J.Animal and Poultry Prod., Mansoura Univ., Vol.10 (8): 261 - 269, 2019

Water and Feed Consumption and Body Weight of Egyptian Buffaloes and Cows under Different Regional Climatic Conditions in Egypt

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ABSTRACT

This study estimated quantity of water, feed consumption and body weight of buffaloes and cows under different climatic regions in Egypt, Data used in this study were collected from six governorates, each two governorates represented different climatic region in Egypt. The study began in January (2010) to December (2015). Monthly visits to each governorate were occurred. The investigation was carried out via three climatic regions [Lower Egypt (LE), Middle Egypt (ME) and Upper Egypt (UE)]. In each governorate, total of 5 villages and 3 farms in each village were represented as a small, medium and large scale farm per village. The measures were taken from 12 animals, perform (6 buffaloes and 6 cows) in two ages groups (G1, 9-12 months of age and G2, 12 -18 months of age). Each farm was visited only one time. Essentially, the animal's respiration rate (RR, r/min), water intake (WI, L/day), feed intake (FI /Kg) and body weight (BW/ Kg) were measured. Data of environmental conditions collected were air temperature (AT, °C) and relative humidity (RH, %) to calculate temperature humidity index (THI). A prediction equation was developed based on of THI values WI, L/day, FI/Kg and BW/Kg the main obtained results were: The highest values of THI were detected in Lower Egypt (LE). , while The lowest THI values were in Upper Egypt (UE), The best values of respiration rate (RR, r/min) for the two species of animals (buffaloes & cows) were in Upper Egypt (UE), The relationship between RR r/min and water intake (WI, L/day) was linear for the two species of animals under the three climatic regions , Values of WI, L/day and concentrates feed intake (FI, con /Kg) by cows were more than those of buffaloes for the two ages groups and the significances was clear in G2, under the three climatic regions., The values of roughage intake (FI, R /Kg) were nearly the same for the two species. Animal consumption of water was higher in Lower Egypt (LE) and the lower consumption recorded was in Upper Egypt (UE). Water intake (WI, L/day), continued to increase linearly with increasing THI by the two species (buffaloes &cows), while feed intake (FI/Kg) decreased. Body weight (BW/Kg) of cows were higher than buffaloes in the three climatic regions. By using the predictive equations in the different climatic conditions, one can be enable to detect good earlier estimate of the productivity of the animals. Estimation of THI index in any climatic regions is a helpful tool to predict consumption of water by the two species (buffaloes &cows). Results indicated in accurate the higher prediction ability of amount of water intake for the two species based on the changes occurred in THI. In conclusion the best climatic conditions for the two species is between 71- 74 THI in the three climate regions. The higher consumption from water was in Lower Egypt and the lower consumption was in Upper Egypt. It is very important with climatic changes, using the prediction equation which enable maintaining water and productivity of animal without greater drop of production. This study concluded that it is still possible to maintain or increase meat production from buffaloes and cows under different climatic regions, particularly in Upper Egypt (UE), with available suitable shades above animals, and shading watering to protect from solar radiation direction.

Keywords: Climatic regional conditions, Water consumption, Feed consumption, Body weight, Temperature Humidity Index.

INTRODUCTION

Heat stress is a major constraint on animal productivity in arid zones. High climatic temperature with humidity severely decreases growth rate, milk production, reproduction efficiency and immunity of dairy cows (Ashour *et al*., 2000, West 2003, Omran *et al*., 2013). Animals maintain the stability of body temperature within normal range (38.3 - 38.7°C) through increasing the heat loss and reduce the endogenous heat production. Several physiological changes indicate the response of dairy cows to heat which is manifested by number of efforts reactions, including reduced feed intake increased water intake, evaporative water losses from the body, increased respiration rate and altered endocrine functions (Calamari *et al*., 2007). Under thermo neutral condition, water intake equals water loss in the normal adult animal, while under heat stress the major physiological reaction is an increased water intake and consequently body water content. As water is lost through urine, skin and respiratory vaporization under heat stress, a temporary water deficit with increased body fluids concentration stimulates the hypothalamic thirst center to control water consumption.

Kamal (1975) observed that the increase in body water content in heat tolerant animal under hot climatic condition as adaptive reaction to ameliorate heat stress, manifest the least change in most of the physiological functions.

Water salination could affect animal metabolism, fertility, and digestion. Chemical contaminants and heavy metals could impair cardiovascular, excretory, skeletal, nervous and respiratory systems, as well as impairing, hygienic quality of production (Nardone *et al.*, 2010). Omran and Fooda (2012) found that same farms in Middle Egypt depending on wells (salinity of water 2500 to 3000 ppm) for animal drinking in the new reclaimed land did not show any diverse on animal productivity. There is a lack of research related to implications of reduced water availability for land-based livestock systems due to climate change (Thornton *et al.*, 2009).

The livestock sector accounts for about 8% of global water utility and whenever increasing the climatic temperature properly increase animal water consumption (Nardone *et al*., 2010). Omran (1999) reported that constant heat stress in lab at 40c increased water consumption per metabolic body weight $(MBW)^{0.75}$ by 16% in buffalo calves and 25% in Friesian calves, The author added that concentrate intake was reduced by 20% in buffalo and 18%in Friesian calves and reduced the average daily gain (ADG/kg) by 25% in buffalo calves and 20% in Frisian calves.

Ashour (1990) found that buffalo calves increased their water intake in summer than in winter by two folds as absolute values (39.2vs. 20.1L/day) and by three times relative values to metabolic body weight ($W^{0.75}$). With climatic change under Egypt conditions, a regular a adjusting of water consumption is needed for both species where it potentially the main ingredient in milk and meat production in Egypt. The IPCC Fifth Assessment Report identified the "likely range" of increase in global average surface temperature by 2100, is between 0.3°C and 4.8°C (IPCC, 2013).

