Water and Sanitation: A *preliminary* assessment of water supply on selected Odendaal Farms in southern Namibia

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Water is a natural resource that plays an important role in sustainable development and it impacts on the health and sanitation of human beings. "Access to safe water and adequate sanitation is the foundation of development… as no country can advance without a healthy population" (United Nations Children's Fund, 1997). Providing adequate and safe water supply to rural communities in Namibia is a national priority concern owing to the aridity of the regions. Generally, the main problems facing both urban and rural dwellers are water supply and basic sanitation services. Against this background, the project *Sustainable use of Namibia's natural resources: contribution towards enhancing the capacity of future decision makers* (ECAP) aims to provide small scale infrastructural and technical support to the local communities to manage their water supply and sanitation facilities.

To obtain an overview of the situation on several Odendaal farms as part of the communal areas in the south, six farm posts or homesteads were visited within the Grundorner Farmers Association area. These farms were purchased in the 1960s as part of the expansion of communal areas by the government of the time. Soon thereafter a group of Nama-speaking Bondelswarts were settled in the area as their original homelands were suffering from extreme drought (pers. comm. S Bock). While the original farms had consisted of a main homestead and a number of fenced livestock posts each with an independent water supply, resettled people established groups of houses around each of the water points despite their past usage.

Six Odendaal farm posts within the Karas region were preliminarily surveyed for water quality and sanitation. They are:

- Khaitsub
- Nico Pos Doringdraai
- Laurencia Pos Donkerhoek
- Laurencia
- Diamant Kop
- Nico-Noord

METHODOLOGY

The water quality tests were conducted using basic test equipment. A water sample was obtained at each water point and measured individually. A HACH pocket TDS meter was used to test for Total Dissolved Solids (TDS). The meter rod was immersed in the sample water until a reading was obtained (displayed on the mini screen) upon hearing a beep sound. This indicates the salinity of the water which is a determining factor in the electrical conductivity of the water. The result is measured in parts per million (ppm). A non bleeding EMD/Merck pH-indicator strip measured the pH levels of the water sample. For the Nitrates/Nitrites a HACH aquachek test strip for Nitrates/Nitrites was used. A results indicator chart was then used to get the value levels of the chemicals.

To test for phosphates, ten (10) drops of the HACH phosphate reagent was added to the water sample collected in a glass cubicle. The mixture was allowed to stand for a few seconds and a blue tinge was indicative of the presence of phosphates. The hue of the resultant color (light or dark) gives an idea of the level of chemical concentration. However, this result does not quantify the exact amount of the phosphates in the water. Macherey/Nagel *quantofix* ammonium test strips were used to test for ammonia in the water samples. At all the sites, no facilities were available to check the water table.

RESULTS

A) SITE DESCRIPTIONS

KHAITSUB

Five households, situated along a dry water course, were identified on this farm although the total population of individuals was not obtained. The layout of the farm is designed in a way that the kraal is a significant distance away from the water point; however the livestock trough is right alongside the dam. A solar operated borehole situated a further distance from the households, pumps water to the reservoir tanks which are much closer to the homesteads. Next to the borehole stood a dilapidated dam no longer in use. The water from the tap at the tanks was of a good quality when tested, however it had a mineral taste to it. Dip meters to measure the water table were not available.

Exposed cables and water pipes are a concern and it is recommended that they be covered deep in the ground to prevent harsh effects from the sun and trampling by animals to extend their lifespan. The infrastructure overall seems to be in a good condition and well taken care of by the community, requiring minimal maintenance.

Figure 1. The water infrastructure at Khaitsub farm. The middle picture shows some of the measures taken by the community members to protect the infrastructure. In all the pictures it clearly shows the extent of exposed water pipes.

It is assumed that sanitation facilities are lacking on the farm, as no infrastructural set-up suggested otherwise. Indications of deforestation are distinct in the area. A specific plant is known to exist and thrive where land degradation exists, the *Geigeria ornativa.* This plant is an annual or short-lived perennial shrublet, with yellow flower heads which rarely grow 20cm in height. It causes vomiting and then what is known as 'vermeersiekte' in livestock which may result in paralysis a few days after ingestion. This leads to death on the infected animal.

