



Article

Modern Slavery Characterisation through the Analysis of Energy Replenishment

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Abstract: The Brazilian economy was, until the end of the 19th Century, based on slave labour. However, in this first quarter of the 21st Century, the problem persists. These situations tend to be mistaken with “simple” violations of labour laws. This work aims to establish Occupational Health and Safety parameters, focusing on energy needs, to distinguish between the breach of labour legislation and modern rural slavery in the 21st Century in Brazil. In response to this challenge, bibliographical research was carried out on the feeding and energy replenishment conditions of Brazilian slaves in the 19th Century. Obtained data were compared with a sample where 392 cases of neo-slavery in Brazil are described. The energy spent and the energy supplied was calculated to identify the enslaved workers’ general feeding conditions in the two historical periods. The general conditions of food and water supply were analysed. It was possible to identify three comparable parameters: food quality, food quantity, and water supply. It was concluded that there is a parallelism of energy replenishment conditions between Brazilian slaves and neo-slaves of the 19th and 21st centuries, respectively, different from that of free workers. This difference can help authorities identify and punish instances of modern slavery.

Keywords: modern slavery; neo-slavery; slave labour; energy replenishment; human rights; occupational health and safety



Citation: Garreto, Gairo, João Santos Baptista, Antônia Mota, and Mário Vaz. 2021. Modern Slavery Characterisation through the Analysis of Energy Replenishment. *Social Sciences* 10: 299. <https://doi.org/10.3390/socsci10080299>

Academic Editor: Nigel Parton

Received: 4 June 2021

Accepted: 3 August 2021

Published: 9 August 2021

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1. Introduction

1.1. Slavery or Analogous Working Conditions Nowadays

Slave labour, or working conditions that constitute “Labour Analogous to Slavery”, remains a reality in many countries, including Brazil. More than a hundred years after the end of slavery, this form of labour bond exists in many regions worldwide and different economic sectors (Campbell 2008; ILO 2017; Stringer and Michailova 2018; Teh et al. 2019).

According to international treaties, agreements, declarations, and conventions concerning the conditions under which slave labour develops, slavery is characterised as a severe form of human rights violation (Ramos Filho 2008). The International Labour Organization (ILO) estimated in 2016 that around 40.3 million people were subjected to some form of contemporary slavery, of which 24.9 million were in forced labour conditions (ILO 2017). It is less overt than classic slavery (Dando et al. 2016; Soares 2017), and the largest concentration of this group is in the southern hemisphere (PioVesan 2006).

In general, all recognised national governments are against slave labour. Some countries, such as Brazil, address this in their constitution. Other countries make this framework through different types of legislation. In addition, there are international agreements to which most countries are signatories.

The ILO Declaration on Fundamental Principles and Rights at Work, based on several conventions (Conventions 29, 87, 98, 105, 138, and 182) and signed by most countries (Gonçalves et al. 2020; Lourenço et al. 2019; Machura et al. 2019), serves as the foundation

for Brazilian legislation to combat modern slavery. According to Brazilian law, there are four factors that, alone or combined, can lead to the classification of conditions amounting to Labour Analogous to Slavery: (i) subjecting individuals to forced labour; (ii) subjecting individuals to extensive working hours; (iii) subjecting individuals to degrading work conditions; (iv) restricting circulation, by any means, generally due to debt contracted with the employer or manager (representative). Among these four terms, the degrading working conditions and the subject to intensive working hours align with the OHS (Occupational Health and Safety) Standards as a minimum demand for working conditions. However, when these standards are not met, the situations tend to be considered only as violations of these norms. Consequently, they are punished only with fines imposed by labour inspectors. According to this approach, there is no illegal context that fits the criminal code. Consequently, operators of contemporary slave labour evade the sanctions associated with this crime (Ramos Filho 2008) despite submitting neo-enslaved workers to OHS conditions that are much worse than those of other workers (Garreto et al. 2021).

