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PERCEPTION ANALYSIS OF THE WATER RESOURCES QUALITY IN AZUL, BUENOS AIRES PROVINCE, ARGENTINA

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The goal of this paper is to put forth problems affecting surface and groundwater quality in a medium-size Argentine town through the identification of harmful attitudes and their effects on such water resources given the local community perception. It also attempts to point out the resulting generated damages and remediation solutions. The impact to surface water resources has well defined locations on the urban domain, and is mostly linked to industrial waste dumping. As for the groundwater resources, their eventual degradation has not been clearly located, although the general view is that the local authorities bear a high degree of responsibility for such a fact. Pollution of surface water is seen by the public as more important than pollution of groundwater, and this perception is shown to be a result of the influence of the mass media.

INTRODUCTION

Environmental quality is not only a prerogative of those governing but also of citizens themselves (Goldstein and Castañera, 1996). Because of this, it is vital to retrieve the opinions and perceptions on the subject held by the various social actors, inasmuch as they are groups which are involved both as injured by water resources degradation, and as drivers of potentially polluting activities (Peluso, 1996). In the town of Azul, Buenos Aires Province, Argentina (50,000 inhabitants), there exist evident signs of water resources contamination as well as conflicts among different usages/users of such resources (Bucich and Fernández, 1993; González Castelain et al., 1995, Usunoff and Varni, 1995a, Usunoff and Varni, 1995b). This has triggered a number of investigations aimed at retrieving useful information on which correction and maintenance measures may be based. Given such a framework, it is important to have access to the people's perception of problems affecting their environment. The perception of water resources quality by the various social groups, aside from the "true quality" (i.e., coming from scientific data), provides valuable elements for decision makers as well as a basis for the initiation of non-conventional educational activities (Wilhm and Dorris, 1968; McJunkin, 1993; O.M.S., 1985; Westman, 1985; Weber, 1989; Feijoo and Momo, 1991).

The goal of this paper is to unravel the relative importance that the local community assigns to pollution problems which affect the water resources in Azul City (Figure 1). This can be done on the basis of the degree to which various social groups acknowledge polluting activities and the effects on such resources, with a ranking that takes into account the seriousness of the perceived problems.