NICO POS- DORINGDRAAI

Our 'tour guide', Respondent 1 (R1), informed us beforehand that the inhabitants just recently moved onto this farm hence they will be enthusiastic about new interventions. On site, we met up with two farmers (R2 and R3), who also happen to be the caretakers of the water point on the farm. From the four households on the farm, seven small children make up part of the population. The infrastructure (tanks and dams) were repaired in the year 2008, according to the two farmers. The farmers also informed us

that the DRWS technicians did the repairs but did not involve the communities neither did they exchange information on how community members can help in maintaining the water point should any damage occur. Information dissemination is critical to raise awareness of the problems and improve planning and coordination activities. Lack thereof compromises capacity development of the local community members, thereby hampering the sustainability of the services provided.

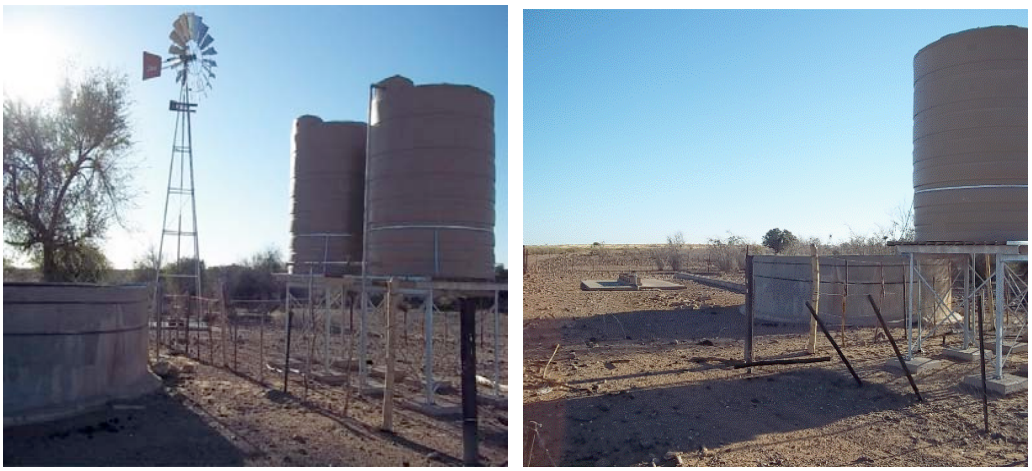


Figure 2 The layout of the infrastructure around the water point: a non functional windmill, water tanks, a farm dam and a livestock watering trough in the background (second picture). The fence around the water point has collapsed and is not maintained.

Currently the windmill is not functional, the tank taps are broken and need repairing, the standpipe handles been removed and possibly misplaced, needing replacement; and the people have no insight or skills to repair and maintain the infrastructure. Other problems noted were the inadequate installations and exposed pipes at the water point. The latter can be addressed by digging deep enough trenches to embed the pipes, thereby avoiding damage by livestock foraging and drinking water in the area. Fencing off certain areas would also offer solution to the damage of water infrastructure by the animals.

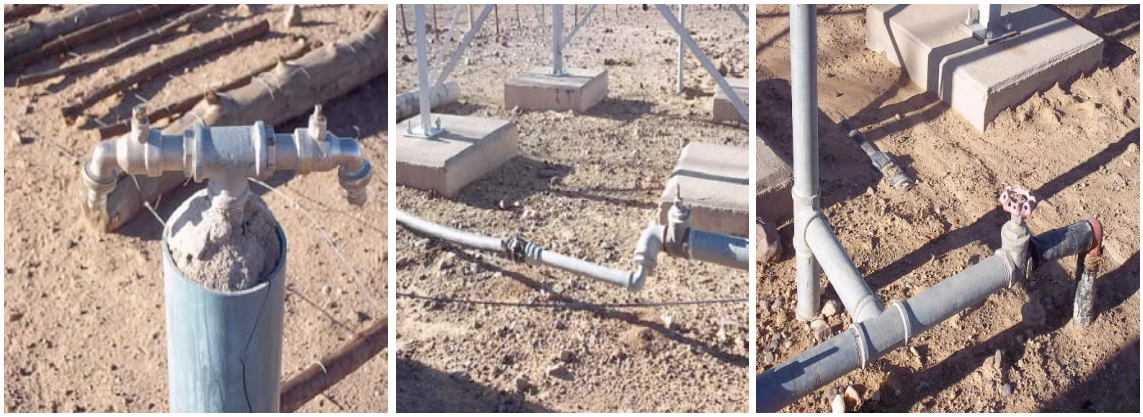


Figure 3 Maintenance is an issue in managing the water point, as depicted in the pictures, where a neglected standpipe with misplaced handles and exposed water pipes are visible

