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Statistical and Mathematical Analysis of Indicators of Changes in the Geographical Distribution of Livestock in Al-Muthanna Governorate for the Period 2015–2025

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ABSTRACT

Livestock farming is one of the most important agricultural activities in Al-Muthanna Governorate, representing a significant source of food and income for the population. Animal husbandry is widespread in rural and desert areas. The research concluded that Al-Muthanna Governorate has begun to suffer in its livestock sector due to drought and low rainfall, which has affected natural pastures. This is compounded by the high prices of feed and other materials, and weak government support, leading many livestock breeders to abandon animal husbandry. This has led to a decrease in this wealth recently, as the absolute change in the studied livestock wealth reached (-80805) during the study period, which threatens the growth of this wealth, not to mention the variation in the distribution of the change index and the relative change of this wealth among the small administrative units, as almost all administrative units appeared with a negative relative change, except for some of them in certain types of animals such as camels and buffalo, for which the relative change appeared in the positive direction.

Keywords: Statistical analysis, change in geographical distribution, geographical distribution, livestock, Al-Muthanna Governorate

Introduction

Livestock in Al-Muthanna Governorate is considered one of the significant economic resources that contribute to supporting food security and improving the standard of living for the governorate's population, especially in rural areas. This wealth includes the rearing of sheep, cattle, goats, and camels, providing primary sources of meat, milk, and their derivatives, in addition to hides and wool. Livestock farming in Al-Muthanna relies on natural pastures scattered throughout the Badia (desert), as well as agricultural fodder, making this sector closely linked to climatic conditions and water availability. Despite the challenges facing livestock—such as water scarcity, desertification, and diseases—it remains a fundamental pillar of the local economy and a promising opportunity for development if provided with appropriate support and care.

First: Research Problem

Livestock is a fundamental economic component in Al-Muthanna Governorate due to its role in supporting food security and achieving rural development. However, the change in its geographical distribution during the period (2015–2025) was not constant; rather, it was influenced by several natural and human factors, such as climate change, availability of water resources, agricultural policies, and rural migration.

Despite the availability of annual statistical data on the numbers and types of livestock, most studies have relied on traditional analytical methods that may not reveal complex spatial patterns or the interactive relationships between influencing variables. Hence, the research problem emerges in the following question:

- Is there a clear variation in the indicators of change in livestock distribution in Al-Muthanna Governorate during the period 2015–2025?

Second: Research Hypothesis

The research proceeds from the following hypothesis:

"There is a significant variation in the numerical and relative distribution of livestock and the values of its distributional changes in Al-Muthanna Governorate for the period 2015–2025 at the level of small administrative units."

Third: Research Objective

The research aims to draw a clear picture of the distribution and the values of change in that distribution for livestock in Al-Muthanna Governorate for the period (2015–2025) at the level of small administrative units, to serve as an excellent reference for researchers and decision-makers in finding scientific and practical ways to preserve and develop this wealth.

Fourth: Research Structure

The research is organized into two sections preceded by an introduction. The first section addresses the numerical and relative distribution of livestock in Al-Muthanna Governorate for the period (2015–2025). The second section examines the change in the geographical distribution of livestock in Al-Muthanna Governorate during the period (2015–2025). The research concludes with several findings and recommendations that suggest solutions to the research problem, followed by a list of footnotes and references used in the study.

Temporal Scope of the Research

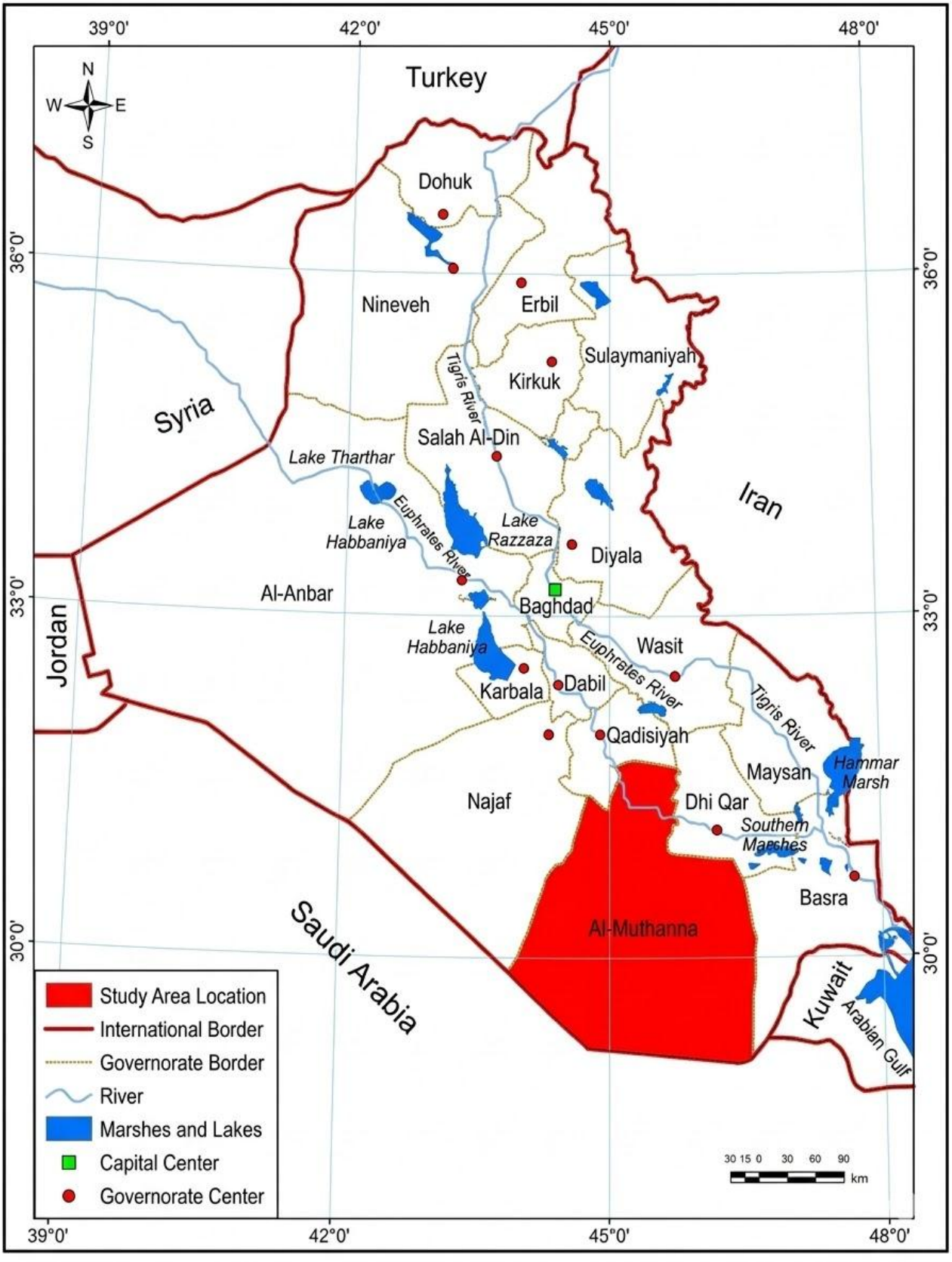
It is represented by the period (2015–2025).

