

## Management Indicators System for a Dairy Farm with Cattle

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**Abstract.-** Management indicators systems are quantitative expressions with an organization used to measure, value and control its functioning. This paper aims to design a management indicator system for a dairy farm with cattle, based on the strategic management postulates of Fred David and on the Balanced Scorecard, in order to diagnose and evaluate its management. The study methodology consists of four phases: 1) diagnosis of the strategic concept of the organization; 2) establishment of strategic objectives; 3) proposal of the management indicator system; 4) evaluation of the management indicator system through design and simulation in a spreadsheet in Microsoft Excel. Through this methodology, it is possible to propose management indicators, their measurement, goals and corresponding objectives. It is worth highlighting the company's management commitment and direction in the formulation of the organization's strategic concept and in making the right decisions to align objectives, indicators and action plan.

**Keywords:** Management indicators, Balance Scorecard, strategic management, dairy production, cattle

### 1. Introduction

A management indicators system allows companies to obtain better performance and achieve the objectives and goals set [1], which respond to a strategic plan designed based on the external and internal analysis of the organization, in order to develop the capacity to measure, evaluate and rethink the processes developed by the company [2]. Measurement is the action capable of providing useful

information about the achievements and goals achieved to verify if the planned objectives agree with the results obtained [2] [3]. The strategic management postulates of Fred David [1] [2], and the Balanced Scorecard (BSC) management model [3] [4] [5], proposed by Kaplan and Norton, allow the companies to formulate strategies according to four perspectives. The present paper consists of the design of a management indicators system for a dairy farm with cattle; able to facilitate the decision-making process in order to represent solutions to this organization, and, also, the methodology could be applied to others functional units to detect possible problems or develop their management capacity.

The conceptual basis of the paper is based on postulates of strategic planning of Fred David [1] [2] and Kaplan and Norton with respect to BSC [3] [4] [5] [6] and, further, in information referring to dairy cattle [8] [9] [10].

### **Nomenclature**

BSC	Balanced Scorecard
SIRAL	Computer System for the Management of Dairy Breeds
%P	Calving Percentage
IPPÑ	Calving-Pregnancy Interval
IPPT	Calving-Calving Interval
DEL	Days in Milk
EPP	Age at First Calving
DCL	Average Duration of Breastfeeding
PCL	Average Production of a Breastfeeding
IN	Heifer Incorporation

## **2. Diagnosis of the strategic concept of the organization**

A diagnosis of the key aspects of the organization related to milk production was made to establish the management indicators [8] [9] [10], referring to the mission, vision, principles and values [1] [2], and, in addition, interviews were conducted with the general manager of ASOCRICA [8], the staff of the farm: the person in charge of milk production, the milking supervisor, the person in charge of feeding process, the company's accounting assistant

## **3. Establishment of strategic objectives**

Mendoza, J. and Aponte, R. [9] propose as challenges to increase national production to supply the market, to consolidate, through genetic improvement, a tropical dairy breed and productive efficiency at the lowest possible cost. They also propose: “with the purpose of increase the dairy production to supply the national market, we must strengthen the Carora breed with genetic improvement program created by ASOCRICA in a dairy breed adapted to the tropic”.

ASOCRICA has established objectives based on production indicators, which are measured by SIRAL [10]. Taking this reference and, through interviews realized with the General Manager of ASOCRICA and, in addition, as a result of a bibliographic review of similar works on the subject, the goals and objectives for the management indicators were defined and established [8] [9] [10] [11].

#### **4. Proposal for the management indicator system**

Management indicators are proposed based on the key processes related to productivity, financial performance, labor productivity, production, reproduction and growth of dairy cattle [8] [9] [10] [11]. The table 1 shows the key processes, name of the indicator, frequency of measurement, trend of the indicator, unit of measurement, objective to be achieved by the farm, objective recommended by ASOCRICA and the alarm parameters depending on their criticality: green (excellent), yellow (warning) and red (improvable).

#### **5. Evaluation of the management indicator system**

To evaluate management indicator system, a spreadsheet is designed in Microsoft Excel to process the data and measure the indicators (Table 2), highlighting the following results: the % P has a value above 85% in 2016 and 2018, while in 2017 the value was 73.33%. The DEL indicator had an excellent value in 2018, while in 2017 with the value of 179 days, it did not reach the goal, in the years 2019 and 2016 did not either. Likewise, the DCL, IPPÑ, IPPT and EPP indicators obtained values below the target value and must be improved. And finally, the PCL and IN indicators highlight, which obtained an excellent value in 2016, while in the period 2016-2019 their values have not reached the objective [8] [10] [12] [13]. Regarding the indicators of the key processes related to productivity, financial performance and labor productivity, they were measured and evaluated, however, due to the confidentiality of the data, a reference value has been highlighted.