Pertaining to sanitation, open defecation was the order of the day. One of the farmers (R2) expressed concerns over this practice and its safety as women, children and the elderly often have to walk considerable distances into the veld to relieve themselves. The farmers noted that where buckets are used and individuals are responsible for the disposal of the waste, usually in dug up holes a small distance from the homesteads

LAURENCIA POS- DONKERHOEK

The chairperson of the Water Point Community (WPC) and a caretaker for these Odendaal farms, (R4) and (R5) respectively, reside on this farm. Three households were observed at this site with a total population of seven individuals, and two children aged seven months and seven years of age. The farm layout consists of a windmill operated borehole and trough approximately 15meters away from the dam.

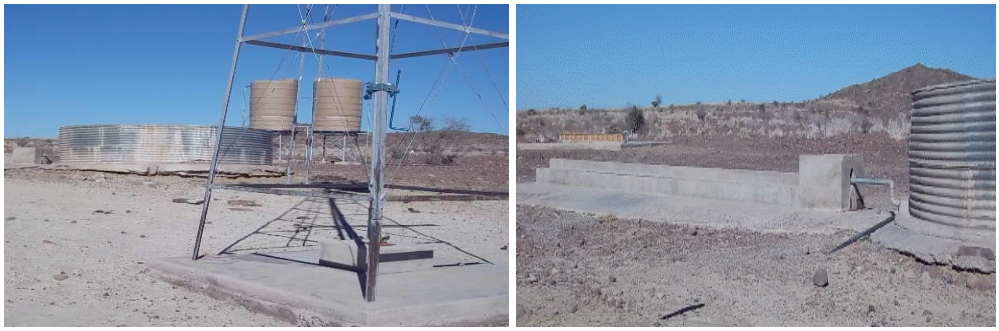


Figure 3 Infrastructural layouts at the water point

Two troughs were observed, one next to the dam and the second one a few meters away from the dam. However, the kraal was located well away from the water point. Similar to Doringdraai Farm, the dams and tanks were also repaired by the DRWS in 2008. The pump however was never maintained for as long as the caretaker can remember. From the observations the concrete trough next to the dam requires cementing to strengthen the infrastructure. Upon inspection it was also clear that the fittings used were of a poor quality due to the leakages observed. Pipes are required to address this problem.

The caretaker, in an attempt to repair some minor damages, did some fittings, but are not sustainable. He placed the blame of all the maintenance issues on the DRWS for making use of 'cheap' fittings which are not sustainable Soil erosion around the farm dams is another evident feature as shown in picture (figure 4, left). There is a need to strengthen the support the foundation of the reservoir where erosion has occurred. Exposed pipes are yet another concern on the farm. The sole standpipe is in an acceptable condition judging from the infrastructure. The community members attributed their removing of the tap handles to avoiding water wastages brought on by animals tempering with the tap. Livestock movement around the water infrastructure should thus be regulated to preserve the equipment.

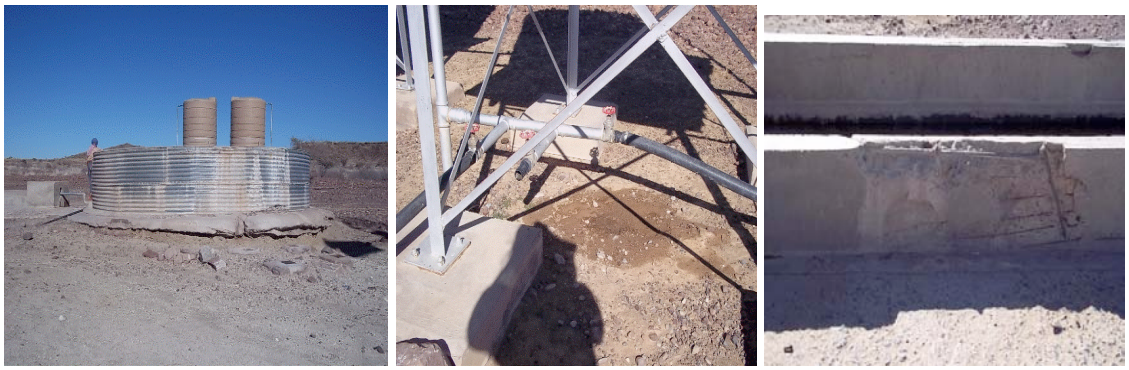


Figure 4 Natural and Infrastructural challenges (from left to right): soil erosion around dam, leakages, fragile infrastructure of water troughs

As for sanitation facilities, open defecation is once again prevalent. One of the three households utilizes the bucket system and has to dispose of the waste in shallow dug out holes.

