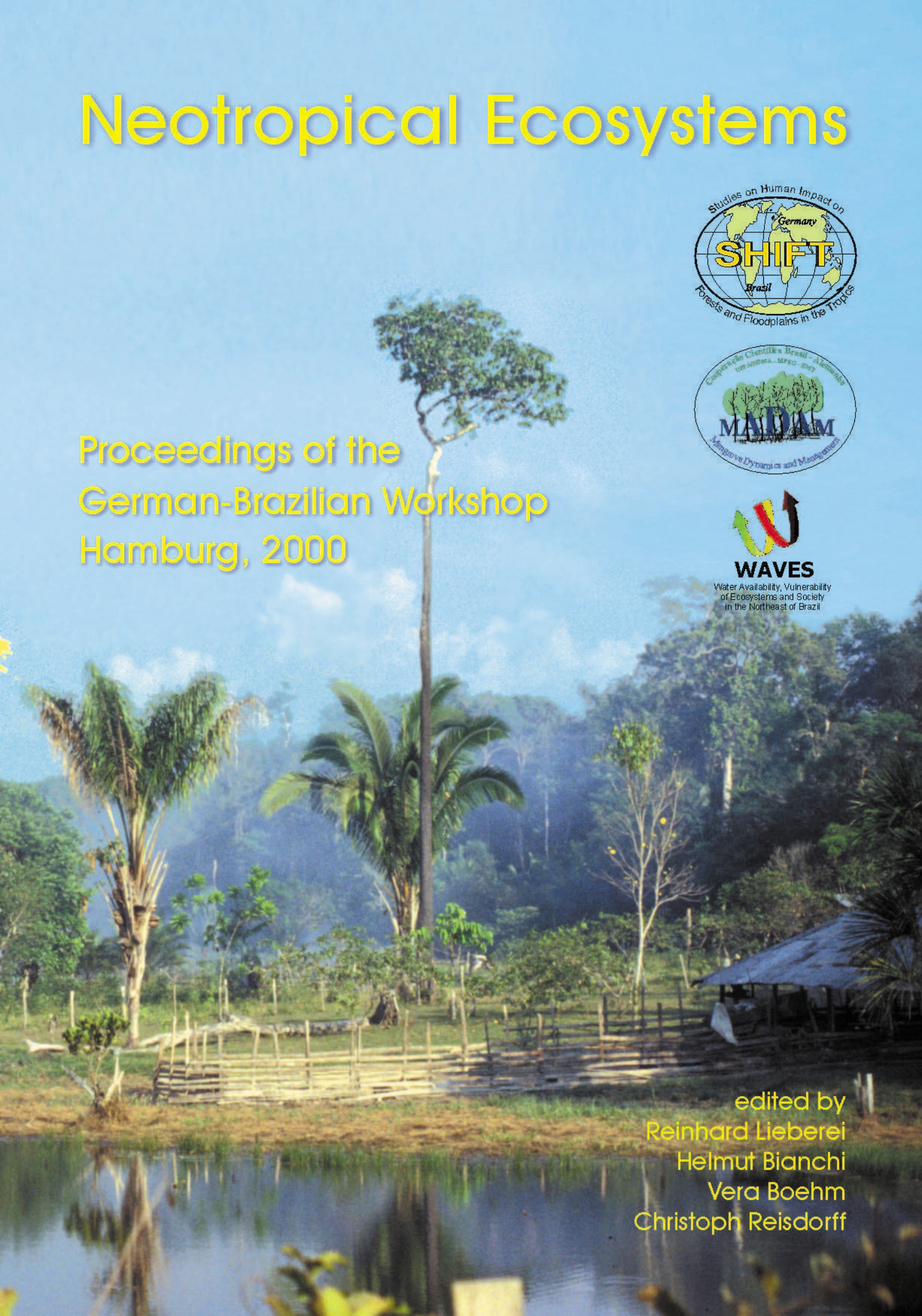
Neotropical Ecosystems



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Reinhard Lieberei
Helmut Bianchi
Vera Boehm
Christoph Reisdorff

