Evaluation of the ecosystem of agricultural soils in al-hira sub-district

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Abstract

The results of the analyses indicate that the presence of *Escherichia coli (E. coli)* bacteria in all the locations of agricultural soils in Al-Hira sub-district indicates the presence of pollution due to human and animal wastes, which occurred through the use of wastewater to irrigate farmlands. They discovered that the highest rates of the E. coli bacteria occurred during spring and autumn seasons which are linked with good temperatures and humidity that supports the activity and reproduction process of the bacteria. On the other hand, minimum was recorded during winter and summer since the conditions of climatic conditions are not conducive to the growth of bacteria as they are harsh.

Keywords: E. Coli, soils, Microbial, Ecosystem, Wastewater irrigation

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Introduction

Agricultural soils are important ecosystems and they support crops growth and human lives. Still, they may be exposed to the contamination of biological, chemical, and radiological pollutants: human and natural (Almayahi, Tajuddin and Jaafar, 2014; Almayahi, 2022). *E. coli* bacteria are employed in the determination of fecal pollution, which is typically done through the application of wastewater irrigation, livestock excreta, or runoffs. The environmental conditions such as temperature, PH, and water determine whether they survive or not in the soil (Leclerc *et al.,* 2001). The recent studies on the territory of Iraq have confirmed the impact of a range of pollutants on soil and water systems like heavy metals and radionuclides (Almayahi, 2020; Almayahi and Tajuddin, 2021; Atlas, 1998). The analysis of the presence of E. coli and the analysis of other ecologic indicators provide the entire picture of the integrity of the ecosystem. The suggested research project will be useful in evaluating the prevalence of E. coli in the soils of agricultural land in Al-Hira and identifying the sources of contamination linked to agriculture and wastewater utilization.

1. Research Problem

How much is the E. coli contamination that exists in the agricultural soils in the Al-Hira sub-district**?**

What are the anthropogenic and environmental factors that cause this contamination?

2. Hypotheses

E. coli is prevalent in Al-Hira agricultural soils due to irrigation with untreated wastewater.

Climatic and hydrological factors significantly influence bacterial distribution and persistence.

3. Objectives

To detect and quantify E. coli in agricultural soils of Al-Hira.

To correlate bacterial contamination with environmental and anthropogenic variables.

To provide a baseline for integrating biological indicators with radiological and chemical soil monitoring.

4. Significance of the Study

This study adds to the awareness of the microbial pollution to the context of the overall environmental health scenario in the Najaf region. The connection of microbial information with the information obtained in previous radiological studies (Almayahi, 2015) improves the domestic environmental management plans.

5. Study Area

The Al-Hira sub- district, which lies in the north of Najaf Governorate (Iraq) between the longitudes 44.8002900 degrees and latitude 33.6918100 degrees, is defined by the high agricultural activity. The major source of irrigation is the Euphrates River and wastewater channels, which makes them more susceptible to biological contamination.

6. Materials and Methods

Various agricultural locations in Al-Hira were sampled with soil. E. coli detection

was done by means of standard microbiological methods through MacConkey and EMB agar media American Public Health Association,) (1926. Physicochemical variables: temperatures, pH and moisture were determined on site. The number of bacteria was calculated as the colony-forming units (CFU/g of soil) (Figures 1, 2).