Spatial Boundaries of the Research

Al-Muthanna Governorate represents the spatial boundaries of this research. It is located in southwestern Iraq, bordered to the south by the Kingdom of Saudi Arabia. It is also bordered by four governorates: Al-Qadisiyah to the north and northwest, Najaf to the west, Dhi Qar to the east and northeast, and Basra to the east, as illustrated in Map (1).

Geographically, the governorate is situated between latitudes 29° 05' and 31° 42' North, and longitudes 43° 50' and 46° 32' East. Al-Muthanna represents the southern part of the Middle Euphrates region, which includes—in addition to Al-Muthanna—the governorates of Babil, Najaf, Karbala, and Al-Qadisiyah.

The total area of Al-Muthanna Governorate is 51,740 km², accounting for 11.9% of Iraq's total area of 435,052 km² (which includes 924 km² of territorial waters). Consequently, it ranks as the second-largest governorate in Iraq by area. The Sedimentary Plain within the borders of Al-Muthanna covers 4,805 km², representing 9.3% of the governorate's area, while the Western Plateau covers 46,935 km², accounting for 90.7% of its total area.



Map (1): Location of Al-Muthanna Governorate in Iraq.

Source: Republic of Iraq, Ministry of Water Resources, General Directorate of Survey, Administrative Map of Iraq, 2025, Scale 1:1,000,000.

Section One: Numerical and Relative Distribution of Livestock in Al-Muthanna Governorate for the Period 2015–2025

Every geographical phenomenon has a specific spatial location that serves as its focal point. Since livestock is one of the geographical phenomena closely linked to space, studying it within its spatial context lies at the heart of the work of geographers and livestock specialists alike, not to mention other complementary disciplines such as mathematics and statistics. Distribution is considered the essential starting point for studying any geographical phenomenon and a necessary step toward understanding the behavior of various phenomena (3).

The concept of distribution holds special importance from a geographical perspective, as well as for livestock specialists and statistical data analysts. It represents the foundation upon which the interpretation of interconnectedness and interaction among a set of phenomena within a spatial dimension is based. This spatial framework represents the area where relationships are formed between different environmental elements on one hand, and livestock and its environment on the other.

The essence of geography is fundamentally linked to the uneven distribution of geographical phenomena across the Earth's surface (4). Geographical studies of livestock—whether in terms of distribution or distributional variance—are of great importance due to the primary and distinctive role these studies play in guiding and ensuring the success of development plans. Distribution entails answering two questions: Where is the phenomenon distributed? And why does it exist in its current form? These are the two questions constantly posed by geographers and livestock specialists, forming the cornerstone of any agricultural geographical study (5).

For instance, it is impossible to study the efficiency of livestock service distribution, such as artesian wells and fodder farms of any kind, in the absence of information regarding the distribution and density of that livestock. Furthermore, it is impossible to develop plans and programs aimed at advancing the livestock sector without knowing where this wealth is located and where its concentration areas are (6).

The concept of numerical distribution is defined by the volume of livestock in a specific area at a specific time; that is, it is based on a quantitative and volumetric basis, viewing this as the primary starting point for classifying regions and determining their levels and ranks. On the other hand, relative distribution takes a different approach to classifying regions by measuring the percentage contribution of each area to the total livestock by type. The combined percentages of these areas constitute the total percentage of the region under study. Therefore, studying livestock distribution using absolute numbers, which represent the volume of that wealth, serves as a numerical indicator reflecting the capacity of an administrative unit to accommodate the largest possible number of livestock when certain human, agricultural, and economic data are available in that unit.

These percentages may illustrate the variation in the phenomenon's distribution over time and according to the spatial context, as well as its importance and the evolution of that importance during a specific period. The task of the geographer and the agricultural livestock specialist is to analyze this significance and explain the reasons for its development based on the available data.

