	2.45	0.2543
	Arts & Humanities	32		
	Social Science	29		
	Total	150		

The table shows that students between age group of 21 to 23 years responded the most and maximum overall response was from faculty of management science students.

Multiple Linear Regression

Awareness and understanding of environmental stewardship and water conservation in four universities was evaluated through multiple regression model.

x_1 = GCWUF, $_2$ = LCWU, x_3 = MWU, x_4 = RWU.

Table 2: Multiple Linear Regression of sampled data

Variables	B	t value	P value
Intercept	2.461	5.88	0.000
X1	.067	1.12	0.001
X2	.085	1.371	0.003
X3	.006	.101	0.000
X4	.024	.231	0.000

Table 3: Sum of square & mean square

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.024	4	.756	.794	.0531[b]
	Residual	138.050	145	.952		
	Total	141.073	149			

Table 4: ANOVA

ANOVA						
Institutes Name		Sum of Squares	df	Mean Square	F	Sig.
Govt College women university Fsd.	Between Groups	1.160	3	.387	.207	.892
	Within Groups	273.300	146	1.872		
	Total	274.460	149			
Lahore College women university.	Between Groups	5.836	3	1.945	1.156	.329
	Within Groups	245.657	146	1.683		
	Total	251.493	149			
Multan women university.	Between Groups	2.516	3	.839	.522	.668
	Within Groups	234.657	146	1.607		
	Total	237.173	149			
Rawalpindi women university.	Between Groups	1.973	3	.658	1.316	.272
	Within Groups	72.987	146	.500		
	Total	74.960	149			

The multiple regression and ANOVA table indicates that university level formal education for awareness, effectiveness and understanding of environmental stewardship and water conservation in all faculties is highly significant by comparing $P < 0.05$.

The discoveries propose that essential conduct estimates like information and viable preparation about water preservation among young females at universities level are vital to prepare them for water conservation at domestic and commercial level. Various resources and programs at government sector women universities are critical drivers, with more relevant strategies can show more awareness and water conservation directions.

The outcomes feature that ladies can assume a part in ecological stewardship, especially with regards to water protection. The current research gives valuable bits of knowledge to illuminate proof-based strategies for preparing women for environmental stewardship, including water protection, through university's formal studies.

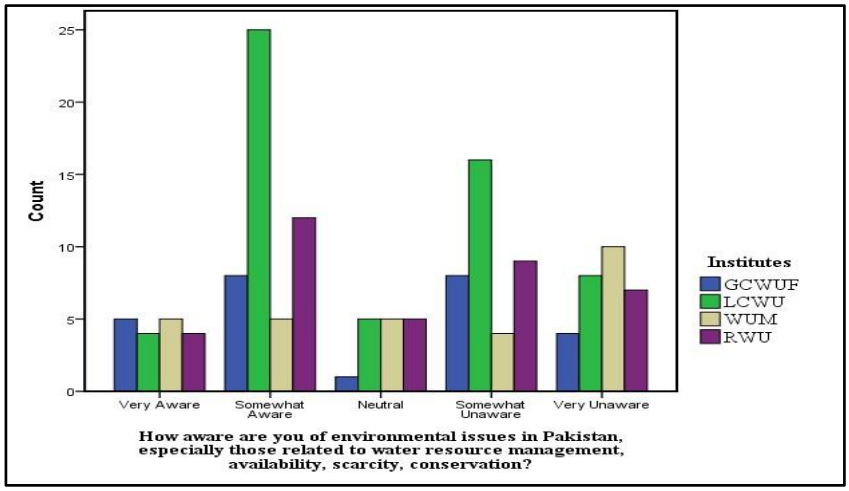

Figure 2: Students awareness about environmental issues in Pakistan

Students of women universities were sampled for their awareness about environmental issues particularly water resource management in Pakistan. The figure 2 shows that 11.3% students responded that they are very aware about environmental concerns and 31% are somewhat aware but 47.3% have very less or no awareness about water related environmental issues of Pakistan.