The objective of this study was to evaluate the animal consumption of water and feed under the different climatic conditions in different regions in Egypt (Lower "LE", Middle "ME" and Upper "UE"). In addition, this work include sat up of a predictive equations linking the change in the temperature humidity index (THI) with the consumption of water, feed and body weight with climate change.

MATERIALS AND METHODS

Animals, management and feeding:

Data used in this study were collected from six governorates in the period from January (2010) to December (2015). Each two governorates represented a different climatic region. Total of ten monthly visits, per each governorate were carried out. Two governorates were selected in Lower Egypt, El Behera and El Menoufia, where the number of buffaloes and cows in each governorate were accounted to some of 384120, 537434 and 369684, 317229 head, respectively as recorded by (LDS, 2017). While in the Middle Egypt, two governorates, El Fayoum and El Menia were included in this work where the Number of buffaloes and cows were about 190604, 291769 and 291739, 337987 head, respectively (LDS, 2017), In Upper Egypt also two governorates were selected (Suhag and Qena), in which the number of buffaloes and cows were 272915, 279845 and 213375, 195156 head, respectively (LDS, 2017). In each governorate, total of 5 villages were visited in which (3) farms were represented as small, medium and large scale farms. Measurers were taken from total of 12 animals, (6 buffaloes and 6 cows) in each farm. Buffaloes and cows were divided into two ages groups, in which total of 6 calves in the same age were included in each group (G1 andG2).Three of which per each species were in 9-12 month of age (G1), and the other were 12 -18 month (G2). Each farm was visited one time only. Total of investigated animal in this study were 4320 heads buffaloes and cows along with the experiment period.

Essentially, winter animal feeds were composed of concentrate feed mixtures (pellets or mashed) and Egyptian clovers, in addition to wheat bran, wheat straw, bean hulls, alfalfa hay, barseem hay, and alfalfa clover. In summer darawah replaced both of alfalfa clover and the Egyptian clover. The concentrate portion was given once/day, and the roughage sources were ad lid, Water was available two times/day in winter and between two to three times /day in summer. Some farms introduced free water all the time in the barn.

Experimental design:

Animals were divided into two age gropes, G1 (9-12months of age) and G2 (12-18 months of age). The experiment lasted 5 year from 2010 to 2015 in table (1) represent the scheme of work in targeted area.

Table1. The scheme of work in targeted area.

Region	Selected Governorate	Visited villages	No. of farmers visited/village	Buffaloes				Cows			
				No	Total of investigated animals per visit	G1	G2	No	Total of investigated animals per visit	G1	G2
Lower Egypt (LE)	El Behera	5	3	384	6	3	3	567	6	3	3
	El Menoufia	5	3	396	6	3	3	317	6	3	3
Middle Egypt (ME)	El Fayoum	5	3	190	6	3	3	291	6	3	3
	El Menia	5	3	291	6	3	3	367	6	3	3
Upper Egypt (UE)	Suhag	5	3	272	6	3	3	289	6	3	3
	Qena	5	3	213	6	3	3	299	6	3	3

G1 and G2: represented the age group which were 9-12 months for G1 and 12- 18 months for G2.
The experimental lasted 5 years along which the No. of animals investigated were about 3876 animals.

The temperature humidity index (THI) were classified according to respiration rate (RR, r/min) Omran and Fooda (2013). Calculation of (THI) by using equation of Mader *et al.* (2006) was as following;

$$THI = (0.8 * T) + [(RH / 100) * (T - 14.4)] + 46.4$$

Where: **air temperature (T, °C), and relative humidity (RH, %)**

The classification of THI values in this investigation represented four climatic conditions per each region as cold condition, thermo neutral condition, mild heat stress condition and moderate heat stress condition (table 2).

Table 2. temperature humidity index (THI) values under different climatic condition in the three climatic regions in Egypt.

Climatic condition	Lower Egypt	Middle Egypt	Upper Egypt
Cold	60.20	57.60	54.10
Thermo- neutral	74.40	73.00	71.30
Mild heat stress	78.70	75.60	73.30
Moderate heat stress	89.92	86.70	84.90

Physiological responses:

Recording respiration rate (RR, r/min), was counted from movements of flank in one minute.

Water and feed Intake estimating was as following:

1- Water intake (WI, L/day) was estimated by a bucket or half a barrel or a trough of cement or according to what being available in the farm. Animals were given water after feeding and calculating the residual. They were given water again before we leave after the end of all estimations in the farm, Drinking water sanality was estimated and it was 400 to 600 ppm.

2- Feed intake (FI/Kg) was estimated during the visit, where the concentrates and roughage portions were weighed before and after offered to animals and the residual was weighted as well before leaving the farm at afternoon.

Animals weights were estimated using a weight tape that designed by (Salama 2002, Salama *et al.* 2002, a, b, Salama *et al*., 2001).

Statistical analysis: as follows

A regression coefficient (b) of temperature humidity index (THI) as a prediction equation were measured as the regression of water ,feed intake and body weight on THI (SAS, 2002). The formula was Y=a+ x b where Y, water, feed intake and body weight, a, intercept x =THI and b the regression coefficient for Y on X. the accuracy R^2 is considered as low when R^2 below 30, moderate when R^2 30 to 60 and high when R^2 is greater than 60.

