EU NORMS AND NITRATE POISONING AT CHILDREN FROM OLTENIA

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Abstract. Romanian agriculture current realities indicates that organized societies with modern equipment and staffed with specialists represent only 20% of the actors in the production, the remaining of 80% being producers with different levels of equipment and staffing specialist. Therefore there are real risks that the inputs used in agriculture (fertilizers, pesticides, etc.) have negative secondary effects (DUMITRU, 2002) through soil and water pollution (GAVRILESCU, 2011). Increased content of nitrates and nitrites in soil and water has become a major factor affecting the health of the population, both rural and urban, and especially children, but in a broader context the entire population consuming water, vegetables fruit from out of control locations (nitrates vulnerable zones) (NAZARYUK et al., 2002). This paper presents the case of illness in children internees at No. 1 Hospital from Craiova for a period of 5 years. One can observe that most cases come from rural areas, 76%, with children aged less than one year and over five years, by introducing in their diet milk powder, tea, soup of carrots and other vegetables that are high in nitrates. Cases have been reported in some villages that were connected to the water system of the village and which were infested with toxic substances. In urban areas the percentage is 24% of illness, it is strongly recommended for measures to limit the content of toxic substances in groundwater and surface water.

Keywords: nitrate pollution, groundwater, children, methemoglobinemia.

Rezumat. Normele UE şi intoxicaţiile cu nitraţi la copiii din Oltenia. Realităţile agriculturii româneşti actuale indică faptul că societăţile organizate cu dotare modernă şi încadrate cu specialişti reprezintă doar 20% din actorii de producţie, restul de 80% fiind producători cu diferite nivele de dotare şi încadrare cu personal de specialitate. Ca atare, există riscuri reale ca inputurile folosite în agricultură (îngrăşăminte, pesticide, etc) să aibă în secundar şi efecte negative (DUMITRU, 2002) prin poluarea solului şi a apei (GAVRILESCU, 2011). Creşterea conţinutului în nitraţi şi nitriţi în sol şi apă a devenit deja un factor major care afectează sănătatea populaţiei atât din mediul rural, cât şi urban, şi în special a copiilor, dar într-un cadru mai larg a întregii populaţii consumatoare de apă, legume şi fructe din locaţiile scăpate de sub control (zone vulnerabile la nitraţi) (NAZARYUK et al., 2002). Lucrarea de faţă prezintă situaţia îmbolnăvirilor la copiii internaţi la Spitalul nr. 1 Craiova pe o perioadă de 5 ani. Se observă că cele mai multe cazuri provin din mediul rural 76%, copii având vârste cuprinse sub un an şi peste 5 ani, acestora introducându-li-se în alimentaţie laptele praf, ceaiul, supa de morcovi şi alte legume care au un conţinut mare în nitraţi. Au fost semnalate cazuri şi în unele comune care erau racordate la reţeaua de apă a comunei şi care era infestată cu substanţe toxice. În mediul urban procentul de îmbolnăviri este de 24%, recomandându-se luarea de măsuri menite să limiteze conţinutul de substanţe toxice în apele subterane şi de suprafaţă.

Cuvinte cheie: poluare cu nitraţi, ape freatice, copii, methemoglobinemia.

INTRODUCTION

For the implementation of Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources, the National Administration "Romanian Waters" is responsible to monitor the quality of groundwater and surface water in order to identify and land survey waters affected by nitrate pollution or likely to be exposed to such pollution, in order to establish and/or review the areas vulnerable to nitrate pollution from agricultural sources. Limit concentration of nitrates in water is 50 mg/l, according to standards. In Romania, a large proportion of groundwater is polluted with nitrates, and over half of the country is vulnerable to nitrate pollution, according to statistics compiled by ANAR experts.

Agriculture remains a major source of water pollution and farmers continue to adopt sustainable practices, huge efforts are needed to restore optimal water quality in the EU. This requires careful monitoring to prevent increasing nitrate concentrations. Member States had to establish codes of good practice for farmers, to be implemented on a voluntary basis throughout their territory, and to develop specific action programs with mandatory implementation by farmers located in areas vulnerable to nitrates.

