

## Evolution of a Murrah buffalo dairy herd under intensive rotational grazing

Otavio Bernardes, MD, water buffalo breeder  
Paineiras da Ingaí Farm, Alambari, São Paulo, Brasil  
[otavio@ingai.com.br](mailto:otavio@ingai.com.br)

### Abstract

We present the management and performance of dairy Murrah buffaloes heard kept under exploitation to progressively intensified pasture in southeastern Brazil for 43 years, highlighting their effects on animal husbandry and economic characteristics of the herd.

### Introduction

Seeking to know the effect of intensification of grazing dairy buffaloes, we compiled the data from our experience in driving a herd of Murrah breed animals exploited in the last 43 years, initially in a extensive model production and promoting successive stages of intensification of various production factors, with the implementation of a greater individual productivity of animals through selection and breeding program; whether implementing appropriate management practices (nutrition, health, reproduction); or pursuing the increased of land productivity with increased crop production of pastures and better interaction of their harvest by animals; or even increasing the frequency and mechanizing milking, etc., keeping however, most of the dry matter consumed being provided by tropical pastures.

### Intensity of exploitation

For schematic effect, we have divided our operation into three distinct phases:

**Extensive:** From 1973, with the herd kept on natural or cultivated pastures of *Brachiaria decumbens* with few divisions, in a lowland area in São Paulo state, known as the Ribeira Valley; providing as roughage supplement *Penisetum purpureum* (napier grass) or pasture deferred grazing in unfavorable times. Between 1983 and 1988, the operation was transferred to Sarapuí city, in the same state, at an altitude of about 600 meters where the herd were kept in semi-stabling, getting as roughage only fresh napier grass chopped. Without concentrates supplementation. One daily milking. Low pressure for selection (herd expansion phase). Focus selection in racial type (Murrah), reproductive capacity and health condition.

**Semi-intensive:** From 1989 to 2000, with the herd raised with *Brachiaria decumbens* pastures with improved varieties in rotationally grazing for lactating buffaloes; stocking the favorable period of about 3-4 AU / ha; roughage food supplementation *Panicum maximum* (tanzania grass) silage and cane sugar in unfavorable periods; concentrate supplementation (15-20% dry matter) for lactating animals. Two daily milking in bucket type system. Average selection pressure (about 10%) focused on the probable production capacity.

**Intensive:** From 2001. Pastures of Brizantha and MG-5 brachiarias pastures in rotational grazing for all animal categories; increasing animal stocking to 5-6 AU / ha; supplementation with roughage silage *Panicum maximum* (grasses tanzania / mombaça) silage and cane sugar in unfavorable periods; supplementation of concentrates to lactating buffaloes (5-6 kg / day) and until weaning calves. Two daily milking in pipeline system, with single file. 15-20% selection pressure based on PTA. From 2014, half of adult females kept in irrigated rotational grazing with high stocking (15-16 AU / ha) in favorable and oat over seeded (*Avena sativa*) in winter period.

### Current farm features and management

Today, the farm has total area of 120 ha, of which 65 hectares are allocated for livestock and the remaining are reserves (forests and lakes) and is located in Alambari city, state of São Paulo. It lies on the Tropic of Capricorn, the 23°38' latitude and 600 meters. Year rainfall average of 1.344 mm and 959 mm in the months of spring / summer (favorable hot period, rainy and long days), with temperature averages between 20 to 31 ° C and 385 mm of rainfall in autumn / winter (unfavorable period - cold, dry and short days) with average temperatures between 14 to 25 ° C. The occurrence of frost is possible and usually of low intensity. The soil of the region is frankly sandy, acid and low fertility. The regional native grasses are *Paspalum notatum* (bahia grass) and *Hyparrhenia rufa* (jaragua grass) but more common cultivated pastures of *Brachiaria decumbens* where the regional average capacity ranges between 0.5 to 0.8 AU / ha (production of 1, 5 to 3.0 t of dry matter / ha / year)

The areas under pastures receive every year fertilization proportional to the production of dry matter required for the estimated production capacity . From 2010 two groups with about 50 cows each and their bull were formed, divided according to kinship function aiming the production of individuals with a maximum of 6.25% of inbreeding rate, The two groups were kept in separate areas one with 15.5 ha and other with 15 ha with brizantha and MG-5 brachiaria grasses, both with 16 paddocks and had similar management as previously described. The proposed maximum capacity was 5.0 AU / ha.