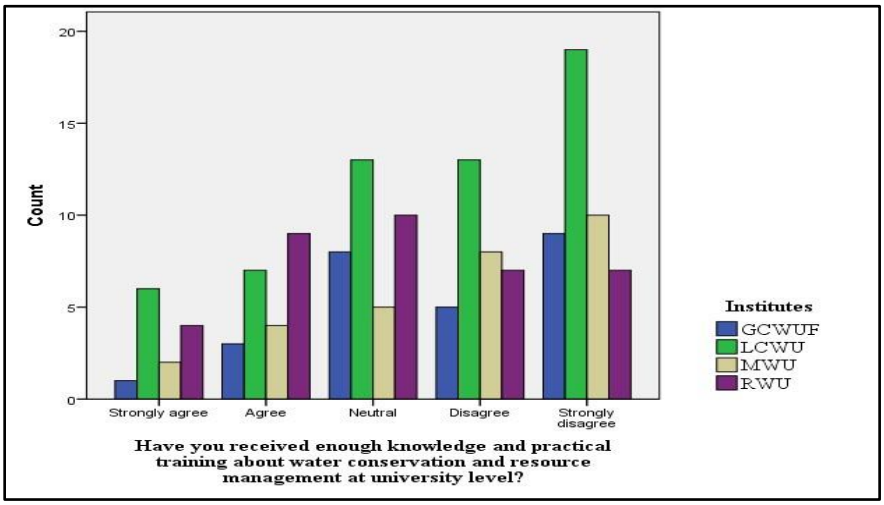

Figure 3: Learning and training about water management at university level.

The statistical evaluation indicates that more than 64% students have not received enough knowledge and practical training for water conservation and resource management from their formal education at university level. About 68% respondents have shared that courses related to water conservation and management are not integrated in their current degree program whereas only 12% have indicated such courses in their ongoing degree.

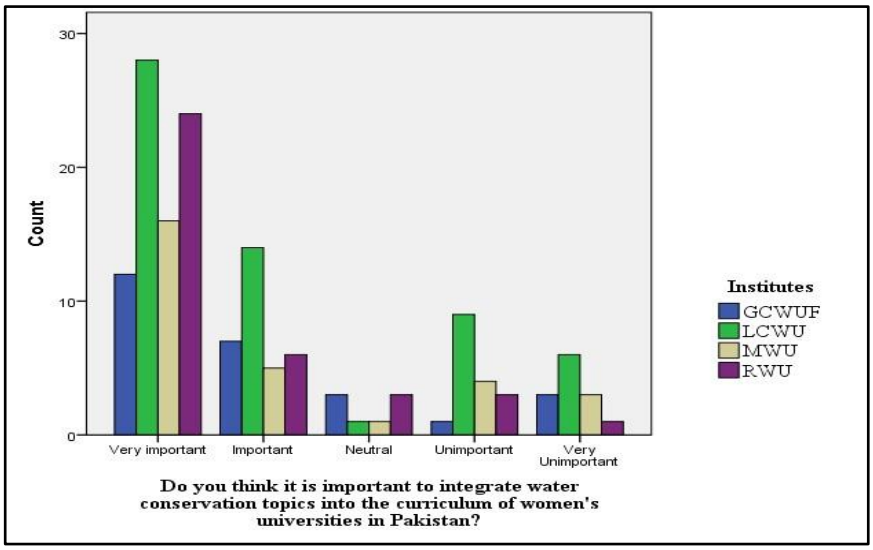

Figure 4: Integration of courses about water conservation in curriculum.

On the other hand, more than 55% have never taken any formal training or education about environmental stewardship for socio-environmental development. According to data collected from university level female students, more than 70% believe that water resource management for conservation is essential for addressing environmental challenges. Curriculum of higher education level should incorporate specific courses to prepare young females to thoroughly encounter such challenges in Pakistan. The current study investigated that 84% respondents have never participated in any initiative or activity about water conservation and environmental stewardship and 83% students revealed that they have never obtained any practical knowledge through internships, or fieldwork activities about water management specifically conservation through formal education.

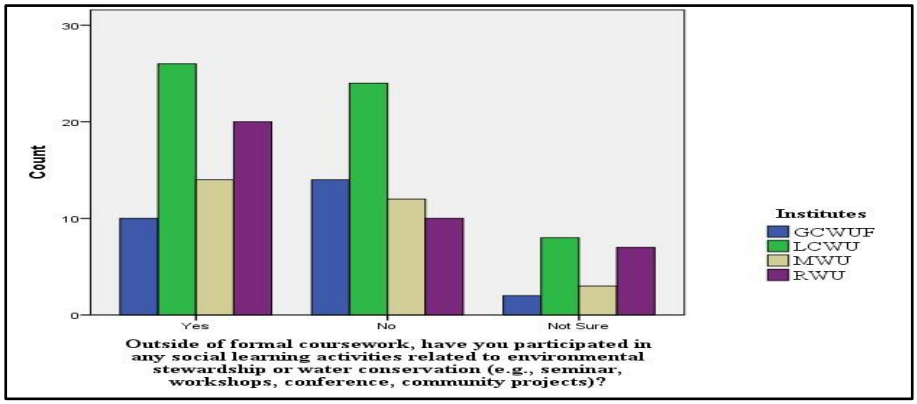

Figure 5: Integration of courses about water conservation in curriculum.

On the other hand, 45% students have reported their participation in social learning activities related to environmental stewardship and water conservation through seminar, workshops, conference, community projects other than formal education.

