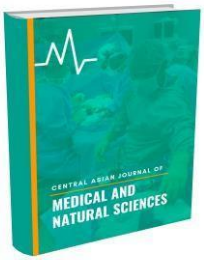

CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS

Volume: 05 Issue: 02 | April 2024 ISSN: 2660-4159

Study of the Physical Properties of Water from Some Wells North of Al-Dur District

Iqbal Ali Hassani , Abid Ahmed Erdwni

Department Biology , College of Education for Women , University of Tikrit , Iraq.

Abstract: *The present study was conducted at the University of Tikrit, College of Education for Women, Department of Life Sciences, and involved a field study of the physical and chemical properties of groundwater north of Al-Dur District (Naameh area). The study aimed to determine the water quality from September 2023 to February 2024. Seven wells were selected in the study area, with part of the tests conducted at the Salah al-Din Water Directorate, Quality Control Division, and the rest at the University of Tikrit - laboratories of the College of Chemical Engineering and Environmental Engineering. The study included several physical properties (air and water temperature, turbidity, electrical conductivity), and the results were compared based on international and Iraqi standards.*

The study revealed that air temperatures varied throughout the study period, with the highest recorded value being 33.8°C in September and the lowest being 7°C in January. Water temperatures showed a narrow range, with the highest value being 26.5°C in September and the lowest being 22°C in February, averaging between 23.67°C and 25.05°C, classifying the water as warm as it exceeded 18°C. Turbidity values were low, ranging between 0.8500 and 1.8017 NTU, with significant temporal and spatial differences during the study period. The highest electrical conductivity value recorded was 6100 µS/cm, and the lowest was 3010 µS/cm.

Keywords: *Groundwater quality, physical properties, Al-Dur District, water temperature, electrical conductivity.*

Citation: Iqbal Ali Hassani, Abid Ahmed Erdwni. Study of the Physical Properties of Water from Some Wells North of Al-Dur District, Central Asian Journal of Medical and Natural Science 2024, 5(3), 525-533

Received: 02h June 2024
Revised: 03th June 2024
Accepted: 05th June 2024
Published: 10th June 2024

Introduction

Since ancient times, humans have recognized the importance of water as an essential element for the life of all living organisms, making water the lifeblood of life. Water is vital for economic and social development, and without it, these become impossible. Due to the increasing demand for water, water resources are continuously diminishing [1]. Therefore, it is crucial to continuously monitor water resources and conduct qualitative studies of various water sources [2].

Water is a main component of cells and is indispensable for enzyme activity. Living organisms can obtain water through different means [4] It serves as a medium for all chemical and biological reactions in the body of living organisms, constituting 80% of the living mass, and can reach up to 99% in plants [3]

Groundwater is the second primary source of potable water for human and animal consumption. It is stored underground between soil and rock pores and percolates through the soil to the lower layers of the earth to form groundwater, found at varying depths depending on the geological formation [6]. Areas lacking surface water may rely heavily on groundwater. Studying groundwater is essential to provide an important water source that can be used in various fields such as agriculture, industry, economics, and human purposes [4]

physical and chemical properties, which are important factors determining water quality and suitability, including the water content of dissolved elements and ions [5]. Groundwater often contains high levels of salts, which can lead to water hardness, varying with the geological nature of the area through which the water flows. Most salts are calcium and magnesium, in addition to solids and dissolved gases , Groundwater also contains sodium and potassium, giving well water high salinity, making it less consumable by humans [7].

Materials and Methods

2 Objectives of the Study

1. To study the physical and chemical properties of water from some wells north of Al-Dur District.

2. To determine the suitability of well water for human and animal consumption and irrigation purposes.

Study Area Description

The study area is located northeast of Al-Dur District in Salah al-Din Governorate, between latitudes 34-50° N and longitudes 45-44° E. It is bordered to the east by the Hamrin Mountains and to the west by the Tigris River, as shown in Figure 3-1, which depicts the location of the study area northeast of Al-Dur District.