Editors Reinhard Lieberei [1], Helmut K. Bianchi [2], Vera Boehm [1], Christoph Reisdorff [1]
[1] Universität Hamburg, Institut für Angewandte Botanik, Ohnhorststr. 18, 22609 Hamburg, Germany
[2] GKSS-Forschungszentrum Geesthacht GmbH, Max-Planck-Straße 1, 21502 Geesthacht Germany

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The Response of the Smallholder Farm to the Introduction of Cattle in Eastern Amazon: the Case of the Bragantina Region

Siegmund-Schultze, M.[1], Rischkowsky, B.[1], Nielsen, S. N.[2], Veiga, J. B.[3], Tourrand, J.-F.[4] and King, J. M.[1]

[1]Universität Göttingen, Göttingen, Germany, [2]The Royal Danish School of Pharmacy, Copenhagen, Denmark

[3]Embrapa Amazônia Oriental, Belém, Brazil, [4]CIRAD, Montpellier, France

Abstract

Small farmers on "terra firme" in the Bragantina region (Eastern Amazon), have increasingly started to keep cattle only since the last 20 years. This region, a 100-year-old agricultural "frontier", shows a high dynamic and diversity in the farming systems, but the core activity has remained slash-and-burn cultivation of cassava with subsequent processing of flour. The more recent introduction of cattle and pasture raises the question how it affects the pattern of resource use within the farm. A household survey including about 40 small farmers in three municipalities of the Bragantina region has been realized to identify the corresponding changes in the farming system and determine the economic benefits from cattle husbandry.

In most cases pastures are established directly after the cultivation of annual crops, thereafter the land used for pasture is nearly completely excised from the agricultural cycle. This can lead to scarcity of fallow land needed for later crop production. The labor demands of land preparation and the planting of pasture compete directly with cropping activities. Maintaining pasture is of a more complementary nature, whereas the care for the animals demands a continuous labor input. In case of need, the cattle herd is a quicker and easier source of large amounts of cash than the cropping activities. The increasing complexity of the whole production system allows for new patterns of product use and a different allocation of production factors but requires a more sophisticated management. The economic analysis has not yet been completed but will clarify which benefits from cattle are driving and if cattle husbandry achieves a higher labor productivity than cropping as often assumed in literature.

Keywords

Cattle, Smallholder, Production factors, Production system, Bragantina region, Brazil

1 Introduction

1.1 Cattle rearing as one element in the complex Amazon farming systems

Small farmers provide 80% of the total food production of Amazonia. The land use patterns show a high diversity and complexity. SCATENA et al. (1996) observed, 23 distinct annual cropping patterns in the 100 fields surveyed in Santarém (West of Pará). They suggested that the selection of fallow length and cropping sequence is subject to the following general constraints:

- the productivity of the land as determined by soil, water and climate;
- ecological requirements and risks associated with particular crops;
- land availability and costs of site preparation and treatments;
- availability of hired labor;
- age structure of the families, their subsistence requirements and preferrences for particular crops, (animals), leisure and non-farm-related production activities;
- local economic conditions including land values, access to credit and non-farm-related employment, and the conditions of commodity markets.

Given these constraints, the farmer has several options to optimize agricultural production and general household utility (according to SCATENA et al.):

1. varying the length of fallow;
2. varying the types and sequences of crops that are planted following a given period of fallow;
3. modifying the clearing and cultivation practices;
4. improving subsequent yields by managing regeneration within a fallow;
5. developing diversified land use systems that contain combinations of pasture, perennials, semi-permanent annuals, areas of extractive reserves and true shifting cultivation;
6. increasing production through the use of external inputs like fertilizer, irrigation and farm machinery.

SCATENA et al. stated a long-term land use strategy that uses a variety of fallow lengths and cropping sequences, but also a trend to shorter fallow periods because of reduced costs of site preparation. These savings compensate the reduced production. Reduced fallow periods are also reported elsewhere (DENICH, 1989), but explained differently: due to population pressure and thus land shortage. HURTIENNE (1999) draws the attention to the various changes in cropping pattern, that had already occurred over time especially in Bragantina region, and favors a cyclic model of changing production systems and thus fallow periods.