It is observed from Table (1) that in 2015, the total livestock in Al-Muthanna Governorate—including all types covered in the research—reached (1,067,054) head. Of this total, the number of sheep was (617,430) head, accounting for (57.9%) of the total livestock in the governorate for the mentioned year. Goats numbered (412,360) head, equivalent to (38.6%) of the total livestock in the study area. Cattle numbered (17,904) head, capturing a percentage of (1.7%). As for buffalo, the number reached (10,370) head at a rate of (1%), and finally, camels numbered (8,990) head, representing (0.8%) of the total livestock in the study area.

Regarding the distribution of livestock in Al-Muthanna Governorate by small administrative units for the same year, it is evident that the Samawah District Center ranked first in the number of sheep, reaching (224,745) head, which is (36.4%) of the total sheep in the governorate. It was followed by the Al-Salman District Center with (88,292) head (14.3%), then the Busaiya Sub-district with (70,387) head (11.9%). Next came the Al-Khidhir District Center with (60,508) head, constituting (9.8%), followed by the Al-Darraji Sub-district with (54,951) head (8.9%). The Al-Najmi Sub-district followed with (35,194) head (5.7%), then the Al-Majd Sub-district with (27,784) head (4.5%), and the Al-Hilal Sub-district with (19,140) head, accounting for (3.1%). Following these were the Al-Rumaitha District Center and the Al-Warkaa Sub-district, each with (14,201) head (2.3%), and finally, the Al-Suwair Sub-district with (8,027) head, representing (1.3%).

Table (1): Numerical and Relative Distribution of Livestock in Al-Muthanna Governorate by Administrative Units (2015)

Administrative Unit	Camels	%	Buffalo	%	Cows	%	Goats	%	Sheep
Samawah District Center	1,437	50.3	5,216	14.5	2,596	23.4	96,492	36.4	224,745
Al-Suwair	0	2.1	218	1.0	179	4.3	17,731	1.3	8,027
Rumaitha District Center	27	18.8	1,950	7.6	1,361	8.4	34,638	2.3	14,201
Al-Hilal	54	5.6	581	22.3	3,993	7.9	32,576	3.1	19,140
Al-Najmi	316	3.8	394	22.6	4,046	5.5	22,680	5.7	35,194
Al-Majd	0	7.0	726	2.2	394	4.7	19,381	4.5	27,784
Al-Warkaa	46	0.8	83	8.0	1,432	7.8	32,164	2.3	14,201
Al-Khidhir District Center	823	9.8	1,016	16.7	2,990	11.7	48,246	9.8	60,508
Al-Darraji	112	1.8	187	5.1	913	9.6	39,587	8.9	54,951
Al-Salman District Center	3,765	0.0	0	0.0	0	9.4	38,762	14.3	88,292
Busaiya	2,410	0.0	0	0.0	0	7.3	30,102	11.4	70,387
Total	8,990	100	10,370	100	17,904	100	412,360	100	617,430

Source: Republic of Iraq, Ministry of Agriculture, Directorate of Agriculture in Al-Muthanna, Statistics Department (Unpublished Data), 2025.

As for the geographical distribution of goats for the mentioned year, the Samawah District Center ranked first with (96,492) head, accounting for (23.4%) of the total goats in Al-Muthanna Governorate. It was followed by the Al-Khidhir District Center with (48,246) head (11.7%), then the Al-Darraji Sub-district with (39,587) head (9.6%). Next came the Al-Salman District Center with (38,762) head (9.4%), the Al-Rumaitha District Center with (34,638) head (8.4%), the Al-Hilal Sub-district with (32,576) head (7.9%), the Al-Warkaa Sub-district with (32,164) head (7.8%), and the Busaiya Sub-district with (30,102) head (7.3%). These were followed by the Al-Najmi Sub-district with (22,680) head (5.5%), the Al-Majd Sub-district with (19,381) head (4.7%), and finally, the Al-Suwair Sub-district with (17,731) head, representing approximately (4.3%).

Regarding cattle in 2015, they were geographically distributed across nine administrative units, as they were absent in the Al-Salman District Center and its affiliated Busaiya Sub-district. The Al-Najmi Sub-district ranked first with (4,046) head, equivalent to (22.6%) of the total cattle in the governorate. It was followed by the Al-Hilal Sub-district with (3,993) head (22.3%), then the Al-Khidhir District Center with (2,990) head (16.7%), the Samawah District Center with (2,596) head (14.5%), and the Al-Warkaa Sub-district with (1,432) head (8.0%). Following these were the Al-Rumaitha District Center with (1,361) head (7.6%), the Al-Darraji Sub-district with (913) head (5.1%), the Al-Majd Sub-district with (394) head (2.2%), and finally, the Al-Suwair Sub-district with (179) head (1.0%).

As for the geographical distribution of buffalo for the same year, the Samawah District Center ranked first with (5,216) head, equivalent to (50.3%) of the total buffalo in the governorate. It was followed by the Al-Rumaitha District Center with (1,950) head (18.8%), the Al-Khidhir District Center with (1,016) head (9.8%), the Al-Majd Sub-district with (726) head (7.0%), the Al-Hilal Sub-district with (581) head (5.6%), the Al-Najmi Sub-district with (394) head (3.8%), the Al-Suwair Sub-district with (218) head (2.1%), the Al-Darraji Sub-district with (187) head (1.8%), and finally, the Al-Warkaa Sub-district with (83) head (0.8%). Buffalo are not reared in the Al-Salman District Center or the Busaiya Sub-district due to high summer temperatures and the lack of surface water required by this animal.