1.2. Slavery in Brazil until the Nineteenth Century

Modern slavery in Brazil has its roots in classical slavery and remained legal until 1888, when it was forbidden by the law (“Lei Aurea”, 13 May 1888). In the early mechanisation period, enslaved workers performed most tasks using only hand tools, such as axes, sickles, and hoes. Human strength was the energy source needed in carrying out tasks. These activities were diverse and included deforestation, arranging lands, planting, and harvesting (Taunay 1839). Even the most sophisticated equipment had men (often slaves) or animals as their primary power source.

Research focusing on 19th-century black slaves (de Lima et al. 2016; Lima 2015; Rodrigues 2009) leaves no doubt about the environment’s relevance and work accidents as sources of illness and permanent injuries such as mutilations that strongly affected the lives of these populations. It also points to a high mortality rate in slaves over 50 years of age, especially in the periods corresponding to the sugarcane harvest (Lima 2015). During these periods, working hours were long and complex, with exceptionally demanding activities pointing to exhaustion as the leading cause of death. Deaths from overwork are also described in landowners’ manuals.

Life expectancy at birth was 30% lower than among the free hired workers (Schwartz 1988). Due to terrible working conditions, the mortality rate caused a 4.5% drop in the population per year among slaves, a loss that was recovered by the importation of new slaves (de Viveiros 1954). This situation led the makers of the guidelines for employers of slave labour to reinforce the need for better living conditions for enslaved workers to improve the mortality rate. Although these guidelines improved the working conditions, they are still considered very poor compared to the free hired workers. Furthermore, the law of improving working conditions only started to be widely implemented after 1850, when the price of slaves suddenly increased due to the prohibition of slave trafficking (Rodrigues 2009).

The poor quality of food supplied to workers is known through the inspection reports linked to recent actions to combat neo-slavery in Brazil. Therefore, this research aims to contribute to establishing technical and scientific parameters to identify modern slavery by comparing OHS conditions of 21st Century contemporary slaves with those of the 19th Century classic slaves, achieved by identifying the source of energy (calories) required for their tasks. The secondary objectives of the current study are:

1. Identify working conditions that constitute Labour Analogous to Slavery and violations of the labour legislation.
2. Define distinct methodologies to deal with conditions that constitute Labour Analogous to Slavery in countries where these practices are still occurring.

2. Materials and Methods

The research followed a methodology of collecting and analysing data from two separate sources. Examining first a sample from inspection reports on combating slave labour targeting contemporary slavery, and secondly examining classical slavery by collecting journal articles and books from electronic databases that were later investigated.

For the analysis of contemporary slavery, a sample of inspection reports on combating slave labour organised by the Inspection Division for the Eradication of Slave Labour (DETRAE) of the Brazilian Ministry of Labour was used. The sample consists of 42 reports characterising Labour Analogous to Slavery produced between 2007 and 2017 in rural activities in different geographic regions of Brazil (Trabalho 2017). 1545 inspections were carried out during this period to combat slave labour (Brasil 2016; G1 2018).

The reports were prepared by 113 different inspectors in teams consisting of up to six members in due diligence, carried out in all Brazil regions, and contain a sample of workers who reach the desired confidence and error levels. The sample does not contain reports with legal fulfilment problems.

Out of the 648 workers covered in the 42 Reports, 392 were considered by DETRAE to be under working conditions characterised as labour conditions analogous to slavery for “exhausting work” or “terrible working conditions” (Brazilian legal classification) by the inspection technicians’ division mentioned above.

Information from the 392 workers identified as undertaking Labour Analogous to Slavery was used. The population definition was based on the estimated 369,000 enslaved people in Brazil in 2018 (Foundation 2018). Confidence was established at 95% and the margin of error at 4.95%.

The formula identifying the sample is as follows:

$$n = \frac{NZ^2p(1-p)}{(N-1)e^2 + Z^2p(1-p)}$$

where n is the sample size to be calculated; N is the population size; Z is the confidence level chosen, expressed as standard deviations; p is the proportion expected to be found, and e is the maximum tolerated margin of error.

For control, reported data were compared with the statistics presented by other studies based on the inspection reports from the Brazilian authorities (Brasil 2016; Brasil 2015).

