Egyptian J. Anim. Prod. (2000) 37 (2): 67-76

EFFECT OF FREQUENCY OF HEAT DETECTION IN BUFFALOES ON LENGTH OF SERVICE PERIOD AND HERD PROFITABILITY

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SUMMARY

An empirical study was conducted to investigate the effect of frequency of heat detection on profitability of buffalo herds. Three herds of non-pregnant buffalo heifers (n=100/herd) were generated. Managerial practices were assumed to be similar in the three herds except for the numbers of heat detections per day. Heat detection was done once (R1), or twice as a control (R2), or thrice (R3) or four times daily (R4) daily. With the exception of the extra cost of more heat detection rounds, feeding, permanent labor, and veterinary services were considered similar in the three herds. The temporary labor of each test of heat detection was estimated as LE 2.5 Egyptian pounds (equals US$ 0.29). Cost of inputs and revenues were calculated using the prevailing farm-gate prices. Heat detection was stopped just after the percentage of conceived animals reached 80%. Gross margin and benefit /cost ratios were used as criteria for evaluating herd profitability.

Results showed that increasing the frequency of heat detection shortened the length of service period ($P<0.05$) from 59.43 $\pm$ 2.13 d to 34.65 $\pm$ 2.13 d. The annual cost per head also decreased from LE. 993.91 to 936.98.

Expected annual gross output per head increased from LE 2101 to 2319. The increase in gross output followed the increase of the frequency of heat detection. Detecting estrus three times daily scored the highest gross margin/ head reaching 16% as compared to two times daily which is the common practice in buffalo herds, as well as the highest benefit/ cost ratio.

Keywords: Buffaloes, heat detection frequency, service period length, herd profitability

INTRODUCTION

Incidence of quiet ovulation in buffaloes (50-79 %, Barkawi *et al.*, 1986 and Aboul-Ela *et al.*, 1987); as reported under two times of heat detection; would result in prolongation of service period (Barkawi *et al.*, 1998). The long service period has

a negative impact on the herd productivity and the expected lifetime production of buffaloes.

Improving efficiency of heat detection is a way to shorten the service period and to successfully inseminate more animals in a shorter time. Increasing frequency of estrus checking rounds to three or four times daily improves heat detection efficiency (Barkawi *et al.*, 1997 and El-Wardani and El-Asheeri, 2000) and increases the expected income of buffalo herds (Barkawi *et al.*, 1999).

Extra labor cost is one of the main factors that could limit increasing heat detection rounds. Thus, decisions concerning the appropriate daily heat detection frequency should be based on the assessment of the effect of extra cost on herd profitability. This requires analysis of the expenses and revenues of the herd.

As no actual data are available on this subject, an empirical study was used to investigate the effect of increasing heat detection frequency per day on service period length and evaluating buffaloes herd profitability in terms of gross margin and benefit/cost ratio. The study was based on actual technical coefficients obtained from buffalo farms.

MATERIALS AND METHODS

Herds and management

An empirical study was conducted in which three herds of adult buffalo heifers (n=100/herd) were generated. To calculate feeding cost, body weight was assumed to be 450 kg. Feeding requirements were calculated, considering live body weight and state of pregnancy. Only heifers were considered in order to avoid complications of feeding animals of different production levels.

To evaluate the effect of frequency of heat detection per day on the profitability of buffalo herds, heifers were proposed to be subjected to three different regimes of heat detection, once (R1), twice which served as a control (R2), thrice (R3) or four times (R4) per day. Figure 1 represents a model for the herd dynamic as affected by heat detection efficiency. In the model, buffaloes showing estrus were mated as early as they display heat symptoms and those returned to estrus were re-inseminated in the next heat period. Buffaloes that did not show estrus were palpated after 60 days for pregnancy diagnosis. Service period and number of services per conception (NS/C) were estimated.

Assumptions

The proposed technical coefficients for investigating herd's profitability were obtained from published reports, research papers and from experiences.

- Conception rate (percentage of cows conceived /service) = 60 % (Oloufa, 1960)
- Total milk yield per head/lactation = 1200 kg (Winrock, 1993).
- Calf mortality up to weaning = 12 %.
- Manure produced = 12 m^3/head/year.
- Heat detection efficiency (number of detected cases out of ovulatory estrus) = 48% for R1, 74% for R2, 91% for R3 and 100% for R4 (El-Wardani and El-Asheeri, 2000).

