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IMPACTS OF PRODUCTIVE AND REPRODUCTIVE PERFORMANCES ON INVESTMENT EFFICIENCY OF BUFFALO ENTERPRISE IN EGYPT

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ABSTRACT

In the Era of Economic liberalization, investment attractiveness has become the major criteria of decision in agricultural activities. Buffalo enterprising, as a livestock activity, is a dynamic type of investment. Where the time element is a function of biological cycle. Such cycle composes of several variables that characterize the potentiality of the livestock type. These variables are age at first calving, service period, milking interval, calving interval, milk season, etc.

A considerable number of animal scientists from the western schools, postulate that the norms of productive performance, particularly the milk yield and reproductive performance, calving interval, and conception rate are constraints that limit the survival of investment in dairy buffalo as economically attractive enterprise, particularly, when the full economic liberalization of the market and foreign trade dominates the agricultural sector.

Therefore, this study would test the sensitivity of the return to investment from the dairy buffalo along the productive life with respect to milk yield and calving interval, as the major traits that affect the efficiency of the buffalo Production, as well as the changes in milk price. The technique of switching value was applied to identify the critical level of the productive and reproductive performance. At such level the return to investment in dairy buffalo enterprise would switch from profitable to non-profitable decision. Accordingly, the study shows the limits of the productivity performance for the development of dairy buffalo and the expected return.

INTRODUCTION

The total number of buffalo in Egypt reached about 3.717millions, of which 42% Dairy-cows, 6% buffalo-bulls, 32% heifers less than 2 years and 20% male calves less than 2 years in 2003 [1]. While the annual growth rate in buffalo population approached 3% over the last two decades, it was only 1% for cattle population [2]. Where the buffalo milk from the traditional small farm system shares by 60%, the specialized commercial buffalo system share is about 17% and the share of buffalo milk from the mixed commercial system (cattle and buffalo) is about 4% of total milk production in Egypt [2]. Although the native cattle represents 33.6% of total buffalo and cattle population, the share of this type in milk production is around 19% because its milk productivity is very low (775 Kg/cow/lactation). The number of foreign cattle share is minor in livestock population, i.e. 2.3%. Therefore, the aggregate share of buffalo milk, from all types of production systems, reaches about 81% of total milk production in Egypt [2]. Egypt has comparative advantage in milk rather than red meat production, particularly from buffalo milk production system [3]. Such comparative advantage stems from producing buffalo milk of 4% fat equivalent at the lowest cost among all other types and dairy systems in Egypt. Cost of milk production from buffalo is also less than the reconstituted imported powder milk in the international market price [3]. The return to one ton of concentrate feed mix generated by milk production confirmed the comparative advantage of buffalo in Egypt [4, 5]. Recently, associated with the Economic reform era and market liberalization, commercial buffalo system has significantly expanded. Buffalo -cows have been introduced even to the commercial farms with

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Foreign cattle [6]. Accordingly, the enterpriser can make benefit from the high solid content of buffalo milk, particularly fat when it is mixed with high milk yield of foreign cattle, which results in higher yield of processed products [6]. Therefore, questions are raised “Can dairy buffalo enterprise be a promising type of investment towards rural development and poverty alleviation? How can the improvement of the productive and reproductive performance of the dairy buffalo generate attractive investment criteria under commercial system and free market conditions?. This study aimed to estimate the criteria of investment attractiveness of commercial buffalo enterprise under free market prices and real life productive and reproductive performances. These are the annual return to the capital invested in dairy-buffalo enterprise, i.e. economic rate of return (ER) and years of capita l recovery (YCR) under free market economy.

Buffalo as a livestock is a type of investment which is affected by its productive and reproductive performances. Therefore, the investment attractiveness criteria are estimated under the scenario of the “poor-performance of dairy buffalo” and the scenario of the potential performance “Good-performance” of the dairy-buffalo from field data surveys. Impacts of improvement in both productive and reproductive traits on ER and YCR are estimated [7]. The target productive performance is the milk yield per lactation, which is a resultant of the daily milk yield and days in milk.