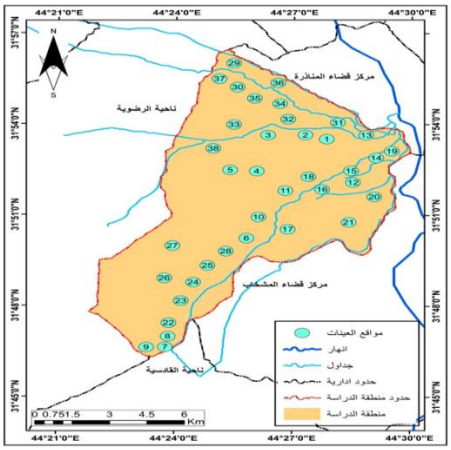

Figure 1: Agricultural soil sampling

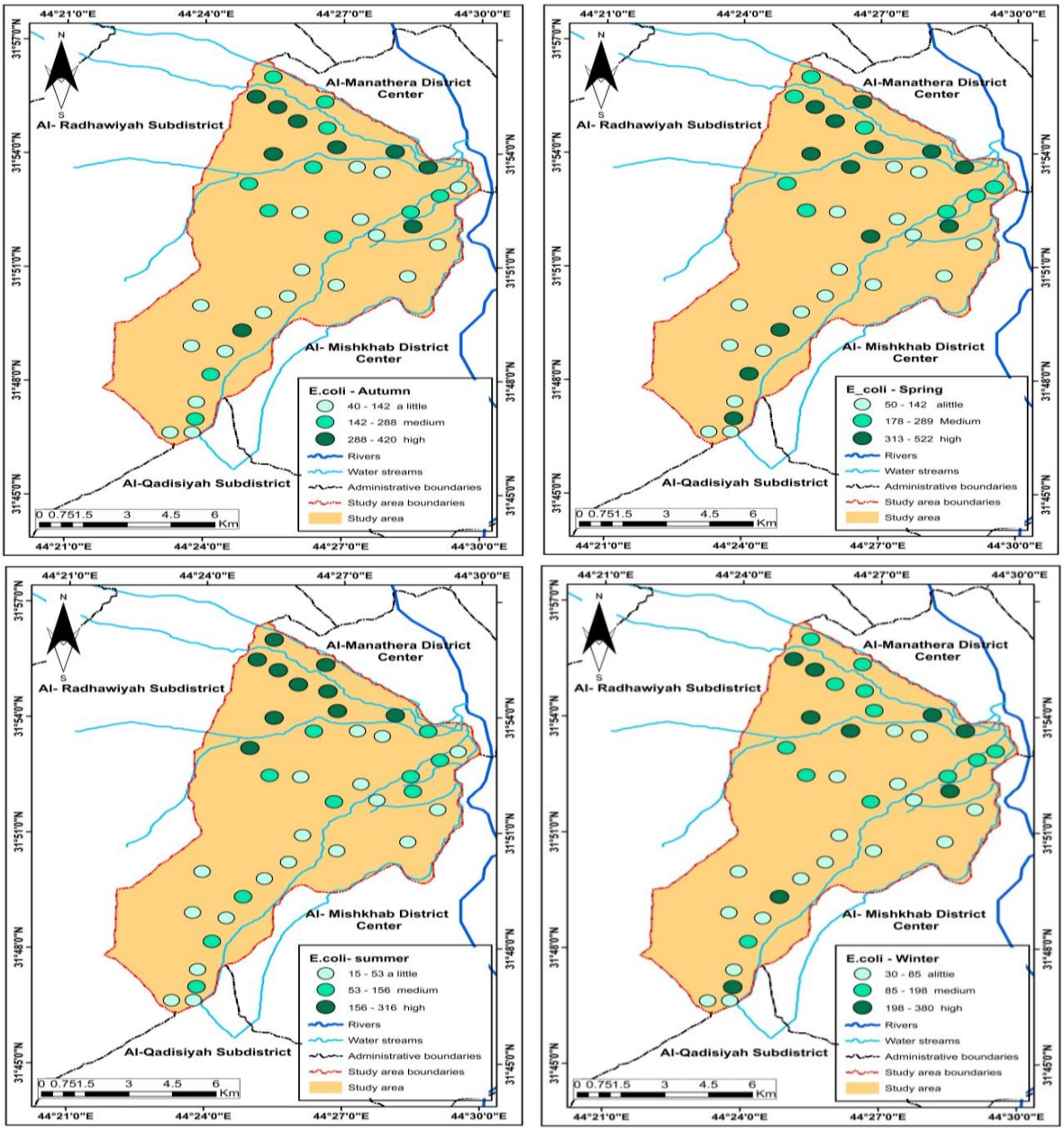

Figure 2. Distribution E. coli bacteria in Al-Hirah district: spatial and time-based distribution.

