Flooded Pasture Production for GRAZING buffalo in THE BRAZILIAN Amazon region

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ABSTRACT
The objective of this work was to present some important characteristics of native pasture ecosystems in flooded areas of Brazilian Amazon, used to produce buffalo milk and meat. Were presented informations about climate, soils, water, vegetation, forage production, nutritive value, animal performance and management of pasture and animals.

Key words: animal performance, flooded grasses, flooded areas, forage production, nutritive value, pasture management.

INTRODUCTION
Considering the hydrological edaphic and vegetative characteristics in Brazilian Amazon, the native pastures are classified in three main ecosystems: 1 - well drained savannas, that correspond to "campos cerrados", in their diverse gradients of herbaceous strata; 2 - badly drained savannas in their flooded gradients , whose prototype they are the native pastures of the Marajó Island; and 3 - alluvial soils native pastures, represented by the "várzeas" fields, exposed to periodic flooding regimens. It is estimated that in this region there are around 75 millions ha of native pastures, being 50 millions ha in "terra firme" and 25 millions ha in flooded land (51).
The cattle husbandry in the Brazilian Amazon region began in 1680 in the Joanes big island, called Marajo island, Para, Brazil, and lately, it expanded to the Low Amazon River region. Only from the 1970s, with the opening of the Belém-Brasilia highway and with incentives offered by the government cattle husbandry began in cultivated pastures of forest areas. Around 25 to 35 millions ha of forest areas were cleared for the establishment of pastures and agricultural plantations in the Brazilian Amazon, which has caused destruction of the cover plants, with damages to the environment.
The native pastures, as the badly drained savannas pastures from the Marajó island, are well stable ecosystems, exploited mainly for beef cattle and buffalo husbandry, in extensive system of management, during more than 300 years, with limited levels of degradation. The rational and intense use of native pastures would be able to reduce pressure of deforestation in forest land terra firme", with the pastures establishment, and to increase output of meat and milk. The native pastures of alluvial soils of varzeas have represented fundamental play in the development of bovine and buffalo husbandry in Brazilian Amazon because they have high potential of output forage of good nutritive value.

NATIVE PASTURES
In the Figure 1 is presented the geographical distribution of common native pastures that occurs in the Brazilian Amazon.

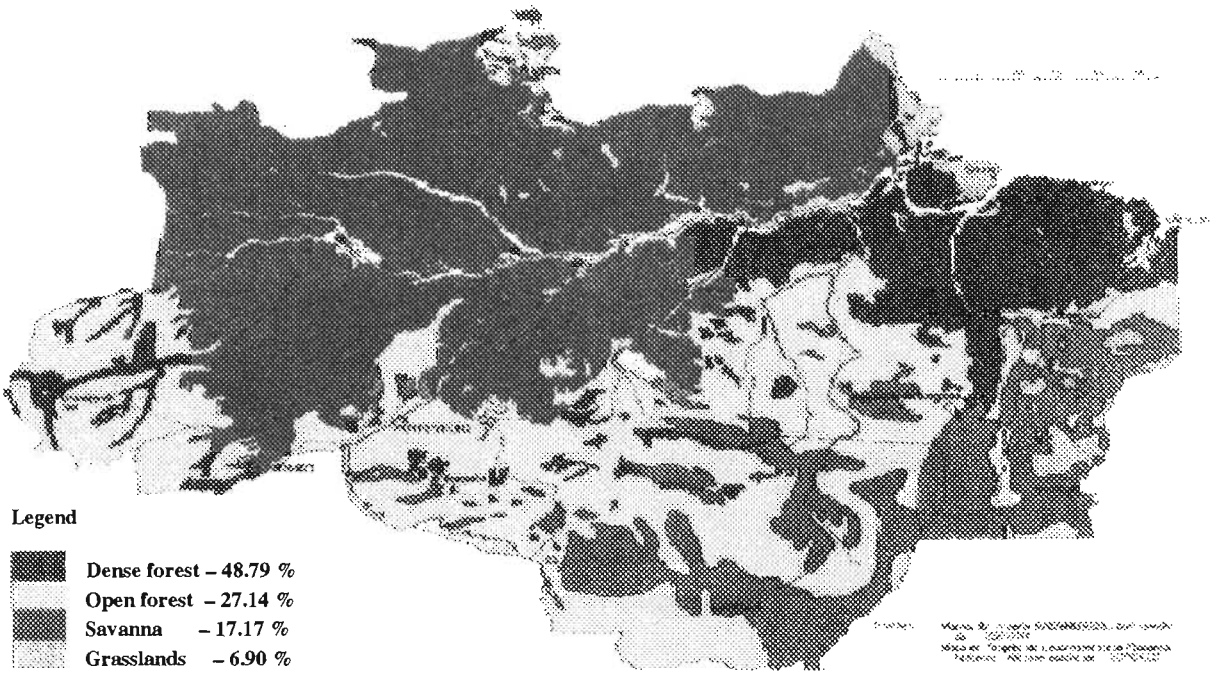

Figure 1. Geographical distribution of vegetation cover in the Brazilian Amazon. Source: (44).

