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# Nucleus Herds and their Impact on Buffalo Dairy Production Systems in some Upper Egypt Governorates

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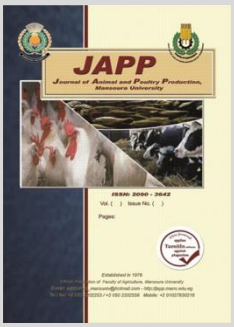


## ABSTRACT

This study aimed to define the role of buffalo nucleus herds at Experimental Research Station of *Mahalat Mosa*, *Kafrelshaiekh* governorate belonging to Animal Production Research Institute (APRI) to raise dairy buffalo herds` productivity, and increase producers` profitability in Upper Egypt of *Assiut* and *Sohag* governorates. A structured questionnaire was developed for gathering information on generated production systems. Analytical methods were used to investigate factors affecting dairy systems profitability. Profitability indicated LE per dairy head per season by 6161.1 LE of *Sohag* herd and 3843.5 LE of *Assiut* herd. Dairy income contributed mainly from the sale of raw milk. Concentrate rations represented the highest costs and the lowest feed economic efficiency (FEE) (1.6 LE/ day). On the contrary, fodder represented the highest FEE (1560 LE/ day). Milk production was 7.65 kg/ head/ day of *Sohag* herd and 7.4 kg of *Assiut* herd. Milk yield recorded 2055.2 kg/ head/ season of *Sohag* and 2003.7 kg of *Assiut* during a lactation period length of 268 days in average for each herd. Milk production was decreased by 19.3% per head per day for respondent producers' herds compared to the origin nucleus herd. Data showed Foot and Mouth Disease (FMD) was widespread; veterinary hubs weren`t close to the producers locations to get the prescribed vaccinations. Concentrate prices constituted the main difficulty derive belief to offering feed alternatives nutritionally valued, and in terms of the total costs. Producers have to initiate their own private associations to finance purchasing animal feed, vaccinations and treatments.

**Keywords:** Nucleus herd, Lactating buffaloes, Upper Egypt, Profitability.

## INTRODUCTION

Egyptian buffalo revealed impact as main dairy livestock although decline in its herd`s number. Importance of buffalo lies in the consumer preference for milk produced by buffalo due to its high fat percentage, milk sold at a bargain price, improved income to producers. In Egypt, buffalo population recorded 3.4 million head. Buffalo milk production recorded 1.7 million tons, where milk gross index recorded 1.4 billion LE (FAO-STAT, 2020). These records clearly imply role of buffalo not only at economic level, but also on sociality acuity, which insist on studying productive traits from systems concern, and searching methodology increase productive efficiency and representation in the Gross Domestic Product (GDP). Elsorougy *et al.* (2022) proved that buffalo livestock generated the highest dairy income in some experimental research stations in Egypt.

In sight of sustainable development strategy pursued by the Egyptian state, enhancement of dairy production systems is of great to respect to maximize exploitation of agricultural resources and deal with current favorable environmental traces. Genetic improvement was described as a key means to increase dairy livestock unit productivity and farm income. Nucleus herds were suggested to overcome limitation in implementation of effective genetic improvement organized in populations at research institutes or experimental station farms (Galal, 1986; Solomon *et al*., 2009). Open nucleus breeding scheme affords procedures for disseminating stock of known pedigree values (Jasiarowski, 1991). In this respect, Bondoc and Smith (1993) mentioned that open nucleus breeding systems were determined to prevent inbreeding, however reduce total recording costs for smallholders. Using an open nucleus breeding scheme was recommended for improving buffalo dairy production and increasing the rate of genetic gain (Nigm *et al*., 2005).

The present study aims to indicate the impact of nucleus herds related to the Animal Production Research Institute (APRI) established at *Mahahlat Mosa* Experimental Station at *Kafrelshaiekh* governorate in improving the productivity of buffalo holders in *Assiut* and *Sohag* governorates of Upper Egypt. Based on the farm budget, the study estimated producers` income from buffalo dairy production to generate a vision to maximize profitability.

## MATERIALS AND METHODS

### Study areas

This study assessed the productive and reproductive performances of buffalo herds holders reared by producers in *Assiut* and *Sohag* governorates benefited from buffalo nucleus herds of *Mahalat Mosa* station of APRI (Fig.1). A field survey was conducted to explore producers' perspectives in terms of the production systems concept and develop strategies for improvement.

