

# Impact of the Iraq Marshlands Restoration Program on Livestock Population and Production in the Southern Marshes of Iraq

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**Abstract:** The USAID Iraq Marshlands Restoration Program (IMRP) promoted the application of two promising initiatives tested from 2004 to 2006: (1) the introduction of alfalfa and maize fodder to feed and improve the nutrition of buffalo and (2) the creation of a veterinary service to increase livestock production and health. The livestock sector in the marshlands has seen dramatic improvement since IMRP ended in 2006. These changes are across the board in the absolute number of livestock (from 66,700 heads in 2006 to 111,525 heads in 2017) and in their increasing diversity (buffalo were 74.33% of all livestock in 2006 but decreased to 70.33% in 2017). Buffalo, specifically, had greater birth weight (40 kg in 2006 and 45.6 kg in 2017), greater daily growth rates (0.3 kg in 2006 and 1-1.25 kg in 2017), higher daily milk yields (8.81 kg/day in 2006 and 9.69 kg/day in 2017), and longer lactation periods (150 days in 2006 and 238 days in 2017). There have been accompanying advances in the closely related meat and dairy markets. Live weight and market prices for buffalo and cattle have increased three- to four-fold. Rising daily milk yields also sparked the creation of cottage industries to produce dairy products using higher fat buffalo milk. These changes all point to an increasingly healthy and dynamic livestock sector in the marshlands. However, other anticipated changes in the marshlands did not meet expectations. In 2006, IMRP predicted a strong shift away from the historical dominance of buffalo ownership to a more diversified pattern of ownership that included the relatively newly introduced cattle and a rapid increase in sheep holdings, making the latter the dominate animal. Instead, buffaloes have continued to be the vastly most numerous animals owned in the marshlands. In 2017, they ranged from 65 to 75% of all livestock holdings. Greater access to reflooded marshes by buffalo herders and increased financial earnings realized from meat and dairy production may help to explain the continued reliance on buffalo ownership. IMRP's introduction of a veterinary service dedicated to working in the marshlands villages was far less successful but highly regarded by Marsh Arabs, being the first time that the services were offered in the marshes.

**Keywords:** Marshland, Iraq, Buffalo, diversity, Performance.

## INTRODUCTION

Several factors have caused the decline and deterioration of the buffalo population in Iraq's marshes, with the first Gulf War, the consequent economic blockade and the removal of supports on feed for breeders playing a major role [1]. The main cause was the systematic drainage of the marshes, which had a disastrous impact on life in the marshes [2]. A study of Iraq's Ministry of Agriculture [3] indicated that the number of buffalo decreased by 57.3% from 150,000 in 1990 to 64,000 in 1999. That change is associated with a drastic decline in production [4]. Buffalo population is distributed as follows: 6.8% in the north, 41.0% in central Iraq and 52.2% in the south. Buffaloes are mostly bred (98%) as low input production systems [5].

The U.S. Agency for International Development (USAID) [6] found that production, animal health, dairy processing, and marketing were all poor, as the local population, commonly called Marsh Arabs, adjusted to their newly imposed conditions. The main reasons for

the poor performance of this livestock sector were inadequate feed supply for the animals and the consequent poor body condition [7], unreliable and/or inaccessible veterinary services [8], poor collection and processing services, and inaccessible market infrastructure.

The 2006 USAID Iraq Marshlands Restoration Program (IMRP) assessment of the sector revealed that buffaloes and their dairy production required immediate attention and improvement. Issues related to processing and marketing could be addressed once production levels increased. IMRP attempted to revitalize buffalo farming and dairy production in the marshlands by focusing on two of the most promising initiatives: (1) introducing and encouraging the cultivation of alfalfa and sorghum to improve animal health and nutrition and increase birth rates and (2) initiating a veterinary service for recently graduated veterinarians to improve access to veterinary services and provide meaningful employment to unemployed and under-utilized young professionals in the livestock sector.