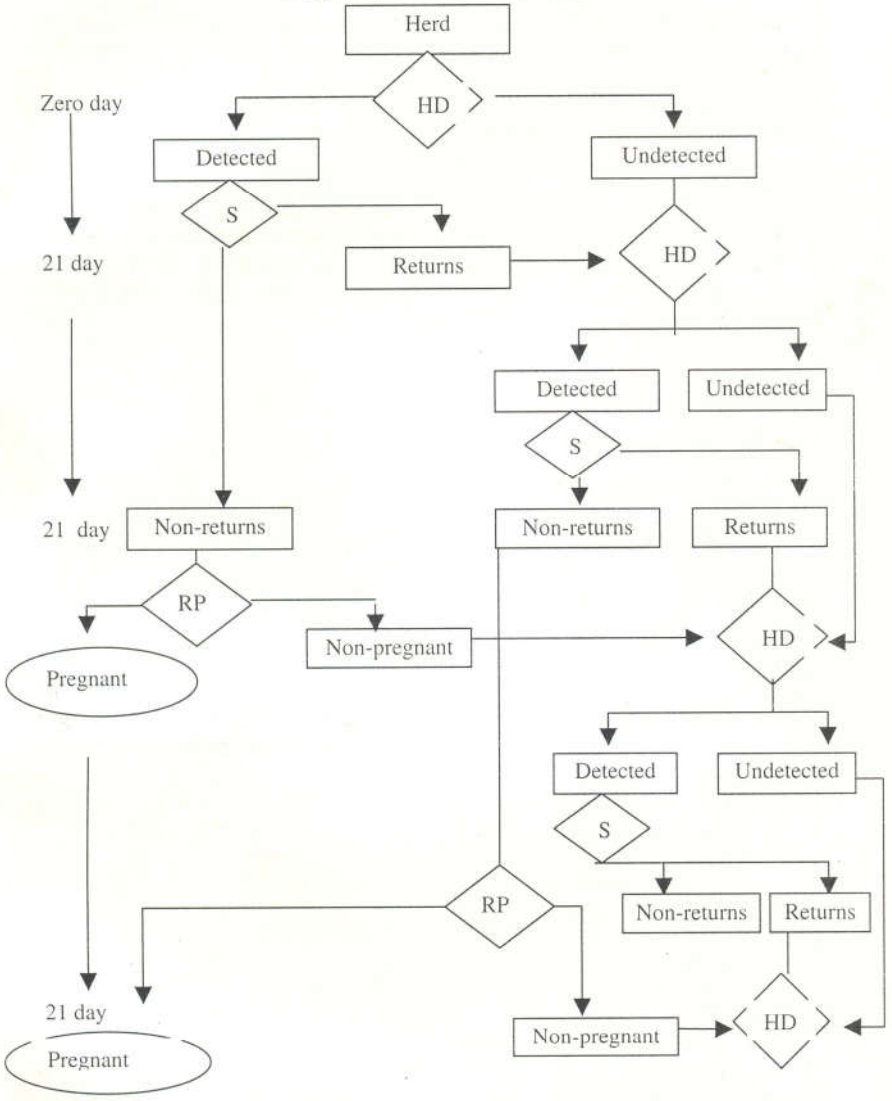

Figure 1: Chart illustrating the dynamics of the buffaloes in simulated herds as affected by heat detection efficiency (HD %), rectal palpation (RP) and conception rate. Heat detection was stopped when the percentage of pregnant animals reached ≥ 80 % (S= service).

- Service period length per herd: was calculated as the interval from starting the experiment to the time at which the percentage of conceived animals reaches 80% (Winrock, 1993).
- Gestation period = 315 d
- Estrous cycle length = 21 d (Shafie *et al.*, 1982)

Criteria for assessment

Gross margin (gross output after deducting the total variable cost of inputs) (Barnard and Nix, 1993), was used to calculate the expected change in herd's profit in response to changes in heat detection frequency. Benefit /cost ratio (the present worth of the gross benefits divided by the gross cost) was used as a criterion for evaluating herd profitability.

Data

The following inputs were adopted to estimate variable cost during the service period:

1- Feeding cost was calculated as LE. 3.9 /day during the service period and the first eight months of pregnancy and LE 4.5 /day during the last two months of gestation period.

