# Feeding behavior and crop damage caused by capybaras (*Hydrochoerus hydrochaeris*) in an agricultural landscape

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## Abstract

This study aimed to assess the yield loss caused by capybaras in rural areas of Dourados-MS, their feeding periods, crop preferences and the landscape characteristics of farms that may affect the occurrence of capybara's herds. Semi-structured interviews in 24 different farms were done during a period between April 2010 and August 2011. Field observations were held at different times of the day, and also during the night in order to record peaks of the feeding behavior in six farms. Direct counting of capybaras along with the group of animals reported as seen by the farmers during the interviews was used to estimate the size of herds. Data was analyzed using the Principal Components Analyses and the Analytic Hierarchy Process. The average number of capybaras found in a regular herd was 18.8 ± 7.90 animals. The average number of capybara herd by farms was of 1.38 ± 0.92 while the average number of capybaras by farms was 32.33 ± 27.87. Capybaras selected rice (*Oryza sativa*) when it was available (14.5% of devastation in 1.18% of total planted area); however, the most eaten crop was corn (*Zea mays*) with 38.55% of loss rate in 16.17% of the total planted area. Capybaras ate mostly in the evening and during the night. The availability of water resources in the rural area predisposed the occurrence of capybara's herds.

*Keywords:* anthropic areas, farming crops, crop damage, selectivity.

## Comportamento alimentar e danos causados por capivaras (*Hydrochoerus hydrochaeris*) em áreas agrícolas

### Resumo

Este estudo teve como objetivo avaliar a perda de safra causada por capivaras em áreas rurais de Dourados-MS, os períodos de alimentação, preferências por culturas instaladas e as características da paisagem nas fazendas que podem influenciar a ocorrência de rebanhos de capivaras. Entrevistas semiestruturadas em 24 propriedades diferentes foram feitas durante o período entre abril de 2010 e agosto de 2011. As observações de campo foram realizadas em diferentes momentos do dia e também durante a noite, a fim de registrar picos do comportamento alimentar em seis das fazendas amostradas. Contagens diretas de capivaras juntamente com as informações obtidas dos agricultores foram utilizadas para estimar o tamanho dos rebanhos. Utilizou-se a Análise de Componentes Principais e a Análise Multicriterial (Processo de Análise Hierárquica – AHP) para as análises estatísticas. O número médio de capivaras por rebanho foi de 18,8 ± 7,90 animais. o número médio de grupos de capivaras por fazendas foi de 1,38 ± 0,92, e o número médio de capivaras por fazendas foi 32,33 ± 27,87. Capivaras selecionaram arroz (*Oryza sativa*) quando disponível (14,5% da predação em 1,18% do total da área plantada), no entanto, a cultura mais consumida foi o milho (*Zea mays*), com 38,55% de perdas em 16,17% da área plantada total, de acordo com os fazendeiros. Capivaras comeram principalmente ao anoitecer e durante a noite. A disponibilidade de recursos hídricos na área rural é um indicador da possibilidade de ocorrência de rebanhos de capivaras.

*Palavras-chave:* áreas antropizadas, culturas agrícolas, predação, seletividade.

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# 1. Introduction

The capybara (*Hydrochoerus hydrochaeris*) is the largest known rodent and presents semi-aquatic habits. The species occurs from Panama to Uruguay river basin in northern Argentina (Ojasti, 1991; Moreira and Macdonald, 1997). Its natural feed behavior is based on certain kinds of plants such as grasses and aquatic species (Ojasti, 1973). However, the species has ample feeding habitude, been able to feed on crop species such as maize, sugar cane and rice (Ferraz et al., 2007).

The wild herbivores have developed different strategies for food selection, based on their morphology and physiology and, also, depending on the variety and abundance of food and surrounding habitat type. Furthermore, food characteristics such as the chemical composition may affect the diet of these animals (Galende and Grigera, 1998; Borges and Colares, 2007).

In several regions of Brazil, there is a growing conflict between wildlife and farmers. The way the original landscape changes may affect directly or indirectly the pattern of distribution and abundance of wildlife (Wiens, 1996; Ferraz et al., 2003). These anthropogenic changes in the environment, especially those related to the introduction of crops may lead to the reduction of the animals' natural habitats. As crops become available and reliable sources of food it allows the expansion of social groups and the increase in the population (Ferraz et al., 2009, 2010).