In 2006, IMRP identified what it is called a "dramatic shift" in livestock populations in the marshes from water buffalo to sheep herding, which largely coincided with

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the drainage of the marshes. With the displacement of most of the indigenous people into drained areas between 1980 and 1992, animal owners could not care for their buffaloes. Water buffalo numbers decreased to low levels throughout the area, except for inside Hammar Marsh, beyond Garmit Beni Said, where small communities of Marsh Arabs lived traditionally on islands where they kept farming a high number of water buffalo.

Interviews with marsh dwellers suggested that about half of the families in Huwaizah and Hammar marshes and two-thirds of those in Nahr Al-Aaz owned buffaloes, but the number of animals were small. Families with water buffaloes generally had four animals in Nahr Al-Aaz, two in Huwaizah, and one in Hammar. Otherwise, farmers kept Arabi breed sheep and cattle which were a cross between Friesian and Al Jenoubi (literally, "southern") breeds, thus well adapted to the local climate with higher milk production.

The main objectives of the present study were to evaluate the effects of two of the most promising initiatives from IMRP: feeding and nutrition of buffaloes by introducing alfalfa and maize fodder, and providing a veterinary service to support buffalo farming and promote production and health.

## MATERIALS AND METHODS

The number of animals and their species were collected from data kept by the departments of the Ministry of Agriculture in Basrah, Maysan and Dhi-Qar governorates.

The 2018 study chose areas adjacent to the marshlands known for agricultural production and livestock breeding (Table 1 and Figure 1). Samples of milk were recorded weekly by the staff of agriculture department in the three districts. We selected only the full and complete records from 2012-2017 of the number of buffalo shown in Table 1. The total number

**Table 1: Study Sites**

	Sites	Number of Herds	Number of Buffalo
1	Maysan Governorate / Huwaizah Marsh	103	400
2	Al Mejar District / Qal'at Saleh District, Huwaizah	95	127
3	Al Mejar District / Qal'at Saleh District, Huwaizah	89	99
4	Dhi-Qar Governorate / Al Chebayish / Hammar Marsh	122	252
5	Al Chebayish / Central Marsh	90	203
6	Al Adil Sub-district / Uoda Marsh/ Central Marsh	76	98
7	Qurna / Central Marsh	132	356
	Total	604	1535



**Figure 1: Study Sites map, as Shown in Table 1.**

of animals was 1,535 milking buffaloes with 9,210 milking records. These data were used to calculate the daily milk yield, total annual milk yield and lactation period (total annual milk yield was equal to daily milk yield times lactation period of each animal).

In addition, we used detailed structured questionnaires to collect information from 103 buffalo owners (987 milking buffaloes and their calves) from the buffalo breeding areas during continuous visits by the impact assessment team. All cattle and sheep breeders were included in the survey. For cattle, the total number of milking cows and calves was 156. We also included, six, four, and five sheep herds in this survey from Maysan, Basrah and Dhi-Qar, respectively. Sheep and their lambs numbered 215 head. The questionnaires included the total number of animals, number of milking animals, daily milk yield, number of milking/day, birth weight, calf gender, type and quantity of available feed, feed consumption. These questionnaires were done to assess and verify the accuracy of the agriculture department records.

Mean birth weight was calculated from the above data collected through our questionnaires. We recorded weights from several slaughterhouses within each studied districts during 2018. The number of slaughtered buffalo, cattle, calves and lambs was 420, 235 and 612, respectively. The daily growth rate of buffalo, cattle, and sheep was calculated as the difference between market weight and birth weight divided by the age at slaughter. The range of age at marketing was 8-10 for buffalo, 10-12 for cattle, and 6-9 months for sheep.

## RESULTS AND DISCUSSION

### Livestock Diversity

Buffalo continue to be the most numerous animals reared in the marshlands in all three governorates. In 2017, they ranged from 65 to 75% of all animal holdings. And while those percentages have somewhat decreased since 2006, the actual number of buffaloes has increased by as much as 17,000 head. In fact, the number of all animals, including cattle, sheep, and goats, has increased.

Table 2 displays the number of each livestock in marshland areas in Basra governorate. It shows a steady increase in all of the animals. It also confirms the continued dominance of water buffalo ownership by the local inhabitants.

