Water Quality and Sanitation With Spatial Data in Nellore rural based on Remote sensing and GIS

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ABSTRACT : The impact on human health and sustainable livelihood, the topic of drinking water and sanitation facilities is becoming a seriously discussed issue among international organizations as well as developing agencies in industrialized countries.

The aim is an assessment of the drinking water quality as well as the sanitation situation in Nellore rural. This was done by studying the existing water and sanitation facilities, sampling the water, evaluating the reason for the poor water quality and mapping the current situation using ArcGIS. Furthermore, technologies for improving the drinking water and sanitation facilities are suggested. The work was carried out by doing a literature study on how water sources and sanitation facilities should be constructed in order to ensure people's health and to meet their needs. Geographic coordinates and water samples were collected from 43 areas in gollakandukur and kandamur villages in Nellore Rural . Interviews on the water situation and sanitation facilities were performed. Furthermore, water samples were analyses different parameters. Pesticide contamination was also taken into consideration when one of the water points was analyzed. Water sources were classified as improved or unimproved according to definitions by WHOSIS. Moreover, the DRASTIC vulnerability model was used to evaluate the groundwater susceptibility to contaminants.

In general, the water quality in the study area was poor and measured values of the analyzed parameters exceeded Nellore rural standards for nitrate, hardness, electrical conductivity and total coliform bacteria. Three points were contaminated with E. coli bacteria. Furthermore, turbidity measurements exceeded Nellore rural standards in eight out of forty three water sources. No pesticide contamination was detected. Sampled water from the densely populated parts of the village as well as unimproved water sources proved to be of poorer quality. Hand-washing facilities are seldom placed in proximity to the toilets. Pit latrines are believed to be the most important source of groundwater contamination in the study area. Other sources are agricultural activities and poor practice when abstracting water from the bore wells. A feasible solution to improve both the drinking water quality and the sanitation situation would be to install toilets. Improvements of the bore well's features that are suggested include quality pipes with no leakages and maintain premises neatly.

Keywords - Gollakandukur, Kandamur, groundwater, contamination, nitrate, coliform bacteria,sanitation, DRASTIC, WHOSIS.

I.INTRODUCTION

Safe drinking water and basic sanitation are two connected pivotal needs for human well being. The quality of drinking water is used by human vastly, which contains bacteria and nutrients that may contaminate the drinking water sources if these and the sanitation facilities are not managed properly. Poor sanitation facilities also increase the risk of spreading diseases. People with insufficient access to potable drinking water, i.e. consuming contaminated water, may suffer from illnesses on a short as well as long term basis. Besides health aspects, collecting water from decentralized drinking water sources (wells or springs or Drifting pumps) is time-consuming and leaves less time for education and labour. Women and children are in particular exposed to this. Fighting these facts will increase the possibility to reduce poverty. According to statistics of the World Health Organization (WHO), as many as 1.1 and 2.6 billion people lacked access to improved water sources and improved sanitation respectively in the year 2002. A majority of people with insufficient potable water or sanitation facilities live in Andhra Pradesh. In India, problems for instance occur in the rural of Nellore is taken long distance from Nellore urban is gollakandukur and kandamur are complete rural area. in this report referred to as these villages as the poorest villages in Nellore rural economy .

