



Evaluate and Measure the Level of Environmental Awareness on Campus Salahaddin University

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Abstract

Principal component analysis (PCA) is a powerful tool for analyzing data. The other main advantage of PCA is that once you have found these patterns in the data, and you compress the data by reducing the number of dimensions, without much loss of information. It has been called one of the most valuable results from applied linear algebra. It is used abundantly in all forms of analysis - from neuroscience to computer graphics - because it is a simple, non-parametric method of extracting relevant information from confusing data. In fact, pollution the environment in our society is a huge problem which needs to solve and determine the reasons, here taking two different samples from Salahaddin University (students, lecturers) of all colleges, this research takes the negative points or gathers the ideas which helps to build a healthy environment in which you can live in without any hesitation, used the stratified sample in this research by questionnaire form for collecting information. Later PCA has been applied as a tool to analyzing the data and this application has been found to be a successful in this area because we reached to the most important result, the first component of the two levels has (7) common variables and it is usually explained the largest part of the variance in the analyzing, it shows us the convergence of intellectual awareness on campus the university against environmental pollution in the region.

Keywords: Environmental, principal component analysis, orthogonal, eigenvalue-eigenvector, Kaiser measurement.

Environmental awareness: is the individual's perception of the environmental impact on its ionic and non-ionic components and its impact on the environment is positive, works on its survival and negatively works to reduce it and seek to find a solution, or the sum total of all surroundings of a living organism, including natural forces and other living things, which provide conditions for development and growth as well as of danger and damage (Yoxsimer 2015).

Introduction:

There are a lot of reasons that lead to pollute the environmental in our society. Out of job in the university environment, field observed and unconscious behavior of the pioneers of the university towards the environment and this is a negative indicator of the lack of environmental awareness, although the university educated class-conscious to a sufficient extent on environmental problems.

The practice of human various activities and with the scientific and technical development witnessed by the world and what is produced by these activities from the negative effects on the environment and society is the human being is the main cause of environmental pollution, nature provides a livelihood and every life has requirements only takes what he needs them and leaves residue on them, and versatility and the accumulation of consumption (neglect and inattention) and with the passage of time caused an imbalance in the ecosystem balance and we have seen it is necessary to study the assessment and measure of the level of environmental awareness and also we can clarify the nature of the relationship between the rights of its own environment segment of the campus in the capital of the Kurdistan Region community (Erbil). The goal is identify the level of environmental awareness among faculty and students, depending on the scale of the gender and drew the attention of the researchers



conducting the factor analysis to the large data areas of environmental awareness and other areas.

Methods:

Principal component analysis (PCA) as invented by Karl Pearson in 1901, is a procedure to convert a set of correlated variables into uncorrelated ones called principal components. Using mathematical algorithms such as eigenvalue decomposition of the covariance tensor or single value decomposition (SVD), PCA methods find successful applications in many fields (Joliff, 2002).

The central idea of principal component analysis (PCA) is to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This is achieved by transforming to a new set of variables, which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all of the original variables. Computation of the principal components reduces to the solution of an eigenvalue-eigenvector problem for a positive-semi definite symmetric matrix [Jolliffe I.T ,2002, Pricipal Component Analysis,2nd edition].

PCA refers to the problem of fitting a low dimensional affine subspace S to a set of points $X = \{x_1, x_2, \dots, x_N\}$ in a high-dimensional space R^D the ambient space. Mathematically, this problem can be formulated as a statistical problem (Vidal, R., Ma, Y. & Sastry, S. Shankar (2006)). Historically, PCA was first formulated in a statistical setting to estimate the principal components of a multivariate random variable x (Pearson 1901; Hotelling 1933). Specifically, given a zero-mean multivariate random variable $x \in R^D$ and an integer $d < D$, the d "principal components" of $x, y \in R^d$ are defined as the d uncorrelated linear components of x .