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Dairy production systems located in Upper Egypt are described as Mixed Agriculture- Livestock as reported by Tabana, (2000). Livestock herds include mainly lactating animals with small ruminants of sheep, goats, and poultry. Animal feeding was based on green fodder cultivated *Berseem* in winter and green corn (*Darawa*) in summer along with concentrates and crop residues.

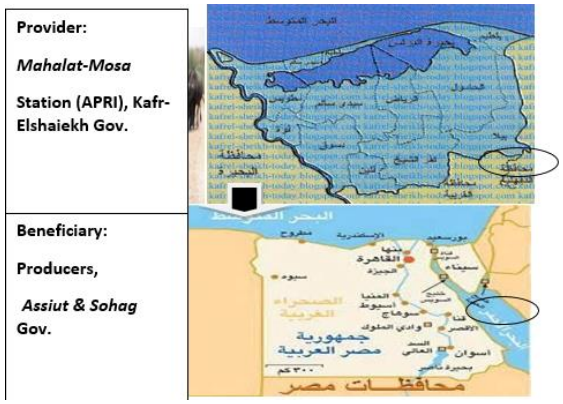


**Fig. 1. Targeted areas of producers (*Assiut* & *Sohag* Gov.) and provider of nucleus herds of *Mahalat Mosa* station (*Kafrelshaiekh* Gov.)**

**Data collection**

Dairy producers distributed in Upper Egypt governorates including *Assiut, Fath, Kosseya, Menkabad* and *Dayrot* districts of *Assiut* as well as *Sohag, Blena, Maragha and Johayna* districts of *Sohag* were interviewed using stratified random methodology. Survey study was conducted from February to June 2023. Face- to- face interview was followed to collect data covering components of differentiated located production systems. A semi-structure questionnaire was developed gathering detailed information on herd composition, feeding systems, reproductive traits, dairy production, farm budget, and income.

**Data analysis**

Statistical analysis was performed using SAS software (SAS, 2014). Least square means were calculated using the general fixed model (GLM). The fixed- linear model was designed to analyze the effect due to ***x*** (herds) as following:

$$Y_{ij}=\mu+X_i+ e_{ij}$$

**Where;**

**$Y_{ij}$ is the observation of the studied productive traits/ LE/ dairy head/ season; where Y1= total concentrate cost, Y2= total fodder cost, Y3= total roughages cost, Y4= total silage cost, Y5= labor cost, Y6= raw milk income, Y7= net profit, μ is the overall mean.**

**$x_i$ is the fixed effect of herds, i = 1 and 2, and $e_{ij}$ is a random effect associated with the individual observation and assumed to be NID (0, σ 2 e).**

## RESULTS AND DISSCUSION

**Herd structure and composition**

Total herd size recorded was 284 and 154 for *Assiut* and *Sohag*, respectively. Lactating animals represented the highest number of the total herd size being 10.2 and 5 for *Assiut* and *Sohag*, respectively. Sire uses for natural insemination of females inside the farm (Table 1).

In *Sohag* governorate, Elnahas (2008) reported that animal units of native cattle, crossbred cattle, and buffalo were 0.34, 0.13, and 1.06, respectively.

Herd size, purpose of rearing types of livestock corresponded to housing practice, feeding systems, and the experience of respondent producer (Zaw Win *et al*., 2018), but the main factor affected herd size wasthe availability of feed resources (Debele and Verschuur, 2014).

**Table 1. Herd structure and composition**

| Item | *Assiut* | *Sohag* |
|---|---|---|
| Female (head/farm) | | |
| Average number of lactating | 10.2 | 5 |
| buffaloes Average number of | 2.4 | 2 |
| pregnant heifers | 3.9 | 2.3 |
| Average number of heifers1-2 year | 4 | 1.8 |
| Average number of heifers> 2 year | | |
| Total | 20.5 | 11.1 |
| Male (head/farm) | | |
| Average number of calves1-2 year | 3 | 1.7 |
| Average number of calves > 2 year | 3.3 | 2.1 |
| Average number of bulls | 0.5 | 0.4 |
| Total | 6.8 | 4.2 |
| Total herd size | 284 | 154 |

Dairy production contributed 40% of the livestock. Female calves were reared to replacement for dairy production. Fattening wasn`t applied by the producers as male calves sale in special occasions at early ages (from 40 to 45 day). Culling percentage was only 3% for either disease or productive disorders (Fig. 2).