FLOODED AREAS OF BRAZILIAN AMAZON REGION

The native pastures of alluvial soils of "várzeas" are located in the margins of Amazon River and its affluent, muddy lakes of water and areas of the estuary. The biggest stretches of those pastures find themselves in the sub-regions of Low and Medium Amazon River and part of Marajó island, that are the more important areas of cattle husbandry in the Pará State, Careiro Island and Altazes region, in the Amazon State, and around 11.7% of the Amapa State area, which are influenced by the muddy water of the estuary of Amazon river (53, 50).

VARZEAS ENVIRONMENT

Climate

On the basis of the climatic classification of Köppen, the great native pastures concentration of varzeas alluvial soils occurs in exposed places to the climates of Am and Aw (54). The average values of temperature oscillate between 24 and 28° C, being the maximus generally between 29 and 34° C and the minimum between 16 and 24°C. In those climatic kinds the rainy periods occur, from December to May or June, and the dry periods, in the other months of the year, with precipitation between 1,500 and 3,500 mm/year, with hydric surplus, from January to June, and deficit, from August to December. The air relative humidity oscillates from 70 to 90% and the brightness from 1,500 to 3,000 hours/year of solar bright. In the Figure 2 are illustrated the climatic datas of Santarém, Pará State, Brazil, where are locate representative native pastures of varzeas alluvial soils.

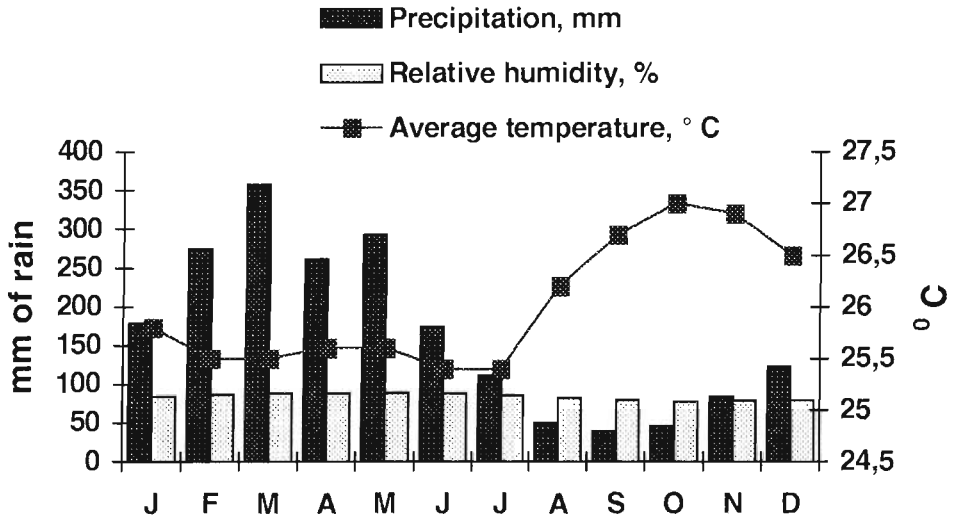

Figure 2. Climatic conditions of Santarém, Para State. Brazil. Note: Average data of 10 years. Source: (4).

Soils

In the alluvial pastures areas in typical varzeas of the Brazilian Amazon predominate the hydromorphic soils, mainly the Inceptissoils, pointing out Humic Gley and Low Humic Gley. Those soils result of the very recent sediments accumulations, that they went and they continue being carried and deposited in the occurrence areas, during of the periodic floods of the muddy rivers. The annual deposition, as occurs in the sub region of the Lower and of the Medium Amazon River, and daily, in the estuary, keep typical varzeas ecosystem soils of the Brazilian Amazon in general, with of high fertility (Table 1). That peculiarity enables to obtain high productivity of forage.

Table 1. Chemical composition of alluvial soils (0 – 20 cm)of typical varzeas of Amazon Region.

Local	$Ca^{+2} + Mg^{+2}$ ($mmol_c/kg$)	Al^{+3} ($mmol_c/kg$)	pH (H_20)	K (mg/kg)	P (mg/kg)
Monte Alegre, PA (Low Amazon)	6.0	2	5.4	230	51
Marajó, PA (Amazon Estuary)	7.4	-	4.9	168	18
Amapá. AP (Amazon Estuary)	8.2	8	5.7	147	68
Barreirinha, AM (Medium Amazon)	6.1	8	5.1	75	42

Source: (51).

Water

The quality of the water in the rivers that flood those pastures has a great influence in the output and in the nutritional grass state, that which depends on the organo-mineral sediments as nutrients source. The waters of Solimões River are richer in inorganic substances that others rivers in the Brazilian Amazon, and they are extremely muddy and carry sediments originating from the Andes fertile soils, in quantity 50 to 150 mg/l (27) and they origin the "várzeas" (Humic Gley and Low Humic Gley) and they generally have high fertility, where the pasture are in general fertile, which not even occur regarding to "terra firme" areas (Table 2). The varzea lakes receive those two kinds of waters, which proportion depends on its size and location (27).