$y_i = u_i^T x \in R, u_i \in R^D, i = 1, 2, 3, \dots, d$ Such that the variance of y_i is maximized subject to:

$$u_i^T u_i = 1 \text{ and } Var(y_1) \geq Var(y_2) \geq \dots \geq Var(y_d) > 0$$

For example, to find the first principal component y_1 we seek a vector $u_1^* \in R^D$, Such that:

$$u_1^* = \arg \max_{u_1 \in R^D} Var(u_1^T x) \text{ s.t. } u_1^T u_1 = 1$$

The following theorem shows the principal components of x can be computed from the eigenvectors of its covariance matrix $\Sigma = E(xx^T)$. PCA was first described by Karl Pearson in 1901. A description of practical computing methods came much later from Harold Hotelling in 1933 (Manly, 2004). The idea of PCA is to keep the variation of the number of (p) original features into a fewer number of k unobservable variables ($k \leq p$), which is termed as principal components, as maximum as possible.

The aim of PCA is to find a new set of variables; say (Z_1, Z_2, \dots, Z_i) in a form of a linear combination of X 's which is $(Z = \alpha^T X)$. Here, $(Z = Z_1, Z_2, \dots, Z_p)$ is a vector of principal components and (α^T) is a matrix of coefficients (α_{ij}) for $i, j = 1, 2, \dots, p$. The first principal component (Z_1) is the linear combination of the original features which mathematically written as:

$$Z = \alpha_{11}X_1 + \alpha_{12}X_2 + \dots + \alpha_{1p}X_p$$

Assemble as the largest as possible of variance of (p) features subject to the condition that $\alpha_{11}^2 + \alpha_{12}^2 + \dots + \alpha_{1p}^2 = 1$. Then, the second principal component (Z_2) is chosen to have the property of having the second largest possible variance of (X_1, X_2, \dots, X_i) while being uncorrelated with the first component (Z_1) .



The remaining principal components are defined similarly, with the j th principal component having the largest possible variance given that it is uncorrelated with the i th principal component for $(i < j)$. Let λ_i be the variance (eigenvalues) of (Z_i) and (α_{ij}) be the eigenvectors of (Z_i) where $(i, 1, 2, 3, \dots, p)$, then these conditions hold for the eigenvalues and eigenvectors.

Data Collection:

Data were collected by the researcher and used the stratified sample for collecting data, where limited the study sample through twelve (12) Colleges in Salahaddin / University, designed the questionnaire form with many questions for this project; it has designed a form after taking expert opinions, were distributed to (Males and females) where (347) lecturers randomly selected from the total (1740) of lecturers and (380) students were randomly selected from the total (22082) of students. And then adopted to represent the studied sample size to reach (737) Forms see (Table -1-) used Likert Scale and (Cronbach’s Alpha) for Reliability and Validity, also there are another table for data which is KOM of sampling and Bartlett’s test see (Table -2-) but the Factor Validity is to choose Factor Analysis.

Table 1: The sample that taken by Likert Scale and Cronbach’s Alpha

Category	Total	Likert Scale for Sample	Cronbach’s Alpha
Lecturers	1740	347	0.681
Students	22082	390	0.739

Table 2: KOM of Sampling and Bartlett’s test

Category	KOM of Sampling	Bartlett’s test		
		Test value	df	Sig
Lecturers	0.790	2167.636	496	0.000
Students	0.732	1713.693	465	0.000

Results and Discussions:

Despite there is many methods to analysis the relationships between variables, the principal components analysis (PCA) was done on the correlation matrix, it was preferred because desired to treat all variables on an equal footing and defined the interesting of each variable, the variables under the study was with different units of measurement, the data has been transforming into standardization, where distributed as normal distribution with mean zero and unique variance, based on the eigenvalues and the kaiser measurement to test the number of significant factors.

Table (3) displays the total of variance explained of data on the level of environmental awareness for students based on the eigenvalues greater than or equal to 1. Where there are (10) significant principal components which their Eigenvalues greater than one, and that means (28) variables reduce into (10) hypothetical variables which reflect common variance between variables that called components uncorrelated with one another to dispose of the multicollinearty and transformed to independent variables that have effected on the environmental awareness by data of a sample of (390) students in salahaddin university. The scree plot Fig.1 seems agrees that ten principal components are adequate to represent the original features. In which these components interpret (55.277) of the total variation for variables, descending from the largest to the smallest variation.