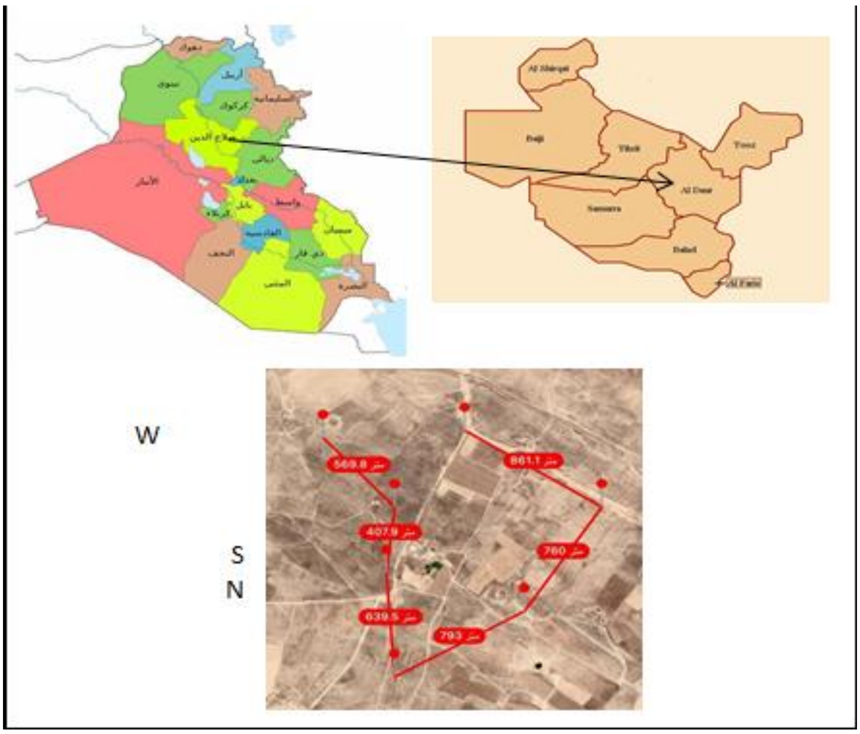

Figure 3-1: Map showing the study area northeast of Al-Dur District

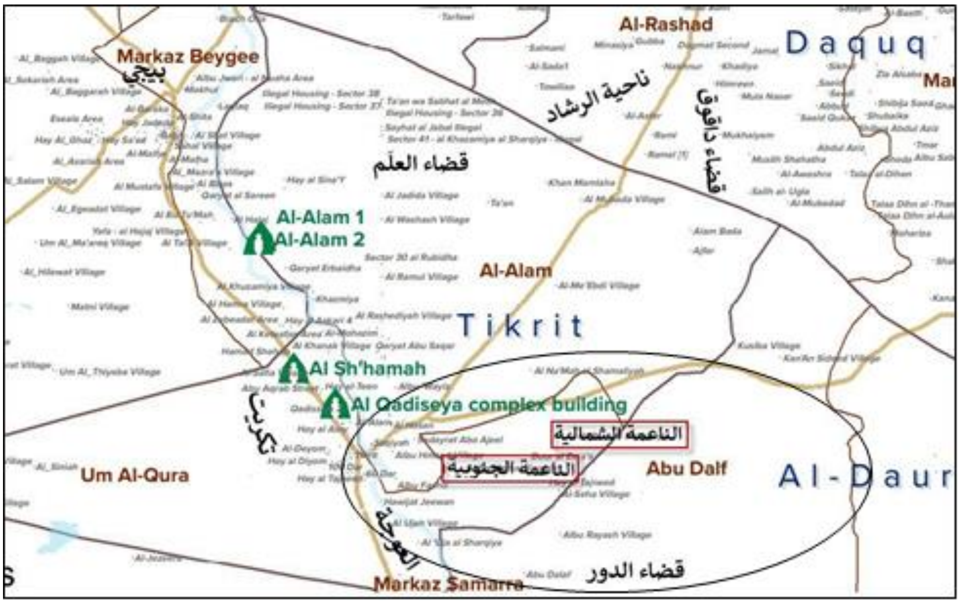

Figure 3-2: Map of Salah al-Din Governorate and the studied area

Description of the Studied Wells

Seven wells were selected, as shown in Figure 1-3. The wells range in age from 1 to 30 years, with casing pipe diameters of 8 inches and extraction pipe diameters ranging from 3 to 4 inches. The study area is 16.736 kilometers from the Tigris River, measured from the farthest well in the study area. The studied wells are distributed at varying distances from each other, with a minimum distance of 500 meters and more than 100 meters apart, at depths ranging from 80 to 100 meters, classified as deep wells drilled by mechanical methods and of the closed type [8].