Dairy production expresses main source of the Egyptian farming systems, income for producers as alternative compensates shortfall in agriculture production resultant recent erosion of cultivated lands (FAOSTAT, 2011). Dairy production systems were classified into mixed-agriculture livestock and commercial production systems (Tabana, 2000). Smallholders were an essential segment of dairy producers located in villages, but some are scattered in the periphery and even within big cities. Number of dairy producers is increasing in peri-urban areas due to high demand for dairy products due to the increasing urban population and the need to provide a source of income. Address Factors affecting dairy production fascinate when framed strategies prove sustainability of the systems. According to Elsorougy (2018), Egyptian dairy sector was extremely affected by international variability in prices, impacted limitation of production inputs. The author investigated the availability to cultivate land as the reason improves productivity; however, land pressure reflects vulnerability of existent farming systems.

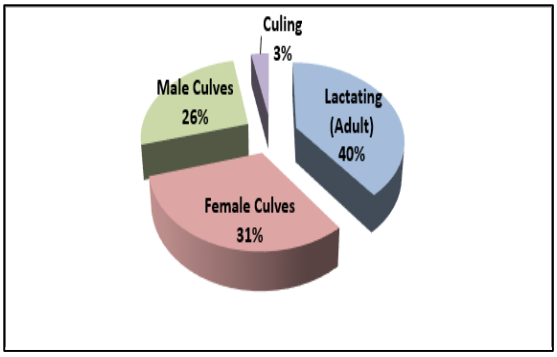


**Fig. 2. % Livestock of the studied herds**

**Feeding systems**

Animal feeding relied mainly on green fodder, recorded the highest feed intake (kg/ head/ day) presented production stages: lactating, dry, growing and pregnant heifer (Table 2).

**Table. 2. Feed intake (kg/ head/ day) related to production stages**

| Intake (kg/head/day) | *Assiut* | *Sohag* |
|---|---|---|
| Lactation period | | |
| Concentrates | 7.53 | 5.5 |
| Fodder | 104 | 55.9 |
| Roughage | 9.08 | 8.8 |
| Silage | 10.1 | 14.7 |
| Dry period | | |
| Concentrates | 3.6 | 2.5 |
| Fodder | 38.2 | 36.5 |
| Roughage | 9.6 | 10.5 |
| Silage | 6.3 | 8.4 |
| Growing period | | |
| Concentrates | 1.85 | 1.8 |
| Fodder | 19.2 | 28 |
| Roughage | 5 | 4.7 |
| Silage | 3 | 4.7 |
| Pregnancy period | | |
| Concentrates | 9.9 | 9.8 |
| Fodder | 25.8 | 36.3 |
| Roughage | 7 | 7.3 |
| Silage | 7.2 | 6.4 |

Since land was cultivated regardless of the agriculture cycle eventually, land cultivation includes "*barseem"* in winter and d*arawa*" in summer represented green fodder along with cash crops (El– Says and El- Wardani, 2004).Shortage of green fodder during summer season compared to winter season was reported where plentiful amounts of "*barseem"* were afforded in winter season. Imbalance of feed resources occurred in transitional period (period between winter and summer seasons) affects productive performance of dairy buffaloes (El- Kerabi *et al*., 1981). Feeding large amount of roughages influences negatively body conditions and in turn lactation in buffalo reared under traditional systems (Aboul-Ela *et al*., 2000). Feeding large amount of concentrates leads to suboptimal volatizing of feed intake causing chorionic diseases (Enmark, 2008).

Regarding the feed economic efficiency (FEE)- calculated by dividing total feed intake (kg) by feed price (LE)- fodder saved 1560 LE/ day, the highest amount among the herds of feed cost fodder saved 1560 LE/day, the highest amount among the herds of feed cost was 25.1 and 22.2 LE for roughages and silage, respectively. Concentrates recorded the lowest FEE didn`t over 1.6 LE/ day (Table 3).

**Table. 3. feed economic efficiency (FEE) (LE/ day) for each feed component**

| Item | *Assiut* | *Sohag* |
|---|---|---|
| Concentrates | | |
| Total Intake (kg/ day) | 22.9 | 19.7 |
| Price (LE/ kg) | 14 | 14 |
| FEE (LE/ day) | 1.6 | 1.4 |
| Fodder | | |
| Total Intake (kg/ day) | 187.2 | 156.7 |
| Price (LE/ kg) | 0.12 | 0.12 |
| FEE (LE/ day) | 1560 | 1305.8 |
| Roughages | | \ |
| Total Intake (kg/ day) | 30.6 | 31.4 |
| Price (LE/ kg) | 1.25 | 1.25 |
| FEE (LE/ day) | 24.5 | 25.1 |
| Silage | | |
| Total Intake (kg/ day) | 26.6 | 33.4 |
| Price (LE/ kg) | 1.5 | 1.5 |
| FEE (LE/ day) | 17.7 | 22.2 |

