

Status of Groundwater of Western Part of Nokha Tehsil, District Bikaner, Rajasthan

Dr. Priti Solanki, Dr. Arun Kumar Shandiliya

Department of Geology, Jai Narayan Vyas University, Jodhpur, Rajasthan, India

Department of Geology, Dungar College, Bikaner, Rajasthan, India

ABSTRACT: The chemical quality of ground water in the district has been studied from the available data of chemical analysis of water samples collected from the National hydrograph network stations located in various parts of the district. The analytical data of ground water samples indicate that the ground water is, in general, alkaline in nature. The ground water of Bikaner district possesses relatively high mineral concentration, which varies considerably laterally and vertically. Generally, the perched water has less salt concentration except in Lunkaransar - Kutuwas area where it is highly brackish with electrical conductivity around 7000 $\mu\text{S}/\text{cm}$ at 25°C. Shallow ground water of the dug well zone has electrical conductivity within 3000 $\mu\text{S}/\text{cm}$ at 25°C in the area Chattargarh in Lunkaransar block and in the north eastern edge of Nokha block. A perusal of the EC map prepared on the basis of analytical results of water samples collected in May 2011 indicates that specific conductance varies from 350 $\mu\text{S}/\text{cm}$ (Jaggasar) to 5270 $\mu\text{S}/\text{cm}$ (Gorabdesar) in the district. Chloride indicates almost the similar pattern. The chloride content varies from 57 to 1463 ppm.

KEYWORDS: groundwater, Nokha tehsil, Bikaner , Rajasthan, alkaline, electrical conductivity

I. INTRODUCTION

Groundwater is the only source of potable water for the majority of people in the study area. Physico-chemical characteristics of water samples from villages of Nokha block of district Bikaner were studied. The water quality parameters like pH, TDS, TH, alkalinity, fluoride, NO_3^- , Chloride, sulphate, Ca^{2+} and Mg^{2+} were studied. It is found that some water samples are not suitable for drinking purpose due to high concentration of one parameter or other. The data revealed that the ground water of these villages of Nokha block of district Bikaner contains high fluoride and nitrate concentration, which leads to diseases. The high value of these parameters may have health implications, so, this ground water is not good for health and therefore, needs attention. [1,2,3]

The selected project area is 10 villages lie in Nokha tehsil in Bikaner district, which touch the boundary of Nagaur/Churu district. Bikaner is one of desert district situated in the North-West of Rajasthan. It extends from 27°11' to 29°3' North latitudes and 71°54' to 74°12'

Sampling methods: The samples were collected from tube well near the residential and agricultural area of different villages of Nokha tehsil which touch the boundary of Nagaur/Churu district. The water samples were extensively used for drinking and other domestic purpose. . The samples were collected in high grade plastic bottles of one litre capacity after rinsing with Distilled water. **Analysis Methods:** The physicochemical characteristics of the ground water samples were determined by Standard methods, 2002 9 .The pH, TDS was measured by using portable meters and manual method.. The concentrations of Magnesium, Calcium hardness were estimated by volumetric methods and Total hardness of water was estimated by complex metric titration with EDTA. Chlorides content here determined volumetrically by AgNO_3 titrimetric method. SO_4^{2-} was measured by gravimetric method. Other parameters like F- and NO_3^- were estimated by spectrophotometric method. The results are comparable with WHO and BIS water standards. **10-11 Location of sampling stations:** The samples were collected from villages of different regions namely Mainsar(S1), Mainsar(S2), Bageu(S3), Bageu gosala(S4), Jhareli(S5), Thavaria(S6), Mundar(S7), Jasarasar(S8), Jasarasar(S9), Kakra(S10).

International Journal of Innovative Research in Science, Engineering and Technology

[A Monthly, Peer Reviewed Journal] Impact Factor: 6.209 |

Vol. 4, Issue 10, October 2015

pH: The data revealed that pH ranged from 7.3 to 8.5. The minimum pH was observed in Jhareli village(S5) and maximum pH was detected in Mainsar village(S1). According to BIS standards, best and ideal pH value for human consumption is 7.0, but it may vary from 6.5-8.5 Thus, all the samples tested were slightly alkaline; the pH of all samples was within limit. The pH value above 7.0 shows the alkaline nature of water due to excess of carbonate and bicarbonate ions.