Reports of damage caused by wildlife in Brazilian rural areas have increased significantly (Mello Filho et al., 1981; Ferraz et al., 2003); nevertheless, the losses assessment is limited. Thus, the use of land for agriculture and the need to protect wildlife using the same area often result in conflicts, and the wild animals are seen as pests by farmers in various regions of the country (MacGowan et al., 2006.)

Dourados is a county of Mato Grosso do Sul state, located in a leading agricultural production area which reduced the capybaras' natural habitat in the region. For the management appropriate policy and decision-making related to wildlife disruption of rural areas it is useful to assess the crop damage, especially those with significant financial impact (Wywialowski, 1996; Ferraz et al., 2003).

The lack of knowledge about the capybara herds in the Dourados region is one of the barriers to identify potential impacts of the species to the ecosystems and to crop production systems. This study aimed to analyze the losses caused by free ranging capybaras in rural areas of Dourados-MS, as well as to identify their feeding activity and preference, and the landscape characteristics of farms that may affect the incidence of capybara herds.

# 2. Material and Methods

This study was undertaken from April, 2010 to September, 2011 in rural areas of Dourados-MS county (22°13'18''S - 54° 48' 23'' W, average elevation of 430m), Mato Grosso do Sul, Center West of Brazil (Figure 1).

The study site belongs to the basin of the Parana river, and it is formed by the Dourado, Santa Maria, Brilhante and Peroba rivers. The climate has dry medium cold winter, and hot and rainy summer (Köppen, Cwa), which is characterized by having average annual temperature of 22 °C. The average annual rainfall is 1400 mm, and annual evaporation is 1100-1200 mm (Alves Sobrinho et al., 1998; Alves et al., 2008).

The original landscape of the area is mainly composed by semi deciduous forest, followed by Brazilian savanna (Cerrado), open fields, alluvial forests and low mountain forests. However, the native vegetation has been mostly replaced by agricultural areas.

Semi-structured interviews were conducted with farmers in the region in order to record the size of cultivated areas, amount of crops damage and the size of the affected areas, as well as the number of capybara herds and their estimated size. The data reported by farmers were related to the seasons of 2009/2010, and the first semester of 2011. Twenty four distinctive properties were included in the survey, varying from 5 to 90 km of distance from the town of Dourados. The size of the surveyed farms varied from 17 to 13.000 ha. After each interview, the areas occupied by capybaras were checked to confirm the species presence. Direct and indirect evidences of animals and groups (footprints, feces, food debris, among others) were recorded with the aid of a digital camera, and the locations of groups were recorded with a Global Position System (GPS) device.

Six of the 24 farms were randomly chosen and visited at different times of day for behavioral observations during activity time and feeding. For the feeding behavior sample the method described by Altmann (1974) was applied. Observations were carried out with the help of a binocular from 05:00h to 19:00h during the day, and from 18:00h to 00:00h for night sampling using a flashlight. Each selected farm was visited at least once a month in each period throughout the research. Each observation lasted 10 min, and it was done whenever animals were found in grazing activity. The total observation time in the field was of 1.836 hours.

To determine the size of herds and the number of animals in the groups, it was considered the mean between direct counting and the information described by the farmers during the interviews. To quantify the damage, the crop area eaten by the capybaras was divided by the total planted area (ha), considering the information described by the farmers.

## 2.1. Data analysis

The Principal Component Analysis (PCA) was applied to determine the relationships between the variables related to the number of capybaras present in the agricultural areas and those related to the crop damage. The following components were assessed the presence or absence of water, the size of water source (ha), the water source (river, stream, pond or dam), the size of preserved area (mandatory for Brazilian farms), and the crop type. Pearson's correlation coefficient (at 5% significance level) was used to identify potential farms' characteristics, which could represent an attraction for the capybara herds, such as water sources

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**Figure 1.** Dourados county, Mato Grosso do Sul, Center West of Brazil.

and native forested area. The same procedure was used to quantify the relationship between the number of animals and the crop damage caused by capybaras. Minitab Software (Minitab, 2007) was used for computing data.

Multi criteria analysis was used to estimate the capybara' crop preference and the period of it feeding activity. The Analytical Hierarchy Process (AHP) is a multi criteria analysis which is characterized by the possibility of estimating a solution to a problem using a matrix (A) of criterion hierarchy (Saaty, 1980; Almeida Paz et al., 2010; Garcia et al., 2011).