Feed cost represented major input initiate profitability of dairy farms. Many strategies were applied in terms of abundant quantities of green fodders in winter season to offset shortages on fodder availability in summer season. In 90`s, Bendary and Younis (1997) proposed maize stalk silage instead of rice straw could reduce total feed cost by about 29%. Sammour (2002) suggested that *"barssem*" silage during the dry period decreases feed cost from 0.04 to 0.64 LE/ head/ day. Daburon (2013) mentioned that non-governmental organizations (NGO`s) take part in decreasing feed costs through grouping input purchases, buy feed from the wholesales and introduce in better prices to the producers. Proportion of fodder and concentrates in daily feed intake linked to feed economic efficiency. Untraditional feeding systems therefore appeared to be a key element of resilience ability.

**Productive and reproductive parameters**

Table 4 shows data of milk yield and reproductive related traits of the studied herds concerning age at first calving, pregnancy period length, calving interval, and days open. Milk yield recorded 7.65and 7.4 kg/head/day in *Sohag* and *Assiut*, respectively. Total milk yield recorded 2055.2 and 2003.7 kg/head/season in *Sohag* and *Assiut* in lactation period length of 268 days in average for both herds.

The relationship between milk yield and reproductive efficiency has been indicated in many studies. One of them was by Qureshi and Ahmed (2008), who reported that buffalo with higher milk yield achieved higher conception rate at first service, more days to uterine involution and first ovulation. A positive correlation between calving interval and milk yield has been reported by Nava- Truijllo *et al.* (2018). In this respect, buffaloes producing more than 8 kg milk per day had extended post-partum anestrous period (El-Fadaly, 1980). Also, de Camargo *et al.* (2015) observed a positive genetic and phenotypic correlation between milk yield, yield and percentage of fat, protein, and somatic cell count with age at first calving, service per conception, and calving interval. Recently, Abd-El Hamed and Kamel (2021) determined that dry period length (DPL) from 61 to 75 days, days open (DO) from 91 to 110 days and days in milk (DIM) from 241 to 270 days accounted for the highest total milk yield, total return and net profit in some commercial dairy farms compared to governmental farms under subtropical Egyptian conditions.

**Table 4. Reproductive traits and milk performance of the studied herds**

| Item | *Assiut* | *Sohag* |
|---|---|---|
| Milk performance | | |
| Daily milk yield(kg/head/day) | 7.4 | 7.65 |
| Lactation period length (day) | 268 | 268 |
| Seasonal milk yield(kg/head/season) | 2003.7 | 2055.2 |
| Dry period length (day) | 171 | 194 |
| Reproductive traits | | |
| Age at first calving(month) | 37.3 | 37.3 |
| Pregnancy period(day) | 317.6 | 320.3 |
| Days open | 136 | 172.5 |
| Calving interval(day) | 452.5 | 483 |

**Dairy profitability**

Seasonal profitability estimated per dairy head was 6161.1and 3843.5 LE in *Sohag* and *Assiut*. Dairy income contributed mainly sale raw milk being 23 LE/kg in *Assiut* and 25 LE/kg in *Sohag* governorates by milk market.

Concentrates represented the highest cost (an average: 24286.5 LE/ head/ season). Fodder and roughages showed the lowest feed cost; they are primarily introduced at farm level (Table 5).

**Table 5. Dairy costs, income and profitability (LSM±SE) of the studied herds**

| Item | *Assiut* | *Sohag* |
|---|---|---|
| Costs (LE/ head/ season) | | |
| Concentrates | 28038.4$^{(a)}$ ±3677.2 | 20534.5$^{(b)}$ ±1694.2 |
| Fodder | 3311.1±1041.3 | 1806.6±173.9 |
| Roughage | 3033±360.1 | 2964.8 ±454.3 |
| Silage | 4090.4±2116 | 5784±1674.8 |
| Labor | 3768.9(bc)±1449.2 | 14129.9$^{(a)}$±5094.4 |
| Dairy incomeRaw milk (LE/ head/ season) | 46086.1$^{(ab)}$ ±4166.5 | 51381.2$^{(a)}$±2858.5 |
| Total profit (LE/ head/season) | 3843.5$^{(ab)}$±4781.8 | 6161.1$^{(a)}$ ±6187.6 |

"*Pasture- based systems"* recorded outstanding cost benefit explaining their ability to convert low cost grass feed into low cost milk (Finerran *et al*., 2010). Also, L. Hanrahan *et al*. (2018) mentioned that high milk yield caused by highly feed intake from pasture improved cost efficiency, has a potential to derive resilience from "*Pasture- based systems"*. Grazing management showed greater profit, more sufficient asset use and operating practices (Datt *et al*., 1999). Increase of net profit was reported as a result to extend grazing season length (Laplle *et al*., 2012). On contrary, reduction in net profit was indicated by increasing dairy farm size, reflecting increase in labor intensity. Use of non- forage feed affects production costs, consequently reduces farm net profit (AHDB, 2012). It is worth declared that pasture has distinct advantage in terms of high inputs costs associated with labor efficiency, product quality and systems sustainability (O` Brien *et al*., 2012).