II.INFORMATION ABOUT DRINKING WATER AND SANITATION

2.1 Reports on water and sanitation

Statistics show that the coverage of people with access to improved water sources differs greatly over the world. In 2008, a majority of the inhabitants in urban areas was covered, while the rural region had very little coverage.Rural areas are to a great extent less covered than urban and what is more, of all the people with access to improved water sources only a small part are connected to piped water systems.This should further be subject to improvements in the future (WHO & UNICEF, 2006).In total, only 59 % of the world population had access to improved sanitation in 2004. Once again, the rural region was the least covered area (34 %) while Nellore rural both had coverage of more than 80 %. Similarly as for the water situation, rural areas were less covered than urban. When looking at the future, the rural population is likely to decrease as urbanization takes place causing the amount of unserved urban inhabitants to increase. Still, current trends indicate that the rural 5 population without access to basic sanitation will be twice the size of the corresponding urban population in 2015 (WHO & UNICEF, 2006).The MDG objective is to cut the proportion of unserved residents by half. The different world regions have different professional and economic capacities to improve their situation, causing different targets to be set for the different regions. The rural area of Nellore is most people arelabours so at least 96 % coverage of improved water sources and 91 % coverage in basic sanitation in order to reach the MDG target of halving the population without access (WHO & UNICEF, 2006). In 2012, 85 % the rural population in Nellore had access to improved drinking water sources and 73 % to improved sanitation. In total (rural and urban areas) the coverage in rural area gollakandukur and kandamur was 90 % for improved drinking water sources and 79 % for improved sanitation in the same year,meaning that an increase of 6 as well as 12 percentage points would be required in order for Nellore rural reaching the target. Larger efforts will be required in the rural areas WHOSIS.

As of 2011 censes, the Nellore mandal had a population of 631,791. The total population constitute, 321,087 males and 310,704 females —a sex ratio of 968 females per 1000 males. 59,631 children are in the age group of 0–6 years, of which 30,781 are boys and 28,850 are girls , a ratio of 937 per 1000. The average literacy rate stands at 80.96% with 463,205 literates.

2.2 Benefits of improved water and sanitation

Investments on water and sewage are in general not prioritized locally because it is considered expensive. The challenging words by The Poverty-Environment Partnership (PEP) state otherwise, which is that "*investing in water is not a drain on the national exchequer, it positively contributes to it*" (WHO). The quote is taken from the report *Linking poverty reduction and water management*, in which PEP seeks to give an understanding of why water management is such an important thing to improve. Firstly, the report states that improved water management is essential for reaching all of the MDGs and that it contributes to all goals either directly or indirectly. Secondly, as the quote implies, investing in water management is profitable whether on large or local scale. Not only will it reduce poverty but also make a positive impact on the country economy, especially if local entrepreneurs are hired. The report refers to several studies made on economical benefits that will arise from investing on improved water and sanitation and they all show benefit-cost ratios higher than one. As a result of improved health and domestic access to piped water, benefits include reduced health costs, decreased mortality rates in addition to advantages of more time for labour and increased school attendance. Hence, improving drinking water facilities and quality as well as sanitation facilities reduces poverty, inequality and enables the local community to develop. Approximately 25 % of the population in Nellore rural people lives in poverty (A.P 2009), which is why improvements in the fields of water and sanitation are needed for a positive development of the society to take place.

2.2 WATER IN NELLORE

The drinking water quality in Nellore varies greatly depending on where it is abstracted (in villages, forests or close to agricultural land). Reports show that the drinking water is often contaminated with a large number of coliform bacteria (including *E. coli*) as well as high concentrations of nitrate and sulphate. In addition, the Nellore rural water is often very hard. Pesticides have been traced in sampled water from bore wells in the vicinity of agricultural land. Residuals of pesticides are believed to origin from the extensive use of such chemicals during the time when Nellore was a part of the Andhra Pradesh.

III.WATER RELATED DIESES AND METHODS

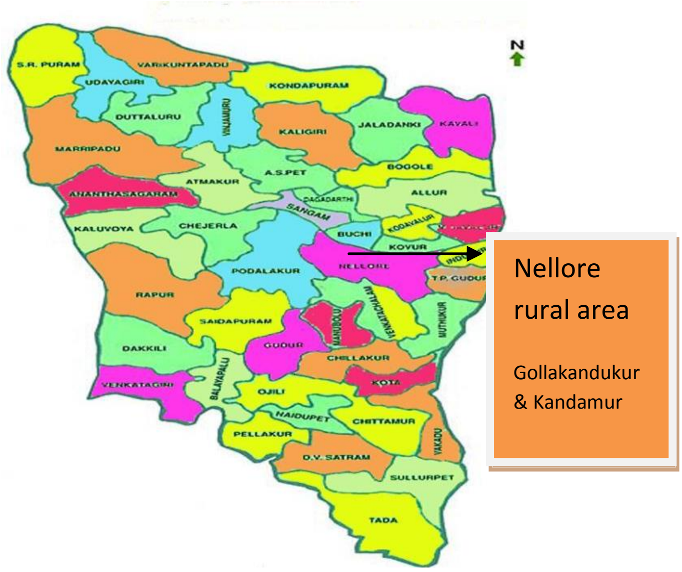
Waterborne diseases: caused by the ingestion of water contaminated by human or animal faeces or urine containing pathogenic bacteria or viruses; include cholera, typhoid, amoebic and bacillary dysentery and other diarrheal diseases.

