BRAZILIAN ANIMAL HUSBANDRY, REGIONAL CONVERSION FACTORS - A NEW PROPOSAL

Pedro Ramos[1]

ABSTRACT - This paper discusses many important aspects of animal husbandry in Brazil, especially bovine husbandry. It proposes new regional conversion factors denominated in standard animal-units to assist in determining the level of land utilization by animal herd owners (cattle ranchers, dairy farmers, sheep herders, etc.). These proposed conversion factors will allow for the creation of various indexes of holding capacity per unit of land. Due to agrarian reform provisions contained within the Brazilian Constitution, ranches that do not achieve a minimum level of land utilization may be reduced in size through expropriation.

Key words: Animal husbandry in Brazil, land utilization, husbandry conversion factors, indexes of holding capacity.

INTRODUCTION

This work is a modified version of research carried out by the National Institute for Colonization and Agrarian Reform, INCRA, conducted to support the 1988 Constitutional mandate permitting the confiscation of under-used agricultural land. INCRA's research evaluated ranch land use efficiency using general conversion factors denominated in animal-units. In this paper, we will propose new conversion

[1] Professor at Economics Institute/University of Campinas, Brazil. Address: Cidade Universitária, Campinas, SP, Brazil, 13083-970. P.O. Box 6135.

factors which are adjusted for both regional differences and animal age. The animal-unit is a reflection of various animal specie's food needs and an indicator of pasture land hectare requirements for the maintenance of these animals.

The proposal presented here was developed using bibliographical investigation, field research, and interviews with professors, producers, producer association representatives, technicians, professionals, and other specialists involved with the Brazilian animal husbandry industry. This research also incorporates contributions and comments from technicians working for INCRA.

Although it is not emphasized in our research, the differentiated taxation of property based on a land use basis, as stipulated in Brazil's new Agricultural Territorial Tax legislation (ITR), is now a Federal responsibility and no longer under the control of the INCRA.

AN OVERVIEW OF BRAZILIAN BOVINE HUSBANDRY

Bovine husbandry is one of the foundations of Brazilian agricultural production and has played an important role in opening the Brazilian frontier. In addition, throughout Brazilian history cattle ranching has led to other types of livestock husbandry activities.

The data presented in table 1 shows that in 1985, "other" livestock represented less that 7% of the total livestock population in Brazil. The number of other livestock shrank from about 10% to 6.8% relative to the number of cattle over the period 1970-1985 (the "golden" phase of the Brazilian farm modernization) (Economics Institute/ University of Campinas, IE/UNICAMP 1993, p. 13).

Table 1 - Number and Distribution of the Cattle and Other Livestock in Brazil - 1985

	BOVINE	OTHER	% of	1970-	1985
REGIONS	udx1000	udx1000(*)	BOVINES	Bovine/ha	
North	8966	781	92.0	0.39	0.43
Northest	22391	3233	87.4	0.50	0.64
Southest	35742	2160	94.3	0.42	0.58
South	24827	1466	94.4	0.88	1.16
Center-west	36116	1064	97.1	0.31	0.61
BRAZIL	128042	8703	93.6	0.51	0.71

Source: FIBGE, Agricultural Census of 1970 and 1985.
(*) Refer to buffalo, horses, asses.

Today, technicians and producers recognize that two factors contributed strongly to the expansion of Brazilian bovine husbandry throughout Brazil. The first was the introduction, crossing breeding, and genetic improvement of the Zebu cattle breeds which began at the end of the last century and accelerated after the 1920's. This led to the expansion of the Nelore breed of Zebu cattle in the 1960's. Nelore cattle usurped the earlier predominance of the Gir and Guzera breeds.

Second, the introduction of new types of land cover which increased the productive capabilities of pasture land. In the early 70's, the introduction of Braquiarias simplified planting of pasture areas in most of Brazil. However, semi-arid conditions in Brazil's Northeast prevented Braquiarias growth. Researchers at the Agricultural Center for Semi-Arid Tropic Researches (CEPATSA in Petrolina, Pernambuco) discovered that a specific plant, Capim Buffel, could be used as a pasture crop in the semi-arid regions of the Northeast. This created even more usable pasture land in Brazil.