Farming systems are changed by varying management, as shown for annual cropping, but also by introducing new components, namely crops or animals (ref. option 5). Smallholders normally start farming with annual crops. Later they might introduce other annual or perennial crops and/or keeping of animals. Subsequently this paper deals with the introduction of cattle to the existing farming systems.

Rearing of large ruminants in Pará started on flooded areas. First corrals for buffalos were built on Marajó island at the end of 17th century, gaining in importance in 18th century, as well as cattle rearing at the margins of the Amazon river and in the region of Bragança/Viseu/Quatipuru (TEIXEIRA, 1953). On "terra firme", the non-flooded areas, cattle husbandry is of a much more recent date. Only just in the last 20 years there has been an important increase in land use for pastures and number of cattle in Bragantina region.

In recent pioneer frontiers like Redenção (frontier of the 1980s, South of Pará), cattle husbandry is very frequent, in Uruará (frontier of the 1970s, Transamazônica) 61% of the farmers own at least one cow, perhaps due to the origin of the new settlers from the South, where cattle husbandry is frequent (TOURRAND et al., 1998). CONTRARILY, VILAR & COSTA (1998) showed for Capitão Poço (frontier of the 1940s, Northeast of Pará) that investments in cattle occurred primarily in farms with relative abundance of land. Also, if labor is scarce, the relative preferrence for cattle over perennial crops is higher (47%) than in farms with labor abundance (27%) (see Tab. 1).

An economic simulation for a very successful smallholder in Marabá (frontier of the 1970s, Southeast of Pará) shows a better gross margin of labor from cattle production (3.50 US$/labor day) than from rice production (2.70 US$/labor day), while one day of hired labor costs 2 US$ (TOPALL, 1991). It is also reported elsewhere (TOURRAND et al., 1996), that labor productivity of cattle rearing appears to be higher when compared to other agricultural activities.

1.2 Farming in the Bragantina region (old frontier)

Bragantina region shows a heterogeneous land use. This is not new, various activities, especially crop cultivation, are reported to have signed periods of the past, and this is going on. Crops that were planted commonly in the past and suffered afterwards a decline are, e.g., mallow for fiber (*Urena lobata*), rice (*Orzya sativa*), black pepper (*Piper nigrum*) and cotton (*Gossypium spp.*). Phytosanitary problems or a drop of market price defined the end of these cultivation periods. The options of the farmer to adapt the production system to changing circumstances are various and the predominant pathways differ by subregion. Nevertheless, cassava production (*Manihot esculenta*) is still the core activity in the research area.

Pasture establishment started to increase only at the end of the 70ies/ beginning of the 80ies. Productivity of planted pastures on "terra firme", non-flooded areas of Amazon region, is generally considered as low. The establishment and maintenance of pasture in the humid tropics are not easy because of relatively low soil fertility, especially lacking in phosphorus, and the rapid regrowth of the secondary vegetation suppressing the planted grass species. Drying up of grass in the drier season increases the occurrence of accidental fire. Looking at the farming system as a whole, pasture takes away land from the cultivation cycle of cassava and other annual food crops. Once the pasture is established it is supposed to be a permanent land use and the area will not be returned to the land reserves with secondary vegetation, regenerating the soil for later use.

Groups according to production factor abundance	Cattle/pasture (US$)	Perennial crops (US$)	Total (US$)	Cattle/pasture (%)
- labor + land	96,194.40	107,618.48	203,812.88	47
+ labor + land	108,003.50	292,089.24	400,092.73	27
- labor - land	8,581.10	115,927.62	124,508.73	7
+ labor - land	17,135.30	145,032.85	162,168.15	11

Source: adapted from Costa, 1995

Tab. 1: Investments in cattle/pasture and perennial crops in Capitão Poço (Aggregated values up to 1993, n @120)

Considering these problems of pasture there is a contradiction in the ecological and economic benefits from the introduction of the new component pasture and cattle into the small farmers' production system. Therefore the objective of this paper is to analyze the changes in the farming system when cattle are introduced. The farm is analyzed as a whole or as a system, as it is practice in ecosystem analysis or economic total budgeting of a farm. Different hierarchical levels, namely farm and regional level, are considered to identify favoring and inhibiting factors for introducing cattle.