Statistical analysis of data was carried out applying the statistical analysis system (SAS, 2002) according to the following model:

$$Y_{ijklm} = \mu + T_i + G_j + A_k + B_l + (TG)_{ij} + (TA)_{ik} + (TB)_{il} + (GA)_{jk} + (GB)_{jl} + (AB)_{kl} + (TGA)_{ijk} + (TAB)_{ikl} + (GAB)_{jkl} + (TGAB)_{ijkl} + E_{ijklm}$$

Where:

Y_{ijklm}: Observation on the m^th animals of the i^th climatic region in the j^th region conditions in the k^th age of calves in the l^th species,

μ: Overall mean,

T_i: Fixed effect due to the climatic region (i: 1 = Lower Egypt, 2 = Middle Egypt and 3 = Upper Egypt),

G_j: Fixed effect due to the climatic conditions (j: 1 = cold, 2 = Thermo-neutral, 3 = Mild heat stress and 4 = Moderate heat stress),

A_k: Fixed effect due to the age of calves (k: 1 = calves less than one year and 2 = calves greater than one year),

B_l: Fixed effect due to the species (l: 1 = Buffaloes and 2 = Cow),

$(TG)_{ij}$: The interaction between climatic region and climatic conditions,

$(TA)_{jk}$: The interaction between climatic region and age of calves,

$(TB)_{il}$: The interaction between climatic region and species,

$(GA)_{jk}$: The interaction between climatic region and age of calves,

$(GB)_{jl}$: The interaction between climatic conditions and species,

$(AB)_{kl}$: The interaction between age of calves and species,

$(TGA)_{ijk}$: The interaction between climatic region, climatic conditions and age of calves,

$(TAB)_{ikl}$: The interaction between climatic region, the age of calves and species,

$(GAB)_{jkl}$: The interaction between climatic conditions, the age of calves and species,

$(TGAB)_{ijkl}$: The interaction between climatic region , climatic conditions, the age of calves and species and

E_{ijklm}: Random error assumed N.I.D. (0, σ^2e).

RESULTS AND DISCUSSION

1- Temperature humidity index (THI) values in different regions:

In table 2 it was found that the highest values of THI were recorded in LE and the lowest values were recorded in UE, Thermo-neutral condition in ME value was (73.00), while mild heat stress in UE was recorded and the value was (73.30), results in Table 3 Cleary reflected the values of RR, r/min and in table 4 reflected to body weight values in two ages of the two species (buffaloes & cows).

Heat stress influences the performances of animal by reducing feed intake, feed efficiency, feed utilization and increased respiration rate, sweating and rectal temperature, causing disturbances in the metabolism. It also increases water intake and water content (Omran *et al.,* 2013; Ashour and Shafie, 1992; Ashour *et al.,* 2000 and Omran and Fooda, 2013)

Hahn *et al.* (2003) &Omran and Fooda 2013 reported that any improve in THI index will ideally be useful as a base for continuing development of biological response function and representative of consequences resulting from primary factors influencing energy exchange between the animal and its surrounding. Khalil and Omran (2018) reported that impact of climatic change on THI values in different three regions (LE, ME ,and UP) in Egypt during the period from 2016 up to 2060 gives evidence for significant changes in THI values during the period from 2046 to 2060. The classifications of THI during the study period indicted that the moderate class showed significant gradual increase with time in all 12 governorates and none stress performance tends to decrease in all governorates to the account of increasing the mild and moderate classes. Du Preez (2000) concluded that THI index is still the best, simplest and most practical index for measuring environmental warmth which causes heat stress in dairy cattle and physiological parameters must always be used together with THI values to determine and evaluate heat stress in dairy cattle. In addition, THI offers a method of combining the more important and easily measured weather factors into a possible measure to compare temperature and humidity data and animal response at different climatic zones and locations.

2- Respiration rate values (RR, r/min):

Table (3) showed means of RR r/min by buffalos and cows according to age groups under different regional climatic conditions. It was found that the less values of RR, r/min was recorded for G2 compared to G1 for the two species. In cold condition, buffaloes recorded less values in UE than cows due to its sensitivity to cold conditions as reported by Omran and Fooda (2013). The best value was in LE climatic region. Cows was more adapted under the three climatic regions , In thermo-neutral climate condition, values of buffaloes were more adapted under three climatic regions, while cows under LE and ME climate regions began to inter in discomfort state.

In mild heat stress conditions, buffaloes began to inter in discomfort under LE climate region. In moderate heat stress conditions, discomfort was performed in the two species clearly in G1than G2. The best values for the two species were in UE climatic region.

Table 3. Mean of respiration rate (RR, r/min) for buffaloes (B) and cows (C) according to age group (G1&G2) under different regional climatic conditions.

Climate regions	Lower Egypt				Middle Egypt				Upper Egypt			
Conditions	G1		G2		G1		G2		G1		G2	
	B	C	B	C	B	C	B	C	B	C	B	C
Cold	23.72	26.80	20.33	25.31	22.04	25.24	19.08	24.40	20.16	24.00	16.99	23.52
Thermo- neutral	27.98	34.64	26.77	28.08	26.44	33.06	25.04	28.08	24.92	29.96	23.14	26.34
Mild heat stress	32.92	39.36	30.67	36.94	32.00	37.64	28.36	35.60	27.08	34.50	26.88	30.88
Moderate heat stress	40.53	54.56	35.04	43.52	38.20	48.50	33.48	39.80	35.59	46.09	32.27	39.29

Fig (1 & 2) showed the relationship between RR, r/min and WI, L/day and it showed linear performance for the two species under the three regional climatic conditions.

The RR, r/min is a good measure to detect the response of animal to variation in temperature and humidity giving a clear evidence of better capacity of heat tolerance (Shafie *et al.*, 1994, Ashour *et al.*, 2004, Omran and Fooda 2013 and Omran *et al.*, 2013). Value of RR increased by 2.5 r/min but RT increased by o.43°C and this was due to the RR play an important role in thermoregulatory mechanism amongst all physiological reactions and body temperature comes next (Kundu and Bhatnagar, 1980). Mclean (1963) stated that the significant increase in RR, r/min under heat stress enables animals to dissipate the excess of body heat by vaporizing more moisture in the expired air, which account about 30% of the total heat dissipation. With increasing environmental temperature, the RR continues to rise linearly until a certain temperature, where the rate of increase in RR r/min slows, and then it almost levels off or slightly decreases (Omran *et al*., 2019).

