

# Total Coliform and Pollution Index of Water from Domestic Wells in Umalaoge Village-Buton Regency- Southeast Sulawesi-Indonesia

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## Abstract

Dug Wells have been used as potable water resources of the most Umalaoge Village residents. The study aimed to analysis total coliform and water pollution index of dug wells in Umalaoge Village. Observational research was carried out in rainy season on January 2015. Water samples had been gotten from six dug wells around the village, total sampling. Parameters were taste, color, turbidity, temperature, total dissolved solid, dissolved oxygen, and pH. Total coliform was counted with MPN double tube method. Data should be compared with WHO and national standard. Result of the research show that the all of water wells had total coliform count from 50 to 1898 MPN per 100 ml, exceeded the permissible limit, and water pollution index of dug wells 1,2,3,4, and 5 classified as weak polluted (2.46-2.93) and dug well 6, middle polluted (6.48). Concluded: water generally from those wells is not safe for drinking except some form of treatment is carried out.

**Keywords:** Total Coliform; Pollution Index; Water Dug Well.

## 1. Introduction

In Indonesia, all artificial wells were important source of potable water in some rural developing areas. Dug Well is water reservoir from soil layer closed to the ground surface.

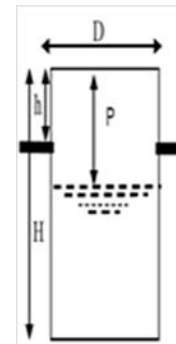
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They can be lined with laid stones, extending this lining upwards above the ground surface to form a wall around the well serves to reduce both contaminations. A more modern method called caissoning uses reinforced concrete or plain concrete pre-cast well rings that are lowered into the hole. Umalaoge village, home to some 1.056 people. The most residents have been taken their clean water from dug wells distributing in the village. It is used for drinking, cooking, washing, bathing, and cleaning of their goods. The preliminary observation shows that wells of Umalaoge village were 5.0 to 7.0 m in depths (Table 1). The perception of residents of the rural villages, that the water from the wells is clean.

**Table 1:** Characteristic of Dug wells in Umalaoge Village

No.	Dug Well Samples	Dug Wells Characteristics (metre)			
		H	h	P	D
1.	1	5,0	0,61	2,85	2,90
2.	2	5,5	0,72	3,10	2,23
3.	3	6,1	0,78	3,58	1,26
4.	4	7,0	0,64	4,12	1,65
5.	5	5,0	0,76	2,23	1,11
6.	6	6,5	0,71	3,35	1,47



Note: H (wellline high) , h (wellhead high), P(distance between dug wellhead and dug well surface), D (diameter of dug well surface)

Poor well location, construction, hygiene and sanitary practices were among the factors affecting water quality. [1]. reference [2] revealed that in Valley, Colorado that 71% of the wells less than 199 feet (60.7 m) tested positive for total coliform and wells classified as having poor and fair wellhead protection tested positive for total coliform. There for wellhead protection and well depth does play a role in bacterial contamination of water wells. According to Tsega, Sahile [3] the water sources were heavily contaminated which suggested poor protection and sanitation practice in the water sources from open dug wells. There is an urgent need for education of inhabitants on effective water disinfection strategies and for regular monitoring of wells. Temperature, pH, and turbidity, together with the infiltration and percolation of surface water, which takes place in the rainy season, seemed to be the driving factors in the shaping and selection of the bacterial community and deterioration of water quality [4]. The risk of bacterial contamination was lower in wells surrounded by a frame and higher during the rainy season. Well contamination with Salmonella poses a potential threat of infection, thus highlighting the important role of drinking water safety in infectious disease control [5] and it does not be treated at home so it's easy to affect waterborne diseases (e.g., cholera, typhus, dysentery, typhoid, diarrhea, and poison of chemical toxicity). This study was carried out aimed analysis total coliform and water pollution index of dug wells in Umalaoge Village.

## 2. Methodology

### 2.1. Location and Time

Observational research was carried out in Umalaoge Village-South Lasalimu District-Buton Regency-Southeast Sulawesi-Indonesia in rainy season on January 2015.