2 Material and Methods

In the research area, information about small farmers without cattle is already available; meanwhile detailed data on small farmers rearing cattle is almost scarce. Therefore a monthly survey of about 40 households was realized recording all ins, outs and internal transactions of all agricultural activities of the farm during one year.

The fieldwork was carried out in three distinct municipalities in order to represent different circumstances of the research area, which involves about 7800 km^2 and 27,700 farms. The municipality of Igarapé-Açu stands for high dynamics of perennial cropping. Bragança/Tracuateua represents a more traditional municipality with important annual cropping sector. As municipality with emphasis on pasture establishment, promoted by extension service, São Miguel do Guamá was chosen.

Farmers keeping cattle representing the prevailing types of land use (pasture and annual crops, pasture and perennial crops, pasture and annual and perennial crops) were selected according to following criteria:

- up to 100 ha;
- pasture plus cropping;
- predominantly non flooded land;
- administration by farmer's family and living on the site;
- manpower mainly by member of family.

3 Results and Discussion

3.1 Households and cattle husbandry in sample

Characteristics of the surveyed smallholder farms are compiled in table 2. As there is often more than one household using the same farm area, the mean of area was calculated per household (44 ha), which on average has 5 members. More than half of the farmer in the sample have a rather diversified land use system, including pasture, annual and perennial crops (25 of 41 farmers in the sample). The combination of pasture with only perennial crops is the least common land use type (only 2 farmers). Sixty percent of the farmers have already claimed short- or long-term credits. Off-farm income is also rather common, but in general it reaches only an important value in form of a pension, being equal to one or more minimum salary (151 R$ since May 2000).

Table 3 gives a summary of the cattle production sector of the studied farms. Cattle rearing in the sample (crossbreds) is predominantly oriented to meat production, milking is less important and traction non-existent. The farmer sell principally adult animals in the neighborhood. The price, normally per kg live weight, is either fixed by weighing, using the balance of a neighboring big farmer, or by visual estimate. The mean herd size is 16 heads, with a mean of 7 female adults per herd. Nearly every herd, even the little ones, is served by a bull, which is replaced at the latest when first daughters reach sexual maturity. Mean pasture size is 13.5 ha, with *Brachiaria humidicola* and *B. brizantha* as dominant grass species in monoculture. Most of the farmers have two or more paddocks, but often they don't use them separately over the whole year. As access to water can be a problem in the less rainy season, the farmer opens all paddocks to facilitate watering. Cattle are supplemented with minerals or pure salt. Nearly two thirds of the farmers rent extra pasture for some months. If this pasture doesn't belong to someone of the family or a good friend, they have to pay a relatively high amount per head and month, ranging from 3 to 5 R$. Sometimes, the payment is done through the construction of a fence or solely work days. In general, the smallholders cattle production is characterized by intensity of land use and extensity of management.

n=41 farmer	Mean	Range	%
Households per site	2	1-12	
ha per household	44	3-100	
Members per household	5	1-9	
Land use types:			
annual crops + pasture			34.1
annual crops + pasture + perennial crops			61.0
pasture + perennial crops			4.9
Households that already used some type of credit			60.9
Households with active off-farm income			14.6
Households with old age pension and/or allowance			43.9

Tab. 2: Characteristics of cattle farms in sample

3.2 Effects of introduction of cattle and pasture to the existing production system

The introduction of pasture and cattle is affecting the allocation of the production factors, as well as the products deri-

n=41 farmer	Mean	Range
Herd size	16	2-71
Female adults per herd	7	1-40
Pasture size (ha)	13.5	1.5-48
Dominant pasture species:	*Brachiaria humidicola, B. brizantha*	
Feeds:	pasture grass and minerals / salt	
Farms with additional rented pasture:	63 %	
Breeds:	"Misturado" (crossbreds from Nelore, Gir, Holstein, Simmental,...)	
Production type:	meat, milk less important, traction non existent	
Commercialization:	predominantly adult animals in neighborhood	

Tab. 3: Cattle production in sample

ved by the farm. Annual crops - primarily cassava, corn (*Zea mays*), cowpea (*Vigna unguiculata*) - are cultivated in a traditional cyclic land use. Pasture, as well as perennial crops, enter in the system at the end of one production cycle, already planted in the cassava field before total harvest or afterwards. Pasture can also be planted (or sown) directly after slashing and burning capoeira (secondary vegetation), sometimes at the beginning intercropped with corn or rice. Afterwards, pasture continues excised from the cyclic system and constant (see Fig. 1).