For the analysis of classical slavery, a bibliographic search was carried out. The research was done in electronic databases (Science Direct, Scopus, Web of Science, Criminal Justice, Ebsco, and Business Source Complete) and Brazilian sources when slavery was legal in that country.

The information extracted from the selected articles was related to country regions, agricultural activity descriptions, working hours, food composition, alcoholic beverage supply, and food quantity and quality.

The caloric intake provided at meals was calculated using the Brazilian Food Composition Table (NEPA 2006), based on diets described as ideal at the time. Subsequently, it was compared with the estimated daily caloric expenditure according to the activities developed. An average routine was used to establish the daily energy expenditure of an adult male worker in activity with a high metabolic rate. The calculations of the metabolic rate levels were made using two standard methodologies (Table 1) (FUNDACENTRO 2002; ISO International Standard 2017).

Table 1. Energy consumption per activity type.

	ISO 7243/2017 (Kcal)	NHO 06 (Kcal) *
At rest	69.6	70
Low	154.8	105
Moderate	255.4	255
High	356.0	425

* Standard of Occupational Hygiene (NHO 06) from the Fundação Jorge Duprat e Figueiredo.

3. Results

3.1. Energy Replenishment of Contemporary Slaves

The reports and testimonies of enslaved labourers were analysed and attached to each individual to characterise the dietary conditions provided to the enslaved labourers. Qualitative and quantitative data related to water, adequacy and quality of food and supply of psychoactive agents were collected from these sources.

Only 3.3% of the sample had access to chlorine-treated water. No report confirmed the potability of water. The water supplied to the other 96.7% did not undergo any type of treatment for drinking.

No information was found related to the amount of food provided for 57.4% of the sample. For the remainder, the amount of food was considered sufficient by 21.6% of the sample, and 78.4% considered it insufficient. In the analysis of the reports, the information confirming that the food provided was of an adequate quantity was considered qualified. That is, it confirmed a supply of animal protein. However, this protein was often obtained through hunting by the workers themselves.

However, the entire sample (100%) indicated that inadequate food quality was consumed. In order to characterise food quality, sanitary conditions of conservation and preparation were considered, and the consumption of spoiled or contaminated food.

Taking advantage of addicted workers was reported by 5.9% of the sample. Usually, a controlled supply of psychoactive drugs, alcoholic beverages and tobacco were also found.

3.2. Energy Replenishment of the Classical Slaves (19th Century)

After analysing the relevance of the collected records regarding the objectives of this study, 19 works were selected for detailed analysis, including six journal articles and thirteen books, eight of which were published during the slavery period.

The studies are analysed and illustrated in Table 2. Recurring indications in the studies prove the inadequate amount of food available to enslaved workers. The meals are also low quality, with a predominance of cassava flour, corn, and beans in all Brazil regions. Animal proteins were rare, and when they were included, they consisted mainly of dried meat and offal and salted fish (Assunção 2015; Pinsky 1988; Schwartz 1988).

Table 2. Description of food and alcohol supply.

#	Geographic Region	Food Composition	Supply Alcoholic Beverages	Food	
				Quantity (Regarding Energy Consumption)	Quality
(Taunay 1839)	All Brazil	Cassava flour, meat or fish and rice or beans	Yes	Below	-
(Schwartz 1988)	Bahia	Cassava flour, rice, dried meat or fish and fruit.	Yes	Below	Low or doubtful
(de Viveiros 1954)	Maranhão	Dried meat with cassava flour.	Yes	-	Low variety
(Assunção 2015)	Maranhão	Rice, corn, cassava flour and dried offal.	Yes	Below	Low or doubtful
(Pinsky 1988)	All Brazil	Beans, corn, pumpkin and cassava flour.	Yes	Below	-
(de Albuquerque 2006)	Bahia	Cassava flour, beans and dried fish or dried meat	Yes	Below	Low or doubtful
(Eugenio 2015)	Minas Gerais	Corn, beans and bacon or pork fat.	Yes	Below	Low or doubtful
(de Lima et al. 2016)	Bahia and Rio de Janeiro	-	Yes	Below	Low or doubtful

Table 2. Cont.