As shown in table 1, only in the South region is the number of bovine per ha greater than one. In 1970, the land use rates were found to be the highest in the regions which had been settled the longest, the Northeast, South and Southeastern regions (IE/UNICAMP, 1990). By 1985, the Center-West, a newly opened border region, had a higher number of bovines per ha than did the Southeastern region. This demonstrated that the large, focused, government subsidy programs in action since the second half of the 1960's had spurred development in

this vast area of the Brazilian frontier. This subsidy program was geared to replicate a historic Brazilian land use pattern – the creation of large farms and ranches (Furtado, 1972). Governmental support of this historic land use pattern was a cause for great social controversy and led to the creation of INCRA.

Although international comparisons must be made carefully, it is important to recognize that productivity indicators for Brazilian cattle ranches are still very low when compared with international standards or with a great majority of competing countries (Vieira & Farina, 1987; Mielitz, 1994; Zoccal, 1994). This is because Brazilian cattle ranching employs an extensive tropical cattle production system in which the natural conditions prevailing in pasture areas play an important role in bovine husbandry. In this tropical productive system, the animals only feed is what they get by foraging for available grasses growing in low nutrient level tropical soils.

Several specialists argued that the available data set (especially, 'official' data) on Brazilian cattle ranching tends to underestimate. This would be reflected by an underestimation of the capacity indices (bovine/ha) presented in table 1, and implies that there is more efficient cattle ranch land use than the data shows. This underestimation may occur because of illegal, unreported slaughter and marketing to avoid taxes. However, this underestimation is only an opinion, and a great many other specialists assert that FIBGE data is good enough.

There are also reasons to believe that the numbers of cattle/ha is overestimated because of the threat of land expropriation stemming from federal land use requirements. The land owners are responsible for providing land use information as the government is hindered from compiling all the necessary data by budgetary considerations. It is clear that the source of all data must be examined in order to determine the likelihood of over or underestimation.

If requested to give an opinion on the Brazilian cattle production system, the specialists we interviewed invariably considered the system inefficient or, at best, that system efficiency could be improved. Even considering the constraints imposed by natural conditions, yields per hectare could be greatly improved if available technologies were implemented.

The press has spread a more critical vision of Brazil's animal hus-

bandry industry, specifically the beef production sector and its productive methods. This is evident in the following citation, "Perhaps as result of its own greatness, the sector has always been able to avoid disruption by calling itself a traditional activity. The sector has always had strong patrimonial support, and, over the years, has been legitimized more for being a shield against the inflation than for its specific productive performance." (Cerri, 1997:74).

It is important to emphasize that the Brazilian animal husbandry industry has very low yield indices per area of land occupied, and that should be considered by the public sector as they move toward an effective agrarian policy. This is a situation which must be changed; either productive indices must increase or the land put to better use. A legal remedy should be put into place to insure that this change occurs; unfortunately, this legal remedy is not available.

THE CONVERSION FACTORS

The Standardization and Use of Capacity Indices: The "Animal-Unit"

The best gauge animal production efficiency is arrived at by measuring the amount foods ingested by the animals over a specific time period in a known area which is transformed into proteins for human consumption. This measurement can be used to determine the quantity of meat or milk per ha/year. Furthermore, something analogous is valid for agro-industrial production efficiency measures in general as the basis of agro-industrial complex efficiency is kilograms of sugar/ha/year. This type of estimate is untrustworthy in Brazil because the quality of the data is affected by the data collector's awareness of INCRA's "capacity index." (see Freitas, Indicadores de produtividade da pecuária do Rio Grande do Sul)

For the time being in Brazil, there is no other data that can be used without causing bigger controversies and relying on even less trustworthy data. This is recognized by technicians, producers, and others interested in animal husbandry productivity measures. These agents restrict themselves to contrasting the numbers that serve as a basis for

the production indices. This is made clear in the Agriculture Federation of Rio Grande oo Sul's document dated 06/28/1994, which was sent to the Minister for Agricultural and Agrarian Reform. In paragraph 2 of the "technical considerations," they write that "it is basic that capacity is not an indicator of productivity in beef production," and we request an "animal load adjustment so that we can measure productivity and sustainability in cattle production." Yet, the indices of capacity per unit of area may be an indispensable indicator of the efficiency or inefficiency of land use. As new production technologies come into use this indicator may be more than adequate to measure the effect of the implementation of any new technological innovation.