LAURENCIA

For a farm of four homesteads the water infrastructure and layout of the farm area is hazardous to human health and existence. Three water points were observed at the farm, two windmill powered and one solar powered. Of the windmill powered water points, one is not functional and has been disconnected completely with no intention to rehabilitate it at all. The solar powered borehole was initially designed to water the orchard, but has now been piped for household use. The tree plantation and orchard in the fenced off area is now watered manually.

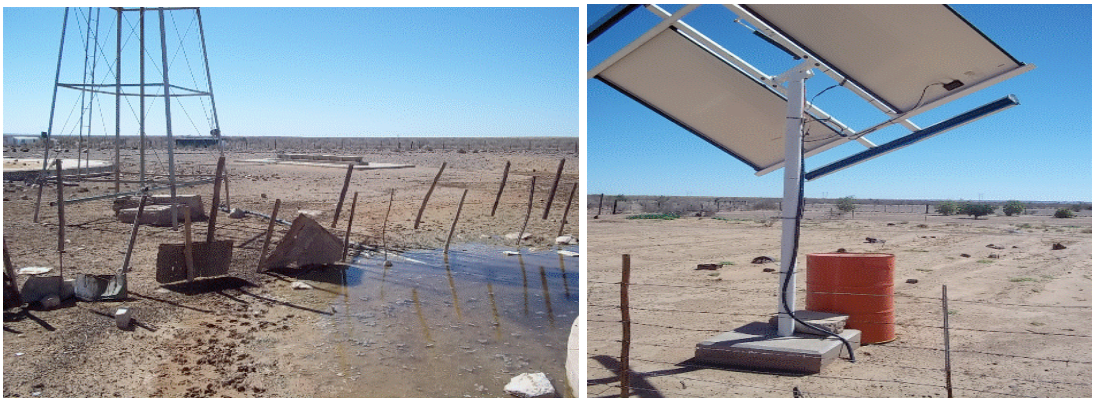


Figure 5 The unrehabilitated water point situated in the kraal area (left) and the solar-pumped borehole (right). The panel is within the fenced-in plantation site.

The borehole at the unrehabilitated water point is located within the kraal which poses a threat to the quality of the groundwater at the farm. The dam has leakages in numerous places and the contaminated standing water around the dam further intensifies the threat to the quality of the groundwater resource in the area.

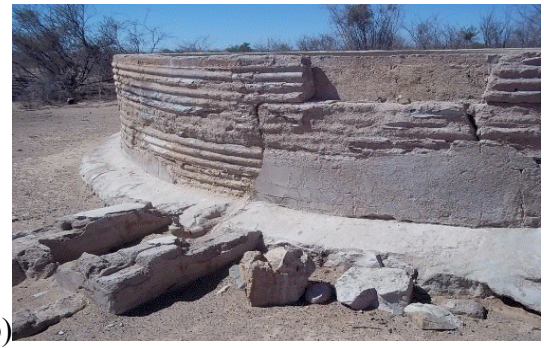
a)  b) 

Figure 6 (a) Potential health hazards to community members from contaminated standing water caused by leakages from the 'crumbling' dam and livestock manure. (b) A dilapidated farm dam

The farm owner who has been living at the farm for 45 years, (R6), alluded that the DRWS were difficult to approach and unresponsive to all the queries he directed to them. To support his small plantation, he installed class 3 pipes from one of the farm dams to the garden as there was not enough pressure height to fill the central farm dam. He was more frustrated with the neglect the directorate has shown towards maintenance of the water infrastructures. He also noted that the 'plastic' water troughs on the farm are "…too small for the entire area" and could be suitable for "a farmer with about 20 goats". Of the three boreholes existing on the farm, one is solar pumped and the other two wind pumped (3 and 9 meters respectively). According to sources questioned, although three boreholes exist in the area, the DRWS will only maintain and repair one specific borehole, the solar powered one situated more than 200 meters away from the tanks. This is because the drinking water for the farm occupants is supplied by this particular borehole, hence takes precedence over the other two.