Periodically, they must review the designated nitrate vulnerable zones, monitor the effectiveness of action programs and modify them to ensure that they are in line with the objectives of the Directive, and to submit its findings to the European Commission. Action programs must include a set of measures under the Directive, concerning, for example, periods when land application is prohibited or minimum storage capacity for manure, and rules to control the spread of nutrients near water or downhill in order to reduce the risk of contamination. The most common poisoning caused by water are nitrate poisoning, described for the first time in U.S. by Comly in 1945 under the name of intoxications with water wells. They are produced by the excess of nitrate in water. Toxic action of nitrates and nitrites is known for a long time.

The problem has become particularly topical from the reporting frequency of acute and chronic poisoning in young children who have consumed vegetable and water with nitrite and nitrate increased content. Methemoglobin is strongly oxidized haemoglobin, iron passing from bivalent to trivalent (RODRÍGUEZ-MAROTO et al., 2009; SUZUKI et al., 2012). In normal conditions, the methemoglobin is formed continuously in the normal erythrocytes, but slowly, and as that occurs, haemoglobin is reconverted by reducing non-enzymatic mechanism (ascorbic acid) and enzymatically, diaphoresis. For this reason, the level of methemoglobin remains always lowered below 0.8% of total haemoglobin in adults and in infants less than 1.5%. In nitrite - nitrate poisoning, methemoglobin formation exceeds the rhythm of reduction and therefore, its percentage increases. Cyanosis becomes perceptible when methemoglobinemia

exceed 10% of the total haemoglobin, and other clinical signs (headache, dizziness, tachycardia, fatigue) occur in over 20% methemoglobin (CĂLINOIU & POPA, 2009). The most sensitive are children in the early years and of these, primarily infants, because of the persistence of foetal haemoglobin (more oxidisable than adult haemoglobin) and insufficient enzyme methemoglobin reduction (GREER & SHANNON, 2005).

Nitrate poisoning resulting in methemoglobinemia continues to be a problem in infants. Most reported cases have been ascribed to the use of contaminated well water for preparation of infant formula (KNOBELOCH & PROCTOR, 2001; HERMAN et al., 1999; JOHNSON & KROSS, 1990).

MATERIAL AND METHODS

Methemoglobinemia is a common medical condition in newborns and infants, occurring with an "epidemic" character in territories with rich soil in nitrate, poisoning is effected by means of water or vegetables (spinach, carrots) grown in the area. Nitrites are contained in the water used to make tea or milk bottles. This is polluted water, typically well water, which is called the "well water intoxication". In such cases the infant age (3 months) and type of food (artificial milk powder preparations for whose preparation well water is used) are very important data to guide diagnosis.

Some vegetable plants, which normally or occasionally fall in infant feeding, can lead to methemoglobinemia when they were grown in fields fertilized with nitrogen fertilizers containing nitrate in large quantities, especially carrot (carrot soup) and spinach (spinach puree). Concomitant gastrointestinal infection, in particular with the *Escherichia coli* and *Klebsiella* appears to play an important role in the production of this type of methemoglobinemia, whereas the proliferation of intestinal nucleation is required for the conversion of nitrate to nitrite. Likewise, these germs (bacteria nitrifying) can cause a rare methemoglobinemia from medicinal products, namely the administration of bismuth subnitrate; the same plant foods mentioned can become harmful, sometimes by simple storage (even in the fridge), for longer time (over 12h).

In such situations, such as refrigerator storage of carrot soup for more than 12 hours, the bacterial flora proliferates, turning nitrates into nitrites, which are toxic. Toxicological implications of these chemicals became more complex after highlighting the cumulative effect of nitrates and possibility of carcinogenic nitrosamines formation. One reason is the enrichment of water by nitrates storage, randomly animal manure and existence of no impermeable septic tanks in the case of rural and urban housing. Nitrate removal from water is a complicated and expensive process (Fig. 1).