However, the argument has been raised that technological improvement implies additional production costs, which lead to higher consumer commodity prices. This argument ignores a primary teaching of economic science: gains in yield can more than compensate for higher monetary outlays for production. There is a need to search for greater productive efficiency based on cost-benefit analyses'. Various combinations of resources are possible to spur efficiency increases, and Government incentives can motivate technological development.

Even though the final product may become more expensive, some action must be taken to improve land use efficiency; the discussion has moved beyond the hypothetical. Efficient land use has becomes part of the Brazilian distributive conflict and is now the basis for all agrarian reform debates. Brazilian land is no longer the abundant factor; the resource is in demand by all levels of society. Appropriate, efficient land use policy must be developed if Brazil is to escape from the vicious cycle of poverty and inequality that has marked its history. Brazil is no longer a country of abundant land; and it cannot remain a country of rudimentary technology, low utilization/productivity, low costs, low prices, and low wages. The inescapable fact is that land is not a reproductive resource; it will not grow. The conflict between the haves and the have-nots has begun, both in demand for land and in demand for higher wages; the conflict is in the open and it is serious.

Data arrives in many formats from many sources and must be standardized to be useful. In this study, conversion factors are used to arrive at one standard measure, the animal-unit (au), which allows comparisons to be made between different species and different animals of

the same species ("Vantagens e limitações dos índices de lotação," I.E./ UNICAMP, 1990).

Table 2 is the table of factors used for conversion to animal-units. This type of conversion table was also used also by Arruda & Sugai (1994), and it is the most well known conversion procedure in this field of research. It was first used in 1933 by a German researcher and is currently used by CNPGC (National Research Center for Beef Production, EMBRAPA, Campo Grande-MS) and by CPATSA (Center for Tropical Semi-Arid Agricultural Research).

Both the general and proposed conversion factors, expressed in animal-units, appear in table 3. One animal-unit corresponds to an adult bovine weighing 450 kg, an equivalent animal of this species (but of different age), or an equivalent animal of another species. The animal-unit is then adjusted to reflect weight differences. When discussed in interviews with specialists, this procedure was found acceptable. The general factors used in this research are those used by UNICAMP (Reports I.E./UNICAMP, 1990, 1993). The general and proposed conversion factors, are presented without consideration of regional differences; this will be analyzed and adjusted for in a later section. The following paragraph explains why our proposed conversion factors, second column of table 3, can assist in determining capacity indices more accurately than the general conversion factors used in previous research. After adjustment for regional variation our proposed conversion factors will become an even more accurate measure and a more useful tool.

As can be seen in table 3, the proposed animal-unit value, the conversion factor, was different from the prior animal-unit value only in the case of oxen and other animals. The proposed reductions in animal-unit value are due to a hypothetical average herd composition adjusted for animal ages. Each herd must contain some younger and therefore smaller animals. In the case of the equines, this reduction was minimal as they need for more food per unit of land.

Table 2 - Factors of Conversion of Live Weight (PV) in Metabolic Weight (PM) and Animal-Units (AU)