### Effect of intensification on reproductive seasonality

Under extensive system of exploitation and natural mating, the reproductive seasonality, is quite remarkable, about 70% of deliveries taking place in summer, and just over 20% in the fall. The intensification of exploitation allows certain slowdown in the distribution of deliveries, reducing deliveries in the summer, with some occurrence in winter and up to 20% of deliveries taking place in advance in the spring, as shown in Chart 1 .

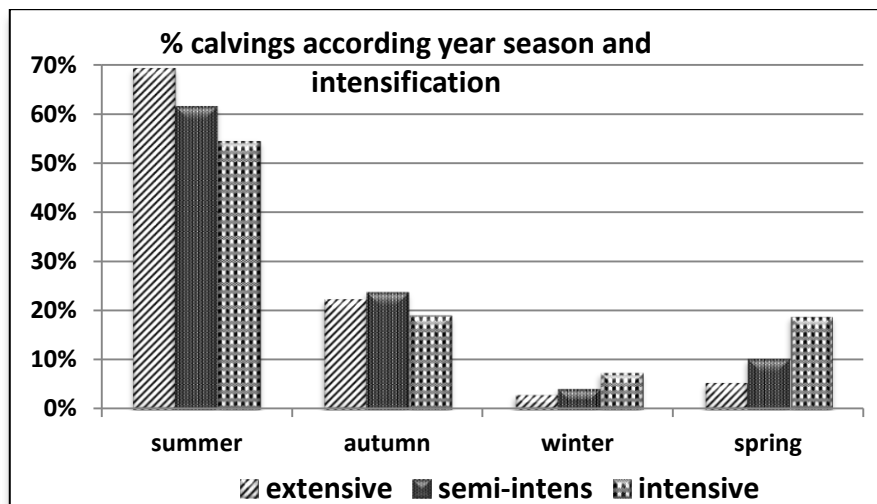


Chart 1. Calving distribution of births in the Paineiras da Ingaí Farm during the seasons depending on the intensity of exploitation.

### Effect of intensification on fertility

In table 1, it shown that with natural mating, the conception rate (percentage of pregnancies according to the number of females with 36 months or more in June each year) increased from 67% to 92% with the intensification of exploitation. In the same way, the incidence of miscarriages and stillbirths went from 2% to 6% of the matrices (highlighting that, in extensive systems may be underestimated by such incidence

greater difficulty checking). Anyway, it appears that the fertility rate, (% of term deliveries due to the number of existing adult females) has increased significantly with the intensification of exploitation, from 65% to 87%.

**Table 1. Fertility, percentage of abortions / stillbirths and pregnancy as the intensification of exploitation.**

Intensity of exploitation	Fertility rate	% abortions/ stillbirths	% pregnancies
Extensive	65%	2%	67%
Semi-intensive	80%	3%	84%
Intensive	87%	6%	92%

Paineiras da Ingaí Ranch and Farm – 1973 a 2016

The calving interval showed no significant differences due to the intensification of exploitation: average 423.6 days during the period of extensive exploration, 408.0 days in semi-intensive and 424.1 days in intensive.

### Effect of intensification on age and weight at first calving

The intensification of exploitation has significantly reduced the average age and increased weight at first calving, as shown in the next tables.