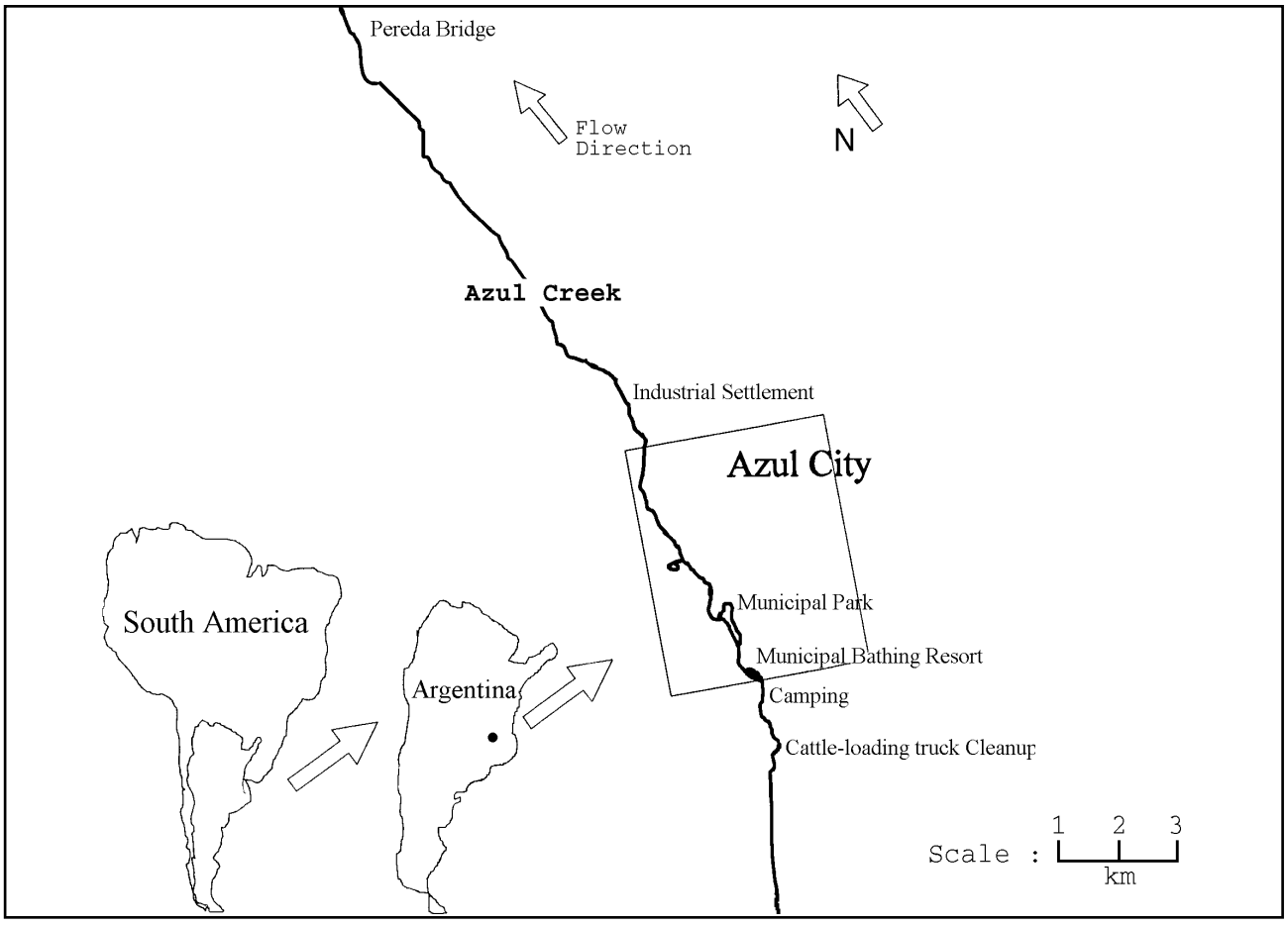

Figure 1. Pre-urban, urban, and post-urban zones in and around Azul City, Buenos Aires Province, Argentina, and important sites mentioned in the text.

From this view point, the type of damages and the eventual solutions are identified, as well as the remediation measures.

DATA AND METHODS

The data were obtained through specially designed polls (Peluso, 1996) involving various social groups in Azul City. Three sampling surveys were carried out: September-December 1994, July-September 1995, and January-February 1996. Four target groups were chosen: (1) users of the water resources (potential polluters or injured/damaged by pollution), (2) decision-makers, (3) educational entities, and (4) individuals doing work which could provide information on the status of water quality.

The first question attempted to establish causal relationships among potentially polluting common attitudes and the usages, or resources affected by them. To do so, a list of usual attitudes and affected resources was presented to choose from and, once a relationship was established, the respondent had to assign a level of seriousness from a given scale. Respondents were also asked to identify spatially (sites in Azul City) where such relationships take place. The answers, which provided spatial locations or sources (e.g., industries), were reinterpreted as frequencies per site, which led to a zonation in urban, pre-urban, and post-urban areas.

Attitudes

The list of common attitudes, coded with letters, was as follows:

A. To dump wastes in the Azul Creek (plastic bags, tires, etc.).

B. To drill wells near septic facilities.

C. To throw wastes down the drain (oils, detergents, expired medicaments, poisons, etc.).

D. To build septic facilities without technical advice.

E. Presence of engineering structures of high environmental impact (roads, dams, etc.).

F. To disregard rules for fumigation (sites, products used, way of preparation, manners of usage).

G. To clean up vehicles, tanks and floors to eliminate animal wastes, gas and oil wastes, paints, stains, pesticides/fertilizers, and to dump the residual water on the soil, into wells, or in the river.