The smallholders' annual demand of land for pasture seems to be generally higher than for perennial or annual crops. But when taking in account the land demand over time - including fallow to regenerate the soil for later use - then the figures look different. In the sample, the average farm in Igarapé-Açu has 39 ha, cultivates 2.7 ha cassava per year using a nearly 10-year-old capoeira. This farm needs already 29.7 ha for cassava production. Subtracting 0.3 ha for the house and the house garden, there are only 9 ha left for other use. This amount is enough to plant perennial crops, which in mean cover 2.2 ha of the farm. Keeping cattle needs in general more land. Calculating with a mean pasture size of 14.4 ha for Igarapé-Açu, then the area preserved for cassava production has to be reduced, normally resulting in a shorter fallow period, and probably negatively affecting the yields. On the other hand, often the farmers do not limit themselves to their own area; but rent additional pasture or a capoeira plot for cassava cultivation from a neighbor.

Fig. 2 visualizes schematically the labor demand of a mixed farm over the year. While cattle need a more or less constant daily amount of time, pasture establishment and maintenan-

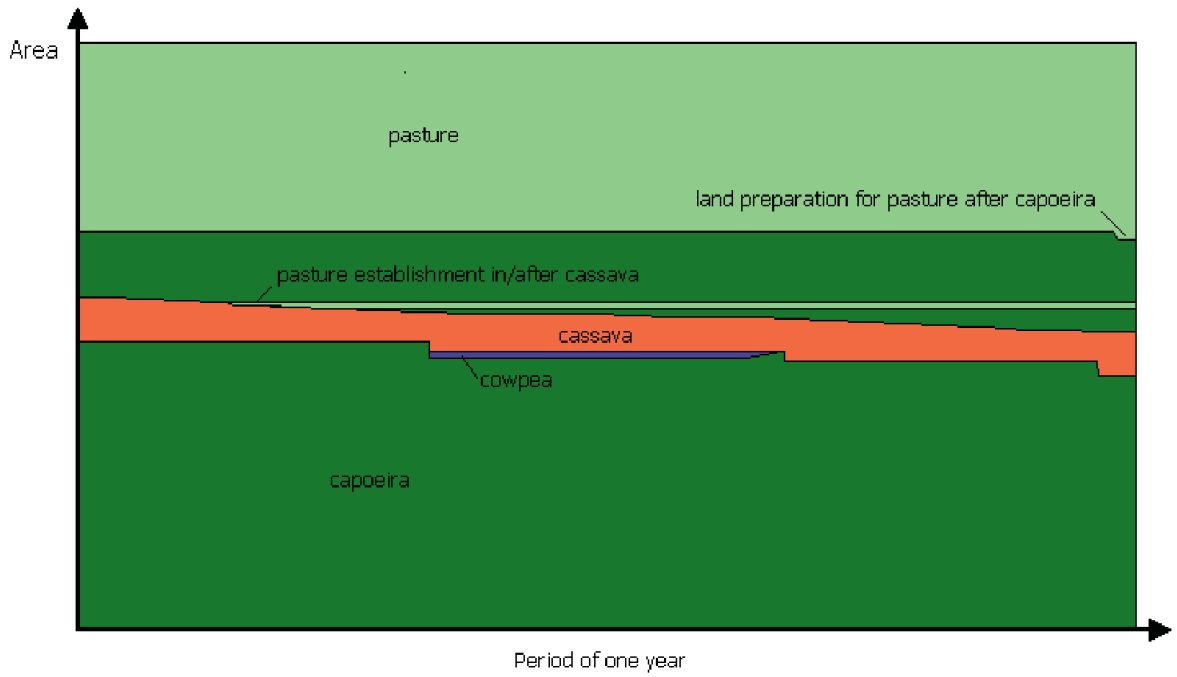

Fig. 1: Land use changes over one year of a farm with pasture and annual crops

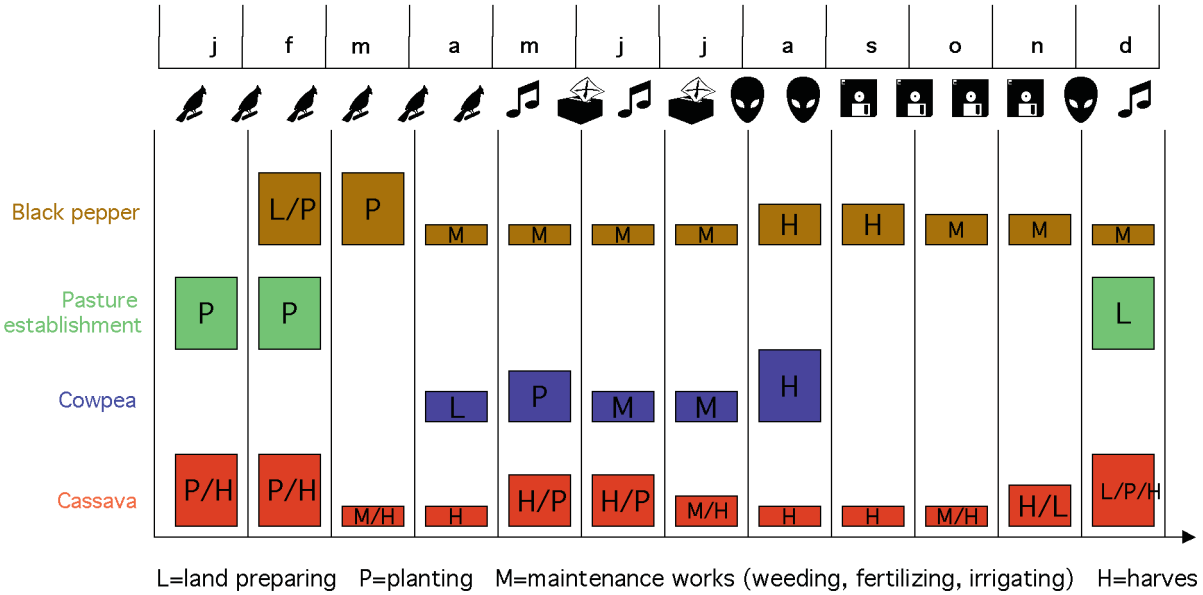

Fig. 2: Labor demand for pasture, annual and perennial crops over the year in the Bragantina region