Regarding camels in 2015, their geographical distribution was limited to only nine administrative units. The Al-Salman District Center ranked first with (3,765) head, equivalent to (41.9%) of the total camels in the governorate. It was followed by the Busaiya Sub-district with (2,410) head (26.8%), the Samawah District Center with (1,437) head (16.0%), the Al-Khidhir District Center with (823) head (9.2%), the Al-Najmi Sub-district with (316) head (3.5%), the Al-Darraji Sub-district with (112) head (1.2%), the Al-Hilal Sub-district with (54) head (0.6%), and finally, the Al-Rumaitha District Center with (27) head (0.3%).

It is noted from Table (2) that there is a change in the geographical distribution of livestock in Al-Muthanna Governorate in 2025 compared to 2015. In addition, there was a decrease in the number of sheep, goats, and cattle in the governorate in 2025 compared to 2015. This is likely attributed to rising temperatures, drought, and scarcity of rainfall, which negatively impacted these animals. Conversely, the number of camels increased slightly because they are more resistant to

heat and drought than other livestock. Buffalo numbers also increased slightly as they receive special care in terms of nutrition and shelter. The total number of studied animals in Al-Muthanna Governorate in 2025 reached (986,249) head; of these, sheep numbered (554,980) head (56.3%), goats numbered (394,650) head (40.0%), cattle numbered (16,912) head (1.7%), buffalo numbered (10,431) head (1.1%), and finally, camels reached (9,276) head (0.9%).

From Table (2), it is also evident that the distribution of livestock across small administrative units in 2025 changed. The Samawah District Center ranked first in the number of sheep with (196,430) head (35.4%), followed by the Al-Salman District Center with (82,475) head (14.7%), then the Busaiya Sub-district with (61,355) head (11.1%), the Al-Khidhir District Center with (54,870) head (9.9%), the Al-Darraji Sub-district with (51,740) head (9.3%), and the Al-Najmi Sub-district with (31,980) head.

Table (2): Numerical and Percentage Distribution of Livestock in Al-Muthanna Governorate by Administrative Units (2025)

Administrative Unit	%	Camels	%	Buffalo	%	Cows/Cattle	%	Goats	%	Sheep
Samawa Center	16.5	1,530	46.6	4,865	14.0	2,360	25.0	98,505	35.4	196,430
Al-Suwair	0.0	0	2.6	267	1.1	182	4.0	15,625	1.4	7,545
Rumaitha Center	0.4	34	20.0	2,087	8.4	1,416	5.7	22,585	2.1	11,590
Al-Hilal	0.7	61	6.0	621	20.5	3,460	9.3	36,875	3.2	17,620
Al-Najmi	3.3	304	3.7	387	22.3	3,795	5.5	21,750	5.7	31,980
Al-Majd	0.0	0	7.1	745	2.4	407	4.2	16,435	4.6	25,750
Al-Warkaa	0.6	53	0.9	96	9.4	1,594	8.0	31,745	2.5	13,625
Al-Khidhir Center	8.7	811	11.0	1,145	17.0	2,875	10.6	41,660	9.9	54,870
Al-Darraji	1.3	118	2.1	218	4.9	823	9.7	38,420	9.3	51,740
Al-Salman Center	41.6	3,855	0.0	0	0.0	0	10.0	39,470	14.7	82,475
Busaiya	27.1	2,510	0.0	0	0.0	0	8.0	31,580	11.1	61,355
Total	100	9,276	100	10,431	100	16,912	100	394,650	100	554,980

Source: Republic of Iraq, Ministry of Agriculture, General Directorate of Agriculture in Al-Muthanna, Statistics Department (Unpublished data), 2025.

equivalent to (5.7%). Following it was the Al-Majd Sub-district with (25,750) head (4.6%), then the Al-Hilal Sub-district with (17,620) head (3.2%), followed by the Al-Warkaa Sub-district with (13,625) head (2.5%). The Al-Rumaitha District Center came next with (11,590) head (2.1%), and finally, the Al-Suwair Sub-district with (7,545) head, representing (1.4%).

As for goats in 2025, the Samawah District Center ranked first with (98,505) head, accounting for (25.0%) of the total goats in Al-Muthanna Governorate. It was followed by the Al-Khidhir District Center with (41,660) head (10.6%), then the Al-Salman District Center with (39,470) head (10.0%). The Al-Darraji Sub-district followed with (38,420) head (9.7%), then the Al-Hilal Sub-district with (36,875) head (9.3%), and the Al-Warkaa Sub-district with (31,745) head (8.0%). The Busaiya Sub-district also captured (8.0%) with (31,580) head, followed by the Al-Rumaitha District Center with (22,585) head (5.7%), the Al-Najmi Sub-district with (21,750) head (5.5%), the Al-Majd Sub-district with (16,435) head (4.2%), and finally, the Al-Suwair Sub-district with (15,625) head, approximately (4.0%).

Small administrative units in Al-Muthanna Governorate maintained their rankings regarding the geographical distribution of cattle in 2025, consistent with the 2015 data. The Al-Najmi Sub-district ranked first with (3,416) head, equivalent to (22.5%) of the total cattle in the governorate. It was followed by the Al-Hilal Sub-district with (3,795) head (22.3%), then the Al-Khidhir District Center with (2,875) head (17.0%), the Samawah District Center with (2,360) head (14.0%), and the Al-Warkaa Sub-district with (1,594) head (9.4%). Following these were the Al-Rumaitha District Center with (1,416) head (8.4%), the Al-Darraji Sub-district with (823) head (4.9%), the Al-Majd Sub-district with (407) head (2.4%), and finally, the Al-Suwair Sub-district with (182) head (1.1%).