Table 2. Minerals percentages proportions in the sediments in suspension in the waters of rivers and deposited in "várzeas" and in "terra firme" soils from the Central Amazon

Chemical characteristics (%)	Sediments in suspension	Sediments deposited	"TERRA FIRME" SOIL
Na	0.06	0.023	0.01
K	0.04	0.023	0.01
Ca	0.94	0.540	0.00
Mg	0.11	0.064	0.01
P	0.064	-	-
Fe	1.48	-	-

Source: (27), adapted by the authors.

The primary productivity of the herbaceous stratum (51), tend to be minor while the water become clearer, because the reduction in the size of the leaves and in the vigor of the grass. The soils utilization in the pastures of flooded varzeas is close related to the water river level. In the regions of the Lower and the Medium Amazon River, there is a difference in level of five meters between the driest time (November and December) and the most flooded time (May and June) in Santarém, Para State. In these regions, the period of the floods coincides with the biggest intensity of the rains and the time less rainy with the low tide of the rivers. In this time, the várzea native fields present excellent conditions for the exploitation livestock farming, where is shown up with the abundance of forage of good nutritious value. In the time of the floods, the pastures continued flooded, complicating the grazing period, which causes the loss of weight and death of animals, mainly of bovine (Figure 3).

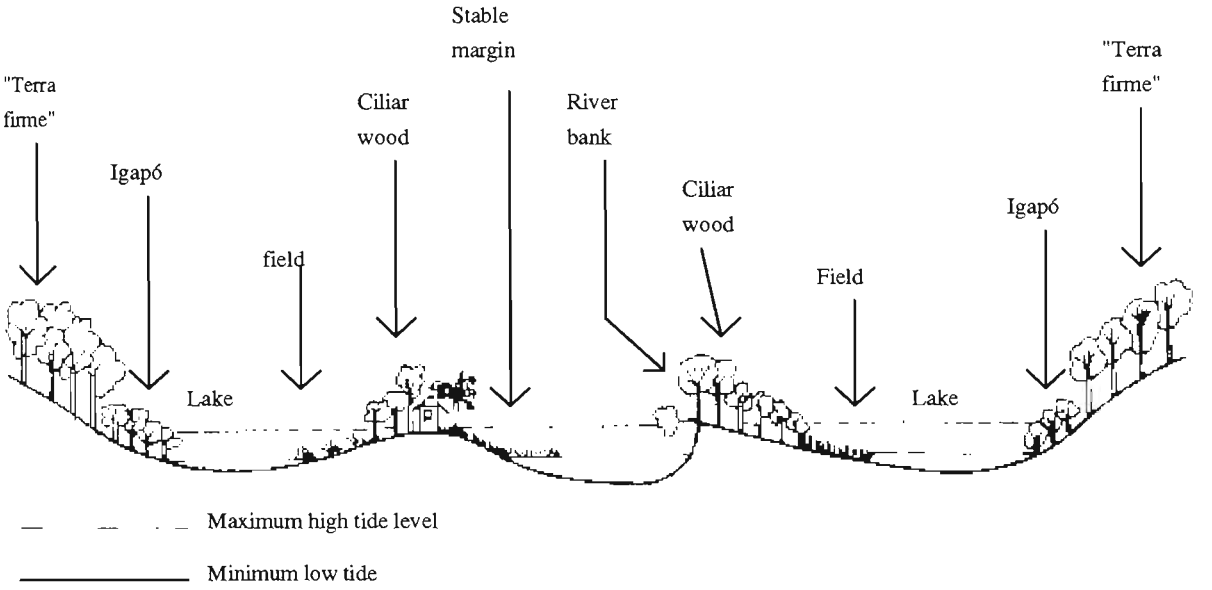

Figure 3. Section of typical varzea ecosystem occurring in the regions of the Low and Medium Amazon River. Source: (56).

Vegetation

Studying animal and food and herbaceous stratum is the more important segment of várzea vegetation ecosystems, were the grasses represent one of the components of it. The most important grass of this stratum, in terms of animal food is presented in Table 3. This species "amphibians" (6), by the fact its survive floating or even being submerse during the floods of the rivers or, still, vegetating in really dry land during the low tide of the waters. In the floods times of the rivers, that coincides with the rainy period, those grasses become inaccessible to do pastures of animals, with exception of *P. fasciculatum* because it vegetates in the more elevated areas of the "várzeas" or, on the "restingas" areas. In that time only the buffalo are able to better use these forages (13), however in the dry times these grasses become also available for the bovine (53).