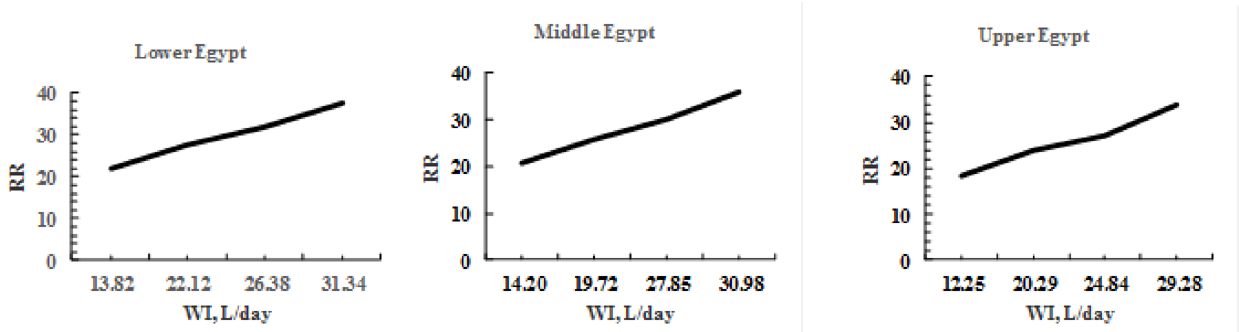

Fig. 1. Relationshep between water intake (WI, L/day/head) and respiration rate (RR) for buffaloes under differ regional climatic conditions.

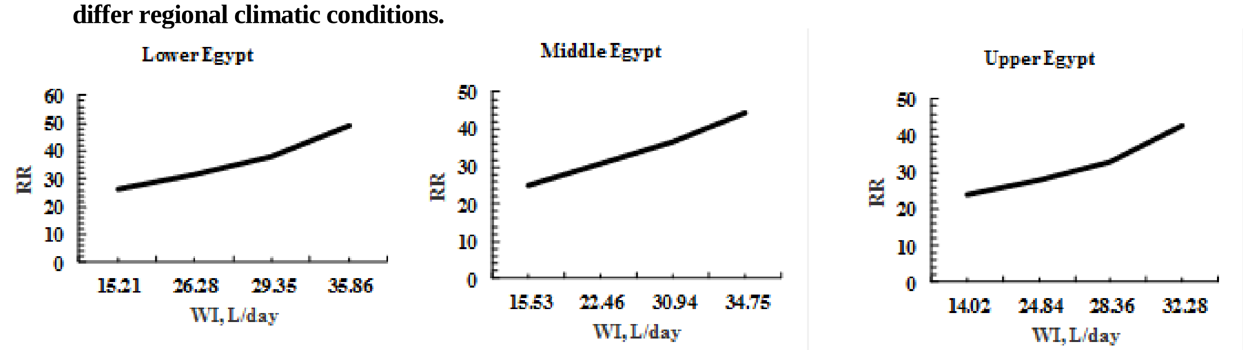

Fig. 2. Relationshep between water intake (WI, L/day/head) and respiration rate (RR) for cattle under differ regional climatic conditions.

3- Intakes and body weight values (BW/Kg):

Table (4) showed values of animal water intakes. The differences were significant ($P \leq 0.05$) among all climatic conditions in the three climatic region, except for G2 which performed non-significant values in cold climatic conditions.

The water consumption in cows was more than buffaloes in the two ages groups within the three climatic regions. The higher values of water consumption was obtained in LE compared to ME & UE. The values of FI/Kg were significant ($P \leq 0.05$) among the three climatic region conditions for the two ages groups in the two species, except of FI con /Kg in buffaloes under thermo neutral climate conditions where the values were not-significant in LE & ME regions. The values were significant ($P \leq 0.05$) in UE climatic region. The values showed the same, in the two ages groups (G1 & G2) for the two species under moderate climate conditions. The values of RI /Kg were significant between the two ages groups (G1 & G2) for the two species in the three climatic regions, except for cows under cold climate conditions in G1 where the values were not significant ($P \geq 0.05$) between (LE & ME), and in G2 under moderate heat stress climate condition between (ME & UE). The values of body weight BW/Kg were significant ($P \leq 0.05$) between the two ages groups for the two species except of LE & UE for buffaloes in G1 under mild heat stress climate conditions.

The values were not significant in the cows under thermo-neutral climate conditions between (LE & ME), and under mild heat stress climate condition between (ME

& UE)., In cold climate conditions buffaloes body weight in G1 were more sensitive than body weight for cows.

The variation of body weight between the two species becomes nearly the same with increased hot conditions (mild &moderate heat stress climatic condition). The value of concentrate consumption for cows in the two ages groups (G1 & G2) increased than those of buffaloes by nearly (1 Kg).

The roughage consumption values were nearly in three climatic regions in the two ages groups (G1 & G2) for the two species. With increased THI, values of water consumption increased and feed consumption for concentrate &body weight decreased while values of roughage consumption were nearly the same in the two ages groups (G1 & G2) for the two species (buffaloes & cows). These results were clearly shown In Fig. (3). WI, L/day continued to increase linearly with increasing in THI. The increased in W, I/day with hot condition is augmented by behavioral eagerness to gulp copious cold water.

Table 4. Effect of climatic condition on water intake (WI, L/day), feed intake (Concentrate, FI, CON/ Kg and Roughage, FIR/ Kg) and body weight (BW, /Kg) in two ages (G1 & G2) for two specie, under three regional climate conditions.