PV	PM	AU	PV	PM	AU	PV	PM	AU
5	3.34	0.03	240	60.98	0.62	530	110.46	1.13
10	5.62	0.06	250	62.87	0.64	540	112.02	1.15
15	7.62	0.08	260	64.75	0.66	550	113.57	1.16
20	9.46	0.10	270	66.61	0.68	560	115.12	1.18
25	11.18	0.11	280	68.45	0.70	570	116.66	1.19
30	12.82	0.13	290	70.27	0.72	580	118.19	1.21
35	14.39	0.15	300	72.08	0.74	590	119.71	1.23
40	15.81	0.16	310	73.88	0.76	600	121.23	1.24
45	17.37	0.18	320	75.66	0.77	610	122.74	1.26
50	18.80	0.19	330	77.43	0.79	620	124.25	1.27
60	21.56	0.22	340	79.18	0.81	630	125.75	1.29
70	24.20	0.25	350	80.92	0.83	640	127.24	1.30
80	26.75	0.27	360	82.65	0.85	650	128.73	1.32
90	29.22	0.30	370	84.36	0.86	660	130.21	1.33
100	31.62	0.32	380	86.07	0.88	670	131.69	1.35
110	33.97	0.35	390	87.76	0.90	680	133.16	1.36
120	36.26	0.37	400	89.44	0.92	690	134.63	1.38
130	38.50	0.38	410	91.11	0.93	700	135.09	1.39
140	40.70	0.42	420	92.78	0.95	710	137.54	1.41
150	42.86	0.44	430	94.43	0.97	720	139.00	1.42
160	44.99	0.46	440	96.07	0.98	730	140.44	1.44
170	47.08	0.48	450	97.70	1.00	740	141.88	1.45
180	49.14	0.50	460	99.33	1.02	750	143.32	1.47
190	51.18	0.52	470	100.94	1.03	760	144.75	1.48
200	53.18	0.54	480	102.55	1.05	770	146.17	1.50
210	55.17	0.56	490	104.15	1.07	780	147.59	1.51
220	57.12	0.58	500	105.74	1.08	790	149.01	1.53
230	59.06	0.60	510	107.32	1.10	800	150.42	1.54
			520	108.89	1.11			

Source: Embrapa-Centro Nacional de Pesquisa de Gado de Corte, Campo Grande, MS.

Note: PV in kg, $PM = PV^{0,75}$; AU = n^{th} PM/97,70.

The State of Rio Grande oo Sul's Federation of Agriculture suggests a ratio of 1.25 adult horses per 1.00 cow (FARSUL, October/ 1991). They estimated that a pregnant cow or one suckling a calf has food requirements corresponding to those of an adult bull.

The alimentary habits of certain animals should be taken in to account in order to improve the accuracy the conversion factors. Furthermore, each type of animal is better fitted to live in different climates and in different regions. Goats are less demanding than cattle and sheep in the type of vegetation they consume.

Table 3 - Conversion Factors to Animal-Units

Animal Category	Reports IE/UNICAMP- AU	PROPOSED AU
Bovines		
-Cow age 2 or more years	1.00	1.00
-Bull age 2 or more years	1.00	1.00
-Working bovine	1.00	1.00
-Calf 2 years or more	0.75	0.75
-Castrated cattle	0.75	0.75
-Calf 1 and 2 years	0.50	0.50
-Calf less that 1 year	0.25	0.25
Other animals		
-Buffalo	1.25	0.90
-Horse	1.00	0.90
-Ass	1.00	0.70
-Mules	1.00	0.70
-Sheep	0.25	0.12
-Goat	0.25	0.12

Source:IE/UNICAMP, July/1993 (Índices de Rendimento da Pecuária), Cattle Breeding Yield Indices, Empirical Results.

Factor Adjustment by Region

Brazil is a country of enormous regional contrasts The country's regions have different climates, soil compositions, topography, etc. These differences cause changes in regional land use capabilities and capacities. As the related ambient diversity in Brazil is very large, land use potential may change within small areas, even within the same ranch or farm. Obviously, the conversion factors cannot be adjusted for all these natural regional and local differences; the available information is insufficient and the number of possible combinations of climate, soil, and topography is immense.

The use of one of the few works on the regional variation in the Brazilian cattle husbandry industry can be of assistance. Table 4 is based on this research and shows some the relevant regional data as it refers to cattle. Although this work is based on the farming census of 1980, the authors data gives an indication of the problem's scope.