In order to implement the AHP, the problem was decomposed into a hierarchy of sub-problems more easily understood (Saaty, 1980; Saat and Vargas, 1998), based on qualitative and quantitative characteristics and relevance of the decision (Figure 2). As the hierarchy is established weight is given to each criterion, and they are pairwise compared (Garcia et al., 2011). The first approach requires that decision makers to reach a consensus on each entry $a_{ij}$ in matrix A, where $k_{ij}$ denotes the parity of element $_i$ to element $_j$ for the decision maker k (k = 1, 2, ..., n) compared

to peers of the matrix A (Bolloju, 2001; Almeida Paz et al., 2010). The elements selected are arranged in descending hierarchy, and the goal is set at the top followed by the criteria levels, combining different types of selection criteria in a multilevel structure, in order to achieve a score for each alternative in order to classify them as the matrix is solved. Calculations were done using the online software AHP Project (2011).

## 3. Results

Signs of capybaras presence during the field surveys were found in 21 of the 24 surveyed farms. Such data were also confirmed by the farmers' during the interviews. The number of herds in each farm varied from one to three, and the number of individuals ranged from 10 to 50 animals per herd. The average number of capybaras per herd followed by the standard deviation was $18.8 \pm 7.90$. The number of capybara herds by farms was $1.38 \pm 0.92$, and the number of capybaras by farms was 3 in average $2.33 \pm 27.87$. The number of capybaras was directly affected by the amount of available water in the farms (r = 0.48; P<0.05). It was
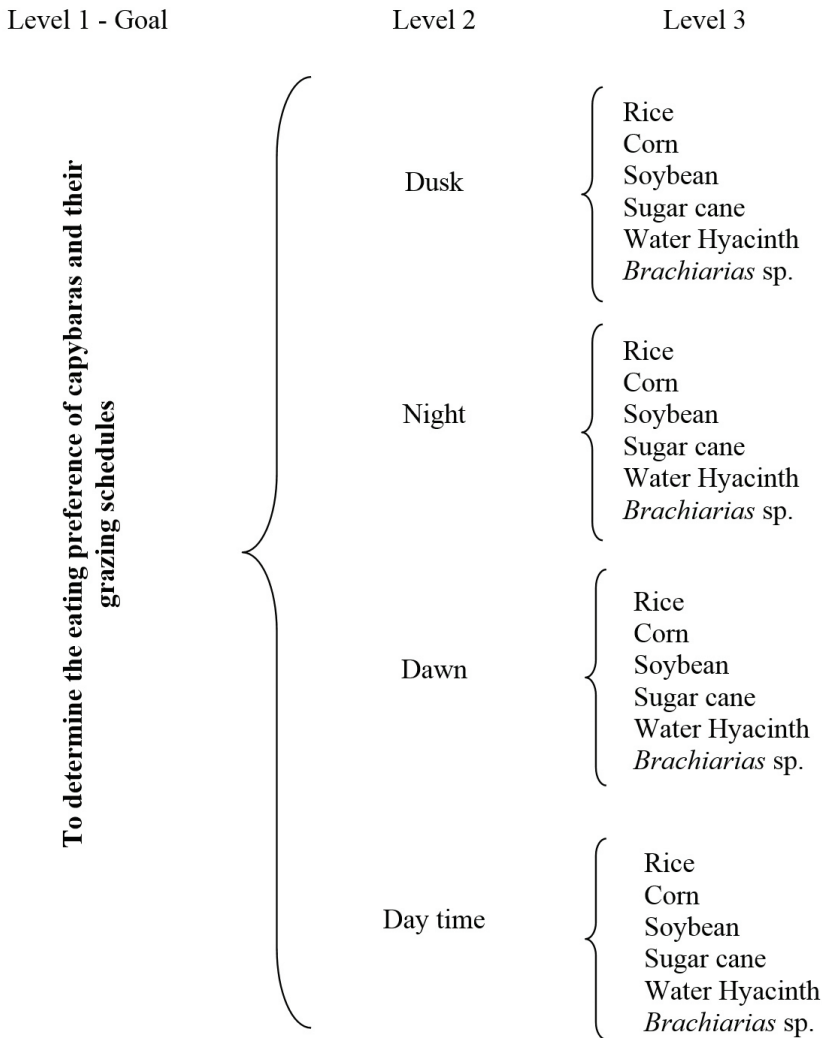
Level 1 - Goal          Level 2          Level 3