#	Geographic Region	Food Composition	Supply Alcoholic Beverages	Food	
				Quantity (Regarding Energy Consumption)	Quality
(Imbert 1839)	All Brazil	-	-	Below	Low or doubtful
(do Alferes and Werneck 1878)	Rio de Janeiro	Beans, pork fat and corn or cassava flour with beans.	Yes	Below	Low or doubtful
(Burton 1976)	Minas Gerais	Corn flour; bean; bacon; green meat	-	-	Low or doubtful
(Flores Guzmán 2013)	All Brazil	Cassava flour or cornmeal and dried meat or bacon. Vegetables and fruits.	-	Below	Low or doubtful
(Gayozo 1818)	Maranhão	Corn, cassava flour and beans.	Yes	Below	Low or doubtful
(Henwood 1871)	Minas Gerais	Beef, bacon, corn, beans, cassava flour.	-	Below	Low or doubtful
(Moura 2004)	All Brazil	Beans, corn angels and dried meat.	Yes	Below	Low or doubtful
(Magalhães 1858)	Maranhão	Cooked corn on the cob and rice with cassava flour.	Yes	Below	-
(Mendonça and Etchevarne 2007)	Bahia	Cassava and sugarcane derivatives.	-	Below	Coarse preparation
(von Tschudi 1980)	All Brazil	Corn and water, beans and dried meat.	-	Below	-
(Tollenare 1978)	Pernambuco	Cassava and meat flour.	Yes	Below	Low variety

Table 2 also shows the regular supply of alcoholic beverages to slaves in all Brazilian regions, being supplied daily in a controlled manner.

This study focused on the description of plantations, which required extensive use of slave labour, allowing a fair comparison with neo-slave labours. Mining was also a routine activity for farm slaves, especially during the off-season.

4. Discussion

4.1. Energy Replenishment in Classical Slavery

The analysed works included objective and subjective descriptions with general information about the enslaved labourer's activities development. Some publications (do Alferes and Werneck 1878; Taunay 1839) have technical and scientific nature, focused on the owners' economic needs. These studies have detailed technical aspects of energy replenishment to achieve maximum economic efficiency, together with the lowest cost of food (calories). The recommendations provided were designed to prevent early illness and death before the return on invested capital.

Although the labourers were the driving force behind plantations and generally represented these rural properties most wealthy, the enslaved were not fed well (Assunção 2015; Pinsky 1988; Schwartz 1988). All the studies analysed classified the food of the enslaved as insufficient for caloric replenishment (Table 2). The only exceptions were de Viveiros (1954) and Burton (1976), who did not contradict the general trend of pointing out food insufficiency. Simultaneously, the food was also considered low quality. Its preparation was carried out carelessly in terms of hygiene and cooking methods or seasoning. This repeated daily diet, almost always the same, led to diseases related to the digestive system

(Eugenio 2015; Imbert 1839). Only four books (Magalhães 1858; Pinsky 1988; Taunay 1839; von Tschudi 1980) did not report any food quality information.

Bean protein is described as the traditional substitute for animal proteins in all regions, providing, together with cassava flour and corn, the basis of the diet of captive workers throughout Brazil. Only the supplements for this food base were regionally based. Animal protein, especially beef, was not generally part of the daily diet. It was only occasionally offered (Klein and Luna 2009).

The enslaved could only be fed corn in “times of scarcity”. However, their food was generally composed of cassava flour and beans (Gayozo 1818; Magalhães 1858). The practice consisted of eating corn on the cob for lunch, and rice with cassava flour for dinner, which forced captives to steal to supplement their nutrition. The Brazilian Farmer’s Guidebook (Taunay 1839), a scientific-technical work aimed at farmers in the first half of the 19th Century, directed farmers towards the ideal diet for the enslaved. The author intended to educate farmers on how to obtain the maximum possible performance of their workers and indicated the necessity of food to provide the minimum replenishment energy for performance.