H. Industrial dumping of wastes to the river or into wells.

I. To dump domestic wastes (sewage) in the river.

J. Non-covered/protected accumulation of domestic wastes.

K. Garden irrigation or filling swimming pools with water from the common water-supply service.

Affected Resources

The list of affected resources, coded with a number, was as follows:

1. Source of water for irrigation and/or cattle-raising activities.

2. Source of water for human consumption.

3. Landscape; personal reward.

4. Environment/place used for recreation (sports, tourism, etc.).

5. Camping and bathing resort.

6. Economic resources.

7. Environment/resource to transport wastes out of town.

8. Environment/resource to receive wastes coming to town.

9. Any type of work source.

10. Garden irrigation and/or filling swimming pools.

The degree of seriousness had to be picked from: unknown (coded as N), absent or mild (coded as A), moderate (coded as M), and high (coded as G).

The second question, from five relationships among attitudes/affected resources chosen by the respondent, asked about the type of damages that could emerge from them (economic, sanitary, resource degradation, quality of life deterioration), and the various solutions for mitigating the problems (educational, political, economic, technological).

The data were processed with basic statistical analyses and multivariate techniques (principal components, R-mode, varimax rotation), with the help of the SPSSPC+ software (Norusis, 1986).

RESULTS AND DISCUSSION

A total of 107 questionnaires with these two questions were distributed. As for the first question, 18 questionnaires (16.82%) were returned unanswered and, consequently, were excluded from the analysis. The results of the completed questionnaires is shown in Table 1. This table presents the number of times each attitude was related to the affected resource at a high and moderate degree of severity, and the number of respondents who picked at least one of such relationships. Table 2

Table 1. Frequencies of the Relationships among Attitudes and Potentially Affected Resources/Uses for High and Moderate Degrees of Severity

Attitudes/Resources Affected	1	2	3	4	5	6	7	8	9	10	Total:	Quest. 1	Freq. (%)
A	22	12	37	14	25	5	5	2	1	0	**123**	**59**	**66.29**
B	8	44	0	2	0	1	1	0	0	0	**56**	**44**	**49.43**
C	6	14	1	4	1	2	11	0	1	0	**40**	**24**	**26.96**
D	8	28	0	0	0	1	1	1	0	0	**39**	**35**	**39.32**
E	2	2	6	3	3	2	0	1	2	0	**21**	**12**	**13.48**
F	14	11	2	1	2	0	2	0	1	0	**33**	**21**	**23.59**
G	19	19	9	17	16	7	4	2	7	0	**100**	**52**	**58.42**
H	18	22	19	24	18	4	8	1	7	2	**123**	**61**	**68.53**
I	20	16	12	18	17	6	4	1	0	2	**96**	**42**	**47.19**
J	3	3	17	10	5	3	16	13	0	3	**73**	**49**	**55.05**
K	1	11	1	2	1	2	0	1	0	4	**23**	**23**	**25.84**
Total:	**121**	**182**	**104**	**95**	**88**	**33**	**52**	**22**	**19**	**11**	**727**		
Quest. 1	**45**	**67**	**52**	**35**	**35**	**16**	**29**	**16**	**11**	**7**			
Freq. (%)	**50.56**	**75.28**	**58.42**	**39.38**	**39.38**	**17.97**	**32.58**	**17.97**	**12.35**	**7.86**			

Note: See text for details on the meaning of letters and numbers.
Quest. 1: number of questionnaires that mentioned at least once a given attitude/affected resource.
Freq. (%): percentage, with respect to the total of valid questionnaires, that mentioned at least once a given attitude/affected resource.

presents the frequency of answers, for each attitude, as related to location in the urban domain or surrounding areas.

With respect to the second question, 26 questionnaires (24.29%) were disregarded because they were unanswered. Table 3 shows the frequency for each type of consequence and solution, according to the given attitudes. Table 4 indicates the results of the Principal Component Analysis (PCA) of the earlier results, aimed at determining the links among potentially harmful attitudes based on estimated

Table 2. Percentage Frequency of Zones Where Harmful Attitudes Towards Water Resources Quality Are Related

Attitude	Pre-Urban	Urban	Post-Urban
A	25	37	17
B	22	2	22
C	8	2	7
D	2	1	2
E	4	0	3
F	6	2	4
G	16	11	9
H	6	8	12
I	2	3	4
J	0	3	1
K	0	1	0

Note: see text for the meaning of letters.