Regarding the geographical distribution of buffalo in 2025, the Samawah District Center ranked first with (4,865) head, equivalent to (46.6%) of the total buffalo in Al-Muthanna Governorate. It was followed by the Al-Rumaitha District Center with (2,087) head (20.0%), the Al-Khidhir District Center with (1,145) head (11.0%), the Al-Majd Sub-district with (745) head (7.1%), the Al-Hilal Sub-district with (621) head (6.0%), the Al-Najmi Sub-district with (387) head (3.7%), the Al-Suwair Sub-district with (267) head (2.6%), the Al-Darraji Sub-district with (218) head (2.1%), and finally, the Al-Warkaa Sub-district with (96) head (0.8%). As noted previously, buffalo are not reared in the Al-Salman District Center or the Busaiya Sub-district due to high summer temperatures and the absence of surface water essential for this species.

Small administrative units also maintained their rankings in 2025 regarding the geographical distribution of camels. The Al-Salman District Center ranked first with (3,855) head, equivalent to (41.6%) of

the total camels in Al-Muthanna Governorate. It was followed by the Busaiya Sub-district with (2,510) head (27.1%), then the Samawah District Center with (1,530) head (16.5%), the Al-Khidhir District Center with (811) head (8.7%), the Al-Najmi Sub-district with (304) head (3.3%), the Al-Darraji Sub-district with (118) head (1.3%), the Al-Hilal Sub-district with (61) head (0.7%), and finally, the Al-Rumaitha District Center with (34) head (0.4%).

Section Two: Changes in Livestock Distribution in Al-Muthanna Governorate (2015–2025)

"Change" refers to the degree of variation in the distribution of a studied phenomenon; it is the difference in that distribution between two specific dates, whether the change is in a negative or positive direction. Geographical and economic phenomena, including livestock, are subject to constant change due to variations in environmental, economic, and climatic conditions. These conditions affect the environment's ability to provide the essentials of life, such as water and food. Furthermore, the significance of the phenomenon itself varies, not to mention the impact of government policies, systems, and laws in place, and the support or facilities provided to livestock breeders, considering livestock a guaranteed economic asset that contributes significantly to achieving food security. It is worth noting that methods for measuring changes in distribution are numerous; we will examine some of them as follows:

First: Absolute Change

Absolute change is the difference in absolute numbers of the distribution of the studied phenomenon between two known dates. Since livestock is a phenomenon subject to change over time, its absolute change—or the difference in its numbers during that period—can be measured (7) based on its distribution statistics across administrative units over several years.

The total absolute change in the volume of the studied livestock in Al-Muthanna Governorate for the period (2015–2025) reached (-80,805) head. This indicates a decrease in livestock in the study area during the mentioned period. This decline is attributed to several factors, including:

- Some breeders abandoning livestock farming due to their occupation with administrative jobs in official departments.
- The inability to cover the costs of maintaining livestock, such as purchasing fodder and medicine.
- Weak government support for such projects.
- Scarcity of rainfall and drought waves accompanied by rising temperatures in the study area, which negatively impacted natural pastures—the natural resource for animal nutrition.

It is observed from Table (3) that the absolute change in the number of sheep in Al-Muthanna Governorate during the study period reached (-62,450) head, indicating a decrease in their numbers governorate-wide. This decrease was also reflected at the level of small administrative units:

- Samawah District Center: Ranked first in the decline of sheep numbers with (-28,315) head.
- Busaiya Sub-district: (-9,032) head.
- Al-Salman District Center: (-5,817) head.
- Al-Khidhir District Center: (-5,638) head.
- Al-Najmi Sub-district: (-3,214) head.
- Al-Darraji Sub-district: (-3,211) head.
- Al-Rumaitha District Center: (-2,611) head.
- Al-Majd Sub-district: (-2,034) head.
- Al-Hilal Sub-district: (-1,520) head.
- Al-Warkaa Sub-district: (-576) head.
- Al-Suwair Sub-district: (-482) head.

As for goats, their numbers decreased in Al-Muthanna Governorate during the study period, with an absolute change of (-17,710) head. While numbers decreased in some small administrative units, they increased in others. A positive absolute change was recorded in four administrative units:

- Samawah District Center: (+2,013) head.
- Al-Hilal Sub-district: (+4,299) head.
- Al-Salman District Center: (+708) head.
- Busaiya Sub-district: (+1,478) head.

Conversely, a negative change appeared in the following units: Al-Suwair (-2,106), Al-Rumaitha (-12,053), Al-Najmi (-930), Al-Majd (-2,946), Al-Warkaa (-419), Al-Khidhir (-6,586), and Al-Darraji (-1,167).

Regarding cattle, their numbers decreased in Al-Muthanna Governorate with an absolute change of (-992) head. This change was positive in four units: Al-Suwair, Al-Rumaitha District Center, Al-Majd Sub-district, and Al-Warkaa Sub-district.