4.1.1. The Caloric Value of the Diet at Rural Work

The ideal minimum daily caloric intake described by Taunay (1839) consisted of 255 g of cassava flour (930.75 kcal), 115 g of salted meat (360 kcal), and 57 g of rice or beans (205.20 kcal), resulting in 1495.95 kcal per day (Table 3).

Table 3. Energy that is contained in the food served to the enslaved.

Food	Unit (%)	Kcal for 100 g
Meat, beef, dried meat, boiled	45.8	263
Meat, beef, tripe, boiled	74.1	133
Meat, beef, dried, boiled	47.2	313
Brown rice, boiled	70.1	124
Flour, cassava, toast	8.3	365
Couscous, corn, boiled with salt	71.1	113
Flour, corn, yellow	11.8	351
Corn, cornmeal, raw	11.5	353
Corn, green, raw	63.5	138
Cod, salted, raw	47.9	136
Cod, salted, braised	65.9	140
Beans, black, boiled	80.2	77
Bacon, raw	28	593
Bacon, fried	6	697
Vegetable oils (all)	NA	884
Pumpkin, boiled	86.4	48
Mango Haden raw	82.3	64
Banana, raw	73.8	92
Cane, brandy	-	216
Sugarcane,	81.7	65
Honeydew	22.1	296

Taunay (1839) did not specify the size of the glass used to supply cachaça. The value of 100 mL (216 kcal) was chosen, varying slightly more or less. Another estimated quantifiable concern is the consumption of bacon. The studies emphasised the use of large quantities in enslaved people’s feeding (do Alferes and Werneck 1878; Eugenio 2015; Imbert 1839). Thus, 100 g of bacon (697 kcal) were added to the calculation of energy replenishment.

Another description (de Viveiros 1954) dates from the mid-19th Century. It states that the food, as the daily average for an enslaved person, consisted of 280 g of dried meat (876.4 kcal) and 675 g of cassava flour (2463.75 kcal). With a total energy replenishment of 3340.15 kcal per day, this diet did not seem to be close to the necessary caloric needs

of the slaves. Even more, it indicated the regular presence of meat, which was not a common practice.

The diet presented by [de Viveiros \(1954\)](#) could also be considered ideal at the time, although it did not mention a supply of alcohol or bacon.

An example of a diet effectively supplied to the slaves was described by Louis-François de [Tollenare \(1978\)](#) in 1816. The author describes a daily diet with 459 g of cassava flour (1675.35 kcal) and 200 g of meat (288 kcal) with nothing else to complement, totalling 1963.35 kcal. This diet was complemented with food grown by the enslaved themselves. Tollenare describes having found “small clearings (in the forest) where *blacks* stealthily went to plant some cassava” since, in this region, few properties allowed the enslaved to cultivate on their own ([Tollenare 1978](#)).

It was also considered an ideal diet for various urban or rural activities, determined by those enslaved by the Public Treasury by Decision No. 151, of 25 August 1829 ([Chaia and Lisanti 1974](#)). According to this rule, a daily serving of 344 g of dried meat (1077 kcal) or 459 g of fresh meat (987 kcal) must be made available daily to the enslaved of the Treasury; 29 g of salted pork (202 kcal); 83 g of beans (269 kcal); 255 g of cassava flour (930.75 kcal). The diet should offer a total energy replenishment of 2479 kcal without the supply of alcoholic beverages.

Underfeeding of the slave population is a common practice among landowners, accompanied by the regular supply of alcoholic beverages (Table 2) as a psychoactive stimulant ([do Alferes and Werneck 1878](#); [Gayozo 1818](#); [Flores Guzmán 2013](#); [Magalhães 1858](#); [Moura 2004](#); [Prazeres 1891](#)) which offered the stimulating side effect of caloric supplementation. This practice was widespread. At the beginning of the 19th Century, the rate of alcohol dependents among the slave population was estimated at 6.8% ([de Lima et al. 2016](#)).