**Table 2. Age at first calving as the intensity of exploitation.**

Intensity of exploitation	age (month)	animals number
Extensive	42,5 ± 13,7 <sup>a</sup>	366
Semi-intensive	37,1 ± 6,5 <sup>b</sup>	293
Intensive	36,2 ± 6,1 <sup>b</sup>	245

Different letters in the same column represent significant differences at p<0.001

**Table 3. Weight at first calving as the intensity of exploitation**

Intensity of exploitation	weight (kg)	animals number
Extensive	475,5 ± 54,5 <sup>a</sup>	78
Semi-intensive	485,9 ± 54,0 <sup>a</sup>	257
Intensive	519,7 ± 60,2 <sup>b</sup>	229

Different letters in the same column represent significant differences at p<0.001

### Effect of intensification of calves mortality

Table 4, shows the increased mortality of calves up to 10 months with the intensification of exploitation, especially those up to 30 days of age, from 5-6% of deaths in relation to live births to 11% in the period intensified exploitation, mainly with the occurrence of diarrheal diseases and lung diseases.

**Table 4. Calves mortality according to total calvings as the intensification of exploitation.**

Intensity of Exploitation	calves born	0-300 days	0-30 days	31-90 days	90-300 days
Extensive	1.271	5%	2%	2%	1%
Semi-intensive	1.211	6%	2%	1%	2%
Intensive	1.150	11%	6%	2%	3%

Paineiras da Ingaí Farm and Ranch - 1973-2016

About deaths in the first month of life in the intensive exploration period (55% of deaths of calves from 0 to 300 days). From birth to 30 days, 25% occur in the peri-natal period until the 3rd day of life and thereafter 49% of them are between 21 and 30 days of life, emphasizing that mothers are milked after 12-15 days post partum, when suckling is restricted to one or two teats which, apparently, it is a factor predisposing to these occurrences.

### Effect of intensity of the exploitation in milk production

It is found that the buffalo have increased and significant differences in milk production during lactation between the 1st, 2nd and more calvings. Total production of lactation in each group, as shown in Chart 2, is significantly higher as exploitation is intensified, from 1.192 liters in pluriparous under extensive exploration to 2.204 in semi-intensive system, reaching 3.020 liters per lactation in a more intensive pasture farming.

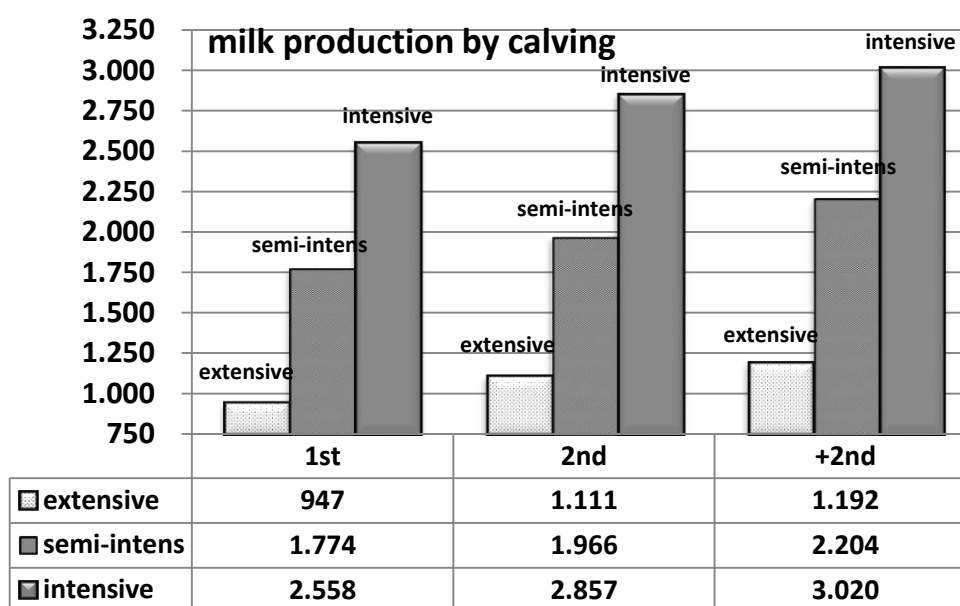


Chart 2. Average production per lactation as intensity of exploitation in first calving (1ª cria), second calving (2ª cria) and more than two calvings (+2 crias) buffaloes.