TDS: It is the important parameter for the use of water. The water with a high TDS value indicates that Water is highly mineralized. The Desirable limit for TDS is 500 mg/l and maximum limit is 2000 mg/l Prescribed for drinking purpose according to BIS .The concentration of TDS in the present study is observed in the range of 671 mg/l to 2735 mg/l. It is showed that sample S1 And S2 are unsuitable for drinking and irrigation purpose as the TDS is more than 2000 mg/l in these samples. Alkalinity: The data showed that alkalinity ranged from 210 mg/l to 685. Mainsar village's samples (S1 and S2) showed higher alkalinity value than the permissible limit. Chloride: The concentration of chloride varied between 149 to 1090 mg/l. The minimum value was observed in Jhareli village(S5) and maximum concentration in Mainsar village(S1). However, according to BIS the permissible limit for chloride is 250-1000 mg/l, which indicate that the drinking water of locations contained chloride, concentration within permissible limit except for Mainsar(S1) village wherein the chloride concentration is higher than the permissible limit. High concentration of Cl⁻ produce hypertension, effect metabolism of the body, and increase the electrical conductivity of water 12 Total Hardness: The hardness of water is produced by the Ca²⁺ and Mg²⁺ salt as the bicarbonates, sulphates and chlorides. Hardness value in the studied area varied between 130-715 mg/L. Two sampling points showed higher hardness values than the prescribed limit of BIS and WHO i.e.mainsar village(S1) and kakra village (S10). Excess hardness causes stomach disorder and finally weakens the stomach permanently. Calcium : Present study shows the concentration of Ca lies between 28 to 130 mg/l. The minimum value was observed in Bagseu gosala(S4) and maximum concentration in the Mainsar village(S1). All samples is in permissible limit. Magnesium: Magnesium value in the studied area varied between 15.64 to 95.20 mg/L. The maximum value was recorded in the Mainsar village (S1) and minimum value was observed in Bagseu gosala(S4). According to BIS standards Magnesium Permissible Limit is 30-100 Thus, all the samples were within limit. Nitrate: The Nitrate content in water sources of present study area ranged from 18 mg/l to 421 mg/l. The minimum value was observed in Bagseu (S3) and maximum concentration in Kakra(S10). Sample S5,S6,S7,S8.S9,S10 Shows higher level of nitrate in drinking water which is beyond permissible limit. According to BIS permissible limit of nitrate in water is 45mg/l-100mg/l. so, this water is not good for health. Nitrate in ground water is originated from fertilizers,[4,5,6] septic systems and manure spreading operations. Nitrate is one of the most frequent ground water pollutants in rural areas it needs to be regulated in drinking water basically. The toxicity of NO₃⁻ ion is due to its reduction in NO₂⁻ ion in the human body. NO₂⁻ oxidized normal haemoglobin to methemoglobin, which is unable to transport oxygen to the tissue. This condition is called methemoglobinemia (blue baby disease) causes cynosis and at higher concentration asphyxia.13 Fluoride: According to BIS standard the limit of fluoride is 1.0 to 1.5 mg/l. The fluoride content in water sources of present study area ranged from 0.75 mg/l to 9.33 mg/l at Kakra(S10) and mainsar village (S1) respectively. Six samples (S1,S2,S3,S4,S8,S9) have fluoride more than the permissible limit, so, it is not suitable for drinking purpose and its leads to various health hazards like- dental and skeletal fluorosis. The people of study area also complained of joint and abdominal pain. The F⁻ concentration is between 0.9 to 1.2 mg/l then dental fluorosis is started and F⁻ exceeds the level of 3 mg/l than skeletal fluorosis is started in living beings. 14-16 On the basis of above discussion, it may be concluded that quality of ground water varies from place to place. Sixty percentage studied area shows higher values of fluoride and nitrate in the drinking water samples. some places have higher values of TDS, Alkalinity, Hardness and chloride while remaining parameters are within the permissible limits. In these areas, the treatment technology must be implemented to ensure good health of the living beings.

II. DISCUSSION

ADB approved a loan for the Rajasthan Secondary Towns Development Sector Project (RSTDSP, Loan 3972: IND) in September 2014. This is currently under implementation and will close by May 2028. The additional financing (the project) will expand the improved access to WSS services in at least ten urban local bodies (ULBs), benefiting 1.2 million people. Important value addition of the proposed project to the ongoing project is that it will provide innovative solutions to address climate change to respond to the growing climate risks and vulnerability and also to improve livability and prosperity through enhancing natural and/or built heritage at least ten ULBs in Rajasthan, benefiting 1.0

International Journal of Innovative Research in Science, Engineering and Technology