Water-washed diseases: caused by poor personal hygiene and skin or eye contact with contaminated water; include scabies, trachoma and flea, lice and tick-borne diseases.

Water-based diseases: caused by parasites found in intermediate organisms living in contaminated water; include dracunculiasis, schistosomiasis, and other helminths.

Water-related diseases: caused by insect vectors, especially mosquitoes, that breed in water; include dengue, filariasis, malaria, onchocerciasis, trypanosomiasis and yellow fever.

how data were processed in ArcGIS.



3.1 DATA ANALYSIS

Data on chemical and bio-organisms concentrations in groundwater were provided by in my servey. The data base contained water samples taken with health officers well owners during 2014 and 2015. Furthermore, Different areas archive was used which consisted of a large number of samples having physical properties such as soil depth, wells capacity, total depth and water level. Geological data including bedrock, soil type, fracture and deformation zones were achieved in digital format from NMC. NELLORE LAND Survey was the source for obtaining land use data and topological data in digital format. In the terms of soil thickness there was no digital data prepared by NMC, Therefore it was decided to digitize a paper map. Regarding data on groundwater chemical and bio-organisms components the wells were not sampled randomly for this study. Drinking water wells are usually constructed close to the houses therefore most bores were found in small villages where groundwater is assumed to be more affected by human activities than general groundwater quality on the rural area. So there is also lack of sampling data from some areas. Many A Groundwater Vulnerability Assessment Method Using GIS and Multivariate Statistics

Factors were derived from geological and topological data used in the analyses such as distance to fracture zones, distance to shore line, distance to deformation zones and slope of the terrain. As this study aimed to consider and evaluate the role of surrounding conditions on chemical components and microorganism concentrations in different areas, several generalization factors were derived, for instance, the predominate land use within 200 meters which was derived from land use maps .

3.2METHODS

It is possible to recognize three main parts in this study. First, preparations of data and maps into appropriate format for applying in the analyses were carried out. The Second phase included extraction of desired information from each map. Finally, the extracted information were explored and analysed statistically in order to recognize significant factors and find correlations among factors. Undoubtedly, Geographic Information System (GIS) provides powerful tools for visualization and analysing of spatially distributed digital data. So GIS has been applied for preparing factor maps as well as to explore surrounding areas of wells which have measured chemical components . The software applied was ArcGIS version 9.3.

In order to explore, organize and analyse the information, STATISTIC version 10 and SPSS version 18 were applied. Several statistical analyses such as basic descriptive statistics, principal component analysis (PCA) and analysis of variance ANOVA were performed for both qualitative and quantitative variables.

3.3METHODS USED FOR PREPARING FACTOR MAP AND EXTRACTION INFORMATION

As the first step to utilize the GIS tools, well chemical data represented as an Excel table which was transformed to a proper format. A 'dbf' file was created in ArcCatalog software which was represented as a shape file consisted of 13 points with an attribute table showing chemical properties of the different areas. The same method has been used to represent those areas which have physical properties such as capacity, ground water level, soil depth and total depth of wells The data base contained 39 areas. To relate the information of these wells to the target wells, the spatial join function in ArcMap was used. According to NMC (2014) the spatial location of the wells has an uncertainty of 200 meters so it has been decided to join information of those wells located within 200 meters of target. After calculating the desired values the Excel file was transformed into a shape file in the manner described before. Regarding wells features information, as it mentioned before, it was registered when the well was drilled, so the age of some information was up to 20 years. Water levels which vary seasonally in a year were not reliable enough to be included in the analyses. The only feature which was used within this study was the median value of soil thickness.