Informal criterion were used to break Brazil down into these various regions. Regions were created "based on similar climatic type, soil type, natural vegetation, relief, geographic position, altitude, agrarian structure, bovine density, the herds main purpose, the technological phase of the predominant husbandry activity, annual herd taxes, growth of the head, and expansion of pasture area. The grouping of microregions obeys vicinity criterion, aiming at the formation of typical contiguous conglomerates, called homogeneous production regions." (Arruda & Sugai, 1994).

Table 4 - Brazilian cattle producing regions - 1980

Regions	Capacity Indices(*)	Past.p/farm(ha)	%Cult.Pasture
1.Western Amazonia			
-Acre	0.87	99.1	74.9
-Upper Solimões	0.92	35.0	37.4
-Roraima	0.16	758.3	5.1
-Manaus	0.75	118.2	33.8
-Madeira	0.41	186.5	72.7
2.Eastern Amazonia			
-Santarém	0.65	108.9	41.7
-Tapajós-Xingu	0.47	370.0	76.5
-Amapá	0.20	299.4	6.6
-Belém	0.43	230.6	25.3
-Araguaia	0.43	265.7	74.0
3.Central-West			
-Rondônia	0.26	115.6	67.8
-N.Matogrossense	0.22	1513.0	34.7
-Cáceres	0.41	649.2	39.9
-Pantanal North	0.25	945.6	12.5
-Rondonópolis	0.30	654.2	35.7
-Pantanal South	0.35	2993.0	14.8
-Upper Taquari-Bol.	0.33	952.8	42.9
-C.Grde.-Dourados	0.64	634.7	67.4
-Tocantins	0.18	426.4	16.3
-Upper Tocantins	0.41	432.2	41.0
-Goiás	0.45	295.8	38.7
4.Northeast			
-Western Baiano	0.28	141.7	36.4
-Maranhão	0.53	71.1	46.9
-North Piauiense	0.47	30.3	7.1
-North Cearense	0.57	53.3	1.1
-Gado-Algodão	0.43	58.0	3.9
-Mata e Agreste	0.73	31.3	51.7
-Sertão	0.35	52.6	19.4
-Reconcavo Baiano	0.52	59.8	54.1
-Serra Geral Bahia	0.46	78.6	41.5
5.Southeast			
-Triang. Minas	0.84	244.6	66.0
-Northeast Minas	0.28	364.6	19.7
-Montes Claros	0.50	181.1	50.4
-Médio Jequitinh.	0.43	142.7	34.9
-Itapetinga-Valad.	0.67	204.3	38.8
-Apper S.Francisco	0.46	141.2	14.5
-Western SP-Paraná	1.10	173.2	86.6
-Araraquara	0.83	149.2	63.2
-Região Leiteira	0.63	72.8	16.2
6.South			
-Colonial	1.17	20.3	42.9
-Campos Gerais	0.55	71.6	29.2
-Campos de Vacaria	0.52	140.1	9.0
-Lit.Catarinense	0.98	26.7	31.2
-Campanha Gaúcha	0.80	153.4	7.2
Average-Brazil	**0.53**	**129.6**	**34.7**

Source: Arruda & Sugai, 1994, pp. 16/7. (*) = adult Animals per ha.

In table 4, climatic variation and natural resource endowment are used as the basic criterion for regional differentiation. Arruda & Sugai, the table's authors, chose these measures because variables such as soil fertility, vegetation, water resources, etc. are difficult – or even impossible – to quantify. Other factors, such as farm area and available financial resources would also affect the data presented in table 4's. Some regions ranchers have more financial resources, and some regions lend themselves to larger farms. Wealthier farms may have a higher animal density as their pasture lands may be better tended and larger farms may have a lower density of cattle per hectare.

A major constraint when modeling these numbers is found in the their huge variation. The capacity index varies in significantly within the same macro region. In the case of table 4's Southeastern macro-region, the capacity index varies from 0.28 ad/ha (adult animals/ha) in Minas Gerais' northwestern region to 1.10 ad/ha in West S.Paulo-Paraná. This variation within macro-regions is found in the two table's other indicators. Nevertheless, the criterion used to generate table 4's homogeneous micro-regional boundaries follows FIBGE's 1980 guidelines.