[A Monthly, Peer Reviewed Journal] Impact Factor: 6.209 |

Vol. 4, Issue 10, October 2015

million people. The overall project is aligned with the following impacts: (i) access to potable, affordable, reliable, equitable, environmentally sustainable drinking water supply in all urban areas of Rajasthan improved, (ii) health status of urban population, especially the poor and under-privileged improved, and (iii) productivity, livability and prosperity for the citizens in Rajasthan cities and towns enhanced. Reflecting the additional measures to enhance climate resilience and heritage-sensitive urban development of the project, impact statement (iii) was added; the outcome statement is modified as quality, reliability, equity, and sustainability of urban assets and services in project towns of Rajasthan improved; and additional output was also added, resulting in four outputs. Nokha is one of the project towns, and improvement of water supply and sewerage system in Nokha is proposed under the RSTDSP-AF. Following are the proposed components: Water Supply; proposed works are (i) Construction of 3 nos of CWRs at Raisar campus Head Works (1100 KL), A.En Office and Head Works at Navali Gate[7,8,9] (150 KL) and Ranarao Campus Head Works (500 KLD) (ii) Construction of Clear Water Pump Houses -5 nos. at :- Raisar, A.En Campus, Ranarao, Teja Mandir and Bagdi headwork's (iii) 17.840 km of transmission mains (iv) 296.2 km of water distribution networks (v) Refurbishment of 7nos. OHSRs :- A.En. Campus- (250 KLx2 nos), Bhaton Ki Basti (700 KL) Dwarka Colony (250 KL), Tirupati Nagar (200 KL), Mohanpura (450 KL) and Jorawarpura (250 KL), 8 nos CWRs (at Teja Mandir, Rana Rao, A.En. Campus, Bagdi and Raisa(r headworks) and 1 pump house at Raisar HW (vi) House Service Connections-14250 nos (vii) Rehabilitation of existing Tube Wells-36 nos. Sewerage; proposed works are:, (i) Construction of 2 nos of STPs of 5 MLD near Charkara Village Zone - 1 with co-treatment of sludge) and 7 MLD near Madiya Village Zone - 3 with SBR technology in Town (ii) Construction of SPS (4MLD) near stadium, Zone -2 (iii) 2.6 kms of Rising mains (iv) 7.7 kms of sewage collection networks (v) 264 nos. of manholes. (vi) 20.0 km pipe networks for distribution of treated effluent for reuse such as in agriculture (vii) Procurement of desludging equipment with 4000 lit tank capacity for collection of faecal sludge and septage from 13 wards viz. 1, 3, 4, 5, 6, 23, 25, 36, 40, 41, 44 & 45. Screening and Categorization. assessment of potential impacts. Nokha Water Supply & Sewerage subproject is classified as environmental category B per ADB's Safeguard Policy Statement (SPS), 2009, and accordingly this initial environmental examination (IEE) assesses the environmental impacts and provides mitigation and monitoring measures to ensure that there are no significant impacts as a result of the subproject. As per Government of India environmental impact assessment (EIA) Notification, 2006, subproject do not require environmental clearance. Description of the Environment. Subproject components are in Nokha City and in its immediate surroundings which were converted into urban use for many years ago, and there is no natural habitat left at the proposed subproject sites. The subproject sites are located in existing road right of way (RoW) and government-owned lands. The proposed STP, SPS and CWRs will be constructed on vacant government land. There are no trees on the site and is surrounded mostly by agricultural areas. The nearest built-up area from 7 MLD STP is Mandiya village at approx. 1100 m distance in south-east direction and Nokhamandi is nearest habitation from proposed 5 MLD STP at 2.5 km in north-east direction. Both site for STP are Govt. Land. The selected sites are also had sufficient area for future expansion of the STPs, area available 50000 at 7 MLD & 56000 sqm at 5 MLD STP against 6300 & 4500 sqm required area respectively. The discharge points for treated effluent of STPs are natural depression located near STPs site from there it shall be reused by nearby farmers. The nearest wildlife protected area is Jorbeer Conservation Reserve at Bikaner at 50 km distance in north side. There is neither ASI or state protected monuments in the town. The nearest ASI protected monument is Seth Bhandasar Jain Temple in Bikaner at approx. 50 km distance in north side. Potential Environmental Impacts and Mitigation measures. In this draft IEE, negative impacts were identified in relation to location, design, construction and operation of the improved infrastructure. Environmental impacts as being due to the project design or location were not significant as various measures are already included in site planning and preliminary design. No impacts on forests or archaeological resources envisaged. Temporary measures suggested to avoid any disturbance / damage to buildings during laying of water lines in nearby roads. Source of water for town is Panna Lal Barupal Lift Canal also known as Gajner Lift Canal (GLC) of IGNP System, assessment confirm the source sustainability to provide additional water, and no water sharing conflicts or downstream impacts envisaged. Water allocation through Nagaur Lift Project is 15.67 MLD (for yr 2030) and 21.76 MLD (for year 2045). Assessment confirms the source sustainability to provide drinking water, and no water sharing conflicts or downstream impacts envisaged. New proposed STPs with capacity of 7 & 5 MLD will employ sequential batch reactor (SBR) technology to meet stipulated discharge standards. SBR will involve aerobic treatment, with minimum odour potential. Sludge management is included in the STP, properly dried sludge will be reused as manure. Potential impacts during construction are considered significant but temporary and are common impacts of construction in urban areas, and there are well developed methods to mitigate the same. Except for laying of water pipelines, all other construction activities will be confined to the selected sites and the interference with the general