In the tables below, it is possible to observe some lactation parameters depending on the level of intensification of exploitation highlighting a progressive and expressive increase in weight at calving, in lactation duration, peak daily production and average daily production.

#### weight at offspring (kg)

Managment	1st cria	2nd cria	+2 crias
extensive	484	552	620
semi-intens	486	554	638
intensive	517	593	661

#### lactation duration (days)

Managment	1st cria	2nd cria	+2 crias
extensive	278	274	272
semi-intens	298	278	272
intensive	315	293	291

#### average daily peak milk (lts)

Managment	1st cria	2nd cria	+2 crias
extensive	4,7	5,8	6,4
semi-intens	8,3	9,9	11,3
intensive	12,1	14,1	15,4

#### Average daily production (lts)

Managment	1st cria	2nd cria	+2 crias
extensive	3,4	4,1	4,4
semi-intens	6,0	7,1	8,1
intensive	8,1	9,7	10,4

As an expression of the animals potential within each intensity of exploitation, it appears that the average performance of the best 10 productions up to 305 days and best 10 daily production peaks observed in each period were:

**Table 5. Averages of the 10 best productions for lactation and the 10 best daily production peaks as intensity of exploitation**

Intensity of exploitation	Average from 10 best lactations up 305 dias (liters/lactation)	Average from 10 best daily peaks (liters/day)
Extensive	1.865	12,4
Semi-intensive	4.165	21,6
Intensive	4.780	23,2

The lactation curves showed distinct behavior according to the intensity of exploitation, especially an earlier peak and greater persistence in more intensified regimes.

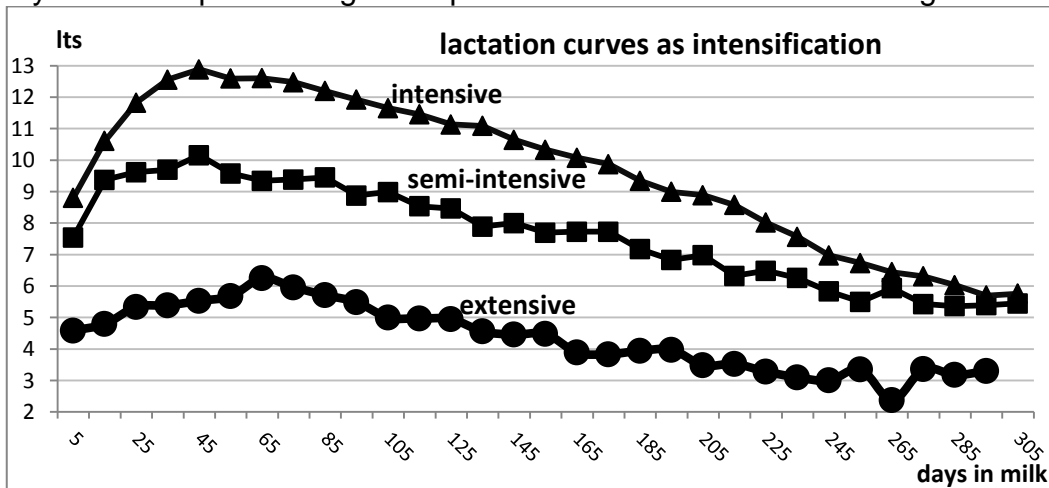


Chart 3. Lactation curves as the intensity of exploitation

### Effect of intensification in pastures support

In the intensification process, the fertilization of pastureland as a function of the stocking and the adoption of rotational grazing with more appropriate time for occupation and rest according to the type of grass used, has allowed, in favorable periods a more homogeneous supply of forages in conditions more suited to animal demand and allows for a higher stocking rate and, consequently, higher production per area. In intensive period the stocking (AU / ha) supported in favorable period under intensified exploitation reached 6.6 AU / ha in 2008 and, considering the total area, including areas intended for production of conserved forages that exceeded 4 UA / ha, highlighting that the average capacity in the region under extensive exploration is about 0.5 to 0.8 AU / ha.