Table 3: Total variance explained of data students for



the level of environmental awareness

Total Variance Explained loadings			
Component	Total	% of Variance	%Cumulative
1	4.078	14.063	14.063
2	2.045	7.052	21.114
3	1.630	5.620	26.734
4	1.458	5.026	31.760
5	1.278	4.407	36.167
6	1.218	4.201	40.368
7	1.151	3.970	44.338
8	1.112	3.836	48.174
9	1.058	3.648	51.822
10	1.002	3.454	55.276

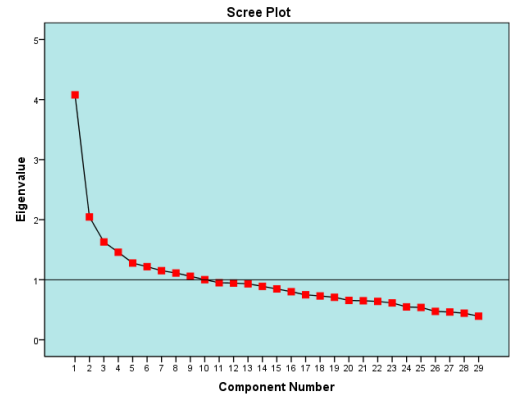


Fig 1: Illustration of the scree plot for students

From the **Table (4)** as a part of PCs method, we automatically obtain information about contribution of each principal component to the total variance of the coordinates, in fact in this case obtained (10) PCs, approximately (55%) of the total variance of the data were accounted. The first principal component is approximately (14%) is accounted and for the first three principal components are approximately (26.7%).

These first three components accounted for the vast majority of the variation in the data and were determined within each component, there are (8) variables that have the highest loadings among the component number one that they come in order from bigger to smaller variables respectively ($Q_{23}, Q_{28}, Q_{22}, Q_{21}, Q_{27}, Q_{19}, Q_{26}, Q_{24}$). This component has the big important effect on the environmental Awareness where it expresses about (%14.063) of the total variation. The biggest variable was (Q_{23}) with the Common quantity (0.572) and the smallest variable was (Q_{24}) with the common quantity (0.6), the second component comes after the component number one in terms of importance expresses about (7.052) of the total variation, it includes (8) variables which the large variable is (Q_{17}) with quantity of communion (0.640) and the smallest one in the same component the variable number (Q_1) with (0.425).

Also component number 3, 4, 5, 6, 7, 8 and 9 comes respectively in the term of significance, the latest component is the component number ten comes the lowest effect on the awareness of environmental which expresses about (%3.454) of the total variation it doesn't have a big effect, which content (4) variables for more detail see the table -4-.

Table 4: Rotated Component Matrix^a for students

	Component										Communalities
	1	2	3	4	5	6	7	8	9	10	
Age	.106	-.079-	-.025-	-.090-	-.114-	.009	-.084-	-.048-	-.038-	.670	.499
Q1	.154	.318	.193	-.128-	.330	.237	.035	-.120-	-.256-	.022	.425
Q2	-.081-	.337	.078	-.106-	.348	-.179-	.066	-.161-	-.050-	.402	.485
Q3	.032	-.011-	.156	.736	.043	.096	-.076-	.108	.127	-.059-	.616
Q4	.080	-.001-	.016	.805	.064	-.067-	.166	-.031-	-.006-	-.014-	.692
Q5	-.051-	.078	.121	.185	.632	-.059-	.108	.026	-.011-	-.039-	.475
Q6	.060	.074	.628	.103	.322	.219	.076	.060	-.100-	-.172-	.615
Q7	.175	.087	.599	-.026-	.182	-.049-	.106	-.068-	-.118-	-.067-	.468
Q8	.119	.137	.729	.145	-.101-	-.115-	-.045-	.002	.081	.155	.642