There are other aquatic plants with potential forrage as *Eichornia crassipes, Ceraptoopteris pteridoides, Salvinia auculata, Pontederia rotundifolia, Pistia stratiotes, Azolla microphylla, Limnobium stoloniferum, Utricularia foliosa, Ceratophyllum demersum* and *Phyllathus fluitans* (31, 1). In the native pastures of alluvial soils of "várzeas", there can be found the legumes *Teramnus volubilis, Mimosa spp, Annulled spp, Rhinchosia minima, Galactia sp, Vigna adenantha, Vigna vexillata, Aeschynomene sensitiva, Aeschynomene rudis, Clitoria amazon, Sesbania exasperata* and *Macroptilium sp* that they are the more important for the animal food (51).

Table 3. The most important alluvial soil grass of várzea to the animal feeding.

Scientific name	Common name
Echinochloa polystachya (HBR) Hitchc[1,2,3,4 (	Canarana verdadeira, canarana fluvial and canarana de pico.
Hymenachne amplexicaulis (Rudg)[1,2,3,4] e *Hymenachne donacifolia* Nees (Raddi) change[2,3,	Rabo-de-rato, paja de água and dal
Leersia hexandra Swartz[1,2,3,4]	Andrequicé, pomonga, lambedora and barit
Luziola spruceana Benth. ex. Doell[1,2,4]	Uamã.
Paspalum fasciculatum Willd. [1,2,3,4,5]	Mori, chigüirera, venezuela grass, gamalote and bamboograss.
Oryza alta Swallen[1,2,3,4]	Arroz-bravo
Oryza perennis Moench[1,2,3,4]	Arroz-bravo
Oryza grandiglumis (Doell) Prodehl[1,2,3,4]	Arroz-bravo
Paspalum repens Berg[1,2,3,4]	Perimembeca and membeca
Panicum zizanioides H.B.K. [2,3,4]	Taboquinha.
Panicum elephantipes Nees[2,3,4]	
Eriochloa punctata (L.) Desv. Ex.Hamil[2,3,4]	
Parathreria prostrata GrisRE[4]	

Source: (6)[1]; (55)[2]; (53),[3]; (51)[4] (7)[5].

The grass (26, 49) *L. hexandra, H. amplexicaulis, O. perennis and O. grandiglumis* have the same photosynthetic mechanism of the cycle C_3, while *E. polystachya* and *P. fasciculatum* of the cycle C_4. Analyses done in 1998 by natural isotopes in samples of grass reaped in the region of the Low Amazon River and Marajó island confirmed those results (Table 4)

Table 4 - Photosynthetic cycle of várzea grass determined by natural isotopes[1].

Grass	$\delta^{13}C$	Photosynthetic cycle [2] (%)
Paspalum fasciculatum	-12,7	C_4
Echinochloa polystachya	-12,1	C_4
Paspalum repens	-11,6	C_4
Oryza sp	-29,5	C_3
Hymenachne amplexicaulis	-28,6	C_3
Luziola spruceana	-28,1	C_3
Panicum laxum	-26,6	C_3

[1]Analysis carried out at the Centro de Energia Nuclear da Agricultura (CENA) da Universidade de São Paulo, Piracicaba, SP. [2] Source: (29)

FORAGE OUTPUT

The native pastures grass of alluvial soils of "várzeas" when planted in peculiar flooded soils produced from 3.676 to 18.133 kg of DM/ha/year (47, 46, 45). That variation is done, mainly, by the climatic type, fertility level of soils, forage specie and by the flooded time of the area. Depending on the places of the area where they grew, the alluvial soils pastures of "várzeas" can

produce more than 20 t of DM/ha/year, mainly in the dry period of the year (51). The literature (30) shows that *Paspalum fasciculatum* can produce 180 t/ha of green matter corresponding to 45 t of DM/ha. That output can be achieved by the *E. polystachya*. The *O. perennis*, *H. amplexicaulis* and *P. repens* grass can produce to 10 t of DM/ha, while *L. spruceana* produces from 5 to 8 t of DM/ha. Those outputs are higher than the natives grass of "terra firme", that varied from 660 to 1.614 kg/ha (59, 15). During the evaluation (17), in the lands native pastures flooded in the Medium Amazon, during two years in two places of the Monte Alegre town (Pará), established an output by cutting varied from 2.692 to 4.722 kg of DM/ha, where the most frequent grass were *P. fasciculatum*, *P. repens*, *E. polystachya* and *H. amplexicaulis*.

NUTRITIVE VALUE

The quality of a forage is done by its nutritious value and consumption. The nutritious value depends on the chemical composition, constituted by the crude protein (CP), crude fiber (CF), ether extract (EE), nitrogen-free extract (NNE), mineral, vitamins and digestibility and the digested products nature (37). These concepts will be use for evaluating the nutritive value from the native pasture of "várzeas" alluvial soils, with the total digestible nutrients (TDN) and gross energy (GE).