**To determine the eating preference of capybaras and their grazing schedules**

**Dusk**
- Rice
- Corn
- Soybean
- Sugar cane
- Water Hyacinth
- *Brachiarias* sp.

**Night**
- Rice
- Corn
- Soybean
- Sugar cane
- Water Hyacinth
- *Brachiarias* sp.

**Dawn**
- Rice
- Corn
- Soybean
- Sugar cane
- Water Hyacinth
- *Brachiarias* sp.

**Day time**
- Rice
- Corn
- Soybean
- Sugar cane
- Water Hyacinth
- *Brachiarias* sp.

**Figure 2.** Scheme of the selection criteria adopted to evaluate the eating preference of capybaras for crops and grazing time.

possible to build up a correlation between the primary and secondary components in the PCA, allowing the separation of the main components into two groups. The group 1 included the variables highly correlated to the increase of capybaras, and in the group 2 the variables were correlated with the crop damage (Figure 3).

Even though variables in group 1 and 2 had presented direct correlation between themselves, some variables of the group 1 presented just a moderate relationship with the second group, which are the number of animals and the crop damage (t). The correlation coefficient between the number of animals and crop damage was of 0.57 (P <0.05). The total cultivated area in the farms was 19,876.44 ha and the percentage of each culture ranged from 0.49% (bean crop) to 35.58% (pasture). The most valuable crops were: 23.79% (soybean), 21.18% (sugar cane), 16.17% (corn), 1.18% (rice), 2.10% (other plant species). The *Brachiaria sp.* grass was the most cultivated grazing area, and it was present in all farms either alone or in rotation with other

crops. Soybean and corn crops were also largely adopted in the Grande Dourados rural area, and the winter corn is also cultivated in between crops.

Sugar cane annual crop had gained large agricultural areas of the region lately, and it was just found in large farms alone or in the consortium with other crops on small farms. The cultivation of rice was only found in medium size and larger farms (> 250 ha). Other crops, such as beans, wheat, oats, and sorghum, were also found to a lesser extent in the surveyed farms.

Although soybeans, corn and sugarcane crops are quite important in the region, the rice crop was somewhat more consumed by the animals as seen in the crop area \9 figure 4). Furthermore, farms presenting more abundant herds of capybaras (until 100 individuals) were located in sites where rice crop was planted. Although grazing pasture is the most common vegetation in Dourados region, its consumption by capybaras is not considered relevant by the surveyed farmers.
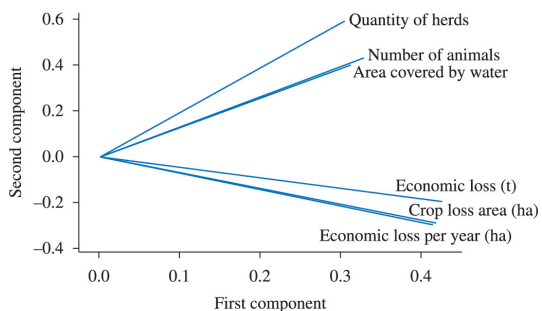
**Figure 3.** Association of principal components presenting the relation between variables related to the increase in the number of capybaras and the crop loss caused by the presence of the animals in the farm.
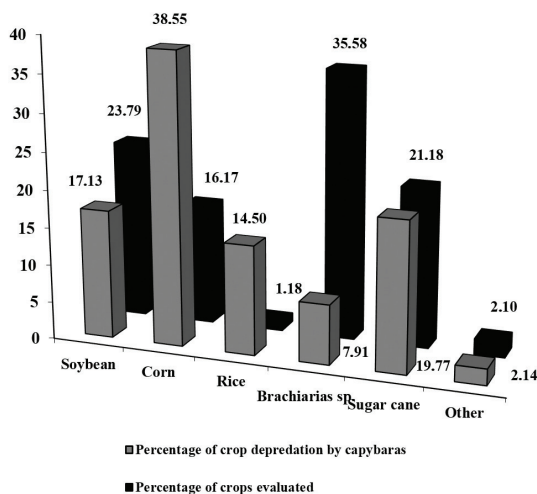


**Figure 4.** Percentage of crop depredation by capybaras in relation to the crop area.



**Figure 5.** Selection between the rice crop and water hyacinth by capybaras during the studied periods.



**Figure 6.** Comparison between crops and grass mostly eaten by the capybaras showing the change in the daily rhythm of the species.

Even with the presence of capybaras in some farms, the animals may not eat planted crops due to the availability of other type of vegetation. Some farmers mentioned capybara' herd grazing on *Brachiaria sp*. which was considered beneficial when there were no cattle herd in the pastures.