Table 1: Locations and specifications of the studied wells

Well No.	Symbol	Location	Depth (m)	Drilling Method	Distance from Tigris (m)	Extraction Pipe Diameter (in)	Casing Diameter (in)	Well Age (years)	Distance Between Wells (m)	Uses
1	W1	North of Al-Dur	85	Mechanical	15876	4	8	1	577	Irrigation and livestock
2	W2	North of Al-Dur	93	Mechanical	15919	4	10	3	402	Irrigation and livestock
3	W3	North of Al-Dur	100	Mechanical	15316	4	10	2	654	Irrigation and livestock
4	W4	North of Al-Dur	100	Mechanical	14985	4	10	23	774	Irrigation, livestock, household
5	W5	North of Al-Dur	93	Mechanical	15766	4	8	3	758	Irrigation, livestock, household
6	W6	North of Al-Dur	100	Mechanical	16488	4	8	3	858	Irrigation, livestock, household

7	W7	North of Al-Dur	100	Mechanical	16216	4	8	7	745	Irrigation and livestock

The Selected Wells for Study

1. **Well No. 1:** Located north of Al-Dur (Naameh area), this well has a depth of 85 meters, is of the closed type, and was drilled mechanically. It has an 8-inch casing diameter and a 4-inch extraction pipe diameter. The well is 1 year old and 15876 km from the Tigris River, used for irrigation and livestock [9].

2. **Well No. 2:** Located north of Al-Dur (Naameh area), this well has a depth of 93 meters, is closed, and was drilled mechanically. It has a 10-inch casing diameter and a 4-inch extraction pipe diameter. The well is 3 years old and 15919 km from the Tigris River, used for irrigation (wheat, barley, and alfalfa) and livestock.

3. **Well No. 3:** Located north of Al-Dur (Naameh area), this well has a depth of 100 meters, is closed, and was drilled mechanically. It has a 10-inch casing diameter and a 4-inch extraction pipe diameter. The well is 2 years old and 15316 km from the Tigris River, used for irrigation and livestock.

4. **Well No. 4:** Located north of Al-Dur (Naameh area), this well has a depth of 100 meters, is closed, and was drilled mechanically. It has a 10-inch casing diameter and a 4-inch extraction pipe diameter. The well is 23 years old and 14985 km from the Tigris River, used for irrigation, livestock, and household purposes.

5. **Well No. 5:** Located north of Al-Dur (Naameh area), this well has a depth of 93 meters, is closed, and was drilled mechanically. It has an 8-inch casing diameter and a 4-inch extraction pipe diameter. The well is 3 years old and 15766 km from the Tigris River, used for irrigation, livestock, and household purposes.

6. **Well No. 6:** Located north of Al-Dur (Naameh area), this well has a depth of 100 meters, is closed, and was drilled mechanically. It has an 8-inch casing diameter and a 4-inch extraction pipe diameter. The well is 3 years old and 16488 km from the Tigris River, used for irrigation, livestock, and household purposes.

7. **Well No. 7:** Located north of Al-Dur (Naameh area), this well has a depth of 100 meters, is closed, and was drilled mechanically. It has an 8-inch casing diameter and a 4-inch extraction pipe

diameter. The well is 7 years old and 16216 km from the Tigris River, used for irrigation and livestock.

Sample Collection

Samples were collected from the studied wells from September 2023 to February 2024, at a rate of once per month. The well water was pumped for 10 minutes to eliminate stagnant and contaminated water, and then bottles were filled with water from the studied wells using 5-liter polyethylene bottles, rinsed three times with the sample water at each well. Air and water temperatures were measured on-site. Additionally, 250 ml opaque bottles were filled from each well to measure biological oxygen demand. Other tests were conducted in the laboratory, including the following physical and chemical examinations:

Physical and Chemical Properties:

Air and Water Temperature: The temperature of air and water was measured in the field using an electronic thermometer with a range from -50°C to 300°C. Air temperature was measured by placing the thermometer in the shade at a height of one meter above the ground level, recording the temperature once it stabilized. Water temperature was measured by immersing the thermometer probe directly in the water from the pump outlet for two minutes, recording the temperature once it stabilized.