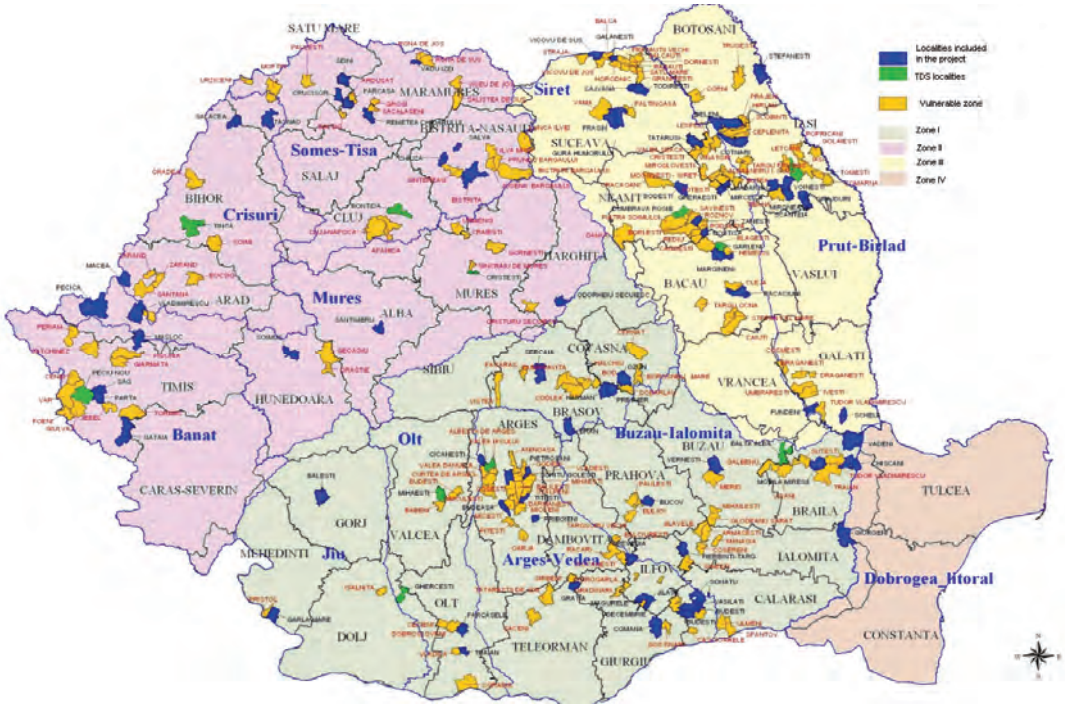

Figure 1. Nitrate vulnerable zones in Romania (original).

RESULTS AND DISCUSSIONS

In this paper we present statistical data of children under 5 years old, diagnosed with methemoglobinemia in 2006-2013. Severe methemoglobinemia condition can cause brain damage or even lead to death. Nitrogen compounds in high concentrations may become toxic. Disruption of metabolism leads to the accumulation of methemoglobin above its normal value. Under physiological conditions the amount of methemoglobin, expressed as a percentage of total haemoglobin will vary with the age as follows:

- premature (0-7 days) - 2.3%;
- premature (7-72 days) - 2.2%;

- new born at term (0-20 days) - 1.5%;
- infant (20 days -1 year) - 0.79%;
- child and adult, under 0.5%.

Most often it comes to polluted well water (organic substances resulting from human or animal manure). Methemoglobinemia does not occur only rarely, when dealing for instance with infants receiving preserved carrot soup (refrigerated or not) for more than 12 hours.

Arguments of the positive diagnosis are:

- age less than 6 months (more frequently 3 months);
- artificial food;
- use of water fountain (more rarely vegetables high in nitrates and other toxic);
- previously healthy child (usually);
- cyanosis "well tolerated" (absence in most cases of cardiac or pulmonary signs that might explain it);
- a possible concomitant diarrheal episode;
- chocolate brown venous blood, which do not become red again in contact with oxygen;
- dosage methemoglobin (values above 2% of all haemoglobin);
- therapeutic trial (reversible under treatment with reducing substances).

To illustrate the existence and dangerousness of nitrite poisoning, we present data that we had access since 2006. It is noted that in the period 2006 - 2013 there have been hospitalizations and their number is different every year, note that in reality the intoxication number is much higher, these figures were recorded only at the Emergency Hospital of Craiova. Dolj County is one of the most affected counties in this respect as we have found out in materials belonging to the Institute of Public Health Bucharest and in newspaper articles.

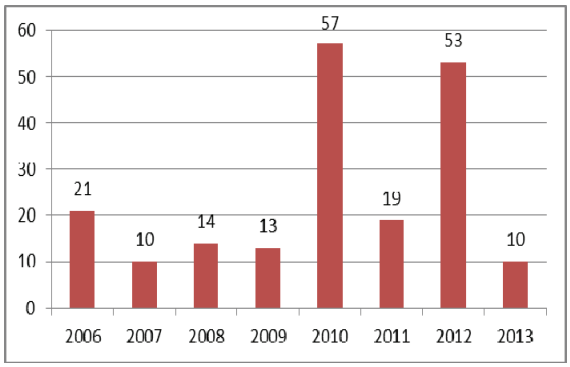

Figure 2. Number of cases of illness in children with methemoglobinemia in 2006-2013 in Oltenia.