Specie	Age	Climatic Conditions	Region Conditions	WI,/L Mean ± SE	FI,CON/Kg Mean ± SE	FI,R/Kg Mean ± SE	BW/Kg Mean ± SE
Buffalo	9-12 months G1	Cold	Lower Egypt	12.32±0.34a	3.30±0.12a	1.02±0.02c	240.40±5.83b
			Middle Egypt	11.12±0.49b	3.80±0.05b	1.07±0.05b	262.0±4.02a
			Upper Egypt	10.50±0.33c	3.55±0.03c	1.12±0.03a	206.0±1.93c
		Thermo- neutral	Lower Egypt	19.13±0.52a	3.80±0.09b	1.20±0.03a	288.00±1.97a
			Middle Egypt	16.76±0.21c	3.84±0.05b	1.10±0.02b	271.00±4.78b
			Upper Egypt	15.48±0.30b	3.98±0.06a	0.98±0.04c	237.00±6.88c
		Mild heat stress	Lower Egypt	23.76±0.32b	3.47±0.05b	0.99±0.02b	246.00±3.99b
			Middle Egypt	20.48±0.32a	3.63±0.04a	1.10±0.04a	272.00±3.41a
			Upper Egypt	19.04±0.48c	3.42±0.05b	0.99±0.01b	249.00±3.64b
		Moderate heat stress	Lower Egypt	26.88±0.22a	3.08±0.04b	0.82±0.03c	254.00±8.01 b
			Middle Egypt	24.44±0.10b	3.18±0.04b	0.99±0.02b	261.0±5.43a
			Upper Egypt	23.56±0.38c	3.44±0.06a	1.46±0.08a	240.0±4.42c
	12-18months G2	Cold	Lower Egypt	14.32±0.34a	6.80±0.07a	2.15±0.03b	367.0±5.20a
			Middle Egypt	14.28±0.20a	6.53±0.05b	2.37±0.06a	360.0±4.37b
			Upper Egypt	13.00±0.36b	6.34±0.15c	2.01±0.02c	310.0±4.06c
		Thermo- neutral	Lower Egypt	24.10±0.64a	6.95±0.05a	1.89±0.05c	398.0±6.34a
			Middle Egypt	22.68±0.37b	6.65±0.09b	2.28±0.04a	388.0±7.64b
			Upper Egypt	21.10±0.30c	6.32±0.03c	1.99±0.02b	361.0±2.45c
		Mild heat stress	Lower Egypt	29.00±0.26a	5.48±0.07c	1.37±0.05c	350.0±10.72c
			Middle Egypt	27.22±0.23b	6.30±0.05b	2.18±0.09a	358.0±0.34b
			Upper Egypt	26.64±0.44c	6.84±0.09a	1.99±0.09b	360.0±4.29a
		Moderate heat stress	Lower Egypt	37.80±0.42a	5.50±0.06b	1.74±0.05c	299.0±4.63c
			Middle Egypt	35.52±0.36b	5.58±0.03b	1.90±0.07b	319.0±4.45b
			Upper Egypt	33.00±0.25c	5.82±0.05a	2.21±0.07a	316.0±5.27a
cows	9-12months G1	Cold	Lower Egypt	13.85±0.37b	5.34±0.09a	1.10±0.02b	247.0±0.32c
			Middle Egypt	14.65±0.40a	4.37±0.10c	1.05±0.03b	288.0±3.12b
			Upper Egypt	13.04±0.40c	5.23±0.03b	1.49±0.02a	297.0±8.30a
		Thermo- neutral	Lower Egypt	24.40±0.21a	4.65±0.12c	1.16±0.03a	286.0±2.11b
			Middle Egypt	23.76±0.12b	4.81±0.09b	1.12±0.03b	292.0±2.45a
			Upper Egypt	20.57±0.43c	5.06±0.06a	1.01±0.04c	257.0±3.26c
		Mild heat stress	Lower Egypt	28.70±0.19a	4.32±0.09b	0.97±0.03c	250.0±5.07c
			Middle Egypt	25.48±0.25b	4.64±0.05a	1.10±0.04a	279.0±0.23a
			Upper Egypt	22.04±0.45c	4.90±0.09c	1.01±0.02b	253.0±6.05b
		Moderate heat stress	Lower Egypt	29.84±0.18a	4.07±0.07b	0.87±0.03c	256.0±3.65b
			Middle Egypt	27.96±0.16b	4.18±0.05b	1.10±0.03b	261.0±1.45a
			Upper Egypt	25.00±0.26c	4.49±0.12a	1.42±0.08a	242.0±4.18c
	12-18months G2	Cold	Lower Egypt	16.56±0.46a	7.66±0.60a	2.16±0.04b	378.0±3.50b
			Middle Egypt	16.40±0.13a	7.25±0.04c	2.37±0.07a	380.0±2.58a
			Upper Egypt	14.00±0.23b	7.40±0.06b	1.98±0.02c	362.0±4.24c
		Thermo- neutral	Lower Egypt	28.16±0.37a	7.00±0.07c	2.21±0.05b	401.0±0.33a
			Middle Egypt	25.16±0.26c	7.18±0.05b	2.31±0.05a	400.0±2.95a
			Upper Egypt	26.10±0.31b	7.25±0.05a	2.04±0.03c	416.0±4.58b
		Mild heat stress	Lower Egypt	32.00±0.19a	6.45±0.08c	1.87±0.05c	356.0±2.83b
			Middle Egypt	31.24±0.18b	6.89±0.05b	2.06±0.07a	361.0±1.65a
			Upper Egypt	29.68±0.21c	7.41±0.05a	1.99±0.04b	362.0±2.39a
		Moderate heat stress	Lower Egypt	41.88±0.49a	6.35 ±0.03a	1.96±0.03b	306.0±1.60c
			Middle Egypt	40.54±0.27b	6.55±0.03b	2.22±0.04a	321.0±2.22a
			Upper Egypt	37.56±0.25c	6.65 ±0.09b	2.21±0.07a	318.0±2.98b

Mean values of groups for each item with different superscripts in the same column are significantly different ($P \leq 0.05$).

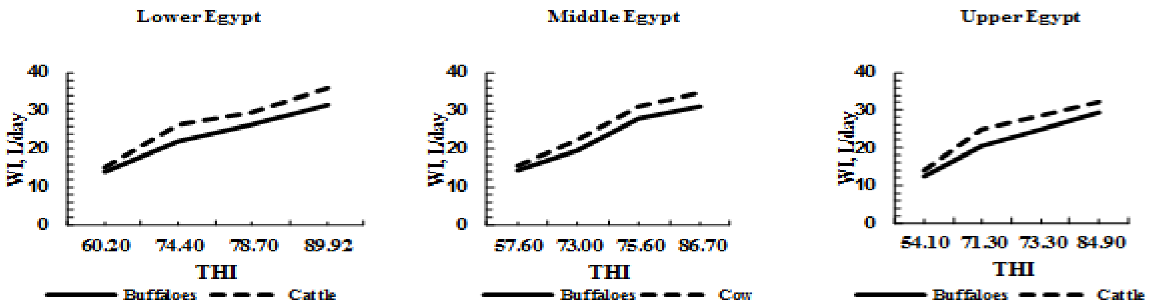

Fig. 3. Relationshep between temperature humidity index (THI) and water intake (WI, L/day) for buffaloes and cows under differ regional climatic conditions.