The results indicate greater feeding nocturnal activity (Figure 5), being the most consumed the water hyacinth in the morning. The AHP analyzes (Figure 6) also indicates that capybaras group present nocturnal activities (grazing), which is probably a behavioral adaptation to human activities most common during the daytime.

## 4. Discussion

The natural habitat of the capybara is characterized by the presence of wetlands surrounded by forest and small open fields associated with crops. Open fields are predominant in such landscape and plants with photosynthetic cycle C4, as sugar cane or grazing pasture (Ferraz et al., 2007, 2009) are quite common. In the present study, there was a positive correlation between the water availability and
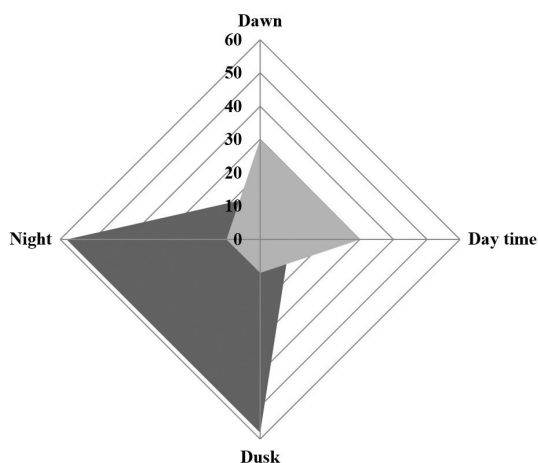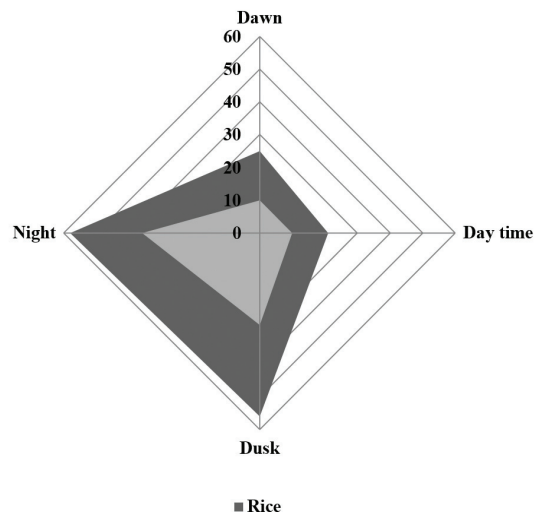
the presence of capybara herds in farms. This association can be explained by the ecology of this species which occupies aquatic environments (Ojasti, 1973). Capybaras use the water as a refuge from predators and as feeding source, as well as an aid in their thermoregulation. In natural areas, these animals feed primarily on semi-aquatic grasses (Ojasti, 1973; Herrera et al., 2011). For the species, the competition for water-related resources is the most influential source of dispersal of young individuals (Ferraz et al., 2009). Ferraz et al. (2007) reported that the land vegetation is amongst the most valuable attributes related to capybaras occurrence, which is in agreement with the results found in the present study. According to Ferraz et al. (2003), capybaras are consumers of corn and

these animals can also be found in areas with sugar cane and grazing pasture (Ferraz et al., 2007, 2009). In the present study capybaras were observed in crop areas of corn and also in soybeans and rice sites, as reported by farmers. However, rice was the most eaten crop, considering its acreage and depredated areas.

In 2007 summer season, the soybean crop area in Dourados area was of 1.718,031 ha and the maize field was of 99.497 ha. Crops grown in the autumn-winter (oats, beans, rice, sorghum, among others) took 49.7% of the cultivated area with soybeans and corn during the summer and, considering the cultivated area in autumn-winter, winter maize occupied 86, 0% of the planted area (Ceccon and Ximenes, 2008). For this reason, the farmers considered the loss of corn (ha) by the presence of capybaras more serious than in other crops.

Both field surveys and farmers interviews indicated the preference of capybaras by flooded rice, instead of other crops. This finding confirms the hypothesis raised by Arteaga and Jorgenson (2007) that when the capybara has the choice within a variety of plants it becomes selective with the diet. When comparing the consumption of corn and rice in the same farm, at the same distance of areas used as shelter by the animals (only on opposite sides of forested area), the corn consumed was higher only at the beginning of sprouting, which overlays the rice harvesting period.