DRY MATTER (DM)

The percentage of DM varies between species and with age (TABLE 5) or where grass is growing up, in over water or soil (32). The *P. repens* grasses have two ways, one that grow up over waters (aquatic) and another one that grow up on soil (terrestrial). Those two forms are peculiar in morphology and in proportion of DM. The percentage of DM is higher in grasses with mature state both in flooded, and land form areas, than in young state form. This grasses them adapts very well in aquatic environment (32). On the other hand, when they were planted on flooded soils (high varzea, low varzea, igapo and restinga), they did not persist (45, 46, 47).

Table 5. Dry matter proportion (DMP), stem length and thickness on the terrestrial and aquatic form of *P. repens*, in the Amazon as State

Parameter	Form			
	Aquatic		Soil	
	Young	Mature	Young	Mature
Dry matter (%)	4.6	14.8	22.8	29.1
Stem length (cm)	197.0	573.0	305.0	474.0
Stem thickness (cm)	0.7 – 1.0		0.2 – 0.5	

Source: (32).

The DM of *E. polystachya* and *L. hexandra* grasses in land form areas and aquatic areas (32) are not so peculiar in morphology as occurs with the *P. repens*. However, DM percentage of *E. polystachya* from the aquatic form (16.5%) is less than the land form (22.6%). The *L. hexandra* grass is a flooded land grass that presents higher percentage of DM (36.2%). However, DM is variable in function of the plants part. The grasses that presented higher proportions of DM were *L. hexandra* and *P. fasciculatum*. Medium percentage of DM in the flooded land grass did not varies when are planted in high várzea soils, low várzea, igapo and restinga (46,47).

CHEMICAL COMPOSITION

Table 6 shows chemistry composition of *Echinochloa polystachya* (canarana-de-paramaribo), in six ages of cut.

Table 6. Chemical composition (% of the DM) of the *Echinochloa polystachya* grass, in six ages of cut.

Composition	Age (days)					
	7	21	36	50	78	190
Crude protein	13.8	13.0	10.5	8.3	9.0	3.8
Crude Fiber	32.0	31.6	33.4	35.6	-	33.6
Ether extract	4.2	2.9	3.0	2.1	2.9	1.3
Ash	12.7	13.3	12.9	11.5	-	8.7
Nitrogen-free extract	37.2	39.3	40.3	42.5	-	52.7
Neutral detergent fiber	-	59.1	59.1	68.8	67.8	-

Source: (34)

The chemistry composition of the grass of varzeas alluvial soils is shown in the Table 7. The proportions of CP in grass were over of the cultivated tropical grass of "terra firme", which are situated from 6.0 to 9.0% (36). Only the proportions of CP in *E. polystachya* (6.6%), *P. fasciculatum* (6.3; 6.4; 5.8; and 6.9%) and *L. hexandra* (5.8 and 6.8%) were lower to the critic proportion (7.0%) that affect the consumption of DM by bovine (35). For the buffaloes, all of those proportions of CP situated themselves above of the critic proportion (5.2 to 5.8) necessary to have positive swing of nitrogen in the rumen (38).

Were evaluated the native pastures flooded lands of the Medium Amazon River during two years (18). The CP average proportion analyzed in 160 samples was 10.3%. The *P. fasciculatum, P. repens, H. amplexicaulis, E. polystachya, Oryza sp.*, and *L. hexandra* grasses presented respectively 6.7; 12.6; 10.8; 8.2; and 12.4% of CP. The CF proportions showed were high as the tropical cultivated grass (33.0 to 37.0%) according to the literature (36), and the of NDF (average of 70.1%) in agreement with the of the tropical grass that exceeded in 65% and that with the increase from the age of growth can reach from 75 to 80% (37). The average proportions of EE, NNE and ash of tropical cultivated grass varied respectively from 1.0 to 3.0%; 35.0 to 55.0% and 8.0% to 12.0% (8). The average percentage of DM of 23.0% showed similar to the grass DM when planted on flooded soils (46).

Table. 7. Chemical composition of aerial part of native grass of varzea alluvial soils.