Results and Discussion

The findings indicated a uniform presence of E. coli in all sites, which proved the prevalence of microbial contamination (Tables 1, 2, Figure 3). Time of the year differences were considerable:

Table 1: E. coli determination at all sites.

Season	CFU/g	Environmental Interpretation
Spring	8,228	Optimal growth due to moderate temperature and high humidity
Autumn	7,242	High growth supported by mild climatic conditions
Winter	5,204	Reduced growth due to low temperature
Summer	4,010	Inhibited growth due to heat and dryness

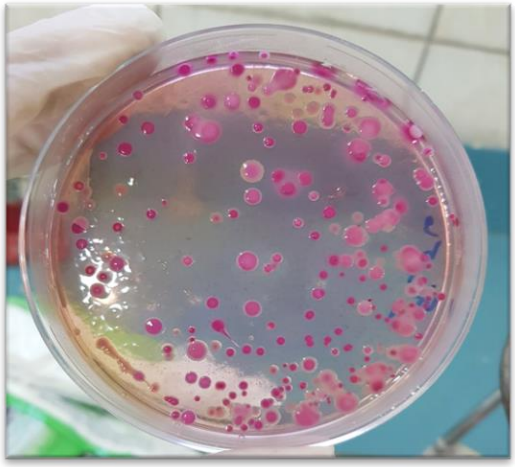

Figure 3: A bacterium dish with E.coli bacteria of a soil sample of agricultural land

Table 2: the count of E. coli bacteria colonies in the agricultural soils of Al-Hira sub-district

Site	Spring	Fall	Winter	Summer
S1	126	101	76	38
S2	50	40	30	15
S3	369	295	221	111
S4	50	40	30	15
S5	245	196	147	74
S6	106	85	64	32
S7	50	40	30	15
S8	360	288	230	108
S9	50	40	30	15
S10	142	114	85	43
S11	313	250	188	94
S12	397	318	238	119
S13	522	420	380	156
S14	225	180	135	68
S15	266	213	160	80
S16	90	72	54	27
S17	50	40	30	15
S18	84	67	50	25
S19	178	142	107	53
S20	142	114	85	43
S21	116	93	70	35
S22	142	114	85	43
S23	330	264	198	120
S24	126	101	76	38
S25	383	306	230	80
S26	50	40	30	15
S27.	80	64	48	24
S28	50	40	30	15
S29.	233	214	195	213
S30.	322	343	212	268
S31	415	381	251	313
S32	313	300	188	241
S33	329	312	221	245
S34	289	286	185	202
S35	351	353	218	279
S36	325	287	191	218
S37	277	408	235	316
S38	282	281	171	199

These results correspond to the tendencies of microbial dynamics in farm soils in the world (Bitton, 2011; Prescott, Harley and Klein, 2002). The higher level of contamination in the northern and central areas is related to the irrigated regions by wastewater streams, which is also revealed in the radiological and physicochemical evaluated Najaf soils (Almayahi, 2022).

Almayahi, 2015 registered that wastewater does not only inject biological contaminants but also augments the level of radionuclides and heavy metals, indicating that there is a multi-pollutant risk to the ecosystem. Microbial and radiological pollutants could occur together and cause synergistic effects on the soil microbial community, crop safety, and human health (World Health Organization, 2017).

Conclusions

Fecal contamination was found in all the Al-Hira agricultural soils through the detection of E. coli. The maximum density of bacteria in spring and fall was ensured by good environmental conditions.

The main source of contamination is the wastewater irrigation.

The results bring out the importance of the integrated environmental monitoring that involves microbiological, radiological, and chemical studies which make the soil sustainability guaranteed.

Recommendations

Install treatment systems of wastewater before farming. Taking periodic microbial and radiological tests.

Create awareness to farmers of the dangers of using untreated wastewater .

Adopt sustainable management of soils in accordance to environment protection standards.

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