The use of concentrates in the diet and the high stocking rate, still result in increased deposition of waste and better distribution in the areas of production, gradually increasing the organic matter content and improving the chemical composition and nutrient recycling resulting nutrient, in medium term, a lower demand for fertilizers per produced unit.

One of the most significant changes in the intensification of exploitation is the increase in milk volume produced by area, as it can be seen in chart 10 that compares the annual milk production average per hectare between 1989-2000 (semi-intensive farming) with production range 1,500 and 3,000 liters / hectare / year and between 2001-2015 (intensive exploitation) with production range 4,500 and 6,000 liters per hectare / year.

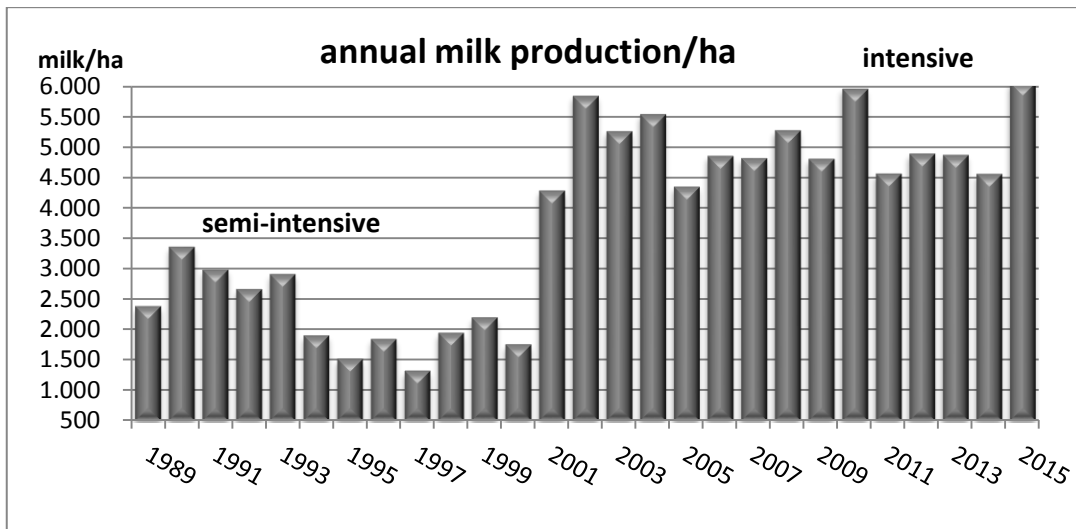


Chart 4. Annual milk production per hectare between 1989 and 2015.

### Effect of Intensification through irrigation

In 2014, an irrigation system was deployed in 5 ha area, triggered depending on the water balance (EPS system). The area was divided with one electric wire fence in 28 paddocks with 1,785 m<sup>2</sup> each one, where the animals remain 1 day, changing plot at late afternoon. Every year the area receives phosphorus fertilization, liming and potassium and nitrogen fertilizer to each output of animals based on the demand of dry matter.

Unlike no irrigated paddocks, in the irrigated plot, dried animals are kept out of the system, eventually returning to consumption of any leftover pastures. The proposed maximum capacity in this area is about 15 AU / ha, with preserved forage supplementation in unfavorable period and oat over seeded.

Another group, also with adult females and a bull is kept in 15.5 ha area with Brachiaria pastures divided in 16 paddocks where they remain for two days. They receive the same amount of concentrates. In unfavorable period they remain three days in each paddock, increasing the rest period to 45 days and in this period receive supplemental forage (silage grass and cane sugar). A nitrogen fertilization is made in 3 applications during the rainy season and adjusted the chemical fertility annually.