This increase reflects the physiological role of W, L/day in counteracting heat stress by increasing water vaporization through skin and /or respiratory surface Shafie and Omran (2018) While in Fig. (5 & 6) FI con as (Kg/day) decreased linearly with increasing in THI for the two species. Animal body weight (BW/Kg) followed the similar trend in (LE & ME) regions while under (UE) the values of (BW /Kg) in buffaloes under thermo-neutral condition and mild heat stress climate conditions were higher than cows due to the sensitivity of cows to hot.

In Fig. (4) The consumption from RI/Kg in LE region was higher for cows than buffaloes while in ME region the values was equal except in moderate condition the value was highest for cows. In UE region cow recorded higher consumption under cold condition.

The productive performance is the most important index out of various indices of animal's adaptability to environmental conditions. Among these indices, the average daily gain is the most indicative index forms the growth and meat production. This index is outcome of water and feed intake behavior, which is affected, greatly by stress factors mainly that climatic and nutritional conditions, Water and feed intakes are affected markedly by ambient temperature (Ashour 1990, Ashour *et*, *al*., 2007, Omran *et*, *al*., 2013).

Omran (1999) reported that constant heat stress in lab at 40°C increased water consumption per Kg MBW by16% in buffaloes and 25% in Friesian calves. The water consumption for cattle in a hot environment is governed by the severity of the heat and the amount of dry matter eaten (Yousef *et al*., 1968) determination of water consumption in animals is important for the evaluation of adaptability and productivity of animals under different environmental condition. Omran (2013) found that under differ condition in Lab (40°C and 25°C) for buffalo calves, the differ between two groups of rumen, the water capacity were lower compared with number of respiration rate under stress in minute., This give indicator to performance of buffalo calves to maintain on body temperature by low quantity for water.

Nangia and Gary (1992) reported that FI during months of higher air temperature was reduced to 40% as compared to that consumed during cooler months. Omran (1999) reported that the ratio of roughage to concentrate was higher in summer than winter in Friesian calves and buffalo calves being 31.3 vs. 29.8% for buffalo, 31.8 vs. 28.5% in Friesian. Addition to the concentrate intake was reduced by heat stress at 40°C in lab from that pre stress by 20 % in buffaloes and 18% in Friesian calves.

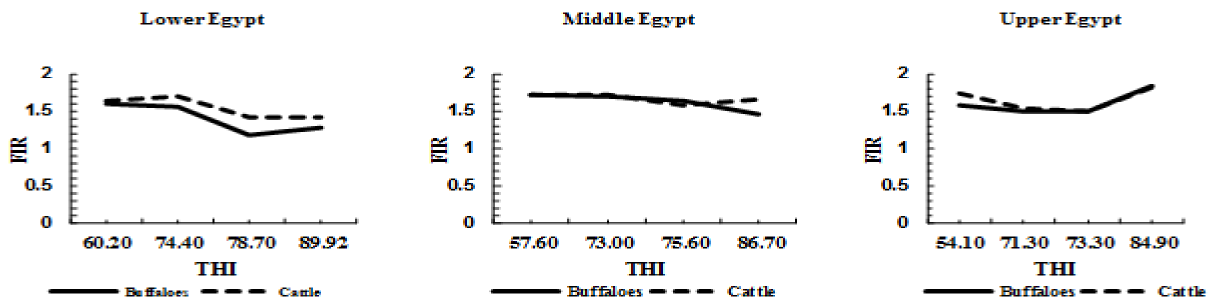

Fig. 4. Relationshep between temperature humidity index (THI) and roughage intake (FIR/Kg) for buffaloes and cows under differ regional climatic conditions.

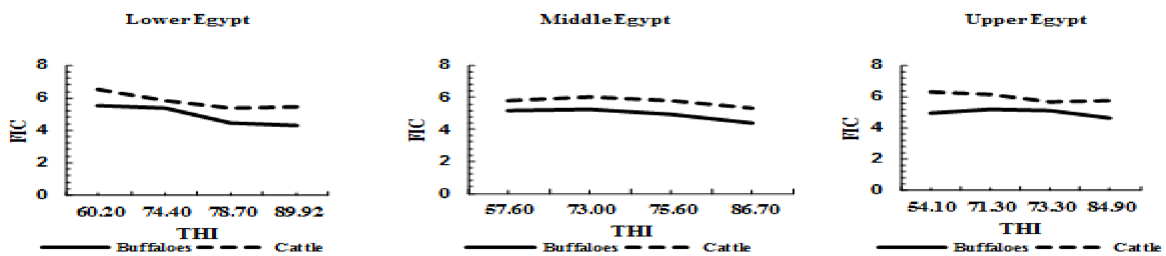

Fig. 5. Relationshep between temperature humidity index (THI) and concentrate intake (FICON/Kg) for buffaloes and cows under differ regional climatic conditions.