The veld serves as the toilet facility and only recently a bucket-system toilet is being constructed at the homestead of the farm owner.

DIAMANT KOP

Three households make up this farmland, with a kraal and water trough in close proximity to the borehole. The kraals contain heaps of humus and manure that corresponds to the water quality test results obtained (see results section).

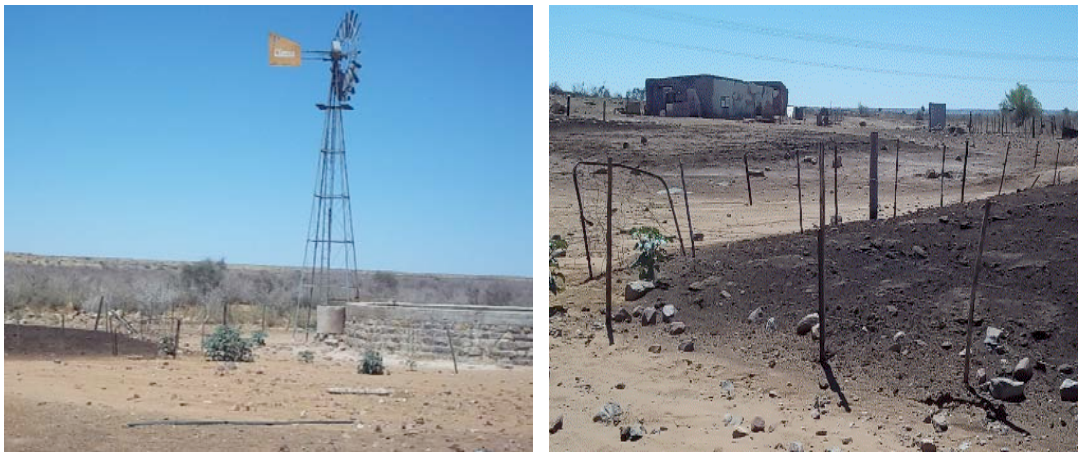


Figure 7 Layout of the farm. The wind-pumped borehole, farm dam, kraal and the households are all in proximity to one another posing threats to individual health and groundwater quality in the area

The infrastructures at the farm are in a very bad state, have been for years and no rehabilitation was done.

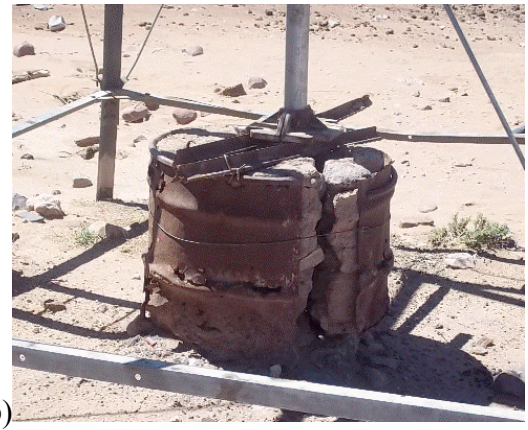
a)  b) 

Figure 8 The bad state of water infrastructure with no intention of rehabilitation. The livestock trough (a) and the windmill foundation (b)

The water in the dam is mainly used for livestock and agricultural purposes, and the three households are catered for by a pipeline and water tanks fed from the Aoruab scheme for domestic use. An informant indicated that approximately four or five months earlier, technicians from the DRWS visited the farm to 'maintain' the infrastructure, however none was done. It is assumed there is no intention to rehabilitate the water point since there is currently piped water supplying the households on the farm. This however raises concerns over the governments' intentions of investing large amounts of money in water infrastructure and in the long run, leaving them destitute.