The results were joined to the target wells using SPATIAL JOIN function. The output was in tabular form including a land use value and the chemical and bio-organisms components of groundwater.

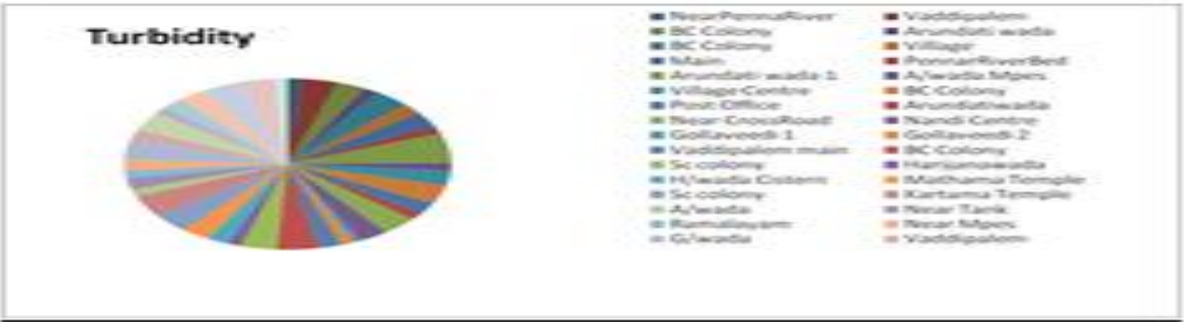
Although there is a possibility in ArcMap to calculate mean or median values in the JOIN function, it did not contribute to reliable result. It could be due to mass of points and a non-normal distribution. For example, in some areas where buffer areas overlap each other, the software just used the values of wells in common just for one buffer zone. To cope this problem, it has been decided to apply ArcGIS functions just for extraction of well information within 200 meters of the target wells and then export data for further study in Excel. In Excel two formulas have been developed for calculation of average and median value of sample values will be joined.