The target reproductive performance is the calving interval. On the other hand the calving interval is also determined by the days in milk and the dry period. The study considered the actual performance of the buffalo cow by lactation season. Therefore, adjustment of milk yield by Mature Equivalent of Milk Yield (MEM) for age and lactation season was not necessarily. As milk price is the resultant of the economic policies introduced to the economy, the sensitivity of ER of the commercial buffalo enterprise to milk price change is also analyzed. To achieve the objectives of this study, a sample survey of commercial buffalo farms was conducted and a linear model for the discounted net present value was designed and analyzed using the proper spread sheet software program.

DATA BASE AND ANALYTICAL PROCEDURES

Data Base

A cluster random sample survey was conducted in 2004 in two main provinces where the commercial buffalo farms are established (Dakahlia and Sharkia providences) located in East Nile Delta of Egypt. The survey covered the agricultural year 2003. The survey forms covered the input-output relations , operating costs, initial investment costs and revenue of each farm. Productive and reproductive performances were collected for each lactation season. The sample covered 50 farms (25 farms from each province). However it should be mentioned that the individual observations accounted the records of 850 dairy buffalo.

Methodology

The model considered that the dairy buffalo had been purchased as a pregnant heifer at the onset of the investment period of the enterprise. However, the purchase price varied according to the buffalo performance. As the model considered the productive and reproductive performance, the time value of money and estimated discount factor was based on monthly time horizon rather than the static annual discrete classical investment analysis model.

As the two major variable inputs which mainly compose the variable cost, i.e. feeds and labor, are associated with the level of production (milk yield) they are estimated as a ratio of the generated milk income per buffalo cow. To estimate the net cost for milk production, the non-milk income is deducted from the total aggregate operating costs per head. The non-milk

income composes of the calf-crop, net inventory change and manure output per buffalo cow per year. The calf-crop estimate is
Affected by the Dairy-cow performance, particularly, the calving rate and also by the rate of mortality of the rearing calves. The model assumes that the calves are sold at weaned age. Therefore, milk yield is the net output after deduction of the quantity consumed for suckling.

The net inventory change per dairy-cow was measured as the difference between the value of the cow at the beginning of the year and its value at the end of the year. The difference is expected to be a positive value, as the dairy-cow promotes from being a pregnant heifer at the purchase date (at the onset of the investment period) up to a buffalo at the first lactation season an so on. Up to the third lactation the buffalo value is expected to increase and then its value would decrease slowly up to the fifth lactation. The buffalo is sold at the closing year of its productive life, after being fattened for some months (it is considered as 3 month in this study). Accordingly, its value is expected to be higher than the purchase price. Therefore, there is no depreciation in buffalo as a capital asset. Such item is replaced by calculating the net inventory change. To deduct the net inventory change from the total aggregate operating cost or to add such value to milk income per buffalo ends up with the same impact or result within the model structure. However, for simplicity, it was treated in the designed model of this study by adding such value to the net milk income generated at each lactation.

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The Investment costs are two items (the initial investment and the purchase price of the pregnant buffalo heifer). The initial investment includes buildings, equipments, tractors and trucks and tools. The share of a dairy buffalo is calculated as an average of the sample data. It is assumed that the initial investment requires one year (12 months) for establishment. The application of the model under poor performance profile does not include automated milking stall and/or feed processing unit on farm. However, all these items and their investment costs per dairy buffalo are included under the profile of the potential performance of the dairy-buffalo It is assumed that the pregnant buffalo heifer is purchased 5 months before delivery. Therefore the gestation period of investment elapses after 17 months.

The model is a linear mathematical one that simulates the cumulative discounted net present value of a dairy buffalo head. The return to investment (ER) is the discount rate that makes such cumulative discounted net present value per dairy buffalo head equals zero. It is an economic rate rather than a financial one, because it is applied under free market economy conditions, as Egypt has passed now about 15 years towards market liberalization. The Egyptian pound (L.E.) is used as a currency unit in the study. One American dollar is exchanged for 6.23 Egyptian pounds as a free market exchange rate. The years of capital Recovery (YCR) are the elapsed number of years to recover the invested capital per dairy buffalo head.