Q9	.025	.581	.295	.031	-.195-	-.024-	.206	-.027-	-.028-	-.053-	.512
Q10	-.049-	-.142-	.012	.265	.040	.038	-.129-	.462	.347	-.090-	.455
Q11	.134	-.107-	.022	.158	.131	.068	.649	-.057-	-.125-	-.095-	.526
Q12	.057	.127	.071	-.048-	-.031-	.028	.727	.131	.176	.007	.605
Q13	.121	.123	.155	-.209-	.183	-.292-	.294	.270	-.036-	.215	.423
Q14	.017	.010	-.047-	.014	-.054-	-.009-	.158	.751	-.142-	-.023-	.615
Q15	.066	.061	.027	-.052-	-.079-	.764	.073	-.052-	.080	-.080-	.623
Q16	.118	.621	-.021-	.180	.125	-.112-	.038	-.007-	-.439-	.138	.674
Q17	.123	.743	.093	-.089-	.161	.070	-.070-	.012	.128	-.055-	.640
Q18	.193	.435	.037	-.115-	.235	.069	-.214-	.419	.173	-.074-	.557
Q19	.437	.331	.003	.012	.390	-.074-	.032	.040	-.017-	-.023-	.462
Q20	-.100-	.029	-.101-	.117	-.046-	.091	.075	-.058-	.820	.005	.726
Q21	.549	.121	.259	.056	-.231-	.070	.024	.224	-.105-	.094	.515
Q22	.554	.330	-.044-	.057	.094	.069	-.047-	-.050-	-.104-	-.166-	.478
Q23	.727	.003	.063	.005	-.024-	-.021-	.147	.068	-.039-	-.104-	.572
Q24	-.363-	-.124-	-.010-	.076	-.280-	.445	.115	.321	.092	.214	.600
Q25	-.129-	-.046-	-.126-	.182	.163	.508	-.053-	.181	.015	.455	.595
Q26	.436	-.080-	.232	-.223-	.390	-.113-	-.190-	.006	-.062-	.065	.509
Q27	.503	.072	.035	.026	.128	.005	.130	-.015-	.230	.322	.451
Q28	.645	-.017-	.217	.093	-.049-	-.057-	.087	-.142-	-.113-	.250	.581

Also in Table (5) displays the total of variance explained for the (PCA) of data on the level of environmental awareness for lecturers based on their eigenvalues greater than or equal to 1, Where there are (9) components with eigenvalues greater than one. It can be seen that with only nine linear combinations of the original features out of (28) variables reduce into (9) hypothetical variables Which reflect common variance between variables that called components uncorrelated with one another to dispose of the multicollinearty and transformed to independent variables, that have effected on the environmental awareness by data of a sample of (347) lecturers in salahaddin university. The scree plot Fig. 2 shows us that it seems agrees ten principal components are adequate to represent the original features. In which these components interpret (55.781) of the total variation for variables, descending from the largest to the smallest variation.

Table 5: Total variance explained of data lectures for the level of environmental awareness

Total Variance Explained loadings			
Componen nt	Total	% of Variance	%Cumulative
1	5.125	17.672	17.672
2	2.127	7.336	25.008
3	1.747	6.025	31.033
4	1.523	5.251	36.284
5	1.249	4.307	40.591
6	1.185	4.087	44.678
7	1.144	3.946	48.625
8	1.065	3.674	52.299
9	1.010	3.482	55.781