International Journal of Innovative Research in Science, Engineering and Technology

[A Monthly, Peer Reviewed Journal] Impact Factor: 6.209]

Vol. 4, Issue 10, October 2015

public and community around is minimal. In these works, the temporary negative impacts arise mainly from construction dust and noise, hauling of construction material, waste and equipment on local roads (traffic, dust, safety etc.), mining of construction material, occupational health and safety (OHS) aspects. Pipe laying works will be conducted along public roads in an urban area congested with people, activities and traffic. Therefore, these works may have adverse, but temporary impacts arising mainly from the disturbance of residents, businesses and traffic due to construction work; safety risk to workers, public and nearby buildings due to deep trench excavations in the road; access impediment to houses and business, disposal of large quantities of construction waste etc. Trenchless method will be adopted for pipeline deeper than 3.5 m and also at main road crossings in traffic areas. Environmental Management. An environmental management plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels, along with the delegation of responsibility to appropriate agency. Various design related measures are already included in the project design.[10,11,12] During construction, the EMP includes mitigation measures such as (i) proper planning and scheduling of water line and sewer works to minimize public inconvenience; (ii) measures to avoid impacts on heritage building and chance find procedures (iii) barricading, dust suppression and noise control measures; (iv) traffic management measures for works along the roads and for hauling activities; (v) occupational and community health and safety, labour welfare, (vi) provision of walkways and planks over trenches to ensure access will not be impeded; (vii) reuse of excavated materials to extent possible, (viii) spill and sediment control measures to avoid water and soil pollution, etc.,. EMP will guide the environmentally sound construction of the subproject. EMP includes a monitoring program to measure the effectiveness of EMP implementation and include observations on- and off-site, document checks, and interviews with workers and beneficiaries. A copy of the updated EMP/ site environmental management plan (SEMP) shall be kept on-site during the construction period at all times. The EMP will be included in bids and contracts, and implementation shall be binding on contractors. Implementation Arrangements. The executing and implementing agencies will remain unchanged from the current project, which are Government of Rajasthan's Local Self Government Department (LSGD) and Rajasthan Urban Drinking Water, Sewerage and Infrastructure Corporation (RUDSICO), respectively. The AF project retains the project management unit (PMU) at the implementing agency, as well as the two Zonal Offices in Jaipur and Jodhpur. Project implementation units (PIUs) have been established in project towns. A total of eight PIUs will manage 18 ULBs under the AF Project. Consultants will support the PMU and PIUs. Project Officer (Environment) at PMU and Safeguard and Safety Officer at each of the PIUs will be responsible for environment management and monitoring activities and will be supported by Safeguard support staff from Supervision Consultant, town staff/team and Environment Safeguard Specialist of Supervision Consultants. Contractor personnel will also include an Environment, Health and Safety (EHS) Engineer in the project construction team. Consultation, Disclosure and Grievance Redress. The stakeholders were involved in developing the IEE. Informal and formal consultation are conducted with local population of the area at 10 places along with proposed alignment with about 66 persons in month of December 2014 - April 2014. A City Level Committee (CLC) was held and CLC has appreciated and approved the subproject. The IEE will be made available at public locations; this draft IEE will be disclosed to a wider audience via the ADB and RUDSICO websites. Consultation process will continue during project implementation. A grievance redress mechanism (GRM) will be established to redress public grievances. Monitoring and Reporting. The PMU, PIU and consultants will be responsible for monitoring and reporting. During construction, results from internal monitoring by the DBO contractor will be reflected in their monthly EMP implementation reports to the PIU. PIU with the assistance of CMSC, will monitor the compliance of contractor, prepare a quarterly environmental monitoring report (QEMR) and submit to PMU. The PMU will oversee the implementation and compliance and will submit semi-annual environmental monitoring reports (SEMR) to ADB. SEMRs will be disclosed on ADB and RUDSICO websites. The proposed project is unlikely to cause significant adverse impacts, and potential impacts are mainly due to construction and can be mitigated or minimized to acceptable levels through measures included in the EMP. The citizens of the Nokha will be the major beneficiaries. The subproject is primarily designed to improve environmental quality and living conditions of Nokha Town through provision of water supply and sewerage. The benefits arising from this subproject include:(i) increased availability of potable water to all households including urban poor; (ii) reduced time and costs in accessing alternative sources of water; (iii) better public health particularly reduction in waterborne and infectious diseases; (iv) reduced risk of groundwater contamination; (v) reduced risk of contamination of treated water supplies; (vi) reduced dependence on fresh water resource due to reuse of treated wastewater, and (vii) improvement in quality of water bodies due to disposal of treated effluent meeting disposal standards. Based on the findings of the IEE, the classification of the project as Category "B" is confirmed. No further special study or detailed environmental