In 2010, it was recorded the highest number of nitrate intoxications (Fig. 2), 57 cases due to water from wells contaminated with nitrates and nitrites; the most affected localities are Brădeşti (NO_3 - 126 mg/l, NO_2 - 0, 78 mg/l - average values), Izvoare (NO_3 - 87 mg/l, NO_2 - 0.95 mg/l, average values), Ghidici (NO_3 - 103 mg/l, NO_2 - 0,30 mg/l, average values), Giurgiţa and Moţăţei (NO_3 - 86 mg/l, NO_2 - 0,41 mg/l). Nitrites get into the water by the fertilization of agricultural land with fertilizers (manure) or synthetic nitrogen fertilizers. It was also found the incorrect placement of wells downstream of latrines, and a very close distance.

Public Health Authority of Dolj recommended to family doctors to have accurate accounts of wells from which water may be used in infant and young child nutrition. Also, doctors are required to perform health education of the population of the territory, not to use water with nitrite in concentration above the normal values. Note that in 2010, in Dolj County, due to nitrite poisoning two infants died. Methemoglobinemia was emphasized at children from rural areas aged less than 1 year and more than 5 years, and represents the 50% for children under 1 year, 8% of children under 1 years, 21% - 1.5 years, 8% - 2 years and under 5%, between 3 years and 5 years (Figs. 3; 4).

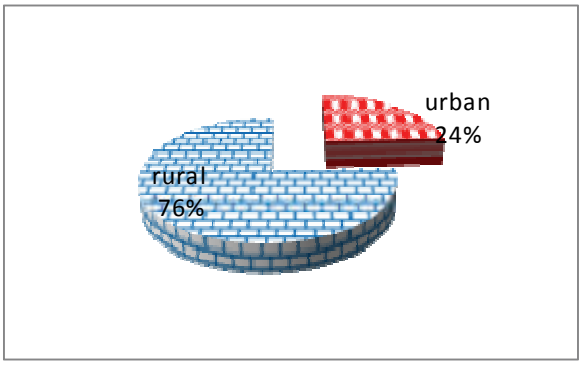

Figure 3. Case for patients with methemoglobinemia (percent) from urban and rural areas.

The highest percentage, respectively diseases were found by using water in preparatory, especially milk powder, and carrot soup. Lower percentages were recorded after the age of two years, when in the diet interfered other vegetables, who have had in composition a higher amount of nitrate, intake of milk being in a lower percentage (Figs. 4, 5).

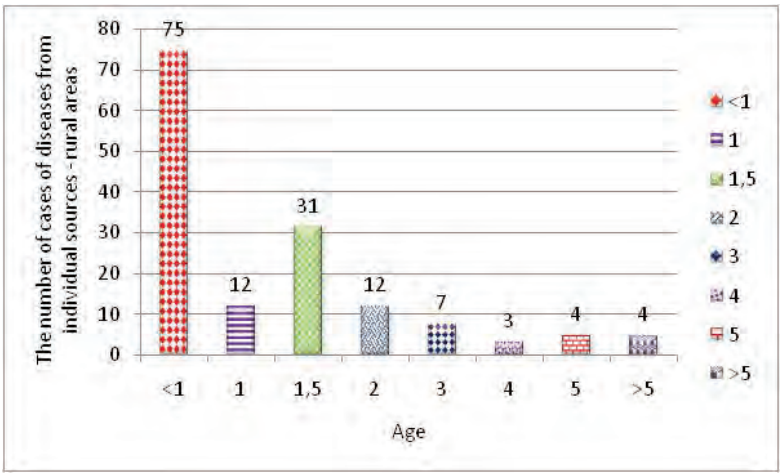

Figure 4. The number of cases of diseases depending on water source (2006-2013) in rural areas.