Huge intra and inter regional variation was also detected by Mielitz (Mielitz, 1994, 94). After he analyzed FIBGE's homogeneous micro-regions, he concluded of that "even in this limited universe of producers, a huge intra and inter regional heterogeneity is observed; and that certainly would increase if the data from other places in the country were examined ...." Searching for interregional comparisons, Mielitz detaches the highly modernized beef cattle production system in São Paulo from 1975-1985, and the opposite extreme, Rio Grande do Sul's cattle production technology which used "lower zootechnical methodology" (Ibid., p. 97). He also calls attention to the enormous heterogeneity in farm size found in Brazil's bovine husbandry industries.

The cattle milk yield is another example of Brazilian regional heterogeneity (Zoccal, 1994). In two of São Paulo state's main milk producing areas, milk production/cow differed greatly. A cow in the Campinas area produced in average of 1,461 liters of milk per year in 1990, while a cow in the São José do Rio Preto area produced only 641 liters/year in 1990. Although contrasts in climate and natural resources exist between these two areas, one cannot attribute such a great yield differential to just these two factors; some consideration must be

given to bovine breed and technological differences (climate in São Paulo, Pedro Junior et al., 1990). However, there is no information available on either subject to help adjust conversion factors.

Another indicator of regional to climate and productive technology variation can come from the herd "slaughter rate." An estimate of this rate is presented in table 5. However, those numbers present smaller dispersion than those in the previous tables.

Table 5 - Estimated Cattle Slaughter– Tri-Annual Averages ,1991/93

REGION	TONS PROD/ HERD TONNAGE.	NUMBER. PRODUCERS/TOTAL.
North	20.3%	18.4%
Northeast	19.6%	17.0%
Southeast	22.1%	18.2%
South	22.7%	18.6%
Center West	21.0%	19.6%
BRAZIL	21.6%	18.8%

Source: ANUALPEC94, FNP Consultoria & Comércio, São Paulo,SP, pp.202/3.

We believe that an adjustment of the conversion factors to reflect regional differences based solely of the average weight of the animals in any region is justifiable. This parameter that would allow the creation of relative coefficients in each producing area which would reflect the combination of regional differences, i.e: type of vegetation, climate, pasture plants, etc. Many other specialists we interviewed pointed out that weight/animal is actually an ideal method for estimating regional differences with regard to cattle. The need remains for new research to collect and refine the animal weight data.

A Proposal for use of Factors Adjusted by Region

Several specialists we interviewed distinguished only two great cattle regions: one located in the Center and South and another in the North

and Northeast. In the Center-South super region the bovine husbandry industry applies modern technological methodology. Many ranchers shifted operations from other, more technologically advanced south-eastern states to the states of Mato Grosso do Sul and Goiás which are also within the Center-South super region. Unfortunately, defining Brazil by using only these two super regions one must the North's rain forest canopy and savanna and the Northeast's semi-arid conditions to be equal.

To avoid this problem and maintain the proposal for super regions, we opted to separate Mato Grosso do Norte from the Center-South region and include it in a new North region. A different adjustment was applied to Northeast Region which will be commented upon later.

Technical specialists made estimates of the "average weight" of adult animals in each region; and we arrived at the following animal-unit factors adjusted by region:

- Center-South (minus Mato Grosso do Norte): 450 kg (a.u.=1.00)
- North (+ Mato Grosso do Norte): 400 kg (a.u.=0.92)
  Northeast: 350 kg (a.u.=0.83)

It seemed necessary separate some of areas within these super regions due to extremely atypical climatic, topographic, and economic conditions. Table 6 is a synthesis in which these intra-regional differences are included in the proposed super-regional adjusted animal-unit values.