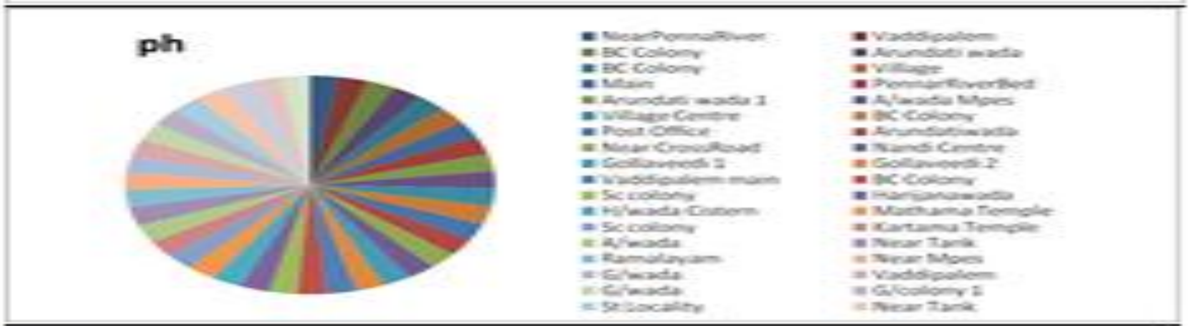
IV.CHEMICAL EXAMINATION OF DRINKING WATER IN GOLLAKANDUKUR AND KANDAMUR

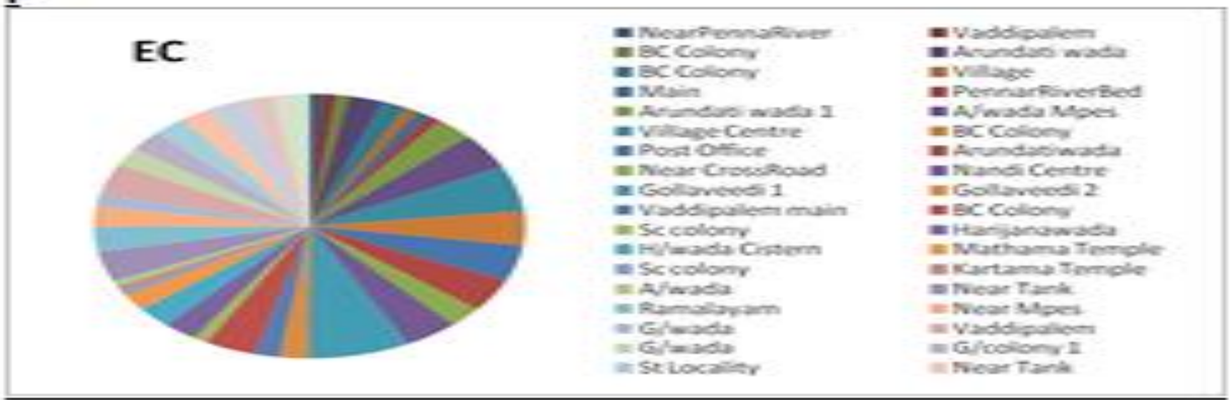
Chemical Examination Of Drinking Water in Nellore Rural on 04-06-2014 to 15-06-2014

S.No.	Name of The Gram panchayat	Loacation	Turbidity	Ph	EC	TDS	ALK	TH	Cal	Mag	Chrolide	Fluoride	Sulphate	Nitrate	Iron
1	Gollakandukur	NearPennaRiv er	0.2	7.2	928	603	120	180	84	23	195	0.3	70	12	0.3
2	Gollakandukur	Vaddipalem	0.5	7.1	997	648	188	268	100	40	246	0.8	68	15	0.2
3	Gollakandukur	BC Colony	0.4	7.2	920	598	156	228	88	34	183	0.6	48	12	0.3
4	Gollakandukur	Arundati wada	0.2	7.3	2460	1599	264	500	136	88	587	1	120	13	0.2
5	Gollakandukur	BC Colony	0.5	7.2	1795	1166	316	388	112	67	376	0.5	94	18	0.2
6	Gollakandukur	Village	0.3	7.3	990	643	164	232	84	35	199	0.6	78	19	0.3
7	Gollakandukur	Main	0.4	7.1	941	611	156	228	84	34	211	0.7	64	21	0.2
8	Gollakandukur	PennarRiverBe d	0.2	7.5	934	609	180	204	72	32	183	0.8	58	22	0.3
9	Gollakandukur	Arundati wada 1	0.8	7.3	2730	1774	392	548	188	87	562	0.6	88	15	0.2
10	Gollakandukur	A/wada Mpps	0.2	7.1	4230	2424	624	676	248	152	913	0.4	174	16	0.3
11	Gollakandukur	Village Centre	0.4	7.5	5380	2749	672	748	312	105	872	0.2	310	14	0.2
12	Gollakandukur	BC Colony	0.5	7.8	4030	3490	700	1144	356	191	1128	0.3	280	15	0.3
13	Gollakandukur	Post Office	0.3	7.1	4250	2619	392	712	276	105	919	0.8	190	16	0.2
14	Gollakandukur	Arundatiwada	0.2	7.3	3860	2762	500	792	316	115	919	0.9	200	18	0.3
15	Gollakandukur	Near CrossRoad	0.5	7.1	2450	2509	580	740	248	119	862	0.4	210	17	0.2
16	Gollakandukur	Nandi Centre	0.4	7	3930	1592	312	540	156	93	565	0.2	120	13	0.3
17	Gollakandukur	Gollavoodi 1	0.1	7.1	7390	2554	388	748	272	115	919	0.3	130	12	0.2
18	Gollakandukur	Gollavoodi 2	0.2	7.2	2060	4803	632	1576	392	287	1311	0.5	400	15	0.3
19	Gollakandukur	Vaddipalem main	0.3	7.2	1763	13390	272	420	156	64	530	0.6	89	16	0.2
20	Gollakandukur	BC Colony	0.6	7.3	3730	1145	288	312	116	47	404	0.5	100	18	0.2
21	Kandamur	Sc colony	0.5	7.1	1061	689	152	204	84	29	214	0.2	98	14	0.2
22	Kandamur	Harijanawada	0.2	7.2	2440	1586	344	568	140	100	467	0.4	150	12	0.2
23	Kandamur	H/wada Cistern	0.3	7.4	2543	1625	312	540	156	93	534	0.3	158	13	0.3
24	Kandamur	Mathamma Temple	0.4	7.2	1941	1261	224	316	136	43	309	0.5	100	15	0.2
25	Kandamur	Sc colony	0.5	7	617	401	116	180	60	19	167	0.6	98	16	0.2
26	Kandamur	Kartamma Temple	0.6	7.2	565	367	100	152	52	24	107	0.7	150	18	0.3
27	Kandamur	A/wada	0.2	7.6	720	468	112	156	84	17	176	0.8	158	19	0.2
28	Kandamur	Near Tank	0.3	7.8	3500	2275	590	796	300	120	941	0.6	100	21	0.3
29	Kandamur	Ramalayam	0.2	7.3	2930	1904	540	572	184	94	562	0.8	50	25	0.2
30	Kandamur	Near Mpps	0.3	7.2	2430	1573	272	500	156	83	458	0.2	80	15	0.2
31	Kandamur	G/wada	0.5	7.1	1436	933	192	460	148	70	331	0.3	78	10	0.2
32	Kandamur	Vaddipalem	0.3	7.2	3650	2372	340	792	352	106	805	0.5	120	13	0.3
33	Kandamur	G/wada	0.5	7.3	2130	1384	300	524	156	89	524	0.6	92	16	0.2
34	Kandamur	G/colony 1	0.2	7.2	2470	1605	348	488	148	82	455	0.7	84	18	0.3
35	Kandamur	St Locality	0.3	7.6	2420	1573	496	568	152	100	530	0.8	85	14	0.2
36	Kandamur	Near Tank	0.4	7.8	2340	1521	292	392	156	57	439	0.6	100	15	0.3
37	Kandamur	Main Village	0.5	7.2	2470	1605	248	408	140	65	594	0.2	80	12	0.2
38	Kandamur	Road Point	0.5	7.3	2220	1443	276	552	164	94	121	0.3	98	11	0.3
39	Kandamur	St Locality	0.2	7.1	2610	1696	288	568	156	100	562	0.2	69	12	0.2