However, the percentage of buffalo in Basra decreased from 2016 to 2017, although their total number increased by roughly 10,000. There has been a decided shift to cattle ownership. Both buffalo and cattle consume the same feed and in roughly similar quantity, but cattle do not need period of time in the water, as buffalo do and produce more milk, especially when local cattle are crossed with Holstein.

Table 3 shows the number of livestock in the Dhi-Qar governorate marshlands over more than a decade. Buffaloes had the largest percentage of the total population, which fluctuated from 66% in 2013 to 76% from 2014 to 2017. There was a sharp increase in buffalo holdings from 2014. It is likely related to the

**Table 2: Livestock in the Marshlands of Basra Governorate**

Year	Number of Livestock Owned					Buffalo as Part of Total
	Buffalo	Cattle	Sheep	Goats	Total	
2006	41200	11650	1200	195	54245	76%
2007	42000	12000	1500	220	55720	75%
2008	42350	12500	2200	350	57400	74%
2009	43982	13000	2600	300	59882	73%
2010	44310	13800	2610	350	61070	73%
2011	46400	14300	3000	350	64050	72%
2012	46870	15000	4000	390	66260	71%
2013	47462	15900	4651	400	68413	69%
2014	48579	16280	6000	560	71419	68%
2015	49762	17450	4000	400	71612	69%
2016	50000	18000	4000	400	72400	69%
2017	51199	18528	8484	666	78877	65%

**Table 3: Livestock in the Marshlands of Dhi-Qar Governorate**

Year	Number of Livestock Owned				Total	Buffalo as Part of Total
	Buffalo	Cattle	Sheep	Goats		
2006	8000	2000	1000	200	11200	71%
2007	10000	2500	1500	250	14250	70%
2008	10300	2800	2000	300	15400	67%
2009	11000	3000	2000	300	16300	68%
2010	13000	3500	2500	350	19350	67%
2011	16000	4000	3000	350	23350	69%
2012	16000	4000	3000	350	23350	69%
2013	16500	4500	3500	400	24900	66%
2014	26000	4000	4000	400	34400	76%
2015	26000	4000	4000	400	34400	76%
2016	26000	4000	4000	400	34400	76%
2017	26000	4000	4000	400	34400	76%

good water availability in the marshes of that governorate.

A number of different livestock in Maysan governorate is shown in the Table 4. Here, the total number of livestock increased by 113 % from 2006 to 2017, and buffalo ownership roughly doubled as well.

Among the three southern governorates that have marshlands, Basra has a larger number of animals than Dhi-Qar and Maysan. A total number of livestock in Basra was nearly 79,000 head in 2017, and in Dhi-Qar and Maysan 40,000 and 25,000, respectively. We

were surprised to learn that the number of buffalos has remained so large in the marshlands, despite water quality and water quantity issues. In 2006, we did not expect that it would be the case

The percentage of buffaloes in the three governorates is shown in Figure 2. Both Basra and Maysan had a decline in buffalo percentage from 2006 to 2017. In comparison, Dhi-Qar shows a sharp increase in 2014 that held steady through 2017. The main reason is likely the quantity and quality of water in Dhi-Qar marshes in comparison with marshes in Basra and Maysan.

**Table 4: Livestock in the Marshlands of Maysan Governorate**

Year	Number of Livestock Owned				Total	Buffalo as Portion of Total
	Buffalo	Cattle	Sheep	Goats		
2006	17500	2200	1123	300	23129	76%
2007	18750	2589	1350	350	25046	75%
2008	20100	2983	1900	450	27441	73%
2009	21800	4000	2000	450	30259	72%
2010	23200	4500	2478	550	32738	71%
2011	25720	5000	3000	650	36381	71%
2012	26736	5000	3000	650	37398	71%
2013	28500	5500	3100	700	39813	72%
2014	30000	6000	3120	700	41834	72%
2015	31988	6500	3600	750	44853	71%
2016	33651	7000	4000	800	47467	71%
2017	34320	7591	4432	820	49180	70%