#### **6. Conclusions**

The proposal for management indicators is the result of a bibliographic review of similar works on the subject, of interviews realized with the General Manager of ASOCRICA and with the administrative and worker staff of the farm to obtain information on the key aspects of milk production. The following results highlight in the measurement of management indicators:

- a) Productivity indicator: The quantity of liters of milk/ha was possible to measure with the records of the quantity of liters of milk per hectare of production.

- b) Productivity indicator: Average quantity of liters of milk produced per cow: 6.89 l/cow (September 2019), 7.34 l/cow (September 2018) and 8.85 l/cow (September 2017).
- c) Financial performance indicator: labor cost/l: 262 Bs/l (August 2019). It only includes personnel who work directly in milk production.
- d) Financial performance indicator: Food cost/l. In December 2018, the food cost/l of milk produced is 20 Bs/l. In August 2019, the value is 507 Bs/l.
- e) Financial performance indicator: Medicine cost/l. In December 2018, the medicine cost/l of milk produced is 1 Bs/l. In August 2019, the value is 10 Bs/l.
- f) Financial performance indicator: Total cost/l. An approach was made in this work to consider the cost of direct labor, medicines and milk freight, nevertheless, the value is conservative since it is necessary to consider additional expenses.
- g) Financial performance indicator: Unit selling price/Total unit cost. An approach was made to consider the cost of direct labor, medicines and milk freight, nevertheless, the value is conservative since it is necessary to consider additional expenses in the cost structure.
- h) Labor productivity indicator: It was measured based on liters/worker (Total milk production divided by the total number of full-time workers) and liters/milker (Total milk production divided by the total number of full-time milkers).
- i) Production indicator: Calving Percentage (% P): with the value of 86.33 % achieved the objective in 2018, while in 2016 and 2017 did not.
- j) Production indicator: Days in Milk (DEL): in 2019, until September, has not achieved the objective, 39 % of the producing cows are in < 120 production days, 18 % of the cows are between 121 – 180 production days and 43 % of the cows in > 180 production days. The DEL indicator achieved the objective in 2018 with the value of 149 days.
- k) Production indicator: Average Duration of Breastfeeding (DCL): in the period 2016 – 2019, the average duration of breastfeeding is 291, 219, 275 and 249 days, respectively, reflecting that they have not reached the objective.
- l) Production indicator: Average Production of a Breastfeeding (PCL): since January – June 2016 with 3633 liters has not reached the objective. In 2017, 2018 and 2019 have been 1595, 2549 and 2191 liters, respectively.
- m) Production indicator: Heifer Incorporation (%IN): this indicator exceeded the objective with 28% in January – June 2016. In 2017, 2018 and 2019 have been 34 %, 36 % and 17 %, respectively.
- n) Reproduction indicator: Calving-Pregnancy Interval (IPPÑ): this indicator has not reached the objective in 2016, 2017, 2018 and 2019 with an average value of 191, 227, 150 and 187 days, respectively.

- o) Reproduction indicator: Calving - Calving Interval (IPPT): this indicator has not reached the objective in 2016, 2017, 2018 and 2019 with an average value of 461, 462, 516 and 431 days, respectively.
- p) Growth indicator: Age at First Calving (EPP): ): this indicator has not reached the objective in January – June 2016, 2017, 2018 and 2019 with an average value of 44, 48, 48 and 47 months, respectively. Further, it highlights that for January – June 2019, the 72 % of the cows have had their first calving after 42 months old and the 28 % of the cows between 36 and 42 months old.

Some of these indicators present a monthly or biannual measurement frequency proposal. The frequency of related to production is biannual by recommendation of ASOCRICA; however, once the management makes the decision to monitor the indicators, SIRAL could supply the monthly information.


















It is recommended to rethink the organization and managerial direction of the milk production process based on the results of the indicators, the recommendations of the veterinarian and the experience of the management and worker personnel of the company, likewise, commitment and managerial direction are indispensable to guarantee success of this strategic plan both in external and internal diagnoses, as well as in the execution and implementation of the strategies and action plans that arise.