Table (3):Absolute Change in Livestock Population in Al-Muthanna Governorate by Administrative Units for the Period (2015–2025)

Administrative Unit	Sheep	Goats	Cattle	Buffalo	Camels
Samawah District	-28,315	2,013	-236	-351	93
Al-Suwair	-482	-2,106	3	49	0
Al-Rumaitha District	-2,611	-12,053	55	137	7
Al-Hilal	-1,520	4,299	-533	40	7
Al-Najmi	-3,214	-930	-251	-7	-12
Al-Majd	-2,034	-2,946	13	19	0
Al-Warkaa	-576	-419	162	13	7
Al-Khidhir District	-5,638	-6,586	-115	129	-12
Al-Darraji	-3,211	-1,167	-90	31	6
Al-Salman District	-5,817	708	0	0	90
Busaiya	-9,032	1,478	0	0	100
Total	-62,450	-17,710	-992	61	286

Source: Based on Tables (1, 2).

Al-Warkaa, where the absolute change for these units reached (+3) head, (+55) head, (+13) head, and (+162) head respectively. On the other hand, the absolute change appeared in a negative direction in the remaining small administrative units of the governorate, which are: Samawah District Center (-236) head, Al-Hilal Sub-district (-533) head, Al-Najmi Sub-district (-251) head, Al-Khidhir District Center (-115) head, and Al-Darraji Sub-district (-90) head.

The absolute change for buffalo numbers in the study area during the mentioned period appeared in a positive direction, reaching (+61) head. At the level of small administrative units, the absolute change for buffalo was negative in the Samawah District Center (-351) head and the Al-Najmi Sub-district (-7) head. Meanwhile, it appeared in a positive direction in the rest of the governorate's administrative units: Al-Suwair (+49) head, Al-Rumaitha District Center (+137) head, Al-Hilal Sub-district (+40) head, Al-Majd Sub-district (+19) head, Al-Warkaa Sub-district (+13) head, Al-Khidhir District Center (+129) head, and finally, Al-Darraji Sub-district (+31) head.

The number of camels in Al-Muthanna Governorate increased during the study period, with an absolute change reaching (+286) head. Their numbers decreased in only two administrative units: Al-Khidhir District Center and Al-Najmi Sub-district, with an absolute change of (-12) head each. Conversely, the absolute change for the remaining units in the study area was positive, reaching (+93) head in the Samawah District Center, and (+7) head in each of the Al-Rumaitha District Center, Al-Hilal Sub-district, and Al-Najmi Sub-district. Furthermore, the absolute change was (+6) head in the Al-Darraji Sub-district, (+90) head in the Al-Salman District Center, and finally (+100) head in the Busaiya Sub-district.

Second: Relative Change

The value of relative change for any phenomenon is calculated by dividing the absolute change value (whether positive or negative) by the value or number of the phenomenon in the previous year, and then multiplying the result by 100 (*).

It is observed from Table (4) that the relative change value for sheep in Al-Muthanna Governorate during the study period reached (-10.1%). This indicates a decrease in the number of sheep in Al-Muthanna Governorate during the period (2015–2025). It also shows that all small administrative units in the study area experienced a decrease in sheep numbers during the mentioned period, reaching.

Table (4) :Relative Change in Livestock Population in Al-Muthanna Governorate by Administrative Units for the Period (2015–2025)

Administrative Unit	Sheep %	Goats %	Cattle %	Buffalo %	Camels %
Samawah District	-12.6	2.1	-9.1	-6.7	6.5
Al-Suwair	-6.0	-11.9	1.7	22.5	0
Al-Rumaitha District	-18.4	-34.8	4.0	7.0	25.9
Al-Hilal	-7.9	13.2	-13.3	6.9	13.0
Al-Najmi	-9.1	-4.1	-6.2	-1.8	-3.8
Al-Majd	-7.3	-15.2	3.3	2.6	0
Al-Warkaa	-4.1	-1.3	11.3	15.7	15.2
Al-Khidhir District	-9.3	-13.7	-3.8	12.7	-1.5
Al-Darraji	-5.8	-2.9	-9.9	16.6	5.4
Al-Salman District	-6.6	1.8	0	0	2.4
Busaiya	-12.8	4.9	0	0	4.1
Total	-10.1	-4.3	-5.5	0.6	3.2

Source: Based on Tables (1, 2).

... with the largest negative relative change of (-18.4%) occurring in the Al-Rumaitha District Center, followed by the Busaiya Sub-district (-12.8%), the Samawah District Center (-12.6%), and the Al-Khidhir District Center (-9.3%). Following these were the Al-Najmi Sub-district (-9.1%), the Al-Majd Sub-district (-7.3%), the Al-Hilal Sub-district (-7.1%), the Al-Khidhir District Center (-6.6%), the Al-Suwair Sub-district (-6.0%), the Al-Darraji Sub-district (-5.8%), and finally, the Al-Warkaa Sub-district (-4.1%).

The relative change for goats in Al-Muthanna Governorate during the study period reached (-4.3%), indicating a decrease in goat numbers between 2015 and 2025. However, four small administrative units showed a positive trend (increase): Samawah District Center (+2.1%), Al-Hilal Sub-district (+13.2%), Al-Salman District Center (+1.8%), and Busaiya Sub-district (+4.9%). Conversely, negative relative change values were recorded in other units: Al-Suwair (-11.9%), Al-Rumaitha District Center (-34.8%), Al-Najmi Sub-district (-4.1%), Al-Majd Sub-district (-15.2%), Al-Warkaa Sub-district (-1.3%), Al-Khidhir District Center (-13.7%), and Al-Darraji Sub-district (-2.9%).