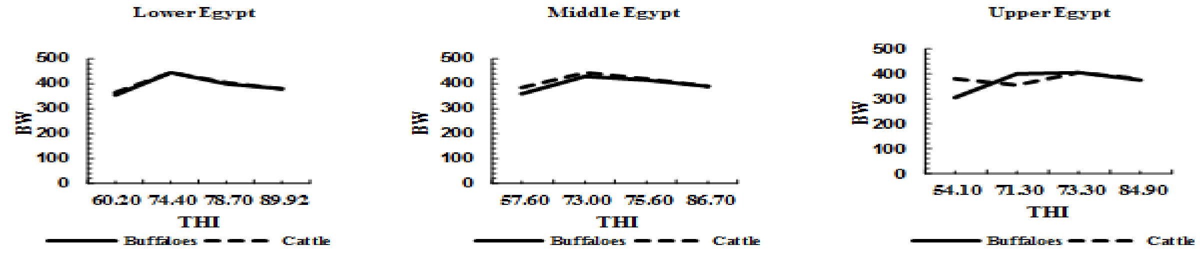

Fig. 6. Relationshep between temperature humidity index (THI) and body weight (BW /Kg) for buffaloes and cows under differ regional climatic conditions.

Niles *et al.* (1980) found that there was reduction in forage by Holstein cow, during summer. They postulated this response to diets high in fibre content resulted in higher acetate production during fermentation .Acetate metabolism results in, somewhat, higher heat increment than other VFA.

Kamal and Johnson (1971) attributed the contradictory responses of live BW under heat stress to the interaction between tissue destruction and water retention. The productive performance for buffaloes in UE region clear bingeing improve THI from 71.30 to 73.30. The climatic condition affect the amount of food, water intake the availability of the potential energy in the ingested forage, the animal heat production system, and the net energy available for productivity and the body composition of growing animals. EI-Masry and Marai (1991) reported that buffalos were more tolerant than Friesians to the environmental condition of Egypt, addition buffalo calves had poorer feed efficiency and higher dry mater intake in winter and higher growth rate in summer than Friesian calves ($P \leq 0.05$). Then the Buffaloes calves more adapted under three regions with helped time of cold by used supplementation diets or housing.

Omran *et, al.* (2011) reported that the buffalo calves with climatic change is more adapted and any improved in feeding, housing, management and employing techniques to modify environmental conditions can realize alleviation of heat lode on the animals during high ambient temperature and can be increased meat production from buffaloes.

Omran *et al.* (2017) suggested that by using of supplement diets ZAD reduced the harmful effects of cold waves, it helps to improve of physiological status postpartum, reduces sensitivity of buffaloes to cold, added to increase the birth weight and dally milk production under Mid Egypt climate conditions.

Table (5) Showed the significance occurred between or among sources of variation (T, G, A, B and their interaction with WI/L, FI con /Kg, RI/Kg intakes and BW/Kg. No significance found between concentrate intake and interaction occurred by T, G and A. Also, no significance found between FI and interaction between G and B, G and A. All other values recorded high ($P \leq 0.05$), higher ($P \leq 0.01$) and highest interaction ($P \leq 0.001$) as shown in table 5.

Exposing farm animal to heat stress impose great burden on the water balance in the body, since the animal has to dissipate excess heat load by vaporization of ample amount of water via skin and respiratory surfaces. Dehydration by lack of water intake-along with stress interrupts the regulation of body temperature and distorts both heat and osmotic balances.

Well controlled mobilization of water between the body compartments is a must in such a combined stress. Assessment of changes in water volume and ions concentration under this condition seems to be a more accurate measure of adaptability of the animal to hot arid conditions. Thus water is very important available to live and production and the consumption links with condition around of all living organisms. The feed consumption as seam to production and increased it, this explain higher significant of value for body weight /Kg with region, environmental, age and species in.

Table 5. Mean squares (MS) and degrees of freedom (df) for water intake (WI, L) and feed intake (concentrate, FICON/ Kg and roughage, FIR/ Kg) and body weight (BW, Kg).

Source of variation	Df	MS			
		WI	FICON	FIR	BW
climatic Regions (T)	2	132.92***	2.84***	3.21***	51445.25***
Climatic condition (G)	3	7377.69***	22.86***	1.81***	248182.23***
Age (A)	1	6599.30***	1999.24***	291.56***	4087546.09***
Species (B)	1	2446.87***	189.85***	3030***	342532.06***
Interactions:					
T*G	6	162.65***	3.63***	1.75***	12130.89***
T*A	2	20.65***	0.73**	1.92***	2873.10**
T*B	2	18.15***	0.89***	0.23*	12127.99***
G*A	3	833.18***	1.34***	0.61***	148068.87***
G*B	3	113.57***	1.51***	0.02^{ns}	21951.04***
A*B	1	56.46***	0.83**	0.07^{ns}	23462.25***
T*G*A	6	88.87***	4.73***	0.67***	2235.26***
T*A*B	2	16.70**	0.21^{ns}	0.47***	11215.25***
G*A*B	3	61.38***	1.04***	0.10^{ns}	3241.87***
T*G*A*B	12	11.58***	1.004***	0.17***	6263.63***

*** : $P \leq 0.05$** : $P \leq 0.01$ *** : $P \leq 0.001$ ns : Not significant ($P \geq 0.05$)**

The age of animal was more sensitive with all source of variation. The climatic condition affect the amount of food, water intake, the availability of the potential energy in the ingested forage, the animals heat production system, the net energy available for productivity and the body composition of growing animals.

Table (6) showed the equations to predict the change income (water and feed intake) and outcome (body weight) along with the excepted change in THI for the two species. With faster and severe climatic changes, the productive disorders arise due to increased heat stress including decreased milk yield, reduced meat production, growth rate, reproduction, immunity due to decreased of feed intake . While mortality and water consumption increased Omran *et, al* (2011, 2013). Estimation of THI index for any region is a helpful tool to predict consumption of water R^2 (%) was 44 and 46 for buffaloes and cows respectively, compared with feed intake and body weight equation which were low the values (4, 2 for FI, con; 1, 1 for FI, R and 1, 0 for BW) for buffaloes and cows respectively.

Table 6. Equation to predicting the changes in Water, Feed Intake and body weight with the expected changes in temperature humidity index THI for two species.