## References

- [1] F. David, La Gerencia Estratégica, Segunda Edición, Fondo Editorial Legis, Bogotá, Colombia, 2004.
- [2] F. David, Conceptos de Administración Estratégica, Décimoprimera Edición, Editorial Pearson Educación, Naucalpan de Juárez, México, 2008.
- [3] R. Kaplan y D. Norton, El Cuadro de Mando Integral, Segunda Edición, Editorial Gestión 2000, Barcelona, España, 2000.
- [4] R. Kaplan y D. Norton, Cómo utilizar el Cuadro de Mando Integral, para implantar y gestionar su estrategia, Ediciones Gestión 2000, Barcelona, España, 2005.
- [5] M.P. Bourne, Cuadro de Mando Integral en una semana, Ediciones Gestión 2000, Barcelona, España, 2014.
- [6] M. Luna y E. Corvaia, Sistema de indicadores para evaluar la gestión del Doctorado en Ciencias de la Ingeniería mención Productividad, REDIP, UNEXPO, ViceRectorado Barquisimeto, Venezuela, Vol. 6, No. 1, ISSN: 2244-7393, <http://redip.bqto.unexpo.edu.ve>, 2016.
- [7] R. Vargas, M. Torres-Samuel, M. Luna, A. Vilorio y O. Sandoval Fernández, Formulation of Strategies for Efficient Cadastral Management, In: Tan Y., Shi Y., Tang Q. (eds) Data Mining and Big Data. DMBD 2018, Lecture Notes in Computer Science, vol 10943, Springer, Cham. DOI:

- [https://doi.org/10.1007/978-3-319-93803-5\\_49](https://doi.org/10.1007/978-3-319-93803-5_49), Print ISBN: 978-3-319-93802-8, Online ISBN: 978-3-319-93803-5, Pp. 523-532, 2018.
- [8] Asociación de Criadores de Ganado Carora (ASOCRICA), Interpretación de los resultados de los Índices Económicos, ASOCRICA, Carora, s/f.
- [9] J. Mendoza y R. Aponte, Cómo medir y controlar los parámetros técnicos para mejorar la productividad en la ganadería. Indicadores de Gestión. IX Jornada de Producción Raza Carora. ASOCRICA. Carora., 2016.
- [10] Asociación de Criadores de Ganado Carora (ASOCRICA), Sistema Informático para el Manejo de Razas Lecheras, ASOCRICA, Carora. 2019.
- [11] A.C. Bywater, Identificación y monitoreo de sistemas de producción de leche competitivos por macrozonas lecheras en Chile, Consorcio Lechero la Cadena Lactea de Chile, <https://consorciolechero.cl> › chile › documentos › biblioteca › unamirada, 2010.
- [12] D. Anderson, D. Sweeney y T. Williams, Estadística para Administración y Economía, Alfaomega, por Cengage Learning Editores, S.A.de C.V., México, D.F., décima edición, <https://www.upg.mx/wp-content/uploads/2015/10/LIBRO-13-Estadistica-para-administracion-y-economia.pdf>, 2008.
- [13] R. Walpole, R. Myers, S. Myers y K. Ye, Probabilidad y Estadística para Ingeniería y Ciencias, Pearson Educación de México, S.A. de C.V., Naucalpan de Juárez, novena edición, [https://verenciafunez94hotmail.files.wordpress.com/2014/08/8va-probabilidad-y-estadistica-para-ingenier-walpole\\_8.pdf](https://verenciafunez94hotmail.files.wordpress.com/2014/08/8va-probabilidad-y-estadistica-para-ingenier-walpole_8.pdf). 2012.

Table 1. Proposal of the management indicators system [8] [9] [10] [11].