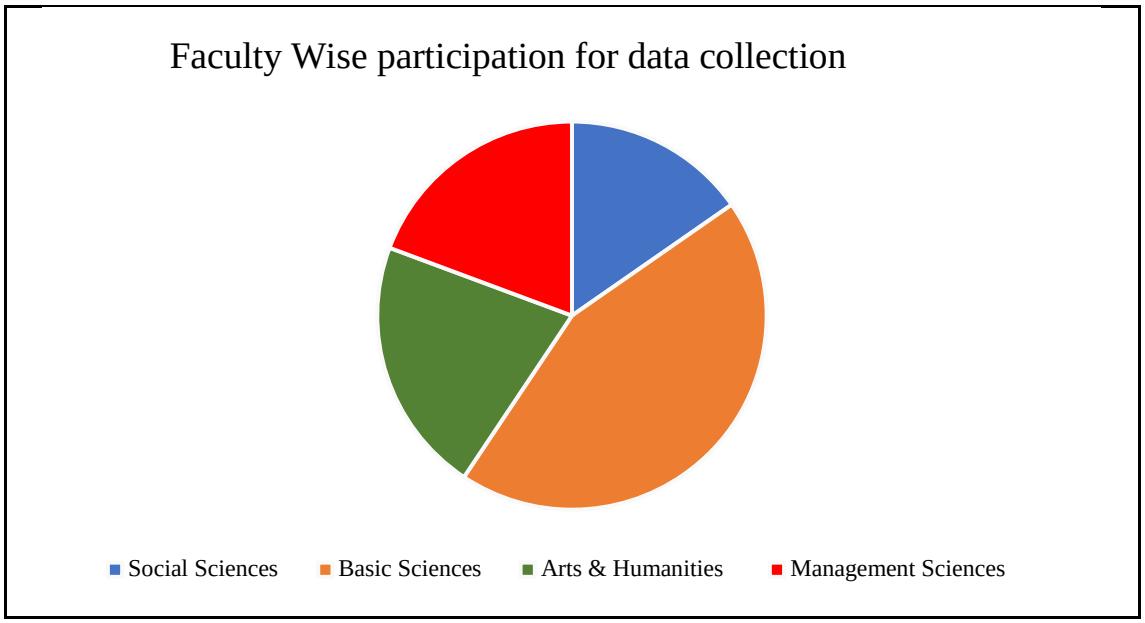

Figure 6: Faculty wise participation for data collection

Table 5: Faculty wise participation for data collection

Faculties	N	Marginal Percentage
social science	23	15.3%
Basic Science	66	44.0%
Arts & Humanities	32	21.3%
Management Science	29	19.3%

Logit model was estimated with water conservation frequency as the ordinal dependent variable and key demographics as the predictors. Similarly, an ordered logistic regression model was estimated with awareness of respondents for water conservation frequency as the ordinal dependent variable and key demographics as the predictors. The result of descriptive statistics, multiple regression and ordinal logistic regression at categorical variables indicates that students from different faculties of selected universities are somehow aware of environmental issues including water scarcity and water conservation but almost half of them have not learnt proper courses about sustainable water management strategies in their entire educational journey.

Table 6: Ordinal Logit Models

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	388.813			
Final	283.927	104.886	17	0.03

Table 7: Goodness of fit through Mc Fadden test.

Goodness-of-Fit				McFadden ~ R-Square
	Chi-Square	Df	Sig.	0.7681
Pearson	1316.890	149	.373	
Deviance	573.065	149	1.000	
Link function: Logit.				

Goodness of fit statistics indicates that the role of female graduates is significant for environmental stewardship and is best fit for socio environmental development of communities because significant value is less than 0.05. The model determines that the necessity of integration of water conservation courses and practical knowledge in the curriculum of women's universities is highly significant for sustainable environmental growth and water resource management. Model summary show the pseudo-R-Square mean that it does not technically explain the variation in ordinal logistic regression. McFadden test shows the variation in the criterion variables. In this case we can say that 76% of respondents believe that water conservation courses should be included in curriculum of degree programs of women universities and practical training and internships should be proposed for better understanding of young female generation about water resource management.

Conclusion

The present study aimed to determine the key variables of water conservation behavior in order to better understand the elements may be targeted in water demand reduction initiatives. This study is therefore a more robust exploration of the role of demographic, social, psychological, and behavioral variables, and their relationship with an objective measure of water conservation. The relationship between the conservation behavior of young female graduates and related factors (attitude, awareness, responsibility) and role of universities for their learning and grooming for environmental stewardship was explored. The study investigated that the most dominant component in water conservation behavior is the awareness about available water resources, availability and scarcity issues and management.

Policy Implications

The current study investigated the educational interaction among women universities and young female graduates for awareness about water conservation and their preparedness for environmental stewardship. These findings could assist more stakeholders and policymakers in raising female awareness, preparation of young generations for environmental stewardship, and their involvement in water conservation efforts through better curriculum integration at the university level.

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