A Groundwater Vulnerability Assessment Method Using GIS and Multivariate Statistics







Rain Fall in Nellore 2015:

Mandal	Cumulative Actual Rain fall(mm)	Cumulative Normal Rain fall(mm)	Deviation(%)	status	Predominant Crops	Irrigation
Nellore	536.4	1077.6	-50.2	Deficient	Rice, sugarcane	command

V.Conclusion

The water quality in is generally poor in Nellore rural areas. The largest health risk is due to deficient drinking water quality containing nitrate and total coliform bacteria as the most hazardous parameters. No pesticide concentration was detected, which indicated that the health of the consumers is not likely to be affected by such chemicals. Nitrate concentrations are believed to originate from the simple pit latrines, frequently used by the villagers. The groundwater might be affected by nitrate leakage from the surrounding agricultural land in addition to cultivations in people's gardens. Nitrate concentrations are higher in the densely populated part of the village and in unimproved water sources. Bacteriological contamination varies greatly in the village and the degree of contamination could not be explained by the population density or the status of the water sources. In addition, no significant statistical correlations were found between nitrate, chloride, EC, turbidity, hardness and total coliform bacteria. Therefore, it is believed that bacteriological contamination most likely occurred at the well, for instance by abstracting water with dirty buckets or not covering the well with a lid.Most groundwater sources within the study area are at high or moderate risk of becoming contaminated. Furthermore, a majority of the drinking water quality is not fit to drink; hence, most households in Nellore do not have access to safe drinking water. If using the groundwater for irrigation the quality is mostly considered as acceptable. A majority of the villagers have access to improved sanitation. Pit latrines are generally placed far from the dwelling-house, often lacking hand-washing facilities. The most important improvement to be implemented would be to upgrade the current sanitation system consisting of pit latrines. Installing toilets would be a good and sustainable solution for both the environment and for the health and comfort of the users. Additional possibilities for improving the water sources would be to collect rainfall or improve the construction of existing wells and springs.