**Figure 1:** Location of Dug wells samples in Umalaoge Village

### 2.2. Material and Methods

Research was carried out aimed analysis total coliform and pollution index of water dug wells in Umalaoge Village. Six Water samples from dug wells were taken used Bottle La Motte, pouring to sterile bottle (500 ml) and putted in cooler boxes at 2-4°C for transportation to laboratory for microbial examination. According to [6], that water samples can be stored at ambient temperatures for 12 hours without significantly affecting the coliform counts. Meanwhile physical and chemical parameters had direct examination at the location after samples collected, and total coliform had counted through MPN double tube method incubating at 35°C for 24 hour. The analysis were carried out according to standard methods of water examination and as reported in World Health Organization (WHO) guide limit for water drinking [7]. STORET-USEPA Method was used to analysis water pollution index [8]. The results were compared with the values stipulated by WHO, and national standard:  $0 \leq PI_j \leq 1.0$  (normal standard water quality),  $1.0 \leq PI_j \leq 5.0$  (weak pollution),  $5.0 \leq PI_j \leq 10$  (middle pollution), and  $PI_j \geq 10$  (strong pollution) [8].

## 3. Results

### 3.1. Odor and Taste

According to opinion of residents that a water dug wells in Umalaoge Village had odor and two of six dug wells had tasted and others tasteless and odorless.

### 2.3. Color

Colors of the water dug wells in Umalaoge Village were ranging from 10 to 15 TCU (Figure 2).

### 2.4. Turbidity

Turbidity of the water dug wells in Umalaoge Village were ranging from 1.06 - 7.70 NTU (Figure 3)

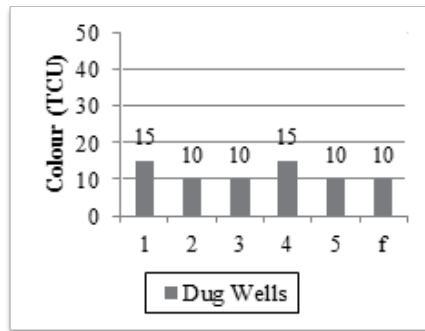


Figure 2: Color value of the water dug wells in Umalaoge Village

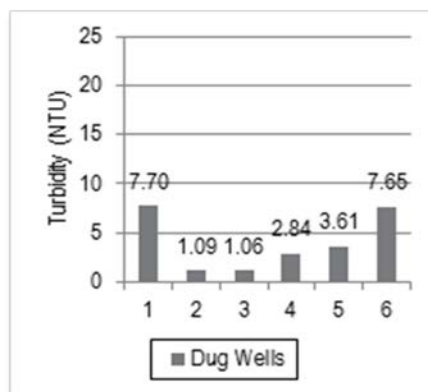


Figure 3: Turbidity of the water dug wells in Umalaoge Village

### 3.4 Temperature

Temperature of the all water dug wells in Umalaoge Village were 27°C, 26°C, 27°C, 26°C, 28°C and 27°C respectively.

### 3.5 Total Dissolved Solid (TDS)

Total Dissolved Solid (TDS) of the water of the dug wells in Umalaoge Village were lowest 380 and highest 4750 mg/l (Figure 4).

### 3.6 Dissolved Oxigene (DO)

Dissolved oxygen of the water dug wells in Umalaoge Village were ranging from 7.80 to 8.60 mg/l (Figure 5)

### 3.7 Power of Hydrogene (pH)

pH of the water dug wells in Umalaoge Village were ranging from 6.89 to 7.39 (Figure 6).