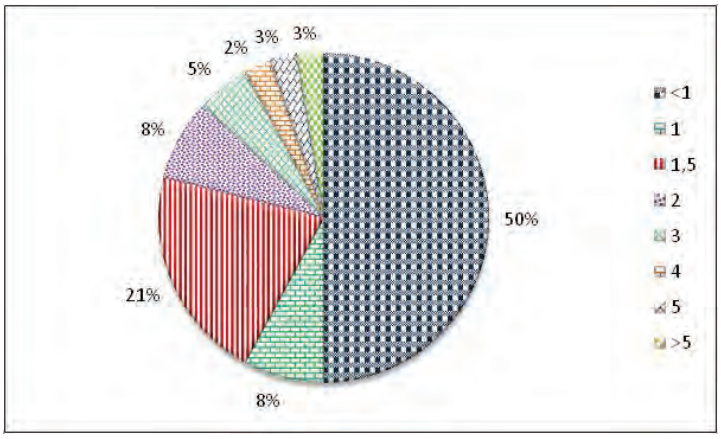

Figure 5. Percentages related to the number of reported cases of methemoglobinemia.

In urban areas there were recorded a total of 48 cases, because the children were given preparations that used water from their own sources (wells drilled shallow) and vegetables were super intensive fertilized, especially on the basis of urea or ammonium nitrate (Fig. 6).

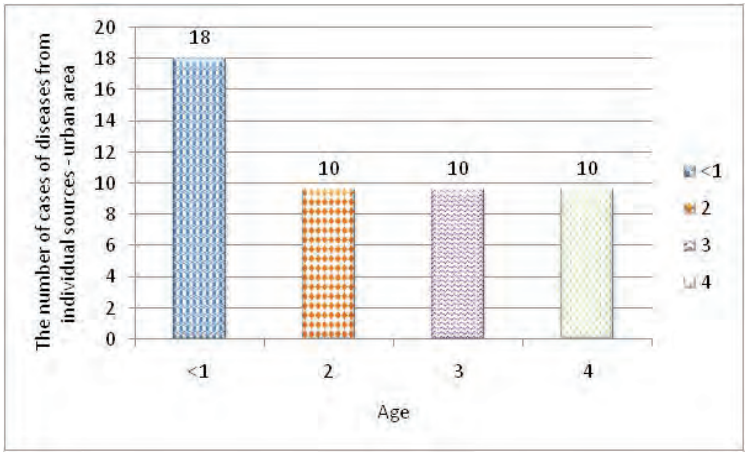

Figure 6. The number of cases of diseases depending on water source (2006-2013) in urban area.

Children under 1 year of age were the most affected; the percentage is 40%, and 10% those between 2 and 4 years (Fig. 7).

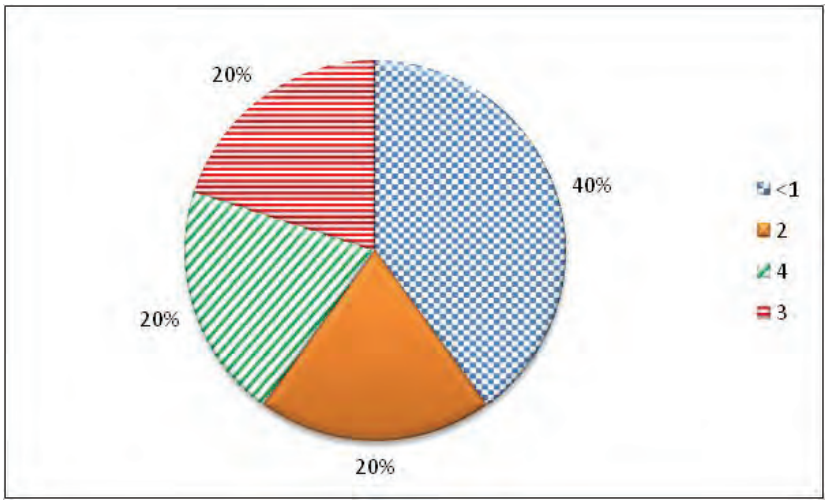

Figure 7. Percentages, related to the number of reported cases of methemoglobinemia in urban areas.

Some localities like Isalniţa, Almăj, even if they had a municipal water supply network, it contained an average quantity of NO_3 (83 mg/l) and NO_2 (0.49 mg/l) over the maximum allowable concentration, which led to a significant number of poisoning that determined to achieve branching to the intercounty pipe of drinking water Izvarna - Craiova (Figs. 8, 9).