Grasses	Reference	Vegetation stage	DM	CP	*CF*	NDF	EE	NNE	A	GE
E.polystachya	(16)	before flowering	-	9.8	37.5	-	2.2	42.5	8.0	-
H.amplexicaulis	(16)	before flowering	-	10.8	33.6	-	2.9	43.3	9.4	-
L.hexandra	(16)	before flowering	-	13.5	34.4	-	2.7	38.2	11.2	-
L.spruceana	(16)	before flowering	-	11.0	31.7	-	2.5	46.8	8.0	-
Oryza sp	(16)	before flowering	-	8.5	38.9	-	2.2	39.3	11.1	-
P.fasciculatum	(16)	before flowering	-	12.5	34.9	-	2.0	38.2	12.4	-
P.repens	(16)	before flowering	-	12.5	35.5	-	2.7	37.5	11.8	-
E.polystachya	(28)	-	-	6.6	-	74.0	-	-	-	4,421
L.hexandra	(28)	-	-	13.1	-	75.0	-	-	-	4,691
P.repens	(28)	-	-	9.7	-	60.0	-	-	-	4,495
E.polystachya	(27)	-	17.4	9.2	-	71.9	-	-	-	3,920
H.amplexicaulis	(27)	-	13.9	21.2	-	65.6	-	-	-	3,930
L.hexandra	(27)	-	30.3	10.4	-	77.8	-	-	-	4,920
O.perennis	(27)	-	16.1	8.1	-	66.5	-	-	-	3,880
P.fasciculatum	(27)	-	25.6	5.8	-	70.9	-	-	-	4,100
P.repens	(27)	-	16.7	9.8	-	69.2	-	-	-	3,990
P.fasciculatum	(25)	Marure	20.8	6.3	34.6	-	1.4	43.0	14.7	-
P.fasciculatum	(3)	40 to 60 days	17.7	6.4	-	-	-	-	-	3,620
P.fasciculatum	(5)	56 days	21.2	8.3	29.5	-	1.0	51.2	10.0	3,763
L.hexandra	(12)	Beginning of flowering	-	5.8	28.4	-	2.1	47.7	16.0	-
L.hexandra	(12)	**FENO**	-	6.3	31.4	-	1.5	45.9	14.9	-
L.hexandra	(24)	Non flowering	30.0	10.1	25.6	-	1.8	52.1	10.4	-
H.amplexicaulis	(58)	flowered	-	9.4	22.1	-	2.3	54.0	12.2	-
H.amplexicaulis	(58)	Feno, flowered	-	7.5	29.2	-	1.4	49.0	12.9	-
H.amplexicaulis	(58)	Silagem, flowered	-	6.9	27.8	-	1.8	45.6	17.9	-
L.hexandra	(33)	-	34.2	7.3	31.2	-	2.3	43.8	15.4	-
P.fasciculatum	(11)	-	32.0	6.9	28.3	-	1.3	48.8	14.7	-
P.fasciculatum	(10)	-	-	-	-	-	-	-	-	4,240
L.spruceana	(23)	-	-	18.8	29.1	-	-	-	12.3	-
L.hexandra	(23)	-	-	14.1	32.1	-	-	-	14.2	-
H.amplexicaulis	(23)	-	-	15.1	31.5	-	-	-	11.9	-
Average		-	23.0	10.0	31.4	70.1	2.0	45.0	12.5	4,164

DM= dry matter; CP = Crude protein; CF= crude fiber; NDF = neutral detergent fiber; EE = ether extract; NNE = nitrogen-free extract; A = Ash e GE= Gross energy

The average gross energy of 4,164 kcal/kg of DM presented by the grass of varzeas alluvial soils was lower to that shown in literature (9) of 4,477 kcal/kg of DM as medium of eighteen tropical cultivated grass, in which *Digitaria decumbens* and *Brachiaria decumbens.* The "in vitro" digestibility of dry matter (IVDM) from aerial parts of the natives grass of "várzeas" alluvial soils, varied from 22.9% to 69.9%. That large variation occurs to several factors as species, plant age, local and time. The *E. polystachya* (51.7%) and *H. amplexicaulis* (51.9%) grass showed higher IVDM and the *P. fasciculatum* (36.3%) grass was the lower. The medium digestibility of 44.9% is underestimated, which was determined only on aereal part from the plant (leaf, stem and dead material). The leaf digestibility is higher than the other part of the plants.

ANIMAL PERFORMANCES

Output of Meat

The males and females buffalo gain weight of diverse races (Table 8) show the better qualitative and productive potential of grass in "várzeas" alluvial soils. For two years the buffaloes Murrah-Mediterranean and Mediterranean exceed more in weight than the bovine, which they reach 350 kg in 2.5 to 3 years (57).

Table 8. Beef production of buffaloes in pastures with "várzeas" alluvial soil, Monte Alegre, Para State.

Race	Sex	N	Daily gain weight (kg)	Liveweight in two year (kg)
Murrah Mediterrâneo	M	9	0.572	453
	F	14	0.519	420
Mediterrâneo	M	73	0.493	394
	F	25	0.476	383
Baio type	M	95	0.416	336
	F	105	0.393	320
Jafarabadi	M	12	0.416	341
	F	12	0.403	331
Carabao	M	23	0.417	349
	F	28	0.400	332

Source: (39, 40, 41, 42, 43). N = number of observation.