Table 3. Percentage Frequency of Harmful Attitudes, Potential Damages as Well as Eventual Solutions (4-Letter Codes)

Solutions/Resources Affected	A	B	C	D	E	F	G	H	I	J	K
PCAL	15.41	16.93	18.18	14.41	7.69	11.11	15.97	14.28	14.91	15.51	5.88
PREC	15.78	8.87	16.36	9.90	7.69	13.88	12.88	13.58	11.60	9.79	17.64
PECO	6.02	2.41	6.36	3.60	7.69	9.72	7.21	10.80	11.04	6.93	13.72
PSAN	17.29	18.54	20.90	18.01	7.69	13.88	16.49	13.58	14.91	14.69	13.72
SECO	4.88	8.06	3.63	16.21	7.69	6.94	3.60	6.27	5.52	11.42	3.92
SEDU	18.04	13.70	21.81	18.01	15.38	13.88	13.40	10.80	12.70	11.02	23.52
SLEG	11.65	10.48	2.72	6.30	15.38	9.72	11.85	12.54	9.94	11.42	13.72
SPOL	6.76	4.83	4.54	3.60	7.69	9.72	10.30	9.05	9.94	7.75	3.92
STEC	4.13	16.12	5.45	9.90	23.07	11.11	8.24	9.05	9.39	11.42	3.92

Note: see text for the meaning of letters.
4-Letter Codes: PCAL = quality of life deterioration; PREC = resource degradation; PECO = economic damages; PSAN = health related damages; SECO = economic solutions; SEDU = educational solutions; SLEG = lawmaking-related solutions; SPOL = political solutions; STEC = technological solutions.

damages and feasible solutions. The numerical differences among attitudes detected by PCA are presented in Table 5, from the mean of the relative frequencies of the numbers emerging from Table 3.

According to Table 1, the attitudes more frequently mentioned were A, B, G, H, I, and J. And the uses mostly chosen were 1, 2, 3, and 4.

As for the geographical locations of conflicts/problems, established from the attitude/affected use or resource in Table 2, two groups were clearly discriminated. Attitudes A, G, H, and I were related

Table 4. Principal Components Analysis (R-mode) to Determine the Grouping of Damages and Solutions for Attitudes Potentially Harmful for Water Resources Quality.

Attitude	P.C. 1	P.C. 2	Communality
F	0.87997	0.22321	0.82417
A	0.86818	0.39852	0.91256
K	0.82041	-0.16759	0.70115
I	0.82738	0.39753	0.84259
G	0.80012	0.47133	0.86235
C	0.75113	0.55031	0.86704
H	0.85407	0.18319	0.76299
B	0.24245	0.90643	0.88040
D	0.13761	0.82581	0.70089
J	0.18753	0.94201	0.92256
Eigenvalue	6.46	1.8	
%Variance Explained	64.7	18.1	

Note: see text for the meaning of letters.
P.C. 1 and P.C. 2: principal components 1 and 2, respectively.

Table 5. Average of Percentage Frequency of Potential Damages to Water Quality and Suggested Solutions for Each Principal Component

	P.C. 1	P.C. 2
PCAL	13.68	15.62
PREC	14.53	9.52
PECO	9.27	4.31
PSAN	15.82	17.08
SECO	4.97	11.90
SEDU	16.31	14.24
SLEG	10.31	9.40
SPOL	7.75	5.39
STEC	7.33	12.48

Note: P.C. = principal component.
4-Letter Codes: PCAL = quality of life deterioration; PREC = resource degradation; PECO = economic damages; PSAN = health related damages; SECO = economic solutions; SEDU = educational solutions; SLEG = lawmaking-related solutions; SPOL = political solutions; STEC = technological solutions.