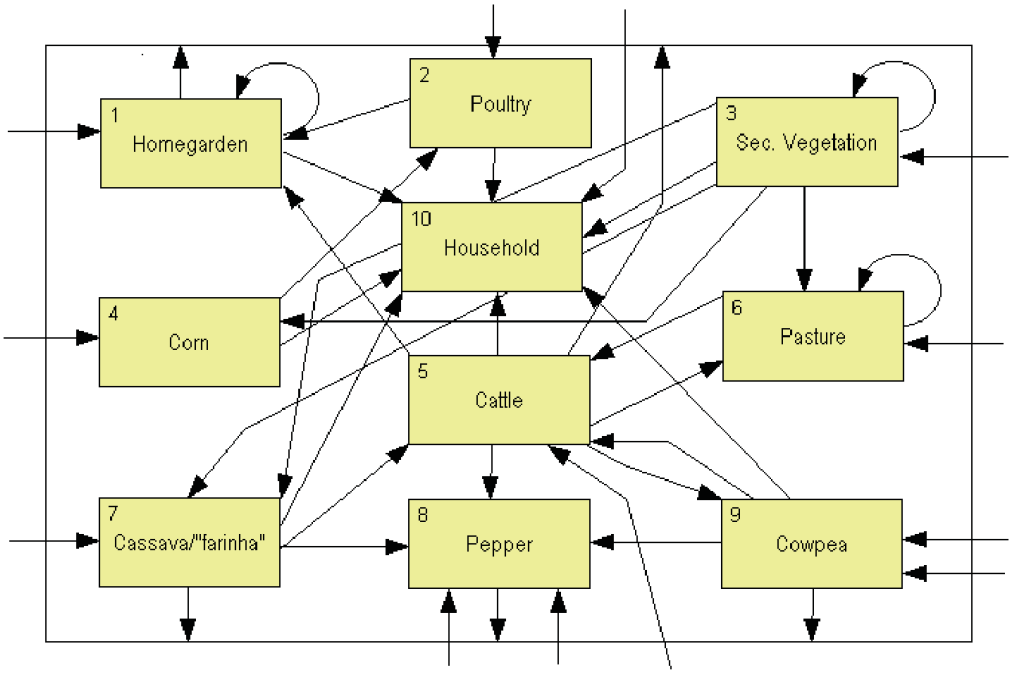

Fig. 3: Biomass/cash flows in production system including pasture, annual and perennial crops

ce are more restricted in time demand. Especially the land preparation and planting of a pasture has to be done in the adequate period of the year, which coincides with the period of land preparation and planting of cassava. This creates a competing situation, while the subsequent pasture maintenance can be done with more flexibility, creating a complementary situation.

Products and cash can be seen as flows entering and leaving the farm systems and circulating within the whole production system (Fig. 3). The internal use of subproducts affects the management of inputs of different activities of the farmer. For example, the subproduct cattle manure can be used as fertilizer for crops. The subproduct cassava peels (peeling is a step in the processing to flour) can be used as feed supplement for cattle or as fertilizer in the pepper plantation. Of course, these subproducts are not always used. The collection of manure requires a place to lock up the herd at night. Most of the farmers have some type of roofless corral. This corral is nearly useless in the more rainy season, as it is too muddy. Also, the corral is only used when the herd is grazing on a paddock nearby. Thus, manure collection is not done continuously, nor very common. Concerning the cassava peels, some farmers do not use them at all, others feed them only when the cattle are not far away from the place of flour processing. Moreover, it is reported that cassava peels are already a commodity, having a price as fertilizer for black pepper, as well as supplement for cattle.

Also the application of capital and cash within the production system is modified when cattle and pasture are introduced. For instance, one can prepare and sell additional cassava flour to pay workers to weed the pasture, or, contrariwise, sell an animal to pay the slashing of capoeira for the following cassava planting. The cash derived from the sale of a head of cattle is easier to get, quicker and a higher amount, compared with what can be obtained from the additional preparation of cassava flour. On the other hand, there is the risk of loosing an asset of quite a high value when, for instance, an animal dies because of a snakebite. Losses due to lacking care decrease in general with increasing experience. Cattle are used as a kind of bank account, but they are not the only one. A fifth of the farmers dispose of a real bank account. Other assets are building land or a brick house in the city.

3.3 Driving forces of changes

Factors, which may favor changes in the production system, are multiple. Decreasing crop productivity and the risks of other activities, as well as available land and capital resources facilitate different trends in land use. Land abundance favors investments in pasture establishment, as seen in Tab. 1. Indeed, even in the Bragantina region most of the cattle are kept in big holdings as herd sizes are of another dimension. But nevertheless, the data also show, that cattle rearing has become very much an activity of small farmers (Fig. 4). As 85% of all cattle owners are small farmers with up to 100 ha, and they keep about 40% of all cattle in the region.

More specific for the introduction of pasture and cattle is the fact that the land value increases with pasture establishment. One land unit (25 ha) with solely secondary vegetation costs