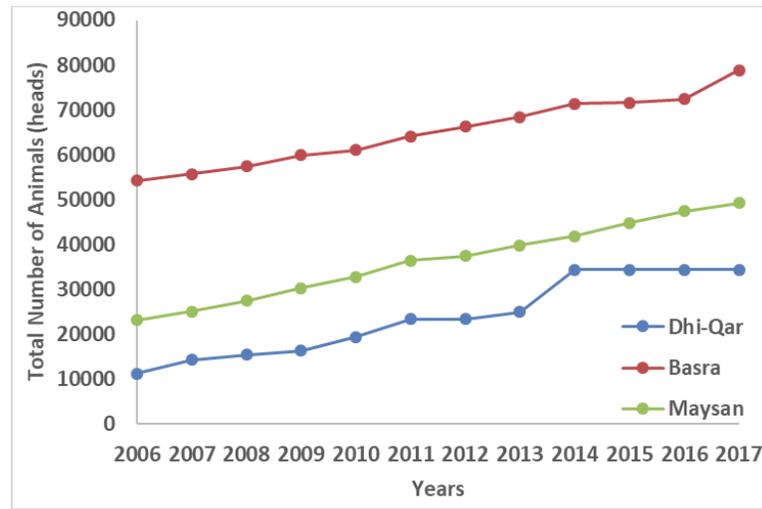


Figure 2: Total Number of Animals in Three Southern Governorates.

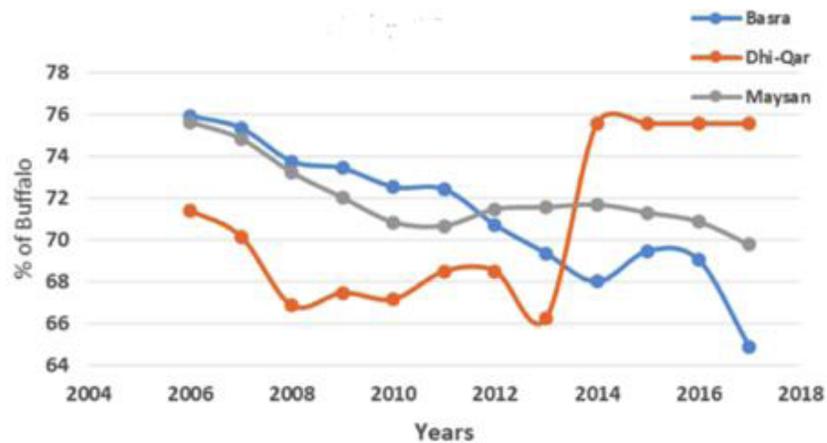


Figure 3: Percent of Buffalo in Different Governorates.

**Reproduction and Calf Performance**

Considerable research has confirmed the relationship between protein nutrition on one hand and the reproduction, pregnancy and lactation of livestock on the other, particularly consuming high protein legumes like alfalfa. High protein diets stimulate live weight gain or reduce live weight loss [9], while increasing ovulation rates [10], placental size [11], birth weight [12] and survival [13]. The increased birth weight possibly lowers the incidence of retained placenta, while milk yield and milk production efficiency are increased [14]. Protein deficiency in early life also prevents the stunting of final body size in adulthood [15].

In general, the number of calves born during the lifetime of a buffalo cow in the marshlands has increased with improvements related to alfalfa and

sorghum cultivation. The calving interval for buffalo, which has been historically high at 450 days, is shorter despite the harsh environment, poor feed supply, high temperatures, and degraded water quality. There has also been an increase in the health and growth rate of calves, especially during their first months due to the increased volume of milk that the calf can suck.

A comparison of livestock birth weight, daily growth rate, and meat prices in 2006 and 2018 (Tables 5 and 6) reveals that nearly all of these key indicators of the livestock sector have increased significantly over the 12 years. Alfalfa has become a common staple of the diet and even bran and straw have increased, stimulating greater birth weight and higher daily growth.

The net profit realized from a kilogram of live weight were ID 1,275 (USD .87), for buffalo, ID 1,166 (USD .79) for cattle and sheep are and ID 1,674 (USD 1.10) for sheep.