to surface-water contamination affecting several reaches of Azul Creek. For the pre-urban reach, upstream from the municipal bathing resort (Figure 1), mention is made about the waste accumulation in the camping area (attitude A), and the effluent of a cleanup facility for cattle-transporting trucks (attitude G, H, and I). For the urban reach, the respondents again chose the lack of cleaning in several sectors -municipal camping, municipal park, river margins- (attitude A). Industrial wastes from unknown origin dumped in the storm drainage system (attitude G, H, and I) are also mentioned. As for the post-urban reach, people were aware of the dumping in the river of the local waste-treatment plant and, in the Pereda zone, of wastes generated by a leather-processing industry (attitudes H and I). The second group points out the peri-urban area, where there is no waste-collecting drainage systems.

The multivariate approach yielded two principal components (PCs), which represent the association of the variables. The first PC groups attitudes F, A, K, I, G, C, and H, whereas the second PC puts together attitudes B, D, and J. Table 5 shows that, in spite of the meager differences among the various Damages and Solutions for the varying Attitudes segregated by each PC, there are variations which can be deemed as relevant when they are explained in a larger framework.

The harmful attitudes and the uses affected, and their location in the local geography, have to be related to the damages raised by such environmental problems, and the alternative remediation measures. Hence, a differentiation can be sketched which takes into account the social actors held responsible for them. Such a segregation may emerge from the analysis of the proposed solutions: most of them are economic and technological, as revealed by PC2, related to attitudes affecting the quality of the groundwater resources, which are in favor of enlarging the domestic waste drainage system (local authorities are responsible for it, and any initiative has so far been stopped because of budget and technical shortcomings).

PC1, associated to aspects related to surface water contamination, points to attitudes taken by industries. The solution having more proponents is of the educational type, seen as a tool for awakening a proper level of awareness by the industry managers. As for the damages, the most evident difference is that, like what was found in other questions of the same survey (Peluso, 1996; Peluso and Usunoff, 1997), people do not see aquifers as water resources as they do surface water resources. This implies that importance is given based on physical evidence of existence (groundwaters are hidden, surface waters are not).

The degree of relevance of any environmental problem affecting the whole community would be closely related to what the mass media see and report, and they actually shape the people's general perception (Peluso, 1996). Published or otherwise publicly available materials focus on the effect of industrial dumping in the river and the microbiological pollution of surface waters, but almost no reference is made to aquifer contamination in spite of it being the exclusive public-water supply. Local groundwaters bear a certain degree of microbiological and chemical pollution, although this fact is hardly reported by mass media. This may be so because it is seen as a problem only affecting restricted areas (without sewage drainage or public water supply coverage), but not as something valid for the whole community. They do pay attention and label them as "community problems" some isolated facts, such as sporadic massive death of fish downstream from Azul City or some high colifecal bacteria counts in some reaches of Azul Creek. In those cases, there was an overwhelming coverage by local newspapers, radio broadcasting stations, and the only TV channel in town (Peluso, 1996).

The information retrieved from the two questions presented here confirm information generated

by other questions in the same questionnaire (Peluso, 1996, Peluso and Usunoff, 1997). The type of attitudes would fall in the realm of surface water contamination and deficient domestic waste disposal, according to the list of alternatives presented in other questions, which, in turn, are related with sanitary damages and quality of life deterioration. Again, there is a clear association between damages and types of solutions, because alternatives of the educational, economic, and technological types are mostly mentioned .

CONCLUSIONS

People's perception on attitudes potentially affecting the local water resources, their damages and solutions, differs between surface and groundwaters. The former are clearly recognized and given specific geographic locations related to industrial waste dumping, whose managers bear the highest responsibility for the damages caused and the mitigation measures. As for the latter, their location is not as clearly identified, although local authorities are held responsible for all it conveys. Locals perceive that the real problems are those affecting the surface water resources and downplay (or ignore) those related to groundwaters, which has been interpreted as the influence of the views of the mass media.

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