Turbidity: Turbidity was measured immediately upon arrival at the laboratory using a HACH-TL2300 Turbidity meter, which measures turbidity in Nephelometric Turbidity Units (NTU). The sample water was shaken to mix, and the measurement cell was filled to the marked level. The cell was wiped to remove fingerprints and water marks, placed in the device, and the reading was taken and recorded from the display [10].

Electrical Conductivity: Electrical conductivity was measured in the laboratory using an EC-meter (HANNA). The sample water was placed in a beaker, and the electrode was immersed for 2-3 minutes until the reading stabilized. The results were expressed in microsiemens per centimeter (μS/cm).

Results and Discussion

1. **Physical Properties**
   a. **Air Temperature**

The results indicated temporal and spatial variations in the air temperature around the study wells. The averages showed no significant spatial differences in air temperature around the study wells, but there were significant temporal differences according to Duncan's test at the 0.05 probability level ($p \leq 0.05$). The current study showed that the average air temperatures around the study wells ranged from 19.95°C to 21.13°C at wells 1 and 2, respectively, as shown in Table 4-1 and Appendix 4-1. The highest air temperature recorded was 33.8°C in September at well 6, and the lowest was 7°C in January at wells 1, 4, and 6. The study demonstrated significant monthly differences in temperature throughout the study period, especially in September and January, reflecting the continental climate of Iraq, which is hot in summer and cold in winter. These results were similar to those obtained by Ibrahim (2015) in an environmental study of some wells in Al-Dur District, where the highest air temperature recorded was 25.4°C at well 7, and the lowest was 23.2°C at well 10. The current study's results were higher than those obtained by Al-Tershan (2017) in a study on the treatment of salinity in some wells' water and the assessment of their physical and chemical properties in Tikrit, where air temperatures ranged from 9.2°C to 16.2°C.

Table 4-1: Monthly and site-specific variations in air temperature during the study period (°C)

Well/Date	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Monthly Average
Sep. 2023	31.5	32.8	33.6	34.0	30.7	33.8	30.9	32.47 A
Oct. 2023	30.0	31.0	32.0	32.0	31.0	30.0	31.0	31.00 AB
Nov. 2023	26.0	32.0	27.0	27.5	30.0	32.0	32.6	29.59 B
Dec. 2023	11.0	11.0	11.0	11.0	11.0	10.5	11.0	10.93 C
Jan. 2024	7.0	8.0	7.5	7.0	9.0	7.0	7.5	7.57 D
Feb. 2024	13.0	12.0	14.0	12.0	11.0	10.0	11.0	11.86 C
Well Avg.	19.95a	21.13a	20.85a	20.58a	20.45a	20.55a	20.67a	

b. Water Temperature

The current study's results for water temperature in the wells, shown in Table 4-2 and Figure 4-2, indicate that the average water temperatures in the study area ranged from 23.67°C to 25.05°C at wells 4 and 2, respectively. The highest recorded water temperature was 26.5°C at well 1 in September, and the lowest was 22°C at well 4 in February. Statistical analysis of water temperatures using Duncan's test indicated no significant temporal or spatial differences at the 0.05 probability level ($p \leq 0.05$). The study results were similar to those obtained by Ibrahim (2015) and Dawood (2022) in studies on groundwater in some wells in Al-Dur District, where water temperatures ranged from 22.4°C to 24.1°C and 17°C to 30°C, respectively. The results were also comparable to those obtained by Al-Tershan (2017), where water temperatures ranged from 21.7°C to 23.6°C. The well water was classified as warm since the temperature exceeded 18°C, as shown in Appendix X for water classification by temperature. The narrow range of temperature variation between months is due to the closed and deep nature of these wells, which are less affected by external climatic changes, unlike surface waters. As water infiltrates, it dissolves and decomposes minerals from the rocks (gypsum and anhydrite), resulting in exothermic reactions that increase groundwater temperature, particularly at greater depths [11].