**Table 5: Livestock Live Weight, Growth Rate, and Meat Prices in 2006 (kilogram / Iraqi dinar) (IMRP, 2006)**

Animal	Birth Weight (kg)	Daily Growth Rate (kg)	Daily Feed Consumption (kg)		Market Weight (kg)	Price of Live Weight (kg)	Meat Price (ID/kg)
			Bran	Straw			
Buffalo	40	0.3	2	4	149.5	2000	4000
Cattle	25	0.2	1.5	3	98.0	2000	4000
Sheep	3.5	0.1	1.5	1.51	24.5	3250	7000

**Table 6: Livestock Live Weight, Growth Rate, and Meat Prices in 2018 (kilogram / Iraqi dinar)**

Animal	Birth Weight (kg)	Daily Growth Rate (kg)	Daily Feed Consumption (kg)			Market Weight (kg)	Price of Live Weight (ID/kg)	Meat Price (ID/kg)
			Alfalfa	Bran	Straw			
Buffalo	45.6	1.000-1.250	3	3	5	450	8,000	14,000
Cattle	41.5	0.535-0.750	3	3	4	400	8,000	14,000
Sheep	3.5	0.120-0.150	1	0.5	1.5	26.2	9,000	16,000

### Daily Milk Yields

IMRP found that daily milk yields for buffalo varied within the marshlands. Yields in 2004 ranged from about seven kilograms in Huwaizah and five in Hammar and Al Chebayish / Central marsh, to ten in Nahr Al Aaz. The difference was possibly due to the fact that the forage and feed for buffalo were more abundant in Nahr Al Aaz than elsewhere. In the marshes, where the daily yields were low, and with only 150 lactation days per year, the annual yield was between 750 and 1070 kilograms. This compares negatively with the annual milk yield of 1342 kilograms recorded in Iraq outside the marshlands [16]. The average annual milk yield was 32 to 46% higher than what IMRP had found in the marshes at essentially the same time.

Buffalo milk yields in the marshlands have improved since then. Daily milk yields are roughly the same in Maysan, Dhi-Qar, and Basra areas where IMRP worked. And all three show a similar, steady increase of almost 2% from 2012 to 2017. These yields would place the buffalo daily milk production in the marshes highly ranked in the world, but still well below Italian buffalo that produce up to 18 kilograms of milk daily.

Interestingly and unfortunately, Nahr Al Aaz, which was recorded with the highest daily milk production in 2004, is suffering from a severe water shortage. Many inhabitants have left the area and moved to the vicinity of Al Chebayish on the edge of Central marsh in Dhi-Qar governorate where water is more plentiful. Previously, Nahr Al Aaz was heavily populated by marsh dwellers, who owned large herds.

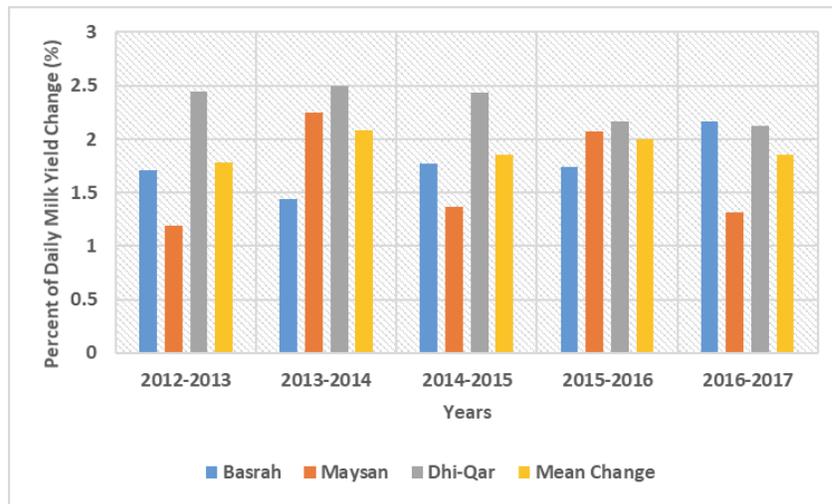
The data presented in Table 7 and Figure 4 were provided by the agricultural offices in the three governorates and in interviews conducted by staff of the College of Agriculture in the University of Basra between 2012 and 2017. These research sites included areas in or near the marshes where alfalfa and sorghum were detected by IMRP in 2004, such as Al Adil in Maysan governorate, which has a high concentration of the two crops.