Dairy enterprise profitability is significantly affected in case of farm was initiatively lacked in assessing feed or milk prices (Hasan *et al*., 2008). Ahmet and Yavuz (2019) added that raw milk or dairy products sale prices give the fact reflects profitability of dairy farms. Gadhvi *et al.* (2021) reported that feed costs were the highest among the total variable costs. Sahar A.Abd El-Rahim *et al*. (2022) reported that benefit cost ratio (BCR) reached 4.2 LE for buffalo produced milk. Balance on nutrition, genetic characteristics and proper rearing of calves affecting dairy production profitability. Optimizing energy use and labor intensity impact positively profitability through reducing production costs (Cwalina *et al*., 2020).

## CONCLUSION AND RECOMMENDATION

Results of the study indicated decrease in milk production from 9.3 kg/ head/ day of originated nucleus herd compared to average 7.5 kg/ head/ day of respondent producers' herds at percentage about 19.3 %. Producers complained Foot and Mouth Disease (FMD) was widespread that veterinary hubs far from producers' whereabouts in remote villages. To get vaccinations, producers have to move with their animals a long distance. Concentrates prices constituted the main difficulty depended import from abroad, was extremely increased due to recent economic measures. Solution comes through directing nutritionists thought towards offering feed alternatives nutritionally valued, and in terms of the total cost. Producers have to initiate their own private associations to finance purchasing animal feed, vaccinations and treatments.

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# قطعان النواة وتأثيرها فى نظم إنتاج الألبان من الجاموس فى بعض محافظات صعيد مصر

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## الملخص

هدفت هذه الدراسة إلى تحديد دور قطعان النواة من الجاموس بمحطة البحوث التجريبية بمحلة موسى التابعة لمعهد بحوث الإنتاج الحيوانى بمحافظة كفر الشيخ لرفع إنتاجية قطعان الجاموس الحلاب, وأيضا زيادة ربحية المنتجين بمحافظتى أسيوط وسوهاج بصعيد مصر. صممت إستمارة إستبيان تشمل المعلومات الخاصة بنظم الإنتاج القائمة. أستخدمت الطرق التحليلية لإستنتاج العوامل المؤثرة فى ربحية نظم الألبان. قدرت الربحية بالجنيه للرأس الحلاب للموسم ب 6161.1 جنيه لقطيع سوهاج و 3843.5 جنيه لقطيع أسيوط. مثل العائد من إنتاج الألبان بشكل رئيسي من بيع اللبن الخام. مثلت الأعلاف المركزة أعلى تكاليف وأقل كفاءة إقتصادية غذائية (1.6 جنيه/ يوم). على العكس, حققت الأعلاف الخضراء أعلى كفاءة إقتصادية غذائية (1560 جنيه/ يوم). سجل إنتاج اللبن 7.65 كجم/ رأس/ يوم لقطيع سوهاج و 7.4 كجم لقطيع أسيوط. سجل محصول اللبن 2055.2 كجم/ رأس/ موسم لسوهاج و 2003.7 كجم لأسيوط عند فترة حليب 268 يوم فى المتوسط لكل قطيع. نقص إنتاج اللبن بنسبة 19.3% للرأس الحلاب لليوم للقطعان لدى المنتجين بالمقارنة بقطيع النواة الأصلى. أظهرت البيانات إنتشار مرض الحمى القلاعية؛ عدم قرب المراكز البيطرية من أماكن المنتجين لأخذ التحصينات المقررة. شكلت أسعار المركزات عبئاً رئيسيا يستوجب طرح بدائل علفية بالنظر إلى القيمة التغذوية والتكاليف الكلية. يتعين على المنتجين إنشاء جمعيات خاصة بهم لتمويل شراء الأعلاف الحيوانية, التحصينات والعلاجات.

***الكلمات الدالة***: قطيع النواة, الجاموس الحلاب, صعيد مصر, الربحية