Table 4-2: Monthly and site-specific variations in water temperature (°C) during the study period

Well/Date	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Monthly Average
Sep. 2023	26.5	25.1	24.0	22.0	24.0	24.0	25.0	24.37 A
Oct. 2023	25.0	25.2	23.9	23.0	25.8	24.0	24.0	24.41 A
Nov. 2023	25.0	25.0	25.0	25.0	24.0	25.0	24.0	24.71 A
Dec. 2023	23.0	24.0	24.0	25.0	24.0	24.0	23.0	23.86 A
Jan. 2024	24.0	26.0	23.0	24.0	25.0	25.0	26.0	24.71 A
Feb. 2024	24.0	25.0	24.0	23.0	25.0	25.0	25.0	24.43 A
Well Avg.	24.58a	25.05a	23.98a	23.67A	24.63a	24.50a	24.60a	

c. Turbidity

The study found low turbidity levels, with the highest value being 3.8 NTU at well 4 in January and the lowest being 0.1 NTU at well 6 in September. Turbidity averages ranged from 0.8500 to 1.8017 NTU at wells 2 and 6, respectively. According to Duncan's test for averages, there were significant spatial and temporal differences in turbidity in the studied well water at the 0.05 probability level ($p \leq 0.05$), as shown in Table 4-3 and Figure 4-3. The results matched those obtained by Hamad (2017) and Hamed (2021), where turbidity values ranged from 0.80 to 1.48 NTU and 0.6 to 1.55 NTU, respectively. The results were higher than those obtained by Al-Tershan (2017), where turbidity values ranged from 0.190 to 0.55 NTU, and Ibrahim (2015), where values ranged from 0.00 to 0.94 NTU, but lower than those obtained by Al-Obaedy (2011), where values ranged from 0.00 to 9.60 NTU. The low turbidity values are attributed to the natural clarity of groundwater due to filtration through soil layers, removing suspended materials and slow or stagnant movement, resulting in low nutrient content and the nature of the rocks and soil containing the water [12]

Table 4-3: Monthly and site-specific variations in turbidity (NTU) during the study period

Well/Date	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Monthly Average
Sep. 2023	1.3	1.9	0.4	2.7	3.7	0.1	0.3	1.4 B
Oct. 2023	1.6	3.1	0.5	0.5	0.5	0.2	2.1	1.2 C
Nov. 2023	0.5	1.5	1.17	0.6	0.8	0.7	2.4	1.1 D
Dec. 2023	1.4	1.1	0.9	0.9	0.8	1.1	1.0	1.1 D
Jan. 2024	1.9	1.9	1.2	3.8	2.2	1.7	1.2	1.9 A
Feb. 2024	3.3	1.31	2.3	1.4	2.5	1.3	1.2	1.9 A
Well Avg.	1.6a	1.8a	1.1C	1.6a	1.7a	0.8d	1.3B	

d. Electrical Conductivity

Regarding electrical conductivity values in the well water samples, shown in Table 4-4, the highest value recorded was 6100 µS/cm in October at well 2, and the lowest was 3010 µS/cm in January at well 5 [13]. Electrical conductivity averages ranged from 3383.3 to 4121.7 µS/cm. These results are consistent with those obtained by Ahmed (2018), where the highest electrical conductivity value was 5310 µS/cm at well 3, and the lowest was 1030 µS/cm at well 2. The current study's results were higher than those obtained by Hamed (2021), where the highest value was 944 µS/cm, and the lowest was 369 µS/cm at wells 6 and 8, with the highest electrical conductivity value being 1029 µS/cm and the lowest 331 µS/cm. The results were lower than those obtained by Dawood (2022), where the lowest value was 4000 µS/cm at well 4, and the highest was 7900 µS/cm at well 7 [14]. Statistical analysis according to Duncan's test indicated significant temporal and spatial differences at the 0.05 probability level ($p \leq 0.05$). The variation in electrical conductivity values is due to differences in the geological formations of the area, temperature variations during the study months, and differences in groundwater depths [15].