In the Experimental Field of the Low Amazon River, from Embrapa Eastern Amazon, during four consecutive years, in the dry time, the quality of the native pastures of "várzeas" alluvial soils was evaluated, with some of savannas well drained and cultivated of "terra firme" through the earning of weight using bovine and buffaloes. In the pastures of "várzeas" alluvial soils evaluated with bovine, the herbaceous stratum was constituted mainly by the *L. hexandra, Reimarochloa acuta* (capim marreca) and *H. amplexicaulis* grasses, while the other evaluated with buffaloes, the botany composition was constituted by 14.3% of *E. polystachya*, 10.0% of *H. amplexicaulis*, 33.3% of *P. fasciculatum*, 22.0% of *P. repens*, 12.0% of *L. hexandra*, and 7.9% of *Oryza* sp. The proportion of CP was 13.3% and the IVDMO was 52.3%. In the native pastures of savannas well drained predominated the *Mesosetum altum* and *Axonopus purpusii* grasses. It was verified that the daily gain of weight (Table 9) varied from 0.455 to 0.763 kg/animal/day, being those variations caused, mainly, by factors hydrologic and hydric (52, 21, 22). The gain in weight obtained with buffaloes were higher than with bovines. The buffaloes also have gain more weight in native pasture of soils alluvial than in cultivated pasture of *B. humidicola*. The weight gain obtained in native pasture of "várzeas" alluvial soils are above of it in the weight gain obtained in tropical cultivated pastures of "terra firme" (37). Parallel, it was evaluated native pasture of savanna well drained with bovine, which lose it around 0.170 kg/animal/day. This shows the good productive and qualitative value of the native pastures of "várzeas" alluvial soils.

Table 9. Gain weight (kg/animal/day) in native pastures of savanna well drained (SWD) and "várzeas" alluvial soils (VAS) and in cultivated pastures in "terra firme" (CPTF) of *Brachiaria humidicola,* Monte Alegre, Para State.

Year	VAS		SWD	CPTF	
	Bovine	Buffalo	Bovine	Bovine	Buffalo
1985	0.629	-	- 0.06	0.552[1]	-
1986	0.455	0.735	- 0.116	0.589[1]	0.612[1]
1987	0.657	0.578	- 0.170	0.518[2]	-
1988	0.527	0.654	-	0.589[2]	0.666[2]
1989	-	0.734	-	-	0.516[3]
1990	-	0.693	-	-	0.527[3]
Medium	0.527	0.717	-0.118	0.562	0.580

[1]Average gain under stock rates of 1, 2 and 3 animals/ha. [2]Average gain under stock rates of 2, 3 e 4 animals/ha. [3]Average gain under stock rates of 3 animals/ha. Source: (52, 21).

The weight gain in diverse animal categories varied from 0.376 to 0.792 kg/animal/day. The weight gain obtained by buffalo of the Mediterranean, Murrah, Jafarabadi and Carabao races were, respectively, of 0.632, 0.541, 0.454 and of 0.419 kg/animal/day. Those differences were caused, mainly, by botany composition and by the availability of forage from the pasture. The Murrah and Mediterranean animals were handled in pasture where predominated, in the herbaceous stratum, good quality grass as *E. polystachya, H. amplexicaulis, L. hexandra, Oryza spp, P. repens* and presented good forage availability. In the pasture where they were located the animals from the Jafarabadi and Carabao race, the grass predominated *P. fasciculatum* that is of limited and nutritious bass value forage availability. In general the weight gain of buffalo in dry and rainy season were, respectively, 0.537 and 0.463 kg/animal/day. The buffaloes performance in all region of the Low Amazon River was enough affected by the large period without rain during the year of 1992.

Work (14), objecting to identify and evaluate the composition of the pasture and diet eaten and the buffaloes weight gain of the Baio type in native pastures of "várzeas" alluvial soils of Monte Alegre, Para State, showed that the forage availability varied from 2,851 to 4,073 kg of DM/ha and the grass more frequent in the pasture were *P. fasciculatum* (37.4%), *P. repens* (22,1%), *E. polystachya* (18.1%), *H. amplexicaulis* (10.0%), *L. spruceana* (10.0%) and *Oryza* sp (2.4%). The most consumed grass were, *P. repens* (24.9%), *E. polystachya* (24.6%). The *L. spruceana* grass was one of the most consumed until October. In December and February its participation in the diet fell for 7.12 and 9.02%, respectively due to the rain and floods of the rivers and consequently, the animals had difficulty to move around to the localities from the area where predominated grass. The *P. fasciculatum* grass of less nutritious value aimed as little consumed, so by bovine as much as by buffaloes, had good participation in the animals diet. The *L. hexandra* considered grass the most tasty and best nutritious value was very little consumed, due to little availability in the pasture.

The gain of weight was respectively 0.333; 0.678; 0.530; 0.480 and 0.677 kg/animal/day ($P<0.05$) in June, August, October and December of 1995 and February of 1996. The less gain of weight obtained in June was due to the elevated level from the water sheet of the tides of the rivers and, consequently, the animals had difficulty for pasture, though there was no forage "deficit". With the lowering of the rivers waters level during the year and the availability other of better nutritious value as *L. spruceana*, the gain increased. The best time for growing fat of the animals in this kind of pasture in the region of the Low Amazon River goes from July to December. However, there are others factors that influence in the animal performance as level of the waters of the rivers, attack of hematophagous and quantity of rain in this period. When the rain decreases, the pasture becomes dry and decreases the gain weight.