Table (4) also reveals a decrease in cattle numbers with a relative change of (-5.5%). Five units also experienced a decline: Samawah District Center (-9.1%), Al-Hilal Sub-district (-13.3%), Al-Najmi Sub-district (-6.2%), Al-Khidhir District Center (-3.8%), and Al-Darraji Sub-district (-9.9%). A positive relative change occurred in Al-Suwair (+1.7%), Al-Rumaitha District Center (+4.0%), Al-Majd Sub-district (+3.3%), and Al-Warkaa Sub-district (+11.3%). The Al-Salman District and Busaiya Sub-district remain devoid of cattle.

The relative change for buffalo reached (+0.6%), indicating a slight increase governorate-wide. At the unit level, numbers decreased in the Samawah District Center (-6.7%) and Al-Najmi Sub-district (-1.8%). Positive trends were recorded elsewhere, with the highest values in Al-Suwair (+22.5%), followed by Al-Darraji (+16.6%), Al-Warkaa (+15.7%), Al-Khidhir District Center (+12.7%), Al-Rumaitha District Center (+7.0%), Al-Hilal Sub-district (+6.9%), and Al-Majd Sub-district (+2.6%).

Camel numbers increased with a positive relative change of (+3.2%). While numbers declined in the Al-Khidhir District Center (-1.5%) and Al-Najmi Sub-district (-3.8%), other units showed growth: Al-Rumaitha District Center (+25.9%), Al-Warkaa (+15.2%), Al-Hilal (+13.0%), Samawah District Center (+6.5%), Al-Darraji (+5.4%), Busaiya (+4.1%), and Al-Salman District Center (+2.4%).

Third: Change Index

The Change Index is a vital indicator for understanding the dynamics of a phenomenon's distribution over a specific period. It is calculated by dividing the relative distribution (percentage) of livestock in a given area for the subsequent year by its relative distribution in the previous year, then multiplying the result by 100 (**).

According to Table (5), the Change Index for sheep distribution varied, with the highest value recorded in the Al-Warkaa Sub-district (108.7%). It was followed by Al-Suwair (107.7%), Al-Darraji (104.5%), Al-Hilal (103.2%), Al-Salman District Center (102.8%), Al-Majd (102.2%), Al-Khidhir District Center (101.0%), and Al-Najmi (100.0%). Lower values were found in Busaiya (97.4%), Samawah District Center (97.3%), and finally Al-Rumaitha District Center (91.3%).

Regarding goats, the Al-Hilal Sub-district recorded the highest Change Index at (117.7%), followed by Busaiya (109.6%), Samawah District Center (106.8%), Al-Salman District Center (106.4%), Al-Warkaa (102.6%), Al-Darraji (101.0%), and Al-Najmi (100.0%). The lowest indices were in Al-Suwair (93.0%), Al-Khidhir (90.6%), Al-Majd (89.4%), and Al-Rumaitha (67.9%).

For cattle, the Al-Warkaa Sub-district ranked first with a Change Index of (117.5%), followed by the Al-Rumaitha District Center (110.5%), Al-Suwair (110.0%), Al-Majd (109.1%), Al-Khidhir (101.8%), Al-Najmi (98.7%), Samawah District Center (96.6%), and Al-Darraji (96.1%). Finally, Al-Hilal recorded

(91.9%), noting that the Al-Salman District remains cattle-free.

As for the buffalo Change Index, the Al-Suwair Sub-district occupied the first rank at (123.8%), followed by Al-Darraji (116.7%), Al-Warkaa (112.5%), Al-Khidhir District Center (112.2%), Al-Hilal (107.1%), Al-Rumaitha District Center (106.4%), Al-Majd (101.4%), and Al-Najmi (97.4%). The Samawah District Center recorded the lowest index at (92.6%), while Al-Salman District is devoid of buffalo.

Table (5) :Index of Change in Livestock Population in Al-Muthanna Governorate by Administrative Units for the Period (2015–2025)

Administrative Unit	% Camels	% Buffalo	% Cattle	% Goats	% Sheep
Samawah District Center	103.1	92.6	96.6	106.8	97.3
Al-Suwair	0	123.8	110.0	93.0	107.7
Al-Rumaitha District Center	133.3	106.4	110.5	67.9	91.3
Al-Hilal	116.7	107.1	91.9	117.7	103.2
Al-Najmi	94.3	97.4	98.7	100.0	100.0
Al-Majd	0	101.4	109.1	89.4	102.2
Al-Warkaa	120.0	112.5	117.5	102.6	108.7
Al-Khidhir District Center	94.6	112.2	101.8	90.6	101.0
Al-Darraji	108.3	116.7	96.1	101.0	104.5
Al-Salman District Center	99.3	0	0	106.4	102.8
Busaiya	101.1	0	0	109.6	97.4
Total	-	-	-	-	-

Regarding the Change Index for camel distribution in Al-Muthanna Governorate, the Al-Rumaitha District Center recorded the highest value at (133.3%), ranking first. It was followed by the Al-Warkaa Sub-district (120.0%) in second place, while the Al-Hilal Sub-district ranked third with a Change Index of (116.7%). Next came the Al-Darraji Sub-district (108.3%), followed by the Samawah District Center (103.1%), the Busaiya Sub-district (101.1%), the Al-Salman District Center (99.3%), and the Al-Khidhir District Center (94.6%). Finally, the Al-Najmi Sub-district recorded (94.3%), noting that the Al-Suwair and Al-Majd sub-districts are devoid of camels.