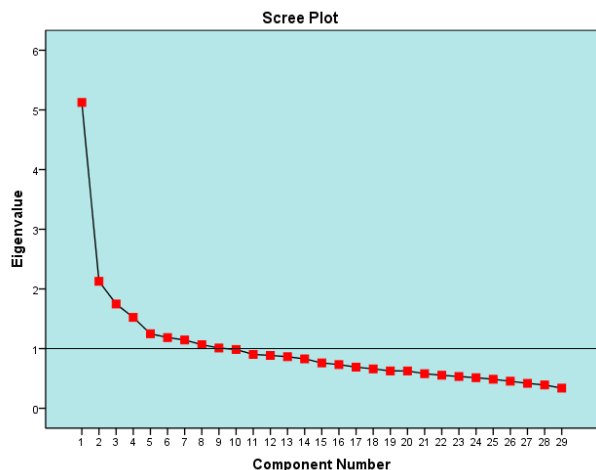


Fig 2: Illustration of the scree plot for lectures



Based on **Table (6)** Rotated Component matrix for lecturers as a part of PCs method, we obtained information about contribution of each principal component to the total variance of the coordinates, in fact in this case obtained (9) PCs and these explained approximately (55.781%) of the total variance of the data were recorded. The first principal component is approximately (17%) from the total variance and for the first two principal components are approximately (25.008%). These first two components accounted for the vast majority of the variation in the data and were determined within each component, there are (12) variables that have the highest loadings among the component number one that they come in order from bigger to smaller variables respectively (Q₂₈, Q₂₇, Q₂₂, Q₂₁, Q₁₉, Q₂₃, Q₂₆, Q₁₈, Q₁₃, Q₁₇, Q₁₆, Q₇). This component has the big important effect on the environmental Awareness where it expresses about (17.672%) of the total variation. The biggest variable was (Q₂₈) with the Common quantity (0.619) and the smallest variable was (Q₇) with the common quantity (0.507), the second component comes after the component number one in terms of importance expresses about (7.336) of the total variation, it includes (7) variables which the large variable is (Q₅) with quantity of communion (0.520) and the smallest one in the same component the variable number (Q₁₉) with quantity of communion (0.462). Also component number 3, 4, 5, 6, 7, and 8 comes respectively in the term of significance, the latest component is the component number nine comes the lowest effect on the awareness of environmental which expresses about (3.482%) of the total variation it doesn't have a huge effect, which content only (2) variables and for more detail see the table -6-.

Table 6: Rotated Component Matrix^a for lecturers

	Component									Communalities
	1	2	3	4	5	6	7	8	9	
Age	.073	.015	.147	-.017-	-.005-	.087	-.043-	.216	.764	.668
Q1	.196	.157	.556	.092	-.084-	-.173-	-.169-	-.089-	.057	.457
Q2	.074	.021	.775	-.059-	-.079-	-.101-	.131	-.118-	.042	.659
Q3	-.019-	-.059-	.054	.774	.129	.032	.105	.117	-.182-	.681
Q4	-.074-	.032	-.017-	.812	-.036-	-.049-	.036	.099	.142	.702
Q5	-.008-	.624	-.021-	.159	-.164-	-.041-	-.266-	-.062-	-.042-	.520
Q6	.051	.429	.356	.019	.272	.028	-.350-	.102	.131	.539
Q7	.316	.578	.155	-.055-	-.125-	.083	.103	.037	.108	.507
Q8	-.001-	.456	.370	-.150-	.323	.119	-.008-	.044	-.020-	.488
Q9	.278	.583	-.005-	.053	-.012-	-.051-	.253	-.044-	-.199-	.528
Q10	.022	.053	-.070-	.083	.813	.130	-.007-	.004	-.057-	.697
Q11	.240	.148	-.101-	.490	.185	-.036-	-.270-	-.100-	.060	.452
Q12	-.006-	.018	-.096-	.152	-.002-	-.010-	.001	.674	.119	.501
Q13	.404	.179	.404	.203	-.167-	.198	-.027-	-.250-	.034	.531
Q14	-.079-	-.020-	-.040-	.030	.127	.572	.139	.447	-.026-	.572
Q15	-.066-	-.005-	-.146-	-.013-	.105	.751	.007	-.153-	.150	.647
Q16	.318	.491	.338	-.030-	.065	.028	-.084-	.078	.003	.475
Q17	.365	.136	.328	-.145-	-.115-	.422	-.051-	.004	-.216-	.520
Q18	.460	.068	.420	-.147-	-.047-	.248	.060	.157	-.130-	.524
Q19	.546	.378	-.040-	-.020-	.051	-.082-	.081	-.033-	.036	.462
Q20	-.056-	-.159-	-.084-	.114	.697	-.011-	.237	.033	.159	.617
Q21	.554	-.237-	.051	.059	.193	-.206-	-.063-	.228	.031	.506
Q22	.581	.168	.117	.027	-.241-	.030	-.108-	-.098-	.103	.471



Q23	.538	.282	-.040-	.049	-.103-	.083	-.262-	.072	.203	.505
Q24	-.045-	-.127-	-.213-	.050	.240	-.028-	.321	-.279-	.477	.533
Q25	-.090-	.033	.017	.037	.162	.075	.782	.064	.047	.660
Q26	.525	-.010-	.259	.095	-.061-	.164	-.113-	-.393-	-.007-	.550
Q27	.715	.103	.082	-.083-	.098	-.037-	.038	-.009-	-.193-	.585
Q28	.750	.140	.151	.035	.005	-.067-	-.030-	-.066-	.058	.619

Conclusions:

The following main conclusions have been achieved (in a sequence of importance):