### Lactation or Milking Period

In 2006, IMRP found that the lactation or milking period for water buffalo in the marshlands was 150 days [16]. This compares unfavorably with the lactation period of 255 days recorded in Iraq outside the

**Table 7: Daily Milk Yield of Buffalo from Marsh in Different Provinces (kilogram)**

Governorate	2012	2013	2014	2015	2016	2017
Basra	8.21	8.35	8.47	8.62	8.77	8.96
Maysan	9.22	9.33	9.54	9.67	9.87	10.00
Dhi-Qar	9.00	9.22	9.45	9.68	9.89	10.10
Mean	8.81	8.97	9.15	9.32	9.51	9.69



**Figure 4:** Daily Buffalo Milk Yield Change in the Southern Governorates (Percent of kilogram change).

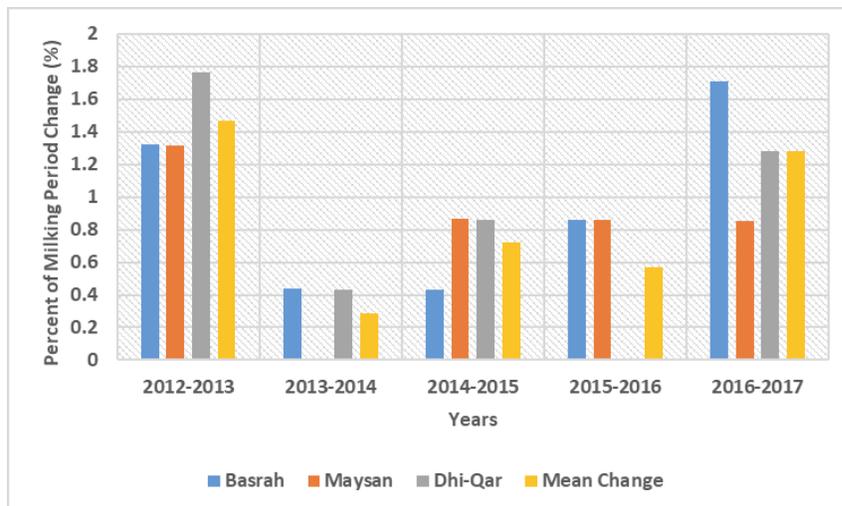
marshlands [17]. The lactation period elsewhere in Iraq was 255 days or 70% higher than in the marshes [18].

In 2018, the annual lactation period for water buffalo in the three southern governorates was 237 or 238 days, with an increase of 58% during the past 12 years. Table 8 indicates that this increase has been incremental, with small but steady increases of one to

four days from year to year between 2012 and 2017. This would mean a roughly 90 kilogram increase in milk production per lactation period for each buffalo. As the length of the lactation period is closely tied to the quality of feed and health of the animal, we think it is fair to conclude that the expansion of alfalfa and sorghum cultivation in the marshlands is at least partly, if not greatly, responsible, for the change.