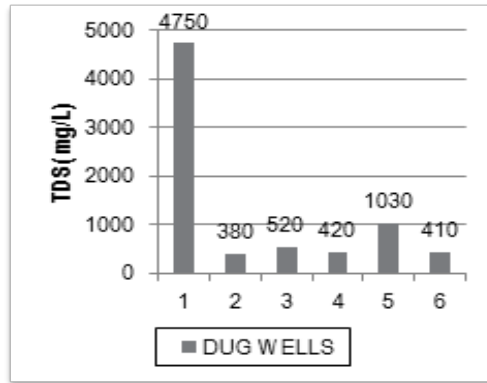


Figure 4: TDS of the water dug wells in Umalaoge Village

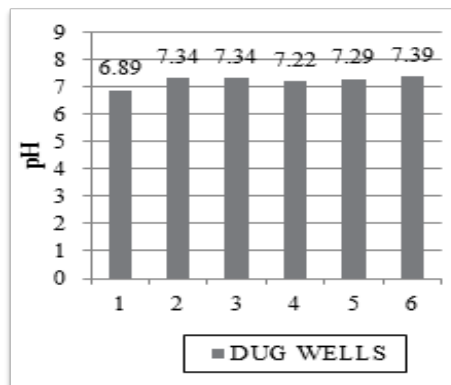


Figure 5: DO of the water dug wells in Umalaoge Village

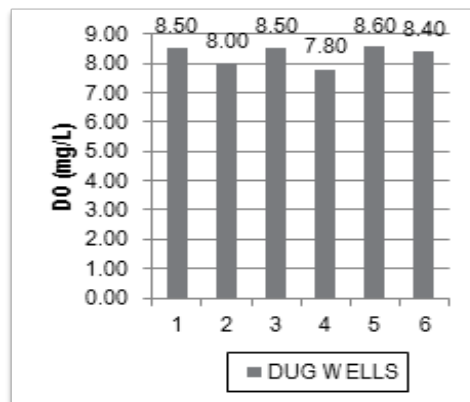


Figure 6: pH of the water dug wells in Umalaoge Village

#### 4. Discussion

Open dug wells could be poor water quality due to ingress pollutant from surface or subsurface ground. Result

studied show that water pollution index of all dug wells in Umalaoge village, viz. 2.61, 2.46, 2.47, 2.93, 2.50, and 6.48 respectively and classified as weak to middle pollution. Construction in poor location, and hygiene and sanitary practices were among the factors affecting water quality of dug wells in Umalaoge Village. The open dug well have been location near to waste water disposal, septic tank from household increased risk contamination, mainly open dug wellheadless and poor lining construction (Figure 7).

**Table 2:** Value of parameters, water quality standard, total coliform, and pollution index of the water dug wells in Umalaoge Village

No.	Parameters	Units	Water Quality Standard	Value of Parameters Dug Wells					
				1	2	3	4	5	6
1	Odor	-	odorless	odor	odorless	odorless	odorless	odorless	odor
2	TDS	mg/L	1500	4750**	520	380	420	1030	410
3	Turbidity	NTU	25	7.7	1.09	1.06	2.84	3.61	7.65
4	Taste	-	tasteless	taste	tasteless	tasteless	tasteless	tasteless	taste
5	Temperature	°C	26-29	27	26	27	26	28	27
6	Color	TCU	50	15	10	10	15	10	10
7	pH	-	6.5-9.0	6.89	7.34	7.34	7.22	7.29	7.39
8	DO	mg/L	6	8.50	8.00	8.50	7.80	8.60	8.40
9	Total Coliform (MPN)	MPN/100 ml	50	68**	50	99**	190**	113**	1898**
Water Pollution Index				2.61 <sup>a</sup>	2.46 <sup>a</sup>	2.47 <sup>a</sup>	2.93 <sup>a</sup>	2.50 <sup>a</sup>	6.48 <sup>ab</sup>
Mark:									
**		=	Exceeded the permissible limit						
a		=	Weak polluted						
ab		=	Middle polluted						

In Umalaoge Village, the dug wells have various permeability from low, moderate to high permeability sub-soils. Furthermore, well liner clearance was a significant factor in all models, indicating that direct surface ingress is a significant well contamination mechanism. Water quality of dug wells in Umalaoge Village had been influenced surface water ingress to hole of wells which take place in the rainy season. TDS of first dug well has exceeded the desirable limit i.e. 4750 mg/l, open dug wells 2,3,4,5,6 had 520, 380, 420, 1030, and 410 mg/l respectively. High concentration of TDS in the first dug well than others could be influenced by water quality on surface and subsurface around the dug wells. The [9] revealed that in Nagpur district, water quality on surface and subsurface had TDS exceeding the desirable limit i.e. 500 mg/l, related to out of which one dug well from Parsodi exceeded the permissible limit--2000 mg/l. Fluoride concentration exceeded desirable limit