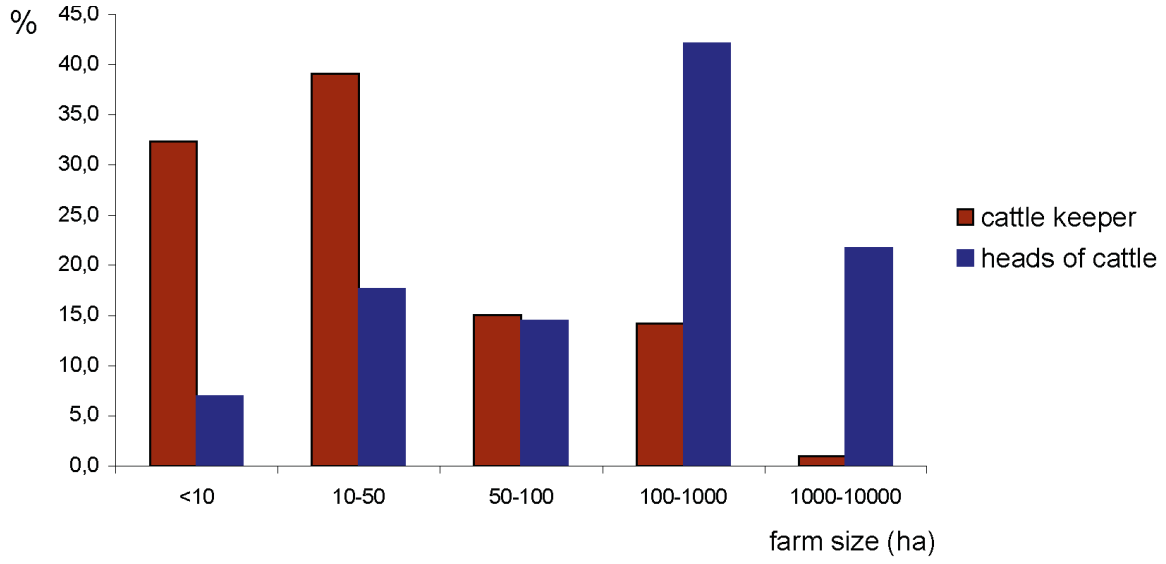

Fig. 4: Cattle keeper (%) and heads of cattle (%) by farm size groups in Bragantina region (data from IBGE 1996)

about 3000 R$. If there are some hectares of pasture, this price can jump to about 4000 R$.

In the municipality of São Miguel do Guamá, the local extension service facilitates a bank credit, which has included in the year 2000 the purchase of some heads of cattle - only from special recognized breeders - and a fixed length of fence. A farmer who only needs to improve his fence and would like to buy poles and wire cannot get only money for this, but also has to buy more animals to claim a credit.

Furthermore, cattle are relatively easy to sell and have more or less stable prices.

The motivation of the interviewed farmers (n=39) to keep cattle can be resumed in income generation (46%), wealth formation (31%), security (13%), and the rest believes merely that it is nice to keep cattle (10%). Cattle owners believe that through cattle husbandry the "money comes rapidly/with facility" or this activity generates "more income (with less work)". They want "to augment" and argue, that "without having to sell animals, today I would be already a fazendeiro". Also they think, that cattle are "better than money in the bank" and that the sale of animals "helps in a need".

Hierarchies, a characteristic of systems, are visible in constraint list: the local economic conditions refer to an other level of hierarchy, as well the age structure of the family members. The loss of one resource type, like cassava peels, is not a problem for cassava flour production, only on farm system level emerges the importance as input for an other activity (supplementing cattle foodstuff), or as ecological problem polluting a water stream. It is necessary to switch from one level to another; sometimes the detail is from primary interest, sometimes it is the general overview.

4 Preliminary conclusions

The changes in a smallholder farm after introduction of pasture and cattle are a different allocation of land, labor and capital, a new pattern of cash and biomass flow within the farm, and a new financing/security system. Currently it is being analyzed which of these changes are economically most advantageous to the farmers, and thus are probably driving the trend to introduce cattle into the system. One hypothesis being tested is that the introduction of cattle results in a higher labor productivity with a better use of underemployed workforce. The other hypothesis deals with intangible benefits from cattle production: If the productivity regarding physical products is low as reported in literature, then the new financing/insurance system might be the primary benefit.

The results also show the high complexity of the mixed systems which make the farm management more difficult. Thus, to arrive at management recommendations, e.g. to avoid unnecessary losses in the actual system, requires to fully understand the interactions within the farm and the external factors driving certain management decisions.

So far, it seems that the changes caused by introducing pasture and cattle lead to a socio-economically more sound farming system. Contrarily, the ecological long-term consequences with regard to soil fertility are most probably negative though the effect is difficult to quantify. Thus, it is indispensable to develop ideas for ecologically more appropriate husbandry practices.

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