2- Heat detection (temporary) labor per day (LE 2.5 for once, LE 5.0 for twice, LE 7.5 for thrice and LE 10.0 for 4 times).

3- Insemination, LE 10 / dose; palpation, LE 5 / time.

4- Vaccination and veterinary treatments, LE 10 / head / year.

5- Permanent labor (two men per herd at LE 5.0 / man/day).

Revenues are measured in terms of total gross output, as the value of herd milk, calves and manure. This combines many different farm products into one measure and allows comparison among different regimes. Farm production prices are assumed to be farm-gate prices:

Milk = LE 1.0 / kg
Calf at weaning = LE 700
Manure = LE 12 / m^3

Data analysis

Data were analyzed by least squares technique using the general linear model of SAS (1990) to examine the effect of frequency of daily heat detection on the studied traits. The studied traits were service period length (day), and total variable costs (LE) during the interval from the beginning of the experiment up to parturition (service period plus gestation period). The fixed effects linear model used in the analysis was:

$y_{ij} = u + a_i + e_{ij}$

Where:

y_{ij} = the ij^{th} observation,
u = the general mean, common to all observations in the population,
a_i = the effect due to the i^{th} number of heat detection, i = 1, 2, 3 and 4
e_{ij} = a random error associated with individual observation,

A gross margin is estimated for each regime as the difference between total gross output and total variable costs to compare among the proposed regimes.

RESULTS AND DISCUSSION

Increasing frequency of heat detection per day shortened ($P< 0.05$) service period length needed to reach the targeted percentage of pregnancy (80%). This however, minimized the interval to first parturition (Table 1 and Figure 2). Number of services per conception was almost equal in the three herds. The shorter service period of R4 is most probably attributed to higher efficiency of heat detection particularly for estrus cases that occur during night hours (Barkawi *et al.*, 1997).

Although, cost of heat detection labor of R4 was four times as much as R1, variable cost of service period plus gestation period was the lowest in R4 followed by R3, R2 and R1, respectively (Tables 1 and 2). Meanwhile, calculated annual variable cost per head under different heat detection regimes (Table 3) ranged from LE 969 to LE 978, in spite of different service period length.

Table 1. Least squares means (± SE) of reproductive traits and variable cost of buffaloes (n = 100/herd) subjected to different regimes of heat detection (once, R1; twice, R2; thrice, R3 and four times, R4)

Trait	Heat detection regime			
	R1	R2	R3	R4
Service period (SP) (d)	59.4 ±2.1[a]	39.3±2.1[b]	34.7±2.1[cb]	29.4±2.1[c]
SP + gestation period (d)	374.4±2.1[a]	354.3±2.1[b]	349.7±2.1[cb]	344.4±2.1[c]
NS/C	1.36 ±0.07[a]	1.38±0.07[a]	1.48±0.07[a]	1.40±0.07[a]
Cost (LE) of:				
Heat detection labor	2.61 ±0.30[a]	3.15±0.30[a]	4.71±0.30[b]	4.20±0.30[b]
Casual labor	37.44 ±0.21[a]	35.43±0.21[b]	34.97±0.21[bc]	34.44±0.21[c]
Insemination	13.6 ±0.67[a]	13.8±0.67[a]	14.8±0.67[a]	14.0±0.67[a]
Palpation	6.8 ±0.33[a]	6.9±0.33[a]	7.4 ±0.33[a]	7.0±0.33[a]
Feeding	923.3±4.5[a]	873.8±4.5[b]	865.5±4.5[b]	850.7±4.5[c]
Veterinary services	10.3 ±0.06[a]	9.7 ±0.06[b]	9.6±0.06[bc]	9.4 ±0.06[c]
Total cost	993.9±5.5[a]	942.7±5.5[b]	937.0±5.5[b]	919.8±5.5[c]

[a,b] Means within row with different superscripts are significantly different at 5% level

Expected gross output ranged from LE 2101 to LE 2319 (Table 2). Gross output showed curve liner trend with increasing frequency of heat detection up to three times daily (R3). Under all the studied regimes about 70% of the gross output was earned from milk, and the rest are from calves (24%) and manure (6%).