Key process	Indicator name	Measurement frequency	Indicator trend	Unit of measurement	Farm objective	ASOCRICA objective	Alarm parameter		
Productivity	l milk/ha	Monthly		l/cow	reference value	reference value	reference value	reference value	reference value
Productivity	l milk/cow	Monthly		l/cow	reference value	reference value	reference value	reference value	reference value
Financial performance	labor cost/l	Monthly		Bs/l	reference value	reference value	reference value	reference value	reference value
Financial performance	food cost/l	Monthly		Bs/l	reference value	reference value	reference value	reference value	reference value
Financial performance	medicine cost/l	Monthly		Bs/l	reference value	reference value	reference value	reference value	reference value
Financial performance	total cost/l	Monthly		Bs/l	reference value	reference value	reference value	reference value	reference value
Financial performance	Unit selling price/Unit production cost	Monthly		dimensionless	reference value	reference value	reference value	reference value	reference value
Labor productivity	l/worker	Monthly		lt/worker	reference value	reference value	reference value	reference value	reference value
Labor productivity	l/milker	Monthly		lt/milker	reference value	reference value	reference value	reference value	reference value
Production	Calving Percentage (% P)	Biannual		%	>85 %	>85 %	>80 %	70 % -80 %	< 70 %
Production	Milk days (DEL)	Biannual		días	around of 150 days	around of 150 days	(140 - 160) days	(120 - 140) days (160 -180) days	< 120 days > 180 days
Production	Average Duration of Breastfeeding (DCL)	Biannual		días	305 days	305 days	(305 -345) days	(285 - 305) days (345 -365) days	< 285 days > 365 days
Production	Average Production of a Breastfeeding	Biannual		(kg * breastfeeding)	>3000	>3000	>3500	3000- 3500	< 3000
Production	Heifers Incorporation (IN)	Biannual		%	25%	25%	22- 28 %	(20 - 22) % (28 - 30) %	< 20 % > 30 %
Reproduction	Calving-Pregnancy Interval (IPPÑ)	Biannual		days	102 days	102 days	(80 - 120) days	(60 - 80) days (120 -140) days	< 60 days > 140 days
Reproduction	Calving-Calving Interval (IPPT)	Biannual		days	365 days	365 days	(365 - 405) days	(330 - 365) days (405 -420) days	< 330 days > 420 days
Growth	Age at First Calve (EPP)	Biannual		month	24 -30 months	24 -30 months	(24-30) months	(30-35)months	> 35 months

6. Table 2. Evaluation of the management indicator system [8] [10] [12] [13].

Key process	Indicator name	Measurement frequency	Indicator trend	Unit of measurement	Farm objective	ASOCRICA objective	Alarm parameter			2019	2018	2017	2016
							reference value	reference value	reference value				
Productivity	l milk/ha	Monthly	↑	l/cow	reference value	reference value	reference value	reference value	reference value	s/i	s/i	s/i	s/i
Productivity	l milk/cow	Monthly	↑	l/cow	reference value	reference value	reference value	reference value	reference value	6,89	7,34	8,85	9,81
Financial performance	labor cost/l	Monthly	↓	Bs/l	reference value	reference value	reference value	reference value	reference value	262	9	s/i	s/i
Financial performance	food cost/l	Monthly	↓	Bs/l	reference value	reference value	reference value	reference value	reference value	507	20	s/i	s/i
Financial performance	medicine cost/l	Monthly	↓	Bs/l	reference value	reference value	reference value	reference value	reference value	10	1	s/i	s/i
Financial performance	total cost/l	Monthly	↓	Bs/l	reference value	reference value	reference value	reference value	reference value	s/i	s/i	s/i	s/i
Financial performance	Unit selling price/Unit production cost	Monthly	↑	dimensionless	reference value	reference value	reference value	reference value	reference value	s/i	s/i	s/i	s/i
Labor productivity	l/worker	Monthly	↑	lt/worker	reference value	reference value	reference value	reference value	reference value	s/i	s/i	s/i	s/i
Labor productivity	l/milker	Monthly	↑	lt/milker	reference value	reference value	reference value	reference value	reference value	s/i	s/i	s/i	s/i
Production	Calving Percentage (% P)	Biannual	↑	%	>85 %	>85 %	>80 %	70 % - 80 %	< 70 %	s/i	86,33	73,33	82,91
Production	Milk days (DEL)	Biannual	↔	días	around of 150 days	around of 150 days	(140 - 160) days	(120 - 140) days	< 120 days	216	149	179	116
Production	Average Duration of Breastfeeding (DCL)	Biannual	↔	días	305 days	305 days	(305 - 345) days	(285 - 305) days	< 285 days	249	275	219	291
Production	Average Production of a Breastfeeding	Biannual	↑	(kg * breastfeeding)	>3000	>3000	>3500	3000- 3500	< 3000	2191	2549	1595	3633
Production	Heifers Incorporation (IN)	Biannual	↔	%	25%	25%	22- 28 %	(20 - 22) %	< 20 %	17	36	34	28
Reproduction	Calving-Pregnancy Interval (IPP <sub>N</sub> )	Biannual	↔	days	102 days	102 days	(80 - 120) days	(60 - 80) days	< 60 days	187	150	227	191
Reproduction	Calving-Calving Interval (IPPT)	Biannual	↔	days	365 days	365 days	(365 - 405) days	(120 -140) days	> 140 days	431	516	462	461
Growth	Age at First Calve (EPP)	Biannual	↔	month	24 -30 months	24 -30 months	(24-30) months	(30-35)months	> 35 months	47	48	48	44