International Journal of Innovative Research in Science, Engineering and Technology

[A Monthly, Peer Reviewed Journal] Impact Factor: 6.209 |

Vol. 4, Issue 10, October 2015

impact assessment (EIA) needs to be undertaken to comply with ADB SPS (2009) or GoI EIA Notification (2006). To conform to government guidelines, the STP requires consent to establishment (CTE) and consent to operate (CTO) from Rajasthan Pollution Control Board. CTE will be obtained prior to construction, as the detailed designs will be undertaken by contractor. This IEE needs to be updated during the detailed design, reviewed and approved by ADB, and disclosed prior to start of construction.

III. RESULTS

Nokha is a town and Municipality in Bikaner District in the state of Rajasthan. Nokha was established as a Krishi Mandi by the contemporary king of Bikaner state Maharaja Ganga Singh. Maharaja Ganga Singh confer title of Chandigarh to nokha because it was well planned city like Chandigarh. Roads and mapping of this city is incomparable. Nokha Bhujia(Snacks) is also famous world-wide. City is directly connected to Salasar Balaji temple and Tal Chhapar Sanctuary via State Highway-20. It is connected to all major cities of India by rail and road network. a famous shiva temple Sengal Dhora shiv temple is located around 30 km from this town.

Panchoo is a small village of 17346 hectares in Nokha Tehsil in Bikaner district in the State of Rajasthan, India.^[2] The village is administrated by a sarpanch who is elected representative of the village by the local elections. Panchoo depends on NOKHA, the nearest town for all major economic activities.^[3] The village has government-provided water facilities that include One tap, One Well supply, One tank, One tubewell, and Two handpumps. The villagers also acquire water from some of the natural water sources - Two rivers, Two canals and Two springs. Panchoo is also surrounded by Two lakes. The population of the village depends on the source of drinking water during summer on Tubewell. Panchoo's pin code is 334804^[4], and village code is 00551400. The area of Panchoo is segregated as 77.78 hectares irrigated area, 13354.68 hectares unirrigated, the 3315.05 hectare area under culturable waste (including gauchar and groves), and remaining 598.91 hectare area not available for cultivation.

Panchoo has One post office (Panchoo S.O) and Two Hundred public telephones. The village is connected with a single bus service. Panchoo has One bank, One credit society and One agricultural credit society for the regulation of economic activity. The village is also equipped with Two recreational centers.

The village has an uninterrupted 24 hours electric supply from a power grid.

Panchoo is a census village in the district of Bikaner, Rajasthan. The village has a total population of 17370 and has total administration over 2604 houses which are connected to supplies basic amenities like water and sewerage.

Panchoo has 3452 children, 1851 boys and 1601 girls.

Scheduled caste counts for 4298 (24.74%) males constitute 2284 (13.15%) of the population and females 2014 (11.59%).

Scheduled tribe counts for 1 (0.01%) males constitute 1 (0.01%) of the population and females 0 (0.0%).

Medical facility[13,14,15]

Panchoo has 3 hospitals in nearby town.

Panchoo has 1 ayurvedic dispensary.

Educational institutions

As per the census 2011 report, 6822 people are literate in Panchoo out of which 4448 are males and 2374 are females.