Annual variable cost per head of R1, R3 or R4 as compared to the regular practice in Egyptian buffalo herds (R2) represented -0.2 %, +0.7 and +0.4 %, respectively. However, gross margin per head for each regime showed that R3 scored the highest reaching +16% compared to R2 (Table 2). This is due to the increase in number of pregnant animals for R3 than other regimes as shown in Figure 2.

This means increasing the expected number of lactations and weaned calves (Figure 3). The interesting point is that R3 had the highest benefit/cost ratio, while R1 recorded the lowest (Table 3).

In conclusion application of three times of heat detection could increase the gross output of buffalo herds and achieve the best benefit /cost ratio.

Table 2. Analysis of variance of reproductive traits and variable costs of buffaloes subjected to different regimes of heat detection (once, R1; twice, R2; thrice, R3 and four times R4)

Trait	df	MS	P
Service period	3	17238.32	0.0001
Calving interval	3	17238.32	0.0001
NS/C	3	0.2766	0.6043
Heat detection labor	3	92.48	0.0001
Casual labor	3	172.38	0.0001
Insemination	3	27.66	0.6043
Palpation	3	6.91	0.6043
Feeding	3	98894.74	0.0001
Veterinary services	3	12.97	0.0001
Total cost	3	101744.60	0.0001

Table 3. Expected annual production values (LE) per head under different regimes of heat detection frequency (once, R1; twice, R2; thrice, R3 and four times, R4)

Trait	Heat detection regimes			
	R_1	R_2	R_3	R_4
Output				
Milk	1476	1494	1638	1512
Calves	505	511	561	517
Manure	120	120	120	120
Gross output	2101	2125	2319	2149
Annual estimates				
Cost	969	971	978	975
Gross margin	1132	1154	1341	1174
Benefit / cost ratio	1.17	2.19	2.37	1.82
% of balance *	- 2.00	0.00	+16.00	+1.70