Table 4-4: Monthly and site-specific variations in electrical conductivity during the study period (µS/cm)

Well/Date	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Monthly Average
Sep. 2023	5350	5470	4880	5090	3980	3890	3370	4575.7 B
Oct. 2023	5100	6100	5070	5100	4900	3880	3150	4757.1 A
Nov. 2023	4480	3110	5030	3480	4010	3830	3230	3881.4 C
Dec. 2023	3330	3070	3180	3340	3160	3380	3350	3258.6 E

Jan. 2024	3100	3150	3110	3020	3010	3770	3430	3227.1 E
Feb. 2024	3370	3460	3010	3400	3430	3800	3770	3462.9 D
Well Avg.	4121.7a	4060.0b	4046.7b	3905.0c	3748.3d	3758.3d	3383.3E	

Conclusions

1. Air temperature variations in September and January were due to temperature differences, while water temperatures showed a narrow range of variation due to their insulation from external temperature changes.

2. Based on Biological Oxygen Demand (BOD) values, the wells were classified as having clean water.

3. Sulfate levels were high and did not meet international and Iraqi standards.

4. Calcium and magnesium hardness, as well as total hardness, did not meet Iraqi drinking water standards.

5. Sodium, potassium, and chloride levels were within Iraqi drinking water standards.

Reference

[1]Al-Janabi, M. A. H. J. (2008). Hydrogeochemistry of the Open Aquifer and Its Relationship to Unsaturated Zone Sediments in the Samarra-Tikrit Basin (East of the Tigris). PhD thesis, Department of Earth Sciences, College of Science, University of Baghdad.

[2] Rajab, W. J., & Al-Qazzaz, H. M. A. (1984). Microbiology, Part Two. Directorate of the University of Mosul Press (Translated), Authors: Eugene W. Nester, C. Evans Roberts, Braian J. McCarthy.

[3] Al-Saadi, H. A. (2002). Ecology and Pollution. National Library - Baghdad, University of Baghdad, p. 615.

[4] Al-Kalabi, Z. D. A. (2016). Study of Development Potentials for Groundwater Investment in Najaf Governorate. Al-Qadisiyah Journal of Engineering Sciences, Vol. 9, No. 2.

[5] Al-Sahaf, M. M. A., Al-Khashab, W. H., & Al-Ata, B. A. K. (1983). Hydrology. Directorate of Books and Publishing, University of Mosul, p. 389.

[6] Abbas, F. H. (2010). Hydrogeochemical Study of Groundwater in the Island Near Samarra-Iraq. The Qatari Journal of Chemistry, Vol. 40, pp. 624-631.

[7] Darwish, S. F. A. (2011). Environmental and Diagnostic Study of Algae in Groundwater of Selected Areas in Tikrit City and Its Suburbs. MSc thesis, College of Science, Department of Life Sciences, University of Tikrit.

[8]Ibrahim, M. M. M. (2015). Environmental and Microbiological Study of Some Wells in Al-Dur District, Salah al-Din Governorate. MSc thesis, University of Tikrit, College of Education for Women, Department of Life Sciences.

[9] Al-Tershan, Z. K. J. (2017). Study of the Physical and Chemical Properties of Water from Several Wells in Salah al-Din Governorate, Tikrit City. MSc thesis, University of Tikrit, College of Education for Women, Department of Life Sciences.

[10] Kena, A. M. A. (2001). Study of the Quality of Sulfuric Groundwater in Nineveh Governorate. MSc thesis, College of Science, University of Mosul.

[11]Hamad, S. J. (2017). Environmental Study of Water from Several Wells in Al-Alam Subdistrict and Measurement of Heavy Element Concentrations in Livestock Milk. MSc thesis, University of Tikrit, College of Education for Women, Department of Life Sciences.

[12] amed, A. A. (2021). Evaluation of Some Physical and Chemical Properties of Well Water in Some Villages Northeast of Kirkuk City. MSc thesis, College of Education for Women, University of Tikrit.

[13] Al-Obaedy, B. H. K., & Salman, M. S. (2011). Study of the Quality and Quantity of Groundwater in Anbar Governorate and Its Suitability for Human and Agricultural Uses. Al-Nahrain University Journal, Vol. 14, No. 1.

[14] Ahmed, A. S. A. (2018). Desalination of Some Well Water in Al-Alam Area - Salah al-Din Governorate Using Safe Methods. MSc thesis, College of Education for Women, University of Tikrit.

[15] Al-Jubouri, M. N. K. (2014). Geographical Analysis of Soil in Al-Alam Subdistrict. MSc thesis, University of Tikrit, College of Education for Human Sciences.