The Brazilian Farmer’s Manual ([Taunay 1839](#)) recommended administering a “*cachaça*” or an alcoholic liquor in the morning and another on Sundays to stimulate production. This guideline appears to have been followed by most landowners. In contrast, the guidelines on the minimum diet requirements for slaves have been overlooked. The supply of alcohol probably exceeded the amount recommended in the Brazilian Farmer’s Guidebook and was cited as a cause of digestive system diseases ([Imbert 1839](#)).

4.1.2. The Caloric Value of the Diet in the English Mines

In the second half of the 19th Century, mines belonging to English companies were also significant users of slave labour. They commonly rented a large number of slaves from Brazilian farms. However, they needed to be more permissive than these farms because of anti-slavery political pressure in the UK ([Burton 1976](#)). Reports of the diets for two of these mines were found, the Morro Velho mine and the Gongo Soco mine ([Burton 1976](#); [Henwood 1871](#)).

At the Morro Velho mine (MG), the diet that an enslaved person received daily was equivalent to 643 g of cornflour (2256.93 kcal), 285.7 g of beans (925.67 kcal), 71.4 g of bacon (423.4 kcal), and 142.86 g of fresh meat (204.48 kcal) ([Burton 1976](#)), for a total of 3810.48 kcal.

At the Gongo Soco mine (MG), the daily ration consisted of 188.57 g of beef (271.54 kcal), 33.43 g of bacon (198.24 kcal), 455.71 g of cornflour (1608.65 kcal), 248.57 g of beans (805.37 kcal), 26 g of cassava flour (94.9 kcal), 850 mL of coffee (76.4 kcal), and 118 mL of *cachaça* (254.88 kcal). A total of 3309.98 kcal daily ([Henwood 1871](#)).

Compared with farms, these mining companies, owned by British corporations, had ideal diets with larger energy replenishment, strongly encouraging their slaves to cultivate their fields ([Burton 1976](#); [Henwood 1871](#)). These practices can also be seen as ways to protect the financial investments of mining companies. For every killed slave, the insurer demanded a high premium ([Burton 1976](#); [Libby 1988](#)).

4.1.3. Energy Expenditure

To calculate the caloric expenditure, parameters were defined based on the description of the agricultural activities carried out by the enslaved people of the 19th Century in Brazil and the usual work rhythm of these workers (de Albuquerque 2006; Assunção 2015; do Alferes and Werneck 1878; de Faria 2012; Gayozo 1818; Lara 2010; Pinsky 1988; Rodrigues 2010; Taunay 1839). Once these parameters were defined, it was possible to estimate the energy expended in work performance.

The daily work of a slave in a plantation followed a routine that started at around 5 am, with the first meal served at 10 am, after five fasting hours. The interruption for the meal was short, of a few minutes, before activities immediately continued. The second meal took place approximately six hours after the first, around 4 pm, and would also be eaten quickly. After the plantations work was over at nightfall, the slaves returned to the farm to work longer at the plantations maintenance activities, such as repairing fences, maintaining tools, cooking, and preparing the necessities to work the next day. At around 10 pm, they were allowed to retire to rest, to repeat the same activities at dawn the next day.

For the calculation of energy consumption, the routine described above was divided as follows: (A) 12 h of high metabolic rate work, developed in the plantations; (B) one hour of low metabolic rate activities during meals; (C) one hour of moderate metabolic rate activities, attributed to walks to and from the countryside; (D) three hours of moderate metabolic rate activities, developed after arriving from the plantation; and (E) seven hours resting or sleeping.

The calculation of caloric expenditure was performed using two methodologies recommended by two acknowledged organisations, ISO (ISO International Standard 2017) and FUNDACENTRO (FUNDACENTRO 2002).

The described activities total energy expenditure (A + B + C + D + E) corresponds to 5935.5 kcal per day when ISO Standard 7243:2017 (ISO International Standard 2017) is adopted. The sum of the same activities results in 6625 kcal per day, calculated by the FUNDACENTRO NHO 06 Standard (FUNDACENTRO 2002).