The linear mathematical *model for one head of dairy buffalo:*

$$NPV = -INV(1+i)^{-a_0} - P_0 (1+i)^{-a_1} + Y_1(1+i)^{-(d+a_0+a_1)} + Y_2 (1+i)^{-(2d+a_0+a_1)} + Y_3 (1+i)^{-(3d+a_0+a_1)} + Y_4 (1+i)^{-(4d+a_0+a_1)} + Y_5 (1+i)^{-(5d+a_0+a_1)}$$

$$(Y_k) = (1-R)(P_m)(M_k) + V_k (P_0)$$

$$R = (NOCM)/(Aver\ Y)$$

$$(Aver\ Y) = (P\ m)(Average\ of\ M)$$

$$(NOCM) = (TAOC) - (NMI)$$

$$(NMI) = CFC + O$$

$$CFC = (CR)^* (N)(1-MR)$$

Investment Attractiveness criteria

i = (ER), when _NPV ~ zero

(YCR) = 1/(ER)

Variable definitions:

INV = Initial investment = Costs of Buildings + Costs of Equipments + Costs of Machinery + Costs of Tools
P0 = Purchase price of a pregnant buffalo heifer
(NMI) = non-milk income
(TAOC) = feed costs+ Labor costs + Veterinary costs + M&R costs + other operating costs items
(Y_k) = Milk income in lactation k
(M_k) = Milk year in lactation k
(Pm) = Milk price per Kilogram
Vk = rate of increase in the value of a dairy buffalo in lactation k.
NOCM = Net operating costs for milk
CFC = Calf-crop
CR = Calving Rate
MR = Mortality rate of rearing calves
O = Organic fertilizer value

RESULTS AND DISCUSSION

The sequence of the results of running the model is presented according to the study objectives, i.e. estimation of investment attractiveness of dairy buffalo enterprise under the profile both "poor performance", and "potential performance", and to estimate the impacts of either narrowing the duration of calving interval by one month, increasing milk yield per head per lactation by 150 kilograms, or a decrease in milk price by 10%.

Investment attractiveness under "buffalo poor performance"

The poor performance of a dairy-buffalo is identified by reproductive traits of 70% calving rate, calving interval around 17 months, due to service period about 6.5 months, and days in milk about 6 months. The associated productive traits were mortality rate of rearing calves of about 11.5%, milk yield at 1st lactation of about 1650 kilograms which reaches its peak of 1950 kilograms at the 3rd season and then decreases gradually, to 1800 kilograms at the 5th lactation. The operating cost as a proportion of the milk income is about 79.5%. Such ratio might reflect poor feed conversion ration (as the main input of the operating costs). The initial investment is L.E. 4000. The purchase price of a pregnant heifer reaches 2500, and the value of the dairy buffalo at the closing time of the enterprise was L.E.3325 after finishing for a period of three months before sale. This poor performance generated an economic return to investment of about 17.8%, which indicates 5.6 years for capital recovery.

This rate is closer to the average discount rate (18%) announced by the Central Bank in Egypt by the end of 2003. The average discount rate of 18% indicates the average return of investment generated from all types of projects in Egyptian economy. Even though, in economic term, this productivity profile of poor performance is close to the minimum feasible return to investment (17.8% versus 18%), it is considered as the switching level of productivity, i.e., less than1650 kilogram of milk at the 1st lactation and/or more than 17 months calving interval the investment in the dairy-buffalo would not be feasible (Table 1).

Investment attractiveness under "buffalo potential performance":

From some progressive herds, the profile of potential performance of a dairy-buffalo was identified by significantly higher reproductive traits than the poor performance profile. The potential performance showed a calving rate of about 79% and calving interval around 14 months, due to service period reached 3.5 months and days in milk about 8.3 months. The associated productive traits are mortality rate of rearing calves about 7.5%, milk yield at 1st lactation per dairy buffalo of about 1850 kilograms which reaches its peak of 2400 kilograms at the 3rd season and approaches 2200 kilograms at the 5th lactation and the operating cost, as a proportion of the milk income, is about 65.7%, i.e. much less than the comparable ratio of the poor performance profile (Table 1). Such ratio is a measure of the efficiency of the variable inputs response, particularly feeds. The lower the ratio, the higher is the efficiency.