Buffaloes		Cow	
Equation	**R^2 (%)**	**Equation**	**R^2 (%)**
WI = -21.46 + 0.68(THI)***	44	WI = -25.43 + 0.79(THI)***	46
FIC = 7.81 + (-0.04)(THI)***	4	FIC = 8.05 + (-0.03)(THI)***	2
FIR = 2.13 + (-0.01)(THI)**	1	FIR = 2.10 + (-0.01)(THI)*	1
BW = 298 + 1.17(THI)*	1	BW = 400 + 0.13(THI)^{ns}	0

*** : P ≤ 0.05** : P ≤ 0.01 *** : P ≤ 0.001 ns : Not significant (P ≥ 0.05)**

Hence, It Can be predicting consumptions of W, L/day for buffaloes and cows under any climate condition. It is then very important with climatic change, using the predictive equations which can help in maintain water consumption by animals with decreased of water due to climatic change and in the same time maintaining animal production, without greater drop of production.

CONCLUSION

The best climatic condition for the two species is between 71- 74 THI under the three climate regions. The higher consumption from water was in Lower Egypt and the lower consumption was in Upper Egypt. Cows were higher than buffaloes in consumption water and feed in the three climatic regions and through two the ages. It is very important with climatic change, using the predict equations which enable in maintaining water and productivity of animal, without greater drop of production. This study concluded that it is still possible to maintain or increase meat production from buffaloes and cows under different climatic regions, particularly in Upper Egypt (UE), with available suitable shades above animals, and shading watering to protect from solar radiation direction.

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الماء والغذاء المستهلك ووزن الجسم للجاموس والابقار تحت ظروف الاقاليم المناخيه المختلفه

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تهدف الدراسه لتقدير كميه الماء والغذاء المستهلك ووزن الجسم للجاموس والابقار تحت مختلف الاقاليم المناخيه فى مصر. وعمل معادله تنبؤ بكميه المياه المستهلكه مع تغير دليل الحراره والرطوبه مع التغيرات المناخيه.تم تجميع البيانات المستخدمه فى الدراسه من عدد 6 محافظات . كل محافظتين تمثل اقليم مناخى فى مصر.بدايه الدراسه يناير 2010 حتى ديسمبر 2015, زيارات شهريه لكل محافظه فى الاقاليم المناخيه الثلاثه فى مصر (مصر السفلى ,مصر الوسطى ,مصر العليا).فى كل محافظه يتم زياره 5 قرى داخل كل محافظه وعدد 3 مزراع مابين مزارع صغير ومتوسطه وكبيره فى كل قريه شهريا وكل مزرعه تم زيارتها مره واحده . القياسات كانت على عدد 12 حيوان فى كل مزرعه (6 عجول جاموس , 6 عجول ابقار). وتم تقسيم الحيوانات الى مجموعتان المجموعه الاولى عمرها من 9-12 شهر والمجموعه الثانيه على عمر من 12-18 شهر . الحيوانات تم تقدير التالى للحيوانات : معدل التنفس فى الدقيقه وكميه مياه الشرب بالتر/يوم والكميه الماكول من العلف المركز والخشن بالكيلوجرام بالاضافه الى وزن الحيوانات بالكيلوجرام. بينما للبيئه: تم تسجيل درجه حراره الهواء ومعدل الرطوبه النسبيه لحساب دليل الحراره والرطوبه.بالاضافه الى عمل معادلات تنبؤ كعلاقه مابين التغير فى دليل الحراره والرطوبه يقابله تغير فى مقدار الماء والعلف ووزن الجسم . وكانت النتائج مايلى اعلى قيم سجلت لدليل الحراره والرطوبه كانت فى مصر السفلى ,واقل قيم سجلت كانت فى مصر العليا . افضل قيم لمعدل التنفس فى الدقيقه للسلالتين كانت فى مصر العليا .كانت العلاقه خطيه بين معدل التنفس فى الدقيقه وماء الشرب المستهلك بالتر للسلالتين تحت الظروف المناخيه الثلاثه. كما اظهرت الدراسه ان استهلاك الماء بالتر والماكول من العلف المصنع بالكيلو جرام اعلى فى الابقارمقارنه بالجاموس فى العمرين داخل اللاقاليم المختلفه. بينما العلف الخشن لم يظهر اى فروق معنويه بين الابقار والجاموس. وكان اعلى استهلاك لمياه الشرب تحت ظروف مصر السفلى للسلالتين واقلهم تحت ظروف مصر العليا. العلاقه بين دليل الحراره والرطوبه و الماء المستهلك بالتر على اليوم والماكول من العلف المركز والخشن بالكيلوجرام للسلالتين علاقه خطيه بتزايد المياه ونقص العليقه. واظهرت النتائج ان اوزان الابقار فى الاقاليم المناخيه المختلفه اعلى من الجاموس .فيما عدا مصر السفلى تحت الظروف المناخيه المثلى اظهر الجاموس اوزان اعلى .افضل ظروف للسلالتين عندما يكون دليل الحراره والرطوبه THI 73 تحت الاقاليم المناخيه الثلاثه .والاداء الانتاجى للسلالتين كان متقارب تحت ظروف مصر السفلى .حساسيه الجاموس للبروده تحسن الاداء عند 71.30THI. باستخدام معادلات التنبؤ يمكن الحفاظ على انتاجيه الحيوان باختيار الحيوان المناسب للاقليم المناخى . واظهرت النتائج الدقه العاليه للتنبؤ بكميه مياه الشرب للسلالتين مع التغير فى دليل الحراره والرطوبه مقارنه بالعليقه او وزن الجسم. وهذا هام جدا مع التغيرات المناخيه للحفاظ على انتاجيه الحيوان دون نقص عالى فى الانتاج . الخلاصه مع التغيرات المناخيه ونقص المياه يمكن الحفاظ على اوزياده انتاج اللحم من الجاموس والابقار على التوالى تحت الاقاليم المناخيه الثلاثه خاصه فى مصر العليا بشرط توفر مظله مناسبه للحيوان لحمايته من اشعه الشمس المباشره وكذلك تغطيه حوض الشرب للحفاظ على ملوحه المياه من اشعه الشمس المباشره.