NICO NOORD

This farm serves as a demonstration site for the surrounding farms (mentioned above and others) in the area because of the developments on the farm. It features a single household, a campsite, an orchard, a bio-gas digester, and a small vegetable and lucern garden. Acting as the 'spokesperson' for the community, the dynamic farm owner, (R1), is enthusiastic about new water and sanitation interventions and the betterment of her community members.

a)  b) 

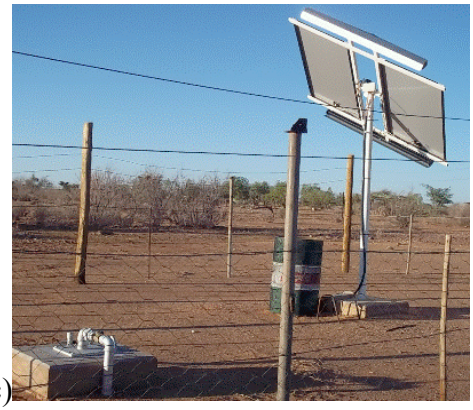
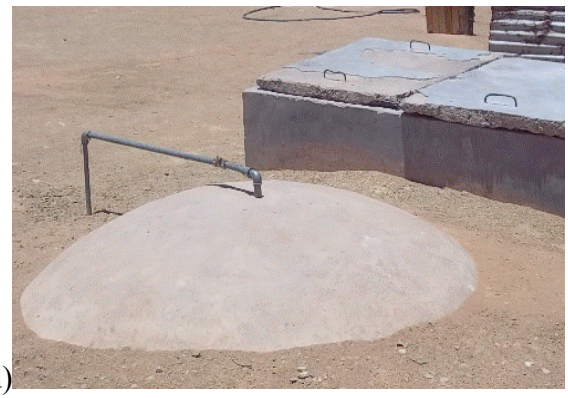
c)  d) 

Figure 9 The various infrastructure and activities at the farm. (a) water infrastructure (water tanks, farm dam, taps in the fore) (b) the small garden with visible lucern (c) the solar powered borehole (d) the biogas digester

The water point and the household are solar-powered. The kraal is situated approximately 50-100m away from the water infrastructures which are in good condition as compared to the other visited farms. Of importance, is the biogas digester which it fuelled by livestock waste according to (R1). Biogas refers to gas produced by the breakdown of organic matter or biodegradable substances and the process occurs in the absence of oxygen. The farm owner went on further to say she uses the generated biogas for cooking purposes and it saves on energy consumption. She commended this as a good practice for rural communities as it is cost-effective, and would like to see this initiative being taken up at other farms provided financial support is secured.

B) WATER QUALITY ANALYSES

Table 1 Water quality assessments of six communal farms in southern Namibia

Farm Name	Total Dissoved Solids (TDS) (ppm)	pH	Nitrates (mg/L)	Phosphates (mg/L)	Ammonia (mg/L)
Khaitsub	780	6.8	10	Minimal	None
Nico-Pos Doringdraai	882	7	20	Present	None
Laurencia-Pos Donkerhoek	560	7	10	Minimal	None
Laurencia					
Diamant Kop	>2000	7	>50	Present	None
Nico-Noord	740	7	20	Minimal	None

From Table 1 the following patterns emerge. The pH is relatively neutral at all sites observed. Although no ammonia was noted in the tests conducted, the presence of phosphates was clearly visible although minimal at most sites. The high nitrate content sampled at Nico-Pos Doringdraai and Diamant Kop is directly related to the layout of the farms, where the borehole is located within the kraal areas. Nico Noord also recorded 20mg/L for nitrates although a different farm set-up was observed. This could suggest upstream and downstream effects of groundwater pollution in the area. Farm Laurencia-Pos Donkerhoek had the lowest reading of TDS. The lowest nitrates were recorded at Khaitsub and Laurencia-Pos Donkerhoek. The farm of about 8 inhabitants and very few livestock (goats) has a kraal situated a significant distance (approx. 100-150m) from the water point. The layout at the water point (slightly elevated from the surrounding areas) does not allow for standing water or foraging of livestock for lengthy periods of time greatly contributing to the results obtained in the water quality tests. No tests were carried out at Farm Laurencia.