Accordingly, the potential performance is much efficient than the poor one not only in milk production but also in feed conversion. The initial investment is L.E. 1100, the purchase price of a pregnant heifer is L.E. 3500, and the value of the dairy buffalo at closing time of the enterprise is L.E.46655 (after a finishing period of three months). This potential performance profile generates an economic return to investment of about 29.6%, which indicates to a capital recovery period of about 3.4 years, i.e. it saves two years as compared to the poor performance profile. This rate surpasses the average discount rate announced by the Central Bank in Egypt (18%) in the year 2003. Therefore, the potential performance of the dairy-buffalo enterprise shows a very promising investment attractiveness (Table 1), which provides enough incentives to relay upon buffalo enterprise for livestock development, milk self-sufficiency, and alleviations of poverty in rural areas.

Response of Investment Efficiency to Productivity Improvements:

The analysis shows that under the poor performance of the dairy buffalo, the investment is still fairly feasible, i.e. close to the average discount rate of 18% in the business market. However, it would be a vulnerable and volatile situation for investment attractiveness because any decrease in milk yield per lactation or an increase in the calving interval beyond what is recorded for the poor performance (Table1) would pull the enterprise to unfeasible conditions. On the other hand, under the potential performance of dairy buffalo, as shown also in Table 1, it is possible to reach a very attractive investment efficiency, i.e., the ER would reach 30% and the capital invested would be recovered within a duration of less than 4 years.

Therefore, it is important to test the feasibility of any program that can be conducted towards raising the milk yield and/or improving the reproductive performance. The model results in Table 2, showed that a reduction in calving interval by one month raises the economic rate of return of investment in dairy buffalo by about 1% (Table 2). This type of improvement could be reached via plans to reduce the length of the service period and/or increasing the conception rate and the percentage of buffalo that reached conception from the first service. Therefore, the calving interval in turn, is a function of the days open. Empirically the days open include the sum of days elapsed to reach evolution of uterus after calf delivery and the duration required for the buffalo conception (service period). The days for uterus evolution are limited to 42-60 days. However, days elapses until the successful conception is the target duration that can be decreased to the most possible minimum days. On the other hand, the nutritive and genetic improvement plans to raise the milk yield by 150 kilograms per lactation raise the economic rate of return to investment in dairy buffalo by 2%. *Investment Efficiency Response to unfavorable economic conditions*

Any fluctuation in fresh milk price at farm gate is considered an image of either favorable or unfavorable changes in

The economy. It was not necessarily to test the impact of milk price increase above the average in the market, i.e. L.E. 2.63. per 1-Kg of fresh milk, because the investment in dairy buffalo is feasible within the range of poor and potential performance. Therefore, only the impact of a possible cycle of recession of the economy is tested. Such unfavorable economic change is represented by a relative decrease in fresh milk price. Table 2 shows that a decease by 10% in fresh milk price was tested, which showed a decrease in the investment attraction by 3%. Therefore the response of investment in the dairy buffalo

Enterprise is more sensitive with respect to milk price changes than reproductive and productive performance.

Table1. Investment Efficiency of Buffalo Enterprise under both Poor and Potential Performances

Specification	Poor performance Profile	Good Performance Profile
Annual Calving rate	70.0%	79.0%
Calves mortality rate	11.5%	7.5%
Survived born calves for sale	0.648	0.69
Initial invest. Value	4000	11000
Initial invest. Period	12	12
Replacement heifer price	2500	3500
time left before 1st calving	5	5
Calvin Interval	17	14
Service period	6.5	3.5
Days in milk	180	250
% (operating cost for milk)/(milk income)	79.5%	65.7%
Total milk/head at season 1	1650	1850
Total milk/head at season 2	1790	2000
Total milk/head/season 3	1950	2400
Total milk/head/season 4	1870	2350
Total milk/head/season 5	1800	2200
Fresh Milk price (L.E./Kg)	2.63	2.63
Buffalo Value at Sale	3,325	4,655
ERR	17.8%	29.6%
Years of Capital Recovery	5.6	3.4

Source: Estimated from the sample survey data for the agricultural year 2004

Table2. Impact of Changes In Milk Price And Production Performance Of Dairy Buffalo On Investment Efficiency

Variable	Calving interval	Milk yield	Milk price
Improvement	one month less	an increase by 150 kg per lactation	a decrease by 10%
ER at poor performance	17.8%	17.8%	17.8%
ER After target changes	18.7%	19.7%	14.8%
Impact on ER change	1.0%	1.9%	-3.0%

Source: Estimated from (Table10 and application of the linear mathematical model generated by the study

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