According to Arteaga and Jorgenson (2007) capybaras' preference for rice is due to its quality and protein content, high calorie and low fiber content, and small size compared to other plant species. Thus, their leaves and sprout can be easily accessed and eaten by animals at all ages. Another important factor for this choice is the fact that rice crop is usually located in flooded areas, near to the area of forests and of water resources (Permanent Preservation Areas – APP, which is mandatory according to Brazilian law), which are used as a refuge by the animals. Ferraz et al. (2007) also stated that capybaras preferred to access areas of food near water. The demand of herds' shelter seems particularly relevant to the species as found in this study. Quintana and Rabinovich (1993) found that capybara population density is higher in ponds with rooted and floating vegetation, than in those without any vegetation. This background probably provides a safe environment for the species.

In the present research capybaras preferred grazing on areas close to bushes and forested lands. Another noted feature was that these animals have accessed more areas near to the preservation areas of farms, showing a preference for sites that enable their fast escape. For Ferraz et al. (2003) the damage in crop areas adjacent to forests were significantly higher than in other areas, similar to the results found in the present study. To the authors farmers should avoid planting in areas adjacent to forest fragments occupied by capybaras and, whenever possible, adopt population control practices for reducing the incidence of losses in farm crops.

Sugar cane is among the most consumed plants by the capybaras, and their consumption was proportional to the planted area in the study region (Ferraz et al., 2007). Areas of sugar cane crop may represent food and shelter, at least during part of the year, especially near water sources without floating vegetation. Capybaras feeding on sugar cane were also found in this study, mainly in farms with streams or ponds (without aquatic vegetation) mostly used by the feed cattle to drink water.

Soybean consumption was small, and only few farmers reported crop depredation by capybaras. The damage was considered equivalent to the observed in winter maize crop. However, some farmers reported that, between soybean and corn, the greatest crop damage was observed in soybean. One reason the animals preferred this option may be the distance of this crop and the forest, since soybean is found closer to the forested areas than the corn crop. This result was also found by Quintana and Rabinovich (1993) and Ferraz et al. (2003). In one farm, where capybaras were acquainted to the human presence and had access to all types of foods, except rice, the animals moved more than 500 m from the shelter place to graze in the corn fields, especially at the sprouting stage.

The grazing pastures were barely eaten by capybaras. According to Ferraz et al. (2007), when they are cropped alone or found with small fragments of forest, as occurred in this study. It represents only food for capybaras, and it can hardly serve as a shelter for the species.

Under natural conditions with little human intervention, capybaras are diurnal animals, with peak activity concentrated in the afternoon and evening periods (Ferraz and Verdade, 2001). However, in farm areas or other of high hunting pressure, these animals tend to become nocturnal and hidden (Moreira and MacDonald, 1997; Ferraz et al., 2007), agreeing with the results found in this study. The capybaras were more active in the afternoon, from 16:00h until the early evening; however, they can carry out their activities at any time of the day, especially in the rainy season (Ojasti, 1973).

Aquatic plants are a primary source of food supply for capybaras in nature (Quintana et al., 1994). In this study, aquatic plants were consumed only at dawn and during the hottest hours of the day, next to the rest area and shelter, and most records of capybaras in crops were done about 20:00h. The findings contradict the pattern of activity and the use of the surrounding environment by the species described by Jacomassa (2010), which suggested that capybaras are most active at dawn and midday, foraging more often in the middle of the day (66%). Higher nocturnal activity of capybaras in the present study might be a behavioral response of the animals to the human activities during the day in the region (Moreira e McDonalds, 1997; Ferraz et al., 2007).

The number of animals had moderate and direct correlation with damage to crops, especially when it is evaluated in tons of grains. These results reinforce the statement that the presence of capybaras is associated with the loss of crop production (Ferraz et al., 2003). The higher the number of capybaras in the agricultural areas,

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the greater demand for food, consequently, a larger increase in crop damage (Ferraz et al., 2003).

## 5. Conclusion

The cultivation of rice in flooded areas was preferred by the animals, possibly due to nutritional and morphological characteristics of the plants and by the fact that individuals feel safe eating near to their areas of refuge. The number of animals was influenced by the extent of water areas in the farms, and the crop losses were related to the size of the herd. The main financial loss was observed in corn crops, since it is cultivated during almost every year and all year around.

The peak of feeding activity of capybaras was on the evening and night periods, probably as an adaptation to human activities in the region. The results support the allegation that the presence of capybaras was associated with crop production losses, and larger areas of water bodies allow the settling of larger herds.

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