The first atypical mini-region is the Jequitinhonha Valley in the Southeastern super-region. Natural conditions in that area make it practically equal to the semi-arid Northeast; the Valley is part of the "Drought Polygon," as defined by SUDENE. The Northeast region's Zone of Mata (Woods) is the second atypical mini-region. The natural conditions in that vast area are alien to the semi-arid conditions in the rest of the super region. Thus, the Northeast was redefined to include only arid areas and the "zone of transition;" the "Wasteland." (Andrade, 1973; Melo, 1978) The third atypical mini-region is Mato Grosso's wetland area where temporary droughts and "flooding restrict the feeding of the cattle" and create "severe restrictions to the adoption of technologies need to create more efficient production systems." (Arruda

& Sugai, 1994:43)

Two species in two regions deserve special consideration when creating conversion factors. Sheep husbandry, of both of domestic and imported breeds, is a very important industry in Brazil's far south where semi-intensive production systems are often in use. Given the feeding requirements of these animals, the assignment of a considerably higher conversion factor than the one shown in table 3 is justifiable.

In Brazil's extreme Northeast, goats are a economic mainstay. They are capable of using to advantage the Northeast's sparse selection of plants and survive in those harsh semi-arid lands. It is therefore justifiable to reduce the goat conversion factor from that shown in table 3. CPATSA's researchers use a conversion factor of seven goats per cow but admit to a practical relationship of ten to one. This relation can be expressed in another way: if a cattle demand 13 hectares of bush per animal, one goat needs 1.5 ha.

Table 6 presents our proposed conversion factors adjusted for regional differences. Our conversion factors account for the diverse natural conditions under which Brazil's animal husbandry industries operate. We believe that the use of regionally differentiated factors is more appropriate than the use of general factors. This, however, should not be interpreted as an endorsement Brazil's land use policy. These regional adjustments must not impede the implementation of technological advances to improve efficiency across this industry. We could continue this discussion but that might become an interminable bore.

Table 6 – Regional Conversion Standards In A.U.

k	F (*)	F1 (**)	F2(***)
Bovines			
-Cow age 2 or more years	1.00	0.92	0.83
-Bull age 2 or more years	1.00	0.92	0.83
-Working bovine	1.00	0.92	0.83
Cat. Animal	Center/South(-Mt)	North(+Mt)	Northeast
-Calf 2 years or more	0.75	0.69	0.63
-Castrated cattle	0.75	0.69	0.63
-Calf 1 and 2 years	0.50	0.47	0.42
-Calf less that 1 year	0.25	0.23	0.22
Other animals			
-Buffalo	0.90	0.83	0.74
-Horse	0.90	0.83	0.74
-Ass	0.70	0.64	0.59
-Mules	0.70	0.64	0.59
-Sheep	0.15	0.14	0.12
-Goat	0.13	0.12	0.11

(*) Except the area of the Valley of Jequitinhonha and the Pantanal of Mato Grosso do Sul, whose factors should be equal to those in the Northeast;

(**) Except the Pantanal region of Mato Grosso do Norte, whose factors should be equal to the Northeast

(***) Except for the Zona da Mata area, whose factors should be equal to the North region (+ Mato Grosso do Norte).

Source: The author, based on field research.

FINAL COMMENTS

The proposal presented here took into consideration some important aspects of Brazilian cattle husbandry and some of the problems encountered when comparing and determining yield per hectare. In our research we attempted to create a conversion factor which could be used as an instrument to quantify reality. This conversion factor is presented as part of a solution for the operational and/or methodological difficulties that must be addressed before the Constitutional agrarian reform mandate can be effectively implemented. Although one can suggest alternatives to and refinements of our proposal, we have

attempted to be consistent and fair. Hopefully, the difficulties we encountered in arriving at a fair conversion factor will not hinder indispensable, necessary governmental action.. This research has presented some of the criteria which can be used justify a heavier tax burden on property owners who use their property in ways which are incompatible with the land itself. Taxation can increase the amount of land available for land redistribution programs.

Finally, those discussions within this paper which concentrated on the constraints we encountered in arriving at our proposed conversion factors should not invalidate the procedure applied by INCRA.