Conclusions

1. Low Livestock Density: There is a low number of studied livestock in Al-Muthanna Governorate relative to its total land area. This is primarily attributed to the vastness of the Al-Muthanna Badia (desert), which suffers from drought and low rainfall, as well as a decrease in the number of livestock breeders, which has negatively impacted animal populations in the study area.
2. Population Decline: A decrease in the numbers of sheep, goats, and cattle was observed in Al-Muthanna Governorate during the study period, while buffalo and camel numbers increased only by marginal percentages. This reveals the significant impact of drought, fodder shortages, weak government support, and a lack of experienced labor in livestock management. The total absolute change in livestock volume reached (-80,805) head.
3. Distributional Variance: There is a clear variation in the values of relative change and the Change Index for livestock distribution across Al-Muthanna Governorate. This variance is caused by the fluctuations in absolute change (increases and decreases) and the differing distribution percentages among administrative units within the study area.

Recommendations

1. Data Accessibility: It is essential to provide official, annual data on livestock populations in Al-Muthanna Governorate. This would allow researchers to enrich their scientific studies and enable decision-makers to make informed choices regarding the distribution of fodder, veterinary treatments, and the overall development of this sector.
2. Scientific Planning for Resources: A scientific plan must be developed to expand fodder cultivation and develop natural pastures by establishing agricultural reserves in the Al-Muthanna Badia. This includes harvesting and storing rainwater for irrigation and providing drinking water for livestock.
3. Enhanced Government Support: Government support for livestock projects must be increased, recognizing them as a fundamental pillar of the economy and a vital component of national food security.

Here is the English translation of your footnotes, formatted according to academic standards:

Footnotes Translation

[1] Republic of Iraq, Ministry of Planning, Central Statistical Organization, *Annual Statistical Abstract 2010-2011*, Table 1/1, p. 6.

[2] Ali Sahib Talib, "Geographical Characteristics in the Middle Euphrates Governorates and Their Spatial Relationship to Agricultural Specialization," *Journal of the Iraqi Geographical Association*, Issue No. 44, 2000, p. 70.

[3] Safouh Khayr, *Geographical Research: Methods and Techniques*, Dar Al-Marikh Publishing, Riyadh, 1990, p. 315.

[4] Hooson, D.J.M., "The Distribution of Population as the Essential Geographical Expression," *The Canadian Geographer*, No. 17, 1960, p. 11.

[5] Safouh Khayr, *Geography: Subject Matter, Methods, and Objectives*, Dar Al-Fikr, Damascus, 2000, p. 340.

[6] Abdullah Nasser Al-Rufaie, *Animal Production*, Dar Al-Kutub for Printing and Publishing, Baghdad, 2015, p. 87.

[7] Younis Hammadi Ali, *Principles of Demography (Population Studies)*, 1st Edition, Dar Wael for Publishing, Amman, 2010, p. 109.

(*)

$$R = \frac{P2-P1}{P1} \times 100$$

- R= Relative Change
- P1 = Number of Livestock in 2015
- P2 = Number of Livestock in 2025

Source:Abdul-Jalil Abdul-Wahab Abdul-Razzaq, *A Geographical Analysis of Population Distribution in Al-Muthanna Governorate for the Period 1987–2012*, Master's Thesis (Unpublished), 2014, p. 54.

$$\text{Coefficient of Change} = \frac{Percentage\ Distribution\ of\ Livestock\ across\ Administrative\ Units\ (2025)}{Livestock\ Proportional\ Distribution\ by\ Administrative\ Unit\ (2015)} \times 100$$

Source: Hussein Ali Abid Mohammed Al-Rawi, *Changes in Population Distribution and Spatial Movements in Al-Anbar Governorate for the Period 1977–1997*, Ph.D. Dissertation (Unpublished), College of Arts, University of Baghdad, 1999, p. 56.

References

I. Books

1. Khair, Safouh. *Geographical Research: Methods and Techniques*. Dar Al-Marikh Publishing, Riyadh, 1990.
2. Khair, Safouh. *Geography: Subject, Methods, and Objectives*. Dar Al-Fikr, Damascus, 2000.
3. Al-Rufaie, Abdullah Nasir. *Animal Production*. Dar Al-Kutub for Printing and Publishing, Baghdad, 2015.
4. Ali, Younis Hammadi. *Principles of Demography (Population Study)*. 1st Edition, Dar Wael Publishing, Amman, 2010.

II. Theses and Dissertations

1. Al-Rawi, Hussain Ali Abd Muhammad. "Changes in the Population Distribution of Al-Anbar Governorate and Their Spatial Movements for the Period 1977–1997." PhD Dissertation (Unpublished), College of Arts, University of Baghdad, 1999.
2. Abdul Razzaq, Abdul Jalil Abdul Wahab. "A Geographical Analysis of Population Distribution in Al-Muthanna Governorate for the Period 1987–2012." Master's Thesis (Unpublished), 2014.

III. Official Documents and Government Sources

1. Republic of Iraq, Ministry of Water Resources. *General Directorate of Survey, Administrative Map of Iraq*, 2025, Scale 1:1,000,000.

2. Republic of Iraq, Ministry of Agriculture. *Directorate of Agriculture in Al-Muthanna, Statistics Department (Unpublished Data)*, 2025.

IV. Journals and Periodicals

1. Talib, Ali Sahib. "Geographical Characteristics in the Middle Euphrates Governorates and Their Spatial Relationship to Agricultural Specialization." *Journal of the Iraqi Geographical Society*, No. 44, 2000.

V. Foreign Sources

1. Hooson, D.J.M. "The Distribution of Population as the Essential Geographical Expression." *The Canadian Geographer*, No. 17, 1960.