**Table 8:** Lactation Period of Marshland Buffalo in the Southern Governorates (day)

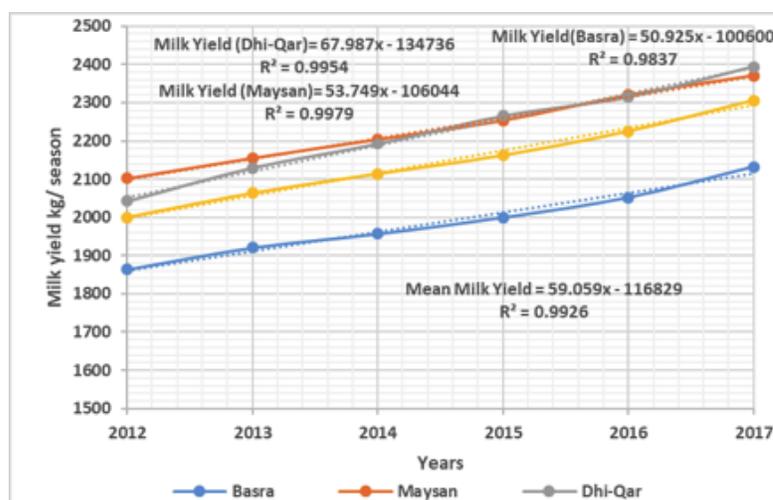
Governorate	2006	2012	2013	2014	2015	2016	2017
Basra		227	230	231	232	234	238
Maysan		228	231	231	233	235	237
Dhi-Qar		227	231	232	234	234	237
Mean	150	227	230	231	232	234	238



**Figure 5:** Percentage of Lactation Period Change for Water Buffalo.

**Table 9: Annual Milk Yields of Buffalo in Southern Governorates (kilogram)**

Governorate	2012	2013	2014	2015	2016	2017
Basra	1863.67	1920.50	1956.57	1999.84	2052.18	2132.48
Maysan	2102.16	2155.23	2203.74	2253.11	2319.45	2370.00
Dhi-Qar	2043.00	2129.82	2192.40	2265.12	2314.26	2393.70
Mean	1999.87	2063.10	2113.65	2162.24	2225.34	2306.22

**Figure 6:** Trend of Milk Yield during 2012-2017 (kilogram).

### Total Annual Milk Yield

When calculating milk yields over the lactation period, we found a steady increase from 2012 to 2017. Regression analysis was used to determine the association of yield and time. Our data showed a very accurate predictive rate of 99%, which can be used to evaluate different plans to improve buffalo milk production.

The three governorates all experienced a linear increase in milk yield over the period: 50.9 kilograms in Basra, 53.7 kilograms in Maysan, and 67.98 kilograms

in Dhi-Qar. The overall average increase in milk yield was 59.05 kilograms. This increase suggests a dynamic improvement in milk yields in the marshlands, which we believe can be attributed in part to IMRP's initiatives 12 to 14 years earlier when alfalfa and sorghum were first introduced into the area.

### Financial Benefits

In calculating the monetary benefit of milk production improvement, the price of one kilogram of raw milk is about USD 1.25. The net profit from selling of each buffalo every year is about USD74 (59.05-

**Table 10: Estimated Daily Gross Income, Costs, and Net Profits from Dairy Production**

Dairy Product	Quantity (kg)	Unit Price (USD)	Income and Costs (USD)
Cheese	47.0	5.6	263.20
Yoghurt	364.0	2.0	728.00
Cream	10.5	11.2	117.60
Milk	25.0	1.25	31.25
Daily gross income based on 750 kilograms of milk			USD 1,140
Estimated daily costs			USD 900
Estimated net profit			USD 240

kilogram x USD 1.25= USD 73.82). The total profit will depend on the number of buffalos kept by each breeder. The number of animals per herd has also increased dramatically since IMRP closed in 2006.

Table 10 calculates daily gross income of a small-scale commercial dairy industry on the margins of the marshes in Bayt Wafi of USD 1,140 from dairy products using 750 kilograms of raw milk. One operator estimated that her production costs, including producing her own milk or buying it from others, transportation, labor, shop, equipment and running costs, were about USD 900. That leaves about USD 240 net profit.

## ACKNOWLEDGEMENTS

The authors would like to thank DAI in Bethesda, Maryland, USA, for providing generous financial support for the research and analysis. We also acknowledge the assistance provided by agricultural department staff in the three southern governorates who provided data and helped contact animal owners who were uniformly collaborative and generous in their dealings with us. We also single out Um-Haider of Bayt Wafi who provided essential data about her small-scale dairy operation.