REFERENCES:

[1] Aller, L., Bennett, T., Lehr, J.H., Petty, R.J., Hackett, G., 1987. *DRASTIC: A standardizedsystem for Evaluating Ground Water Pollution Potential by using Hydro geological settings*, http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20007KU4.txt (2 Dec., 2009).

[2] ARFC, 2009. Maps provided by Tamara Rudenco at the Agency for Land Relations andCadastre of the Republic of Moldova (6 Oct., 2009).

[3] Aquastat, 2009. FAO's Information System on Water and Agriculture; AQUASTAT maincountry database, http://www.fao.org/nr/water/aquastat/dbase/index.stm (5 Nov., 2009).

[4] Bauder, T.A, Waskom, R.M, Davis J.G, 2009. *Irrigation Water Quality Criteria*, http://www.ext.colostate.edu/PUBS/crops/00506.html (7 Dec., 2009).

[5] Borlänge Energi, 2009. www.borlange-energi.se (20 Jan., 2010).Childinfo – Unicef, 2010. *Coverage estimates Improved Sanitation Republic of Moldova*,

[6] WHO/UNICEF Joint Monitoring Programme for Water SupplyandSanitation.http://www.childinfo.org/files/MDA_san.pdf, (3 Feb., 2010).

[7] Conant, J., & Fadem, P., 2008. *A Community Guide to Community Health.* HesperianFoundation, Berkeley, California. ISBN 9780942364569.

[8] Draoui M., Vias, J., Andreo, B., Targuisti, K., Stitou El Messari, J., 2007. A comparativestudy of four vulnerability mapping methods in a detritic aquifer under mediterranean climaticconditions. *Environmental Geology* 54:455-463.

[9] Esrey, S., Gough, J., Rapaport, D., Sawyer, R., Simpson-Hebért, M., Vargas, J., Winblad, U.,1998. *Ecological sanitation, 1st ed.* Sida, Stockholm. ISBN 9158676120.

[10] European Environment Agency, 1999. *Groundwater quality and quantity in Europe,environmental assessment report no 3*. Report: enviassrp199903.

Franson, 2009. Coordtrans V2.3,

[11]Gaisma,2009.http://www.gaisma.com/en/location/chisinau.html (20 Jan., 2010).Gomezdelcampo E. & Dickerson R., 2008. A modifiedDRASTICmodelforSitingConfinedAnimalFeedingOperations in Williams County, Ohio, USA. *Environmental Geology* 55:
1821-1832.

[12] Google, 2009. www.google.se (17 Oct., 2009).

[13] Grip, H. & Rodhe, A., 2003. *Vattnets väg från regn till bäck, 3rd ed.* Hallgren & FallgrenStudieförlag AB, Karlshamn. ISBN 9173827622.

[14] Ministry for Foreign Affairs, 2006. *Samarbetsstrategier för utvecklingssamarbetet medMoldavien januari 2007 – december 2010.*, report UD2006/19849/EC.

[15] WHO, 2009c. http://www.who.int/topics/sanitation/en/ (26 Oct., 2009).

[16] WHOSIS, 2009a. www.who.int/whosis/whostat/EN_WHS09_Table5.pdf (15 Oct., 2009).

[17]WHOSIS,2009b.http://www.who.int/whosis/indicators/compendium/2008/2wst/en/(15 Oct., 2009).

[18] WHO & UNICEF, 2006. *Meeting the MDG drinking water and sanitation target: the urbanand rural challenge of the decade*,http://www.who.int/water_sanitation_health/monitoring/jmpfinal.pdf (26 Oct., 2009).