Regarding the supported capacity in each system, being pastures the exclusive roughage in the favorable period that extends for about 7 months of the year and complemented by pastures silage and sugar cane we verify that the non-irrigated area, stocking ranged on average from 2.4 to 4.9 AU / ha, while in irrigated area, animals were kept in a capacity between 7.8 and 15.5 AU / ha, highlighting that the stocking average for properties in the region is about 0,5 to 0,8 AU / ha.

About milk production, it was found that the average annual production per animal was slightly lower in irrigated area (-5.9%), while production per hectare was 75.5% higher in the irrigated area reaching annual production of 11,668 liters / ha / year.

Table 6. Annual production of buffalo milk and per hectare in areas under irrigation or not.

Production and productivity	irrigated area	non irrigated area
Liters milk/ animal/year	3.552	3.761
Liters milk/ ha /year	11.668	6.648

Paineiras da Ingaí Farm

## **Selection and improvement**

The herd was based on 117 crossbred females subjected to absorbent crossbreeding by pure Murrah bulls, initially direct descendants from imported origin from India and later, including descendants of this crossings. Until 2016 it was used a total of 24 bulls purchased from third parties and 51 bulls produced in the farm to produce 3,034 descendants.

In the period of extensive exploration, given the need for quantitative expansion of the herd and the lack supply of females in the country, the selection process consisted solely on elimination of animals by health or reproductive problems. Once achieved the proposed quantitative stability replacements based on milk production and racial profiling began. The female breeding value from females born in this phase was from -50 kg milk to +150 kg.

In the period of semi-intensive farming, almost all animals with phenotypic characterization of the bred, the selection process was aimed mainly milk production, evaluating the animals through the estimate of your Most Probable Producing Ability (MPPA). In the absence in the breeding market proven bulls in the market, we tested several "genealogical lines" to identify the most productive families and eliminating the lower potential. The female breeding value from females born in this phase was from +150 kg milk to +500 kg.

In intensive exploration period, we began to use the evaluation of the animals through the estimate of its breeding value (PTA), calculated by BLUP-Animal Model (ASREML software) technique, which takes into account the relationship matrix of all herd animals and includes the model factors identified through analysis of variance as a significant source of variation such as age at delivery, number of deliveries, place of production, calving season-year and, as random factors, the father and the interaction of mother-father. In order to increase the accuracy of the model, we include the production data of Laguna Farm (from Ceará state), with animal origin in our herd so, analyzing 4,864 lactation from 1,528 adult females controlled between 1983 and 2016, to calculate the individual PTA production adjusted to 305 days, trait whose heritability estimate is  $0.338 \pm 0.035$ . The female breeding value from females born in this phase is from +500 kg milk to +920 kg.

With a selection pressure from 10% in semi intensive phase to 15-20% in the intensive phase, this strategy resulted that currently, the 110 adult females are daughters of 18 different bulls (from 37 used), and its average coefficient of inbreeding is 5.5% .

## **Bibliography**

**Bernardes, O.** Produção de búfalas leiteiras. Anais do IV Simpósio de Bovinocultura leiteira (SIMLEITE) 31/10- 02/11. Viçosa-MG,Brasil, 2013. Pag. 279-316.

**Campanille, G., Bernardes,O., Bastianetto,E., Baruselli, P.S., Zicarelli,L. , Vecchio,D.** Manejo de búfalas leiteiras. Associação Brasileira de Criadores de Búfalos. 2007. 80 pags.

**Mendonça,F.C, Rassini,J.B.** Método EPS para manejo de irrigação de forrageiras. Embrapa Sudeste. Circular Técnica 63. 2009.

**Zicarelli, L** Alimentazione della Bufala da Latte. Dipartimento di Scienze Zootecniche Ispezione degli Alimenti, Faculta di Medicina Veterinaria. Universita Degli Studi di Napoli Federico II.2001

**Zicarelli, L. 2001** - Alimentação da búfala leiteira. II Simposio Paulista de Bubalinocultura – Pirassununga –SP - Brasil