* Deviated from R_2

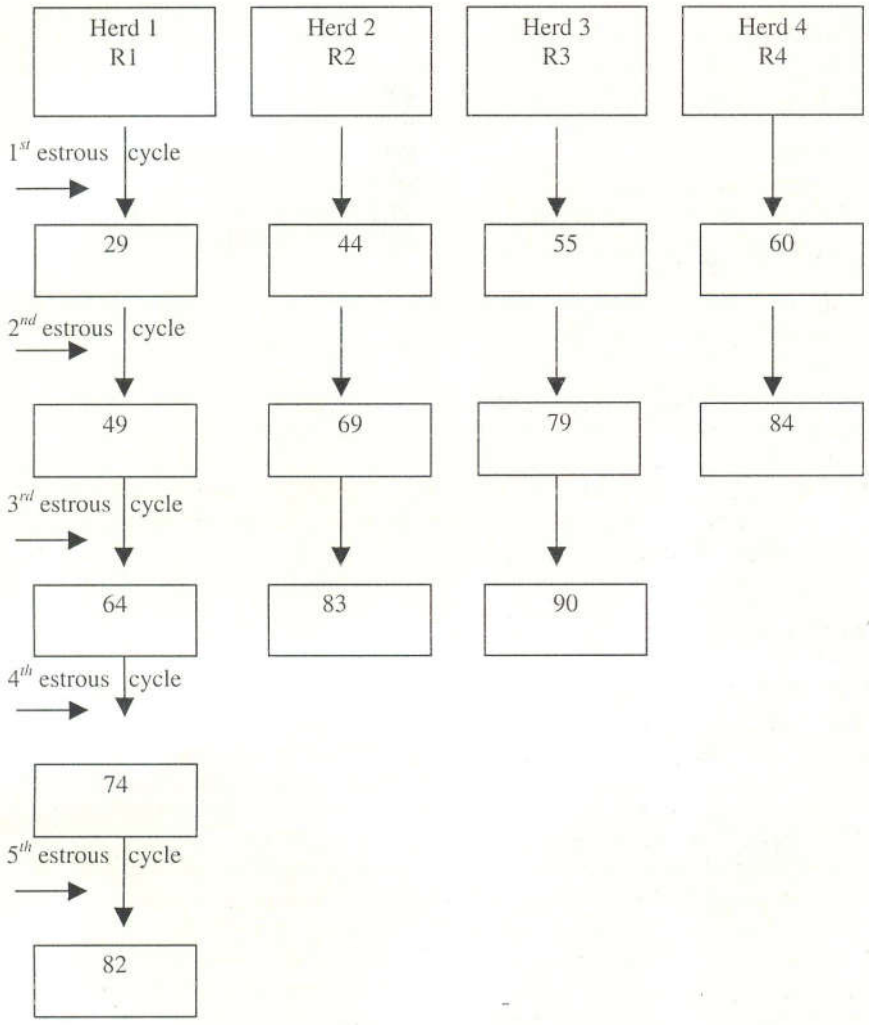

Figure 2: Cumulative number of conceived animals in herds (n=100) subjected to heat detection regimes of once (R1), twice (R2), thrice (R3) and four times (R4) per day, calculated under 60% conception rate per insemination.

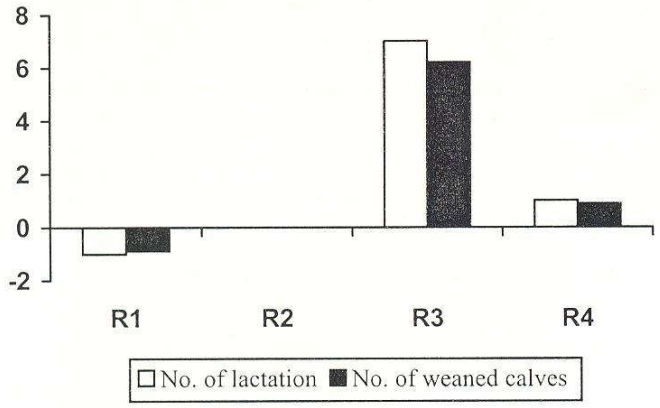

Figure 3: Expected difference in number of lactations and weaned calves in herds subjected to one (R1), three (R3) or four times of heat detection as compared to R2.

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تأثير تكرار مراقبة الشياع على كل من فترة التلقيح وربحية قطعان الجاموس

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أجريت هذه الدراسة لتحديد تأثير عدد مرات مراقبة الشياع على ربحية قطعـــان الجـــاموس، حيث تمت محاكاة أربعة نظم لمراقبة الشياع (مرة واحدةR1 ، مرتان R2 ، ثلاث مرات R3 ، أو أربع مراتR4 لأربعة قطعان من العجلات الجاموسى يتكون كل منـــها مـــن ١٠٠ رأس ، وذلـــك بفرض أن العمليات المزرعية فى القطعان الأربعة متشابهة فيما عدا عدد مرات مراقبة الشياع.

وقد شمل حساب التكاليف المتغيرة كل من التغذية ، العمالة الدائمة ، الخدمات البيطرية .كمـــا تم تقدير العمالة المؤقتة والخاصة بمراقبة الشياع على أنها ٢,٥ جنيه للمرة الواحدة/ يوم تتضـــاعف تبعا لعدد مرات إجرائها ، وقد حسبت أسعار التكاليف المتغيرة وكذا المنتجات المزرعيـــة علـــى أساس السعر السائد.

شملت المعاملات الفنية كل من:

١- كفاءة مراقبة الشياع وكانت ٩٠،٧٤،٤٨% فى كل من القطعان الثلاث على التوالى

٢- توقفت مراقبة الشياع بمجرد وصول نسبة الحيوانات الحوامل إلى ٨٠%،

٣- نسبة الإخصاب/ تلقيحة ٦٠%. واتخذ هامش الربح وكذا نسبة المخرجات/ المدخـــلات كمقياس للتقييم الاقتصادي لأربحية القطيع.

أوضحت النتائج أن:

١- زيادة تكرار مرات مراقبة الشياع أدى إلى تقليل طول فترة التلقيح معنويا. ($P < 0.05$)

٢- كانت التكلفة المتغيرة السنوية /رأس/ نظام متقاربة (تراوحت القيمة بين ٩٦٩ ، ٩٧٥ جنيه.

٣- (تراوحت قيمة صافى الإيراد السنوى المتوقع للرأس تحت كل النظـــم(بيـــن ٢١٠١ ، ٢٣١٩ جنيه)، كانت زيادة صافى الإيراد موازية للزيادة في عدد مرات مراقبة الشياع .

٤- حققت مراقبة الشياع ثلاث مرات مقارنة بمرتين يومياً أعلى عائد سنوي (حوالى ١٦%) كما سجلت أيضا أعلى نسبة مخرجات إلي المدخلات.