ACKNOWLEDGMENTS

I am thankful to Profs. Luiz Carlos Guedes Pinto and Bastiaan P. Reydon, my colleagues at the IE/UNICAMP; the technicians of the INCRA, Silvia Elizabeth de C.S. Cardim, Elizabeth Prescott Ferraz and Gilbert Bampi; those who commented the first version of the text; as well as the review's helpful referees.

REFERENCES

ANDRADE, M.C. de. *A Terra e o Homem no Nordeste*. S.Paulo, Ed.Brasiliense, 1973, 3a. ed.

ANUALPEC94, Anuário Estatístico da Pecuária de Corte. FNP-Consultoria & Comércio Ltda., S. Paulo, 1994.

ARRUDA, J.de A. e SUGAI, Y. *Regionalização da Pecuária Bovina no Brasil*, Embrapa, Brasília, 1994.

CERRI, C. "Pecuária-Manejo aponta um novo ciclo". In *Globo Rural*, Ed.. Globo, RJ, Março 1997, pp. 73-84.

CORREA, Afonso S. *Alguns Aspectos da Pecuária de Corte no Brasil*. EMBRAPA/CNPGC, Campo Grande-MS, 1983.

CORREA, Afonso S. *Sistemas de Criação de Gado de Corte Predominantes no Brasil*. EMBRAPA-CNPGC, C. Grande, 1989.

FARSUL-Federação da Agricultura do Estado do Rio Grande do Sul, *Considerações Técnicas*, Porto Alegre, 28/06/1995.

FARSUL-... *Capacidade de Suporte de Campo Nativo no Rio Grande do Sul*, Porto Alegre, Out./1991.

FREITAS, Claro L. de, *Indicadores de Produtividade da Pecuária do Rio G.do Sul*, Porto Alegre, s.d., mimeo.

FREITAS, Claro, L. de, *O Cálculo do Efetivo Pecuário*, Porto Alegre, s.d., mimeo.

FURTADO, C. *Análise do "Modelo" Brasileiro*. Ed. Civ.Brasileira, R.J., 1972.

IE/UNICAMP, *Indices de Rendimento Utilizados como Parâmetros no Cálculo do ITR*. Convênio MIRAD-FECAMP,Campinas, Janeiro/1990.

IE/UNICAMP. *Índice de Rendimento para o Cálculo do Grau de Utilização e Grau de Eficiência na Exploração da Terra*. Campinas, Julho/1993.

MELO, M.L. de. *Regionalização Agrária do Nordeste*. Recife, SUDENE, Série Estudos Regionais, 1978.

MIELITZ, C. *Modernização e Diferenciação na Bovinocultura de Corte Brasileira*. IE/UNICAMP, Campinas, 1994 (tese doutoramento).

NASCIMENTO, J.do et alii, Zoneamento Ecológico da Pecuária Bovina do Estado de S.Paulo. In B. *Indústr.anim.*, SP, 32(2):185-237, jul./dez. 1975.

PEDRO JUNIOR,M.J. et alii, Aptidão Climática para Plantas Forrageiras no Estado de São Paulo. In B. *Técn. Inst.Agron.*, Campinas, 139, 1990, pp. 1-14.

PEIXOTO,A.M. (Ed.) *Bovinocultura Leiteira-Fundamentos da Exploração Racional*, FEALQ, Piracicaba, 1986.

PEIXOTO,A.M. (Ed.) Indices de Produtividade da Pecuária de Corte. In *Bovinocultura de Corte-Fundamentos da Exploração Racional*, FEALQ, Piracicaba, 1986, pp. 1-21.

VIEIRA, C.A. e FARINA, E.M.M.Q. *Pecuária Bovina Brasileira-As causas da crise*. IPE/USP, São Paulo, 1987 (Relatórios de Pesquisa).

SUGAI, Y. et alii. Análise Espacial do Gado de Corte no Brasil. In CONTINI, E., et alii. (orgs.). *Alimentos, Política Agrícola e Pesquisa Agropecuária*.EMBRAPA, Brasília, 1989.

ZOCCAL, R. *Leite em Números*, EMBRAPA-CNPGL/FAEMG, B. Horizonte, 1994, 131 p.