TDS in drinking-water varies considerably in different geological regions owing to differences in the solubility of minerals. There is no reliable information on the possible effects of TDS ingestion on health, and no health-based guideline value is proposed. A 1984 publication on the *Guidelines for Drinking-water Quality* (WHO, 2007), a guideline value of 1000 mg/litre was established for TDS, based on taste considerations. The palatability of water with a TDS level of less than 600 mg/litre is generally considered to

be good. However, drinking-water becomes significantly unpalatable at TDS levels greater than about 1000 mg/litre. Moreover, high levels of TDS measures causes excessive scaling in water pipes and household appliances thereby shortening their life span. No health-based guideline value for TDS has been proposed for Namibia. Natural levels of ammonia in groundwater and surface water are usually below 0.2 mg/litre. Anaerobic groundwaters may contain up to 3mg/litre. Ammonia in water is an indicator of possible bacterial, sewage and animal waste pollution (WHO, 2007). Toxicological effects are observed only at exposures above about 200mg/kg of body weight.

DISCUSSION

In order for Namibia to meet its millennium development goals, provision of water and basic sanitation should be an obligation to sustain livelihoods in communities. The quality of drinking water determines the level of community health. According to the National Planning Commission (2007) report, inadequate water supply and unfunctional water infrastructure continue to pose a health hazard more especially to the poor. High nitrate content could pose dangers to the health of children younger than one year old. A standard nitrate content of up to 50 mg/litre is high but still acceptable, thus, bottle fed infants still stand a risk of methaemoglobinaemia at short-term exposure rates.

According to the World Health Organisation (WHO, 2007) methaemoglobinaemia forms as a result of the reaction of nitrate with haemoglobin in the red blood cells. The consequences could be fatal in young children because the oxygen is bound and its transport to the rest of the body is inhibited. Nitrate is found naturally in the environment and filtrates to the groundwater as a result of inappropriate land-use activities (accumulation of livestock manure and excess fertilizers), and nonfunctional wastewater disposal systems (WHO, 2010; Kakujaha, 2010). Not much can be done about the chemical content situation of the water, but the community members should be informed as to what precautionary measures they can take e.g. making sure there is no water left standing in the kraals or water trough area, to prevent worsening the situation.

Nitrates are not held by soil particles and are easily moved by water (Kakujaha, 2010). Contaminants and nutrients in livestock droppings dissolve in these pools of water which eventually trickle down to the groundwater. Although minimal concentrations may be recorded at present, long-term effects could pose serious threats to the water source, eventually human health. Observations are that sustainability of water services in rural areas is quite low due to technical problems, as well as management aspects (National Planning Commission, 1997; Karl Kisting (pers. comm.)).

Table 2 Chemical water quality guidelines in Namibia (Adapted from Bockmuhl, 2009)

Parameter	Unit	Group A	Group B	Group C	Livestock watering
pH		6.0-9.0	5.5-9.5	4.0-11.0	4.0-11.0
Conductivity	mS/m	150	300	400	
TDS (determined)	mg/l				6000
Sulphate as SO_4	mg/l	200	600	1200	1500
Chloride as Cl	mg/l	250	600	1200	3000
Fluoride as F	mg/l	1.5	2	3	6
Nitrate as N	mg/l	10	20	40	100
Nitrite as N	mg/l				10
CaCO3	mg/l	300	650	1300	
Calcium as Ca	mg/l	150	200	400	1000
Magnesium as Mg	mg/l	70	100	200	500
Sodium as Na	mg/l	100	400	800	2000
Potassium as K	mg/l	200	400	800	
Iron as Fe	mg/l	0.1	1	2	10
Manganese as Mn	mg/l	0.05	1	2	10

According to Bockmuhl (2009) water for human consumption should fall within group A and B; and for livestock watering in group C. The challenge we all have is how to put water in the minds of the people? The type of sanitation practiced, open defecation, is similar at all sites visited with an exception of two cases where the bucket system is used. Provision of adequate sanitation facilities still has a long way to go before the goal is realized.

A water point committee exists for the Nico Noord Odendaal Farms with the representatives from the various farms visited. It comprises seven members in total with different portfolios (Chairperson, Deputy chairperson, Secretary, and ordinary members) and a caretaker for each water point. (R1) serves as the committees' deputy chairperson.

CONCLUSION

The Government's aim to provide adequate water supply is no doubt commendable. However the situations in the communal areas remain unsatisfactory and these challenges in water infrastructure and sanitation pose a potentially serious hazard to the groundwater resource. Although infrastructures are available from the Odendaal Farms the maintenance aspect is severely lacking. The main concern is to provide rural communities with clean and safe drinking water, as well as appropriate sanitation facilities for improved livelihoods. It is recommended that a community based management approach is necessary for the long term benefits of the services provided to the rural people.

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