1.0 mg/l. Nitrate exceeded desirable limit of (45 mg/l), bore well from Salwa exceeded the permissible limit-- 100 mg/l. Dug wells from Parsodi had total hardness exceeded permissible limit (600 mg/l). Maximum hardness (3.582 mg/l), chloride (1.716 mg/l) and magnesium (572 mg/l). Others factors could influence drinking water quality, viz. pH, electrical conductivity, total dissolved solids, total alkalinity, total hardness,  $\text{Cl}^-$ ,  $\text{SO}_4^{(2-)}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$  and  $\text{K}^+$  [10].



**Figure 7:** The Dug well construction in Umalaoge Village

(A: lined with laid stones; B: casting well rings that are lowered into the hole)

Various water quality parameters of open dug wells in Umalaoge Village had been measured, viz. odor, color, turbidity, taste, temperature, pH, total dissolved oxygen,. Result show that just dug wells 1 and 6 had odor and tasted, unsuitable as clean water resources. Turbidity, temperature, pH, and total dissolved oxygen had in range permissible limit. According to Machado and Bordalo [4] that temperature, pH and turbidity, together with the infiltration and percolation of surface water, which takes place in the wet season, seemed to be the driving factors in the shaping and selection of the bacterial community and deterioration of water quality. Total coliform count ((indicator of poor sanitary quality) of water dug wells in Umalaoge was investigated. A total coliform of water dug wells had high counted, viz. 68, 99, 190, 133 and 1898 MPN/100 ml, exceeded permissible limit, and just two dug wells had in permissible limit (50 MPN/100 ml). Bacteriological contamination of the all dug wells in the Umalaoge Village could be due to near to septic tanks, shallow depth, and improper construction of wells. According to Mile, Jande [11] that bacteriological contamination of well water could be due to improper construction of wells, refuse dumping sites and various human activities around the wells. The shallow depth, water logging and presence of septic tanks in the near vicinity are the possible reasons of poor microbial quality of hand pump drinking water. *Escherichia coli*, *Klebsiella* sp., *Enterobacter* sp., *Shigella* sp. and *Salmonella* sp. could be identified. The presence of enteric pathogens in water sources pose threat to human health [12]. In Papua New Guinea, individuals in villages using Sepik River water as their primary water source had significantly higher incidence of diarrhea than those primarily using other water sources (streams, dug wells and catchments) [13].

Sanitary practices of residents could influences quality of environment around the dug wells in Umalaoge Village. Garbage and waste water disposal from household, agriculture, and cattle were significantly affect to surface water quality and water of dug wells. According to Hynds, Misstear [14] that on-site septic tank

presence was the only risk factor significantly associated with bacterial presence in hand dug wells and point agriculture adjacency was significantly associated with water quality of dug well. Poor sanitary practices of residents when using water of dug wells were other factors affecting water quality in Umaloage Village. Bathing, washing dresses and other goods near the headwells potentially increase poor water quality of dug wells. According to Okotto-Okotto, Okotto [15] that water quality trends were complex, but nitrate levels were related to both sanitary risks and rainfall.

## 5. Conclusion

Discussion with residents about useful water dug wells as drinking and non-drinking domestic uses (e.g., cooking, washing of plates, cups, cutlery etc.) was evident. While the total coliform counts and pollution index reflected the unsanitary habits of the well users. Therefore, water generally from these wells is not safe for drinking except some form of treatment is carried out. So there is need for social discourse and more public health campaign aimed at transforming habits in sanitary practices. Regular monitoring of groundwater quality, abolishment of unhealthy waste disposal practices and introduction of modern techniques are recommended.

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