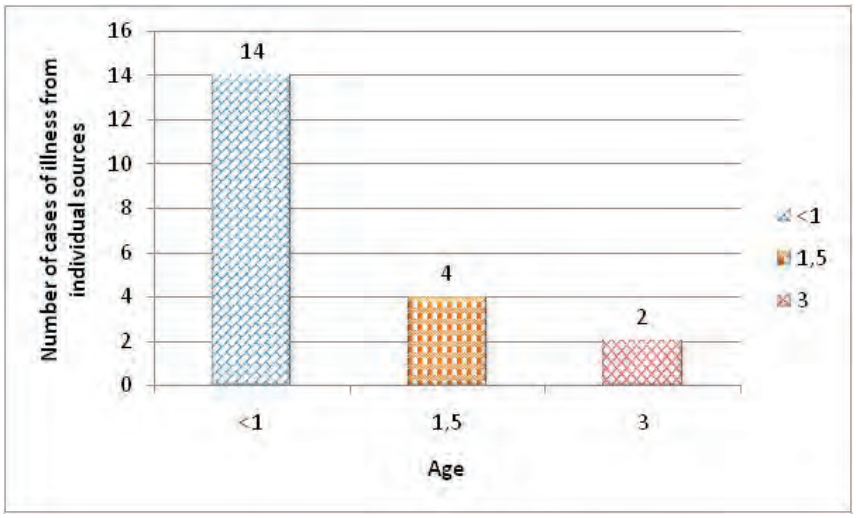

Figure 8. Number of cases of illness depending on water source- municipal network (2006-2013).

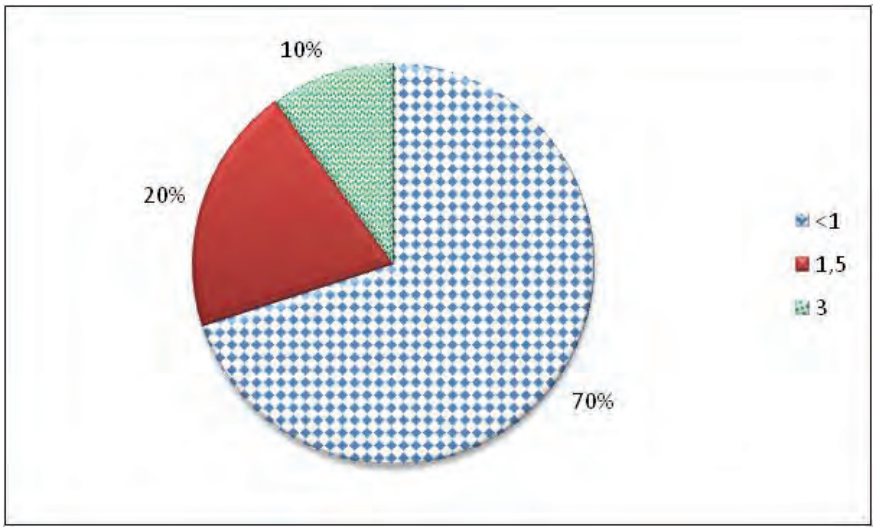

Figure 9. Percentages, related to the number of reported cases of methemoglobinemia in localities connected to the municipal network.

CONCLUSIONS

Due to increasing discharge of industrial waste or household, excessive fertilization and improper placement of individual sources of water, there is a danger that it can no longer be used for drinking, as there are a number of toxic substances present (NO_3, NO_2). All these fully justify the need to preserve water quality concern for timely detection of toxic elements and finding appropriate means to make them harmless.

Most action programs fully cover all essential measures, include annual limit of 170 kg per hectare of nitrogen from manure under the Directive. However, some programs must establish more stringent rules on storage provisions, balanced fertilization and periods in which fertilization is prohibited.

Drinking water with nitrate in various forms (milk powder, tea, soups, vegetable based on fertilizers containing nitrogen) resulted in methemoglobinemia in children between 1 and 5 years. The highest frequency was recorded in rural areas, but also in villages connected to the water system community. In urban areas, there were registered diseases in children, due to the use of water from improperly installed or improperly fertilized vegetables.

It is particularly important to inform the population about water sources, location of water fountains, construction of wells and how to preserve its health. In this sense, people who build wells have to place them so that no stables be nearby, latrine and water runoff does not cause groundwater contamination (if the land is not flat, the fountain is constructed upstream).

Regarding the education of the population, it seems to be more effective than the application of stipulations of law, such penalties. In this respect an important role is played by mass - media which informs the public on measures to be taken in order to prevent pollution and its consequences.

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