MILK OUTPUT

The buffaloes are not used intensively for commercial milk output in the Brazilian Amazon, mainly due to its limitation in exploitation, as developed in areas of flooded lands. However, at present, there are some farms which are raising these animals for milk output, in cultivated pastures of with high forage response and good nutrition values. Those areas, in general, have difficult access to the center of consumers, and they characterize itself by extensive production systems. In native pastures (19) of "várzeas" alluvial soils from the region of the Medium Amazon, buffalo females of Baio type produced in the 1st and 2nd lactation, with a milks daily rate, 1,024.57 kg, in 253 days, with a daily output rate of 4.05 kg and 8.32% of fatness, showing up that the buffaloes have good capacity to produce enough milk in this kind of pasture.

ANIMALS AND PASTURES MANAGEMENT

The grasses that consist of the herbaceous strata of native pastures in varzeas alluvial soils have high potential of output and good nutritious value. Soils are of good fertility and they keep flooded during six months pear year (January to July) receiving deposition of sediments in suspension in the waters of Amazon River and its affluent. The forage minerals are sufficient for attending the level of slaughter weight of the animals. In the region the animals are not supplemented and there is no

new of possible minerals deficiencies occurred in the pastures of "várzeas" alluvial soils. Therefore, the biggest problem is the flooding of the pastures by the waters of the rivers.

The livestock farming is a very important activity for the socioeconomic development of the micro-regions of the Low and Medium Amazon River, where the bovine populations and buffaloes add 781 thousand heads (48). Predominate, in the region, bovine creation mixed race from the Nelore, Gir, Indubrasil and Guzerá races and buffaloes from the Mediterranean race. The birth average is 60%. The animals mortality indices until 1 year and from 1 to 2 years are 13 and 4% respectively (57). The bovine are slaughtered with 34 months of age and average weight of 353 kg. The buffalo are sold with 27 months, weighing 420 kg (2).

The native pastures of "várzeas" alluvial soils have represented fundamental importance in the development of raising of bovine and buffalo, by having high potential of output and good nutrition values. Those pastures can be better used in dry season. In the flooding time that coincides with the rainy one, the farms retain the animals from "várzeas" or keep on elevated corrals, named "marombas", feeding them with cut native grasses , but with small livestock..

Another alternative is to withdraw the cattle from the "varzeas" and lead them to "terra firme" and put them in native pastures areas of savannas well drained of covered or in pastures cultivated fields of *Brachiaria humidicola*, as a pasture-integrated system. This system showed the good economical and productive performance in the buffaloes termination, which permits the alive animals reach 450 kg of weight under two years old (Table 10).

The productivity in the "terra firme" can be increased substantially through the intensive rotation management system, using good pastures management, high potential genetic animals, control of weeds and fertilization with nitrogen, phosphorus and potassium. In Belém, Para State, bovine Nelore race, in *Brachiaria brizantha* with pressure of grazing from 4.1 to 4.6 animal units (A.U.= adult weighing 450 kg)/ha/year revealed a daily weight gain of 0.510 kg/animal and a gain of weight/ha/year of 852 kg. With buffaloes from Murrah race in pastures of *Panicum maximum* cv. Tobiatã were obtained the gain of weight of 0.800 kg/animal, achieving 500 kg of weight in 18 months, with pressure of pastejo of 3 to 5 A.U/ha/year getting 1000 kg/ha/year, with liquid prescription of US$ 166.40/ha/year (US$ 1.00 = R$ 2,50), value that exceeds in eight times those obtained in the livestock output system from the Brazilian Amazon (20).

Table 10. Parameters of output in integrated systems of native pastures of "várzeas" alluvial soils and cultivated "terra firme".

Parameters (kg)	System 1	System 2	System 3	System 4
Flooded soil (168 days)				
- Initial weight	199.5[a]	189.4[a]	210.0[a]	175.7[a]
- Final weight	322.2[a]	327.8[a]	319.1[a]	-
- Daily weight gain/animal	0.730[a]	0.824[a]	0.650[a]	-
"Terra firme" (196 days)	-	-	-	-
- Initial weight	322.2[a]	327.8[a]	319.1[a]	-
- Final weight	453.2[a]	448.2[a]	427.1[a]	-
- Daily weight gain /animal	0.669[a]	0.615[a]	0.551[a]	-
- Daily weight gain /196 days	131.1[c]	241.0[b]	324.1[a]	-
Total experiment period (364 dias)	-	-	-	-
- Initial weight	199.5[a]	189.4[a]	210.0[a]	175.7[a]
- Final weight	453.4[a]	448.2[a]	427.1[a]	320.3[b]
- Daily weight gain/animal	0.697[ab]	0.711[a]	0.596[b]	0.397[c]

System 1 - native pasture of varzeas alluvial soils and pasture cultivated of *B. humidicola* in "terra firme", under stocking rate of 1 animal/ha; System 2 - similar to the system 1, in the stocking rate of 2 animals/ha; System 3 -Similar to the system 1, in stocking rate of 3 animals/ha; and System 4 - traditional, only native pasture of "varzeas" alluvial soils. Average followed by the same letter in the horizontal do not differ statistically, according to Tukey test, level P<0,05. Source: (22).

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