## REFERENCES

- [1] Al-Fartosi K, Al-Saedy J. Mesopotamian Buffaloes (The Origin). *Journal of Buffalo Newsletter* 2013; 28: 25-30.
- [2] Richardson CJ, Hussain NA. Restoring the Garden of Eden: An ecological assessment of the Marshes of Iraq. *Bioscience* 2011; 56: 477-489. [https://doi.org/10.1641/0006-3568\(2006\)56\[477:RTGOEA\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2006)56[477:RTGOEA]2.0.CO;2)
- [3] Magid SA, Al-Murrani WK, Alkas JI. Iraq: Country Report, Animal Genetic Resources. Ministry of Agriculture, Baghdad, Iraq 2003.
- [4] Al-Saedy JKM. Mesopotamian Buffaloes: The Origin. *Journal of Buffalo Science* 2014; 3: 30-33. <https://doi.org/10.6000/1927-520X.2014.03.01.6>
- [5] Al-Saedy JKM. Iraqi Buffalo Now. *Italian Journal of Animal Science* 2007; 6: 1234-36. <https://doi.org/10.4081/ijas.2007.s2.1234>
- [6] USAID (U.S. Agency for International Development). Re-establish Livestock and Dairy Production. 2004 Retrieved from <http://www.iraqmarshes.org/activities/livestock.htm>.
- [7] Fazaa NA. Interim Draft Report on Water Buffalo in Chubayish, Nature Iraq 2007; 2(2): 84-89. (<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.505.6107&rep=rep1&type=pdf>)
- [8] Abu Tabeekh MA, Maktoof AS, Abdul Mohsen AM. Solutions or alternatives to protect livestock, especially buffalo from the risk of drought in Basra Governorate. *Canadian Journal of Agriculture and Crops* 2017; 2(2): 84-89. <https://doi.org/10.20448/803.2.2.84.89>
- [9] Lindsay JA, Mason GWJ, Toleman MA. Supplementation of Pregnant Cows with Protected Proteins when Fed Tropical Forage Diets. *Proceedings of the Australian Society of Animal Production* 1982; 14: 67-78.
- [10] Waghorn GC, Smith JF, Ulyatt MJ. Effect of Protein and Energy Intake on Digestion and Nitrogen Metabolism. In *Wethers and Ovulation in Ewes*. *Animal Production* 1990; 51: 291-300. <https://doi.org/10.1017/S0003356100005444>
- [11] Hinch GN, Davis GH, Crosbie SF, Kelly RW, Trotter RW. Causes of Lamb Mortality in Two Highly Prolific Booroola Crossbred Flocks and a Romney Flock. *Animal Reproductive Science* 1986; 12: 47-61. [https://doi.org/10.1016/0378-4320\(86\)90016-3](https://doi.org/10.1016/0378-4320(86)90016-3)
- [12] Stephenson RCA, Edwards JC, Hopkins PS. The use of urea to improve milk yield and lamb survival of Merinos in a dry tropical environment. *Australian Journal of Agricultural Research* 1981; 32: 497-509. <https://doi.org/10.1071/AR9810497>
- [13] Lynch JJ, Leng RA, Hinch GN, Nolan JV, Bindon BM, Piper LR. Effects of Cottonseed Supplementation on Birthweights and Survival of Lambs from a Range of Litter Sizes. *Australian Society of Animal Production* 1990; 18: 516.
- [14] Saadullah M. Studies on Utilization of Rice Straw by Cattle. Ph. D. Thesis. Royal Veterinary University, Copenhagen 1984.
- [15] Preston TR, Leng RA. Matching Livestock Systems to Available Feed Resources. *Asian Livestock* 1987; 10(12): 158-163.
- [16] Reiss P, Farhan A, editors. Iraq Marshlands Restoration Program: Final Report; DAI for the U.S. Agency for International Development. Bethesda, Maryland 2006.
- [17] Ståhl Högberg M, Lind O. Buffalo Milk Production 2003; ([www.milkproduction.com](http://www.milkproduction.com))
- [18] Hussain NA, Reiss P. Exploring Program Sustainability and Impact Twelve Years Later: USAID Iraq Marshlands Restoration Program (IMRP). DAI, Bethesda, Maryland 2018.

Received on 16-02-2019

Accepted on 29-04-2019

Published on 03-09-2019

DOI: <https://doi.org/10.6000/1927-520X.2019.08.02.1>

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