	Main Components		
	1	2	3
Lecturers	Q7, Q13, Q16, Q17, Q18, Q19, Q21, Q22, Q23, Q26, Q27, Q28	Q5, Q6, Q7, Q8, Q9, Q16, Q19	Q1, Q2, Q6, Q8, Q13, Q16, Q17, Q18
Students	Q19, Q21, Q22, Q23, Q24, Q26, Q27, Q28	Q1, Q2, Q9, Q16, Q17, Q18, Q19, Q22	Q6, Q7, Q8
Common variables	Q19, Q21, Q22, Q23, Q26, Q27, Q28	Q9, Q16, Q19	Q6, Q8

The tables above shows that there is a great convergence among the views of the lecturers and the students towards the environmental awareness in the region that they live in through the first three components between two levels, The most important result is the first component because it is usually explained the largest part of the variance in the analyzing the data and there are (7) common variables between lecturers and students, for more understanding the symbols of the variables look at the whole meaning of them in the table -7- (Appendix).

Recommendation:

- Improving environmental awareness begins with building environmental education, Formulating educational curriculum and academic destruction of the environment in all stages of education assessments for the construction of an individual's personality conscious of the environment, which is changing everyday behaviors.
- A comparative study between the scientific disciplines of human faculties and colleges and its impact on the development of environmental trends.
- Conduct further studies on the verification of the effect of curricula and courses on the level of environmental awareness in the various colleges

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APPENDIX:

Table -7-: Questionnaire

Evaluate (measure) the level of environmental awareness on campus

In all honesty we hope Now, the participants in the appropriateness of the questionnaire below tick (√) in exchange for one of the choices that you deem appropriate for each is a true WYSIWYG, note that the purpose of the questionnaire for research purposes only, and does not have any personal recipe as male name, address ..., thanks for cooperation.

Common Questions:

Gender: male female

Age:

Scientific certificate: BSc MSc PhD

Assay Questions:

No.	Statement	Totally Disagree	Disagree	Neutral	Agree	Totally Agree
1.	Environmental awareness is a sense of the environment in which they live and their problems, which makes him responsible for maintaining public health.					
2.	Man is the main reason that leads to the occurrence of damage to living organisms, or ecosystem.					
3.	The campus maintains cleanliness within instructions.					
4.	Halls, laboratories and places scattered within the university clean as required.					
5.	Abide by the laboratory using a waistcoat and muzzle and paws are within					
6.	The most important pollutants come through the remnants of plants and oil and sewage activities.					
7.	I feel uncomfortable when you hear corrosion or expansion ozone layer.					
8.	The use of chemical fertilizers and pesticides One of the reasons of environmental pollution.					
9.	Smoking, cause of environmental pollution.					
10.	Do you think the authorities and the government are only responsible for the cleanliness of the province and the city environment?					
11.	The environmental awareness organizations have a role in educating people to conserve the environment.					
12.	See the best of the existing homes in various places Collection of liquid wastes throw away from the city for the purpose of burning.					
13.	Waste Treatment (Recycling) is the only solution to control and conservative environment.					



No.	Statement	Totally Disagree	Disagree	Neutral	Agree	Totally Agree
14.	I do not have any information about the pollution in the environment where I live risks.					
15.	Increase the number of the population has no effect on the environment pollution.					
16.	Increase the number of cars cause pollution of the environment.					
17.	Environmental actually bad in this day due to the wrong environmental practices and neglect.					
18.	Default in the media and the authorities (the absence of follow-up and control) causes' weak environmental awareness in the community.					
19.	Formulation to maintain law on the environment is an important step leading to a clean and healthy environment.					
20.	Preservation of the environment, of the duties and responsibility of government institutions and not me.					
21.	I think I need more environmental awareness in order to preserve my health.					
22.	If the disposal of your friend (colleague) wrongly towards the environment, advises him and educate.					
23.	I do volunteer work to help the people who work in the field of environmental awareness.					
24.	You are in a public place with your hand and paper or a bottle of water (plastic) after use going to give in the same place (on the ground).					
25.	Go to the headquarters of the university to use my own car, although the place soon.					
26.	Are you willing to change your habits and behavioral to reduce impacts on the environment.					
27.	It is better to see the environment material placed within the main material in the course of education.					
28.	There is supposed to be a dialogue and discussions with colleagues of the province of your environment.					