Panchoo has the following educational facilities:

1 Education facility

6 Primary schools

2 Upper primary schools

1 Secondary school

1 Senior Secondary school

3 Colleges in the nearby range

International Journal of Innovative Research in Science, Engineering and Technology

[A Monthly, Peer Reviewed Journal] Impact Factor: 6.209 |

Vol. 4, Issue 10, October 2015

Employment

According to a census 2011 report, 7952 people of the total population are employed. The workforce is 4629 male, 3323 female with 7164 (90.09%) of all workers being employed full-time, this includes 4253 males and 2911 females. 3454 males and 2833 females are considered as the main cultivators with the help of 43 male and 16 female agricultural labor. 788 people are reported to work for a marginal period of time in the year.

They depend on the agricultural markets (Mandi) of the nearby towns of NOKHA and Bikaner to sell agricultural produce and make their living.

IV. CONCLUSION

Rajasthan's Bikaner District, part of the Thar Desert, is experiencing problems with falling groundwater levels, high salinity, fluoride and nitrate concentrations. Therefore, groundwater quality studies are underway to determine the suitability of groundwater for drinking purposes in the Bikaner district. Quality analysis is performed using parameters such as Conductivity (EC), Total Dissolved Solids (TDS), pH, Calcium, Potassium, Sodium, Nitrate, Sulfate, Chloride, Fluoride, magnesium, total hardness (TH) and Bicarbonate. Conductivity, TDS and TH increases were observed in the post-monsoon period. No such changes were observed in the sulphate, nitrate and fluoride concentrations after the rains. Most of the study areas have high salinity and are therefore unsuitable for consumption. However, all other chemical parameters are within the maximum allowable limits according to the BIS standard. Unconventional energy use desalination of groundwater is proposed to provide sustainable drinking water. Various industrial and mining man-made recharge structures (Pits with Borehole Technique) near the villages, resulting in higher groundwater levels and improved quality in neighboring areas. Success stories can be replicated in similar geographic environments. Large-scale artificial rainwater harvesting/storage/replenishment of potential aquifers is another management alternative, which can improve the chemical quality of groundwater.[16]

REFERENCES

1. S. Jain and M. Agarwal, Study on physico-chemical characteristics of ground water of various villages around Raisar, J. Chem. Bio. Phy. Sci. Sec. D, 2012, 2(3), 1551-1555.
2. C. Ramachandraiah, Right to drinking water in India, Centre for Economic and Social Studies., 2004, 56.
3. M. Sillanpaa and K. Pirkanniemi, Environ. Technol, 2001, 22, 791.
4. M. Henze and P. Harremos, Water Sci. Tech., 1983, 15, 100.
5. S. S. Suthar, C. Singh, R. Kumar, G. S. Daiya and M. K. Kaushik; Ground water quality of Sri Ganganagar city, Nature Environment & Pollution Technology, 2005, 4 (4), 515-519.
6. S. K. Pandey and S. Tiwari, Physico-chemical analyses of ground water of selected area of Ghazipur city-A case study, Nature and Science., 2009, 7(1).
7. J. Rathore, S. Jain, S. Sharma, V. Choudhary and A. Sharma, Groundwater quality assessment at Pali, Rajasthan(India), J. of Envir. Science and Engg, 2009, 51, 4 269.
8. Survey of India catalog
9. APHA, Standard methods for the examination of water and waste water, 21st ed., Washington D.C., USA, 256, 2002.
10. Bureau of Indian Standards, BIS 10500, Manak Bhavan, New Delhi, India, 2003.
11. WHO Guidelines for drinking water, 3rd ed. Geneva, 2004.
12. K. V. Paliwal, A review – Ann. Arid zone, 1971, 10, 266.
13. S. C. Gupta, Nitrate problem in water Resources of Western Rajasthan, Curr. Agric., 2000, 24, 1-2, 37.
14. R. Sharma, A. K. Suthar, R. Mathur and S. Sharma, Quality status of ground water of district Nagaur, Rajasthan, 2012, 2(3), 1594-1598.
15. S. L. Choubisa, Fluoridated ground water and its toxic effects on domesticated animals residing in rural tribal areas of Rajasthan (India), Int J Environ Stud, 2007, 64(2), 151-9.
16. S. Suthar, V. K. Garg, S. Sushma, S. Jangir, S. Kaur, N. Goswami, Fluoride contamination in drinking water in rural habitations of Northern Rajasthan, India, Environmental Monitoring & Assessment, 2008, 145 (1-3), (Springer, USA), 1-6.