The mining routine of English companies does not differ much from those observed in the plantations: (A) 12 h of high metabolic rate work, developed at the mine; (B) one hour of low metabolic rate during meals; (C) one hour of moderate metabolic rate activities, attributed to walks to and from the mine; (D) two hours of moderate metabolic rate activities, developed during the night shift, mainly in domestic activities and in the slave's camps; and (E) eight hours resting or sleeping.

In mines, the total energy expenditure corresponding to the sum of the activities described (A + B + C + D + E) corresponds to 5750 kcal per day, calculated by ISO 7243: 2017 (ISO International Standard 2017), and 6470 kcal per day, calculated by the FUNDACENTRO NHO 06 Standard (FUNDACENTRO 2002).

While comparing the supply on agricultural farms and mines, it is possible to verify a significant difference to the daily average of energy supplied by slave owners. Even the ideal diets defined in the manuals did not exceed half of the daily energy requirements for the required activities. Even considering the diets associated with the English mines, which had a political necessity to employ their slaves differently, the diets provided were well below the necessary caloric expenditure.

Reducing this difference was critical to keeping the enslaved people alive, and energy was provided differently. A common method was an increase in the regular supply of alcoholic beverages. These were already widely used and considered an economical and direct way of providing additional energy to the enslaved, a caloric supplement (Pinsky 1988). Thus, the supply of alcoholic products was used to stimulate production, being reinforced during the harvest (de Albuquerque 2006; Schwartz 1988), when the daily workload increased.

4.2. Energy Replenishment in Contemporary Slavery

4.2.1. Food

Quality—In the analysed sample, the quality of workers consumed food is similar to that of 19th-century slaves. The entire sample indicates the frequent use of spoiled or contaminated food and its preparation under deplorable sanitary conditions. Cases of food stored together with pesticides and agricultural fertilisers or in contact with rodents or in a state of decomposition were recurrent in the analysed reports. At the same time, the most recurrent situations were poor sanitary conditions in food preparation. The places for food preparation were improvised kitchens on dirty boards, not waterproofed, outdoors or inside the accommodation and without access to treated water.

Quantity—As neo-slaves are often isolated in the forest, the only possible supplement is the harvest of fruits, the hunting of small animals in the surrounding forest, or fishing in the farm's watercourses. This type of description is observed in the analysed sample. Other research on contemporary slavery in agricultural activities has also pointed to insufficient energy replenishment with a shortage of animal protein in the diet. This problem is compounded by poorly seasoned meals, consisting mainly of low-quality rice and beans (Lopes 2009; Silva 2009; Soares 2017).

The 33.4% of the sample who had to seek food supplementation indicates that a contemporary slaves' energetic replenishment is less neglected than in classic slavery, where this practice was prevalent. However, it is still quite significant, affecting 1 in 3 contemporary enslaved workers.

The amount of food offered to the enslaved could not be assessed quantitatively. These data were not available in the reports. For this same reason, it was not possible to calculate a probable caloric deficit in the diets offered to these workers. However, energy expenditure was calculated using the same parameters as the calculations performed in Section 3.2.

4.2.2. Water

Almost all the analysed sample workers had access to untreated water (96.7%), generally in unhygienic conditions, cloudy and with a strong flavour, usually stored in reused mineral oil containers. Most of the time, water contamination can be visually detected. The water was used for bathing, washing clothes, but mainly for drinking and cooking.

The supply of treated water to workers seems to be more degrading in contemporary slavery than in classic slavery due to the possibility of contamination by raw sewage or garbage, dumped directly into rivers, or contamination by mineral oil. Both situations were examined in the analysed reports.

4.2.3. Caloric Expenditure—Contemporary Slave Rural Work

The workers' routine for Labour Analogous to Slavery could be quantified from interviews attached to the reports (Trabalho 2017). (A) 9.5 h of high metabolic rate work, developed in the plantations; (B) two hours of low metabolic rate activities during meals; (C) one hour of moderate metabolic rate activities, attributed to walking to and from the countryside; (D) two hours of diverse activities of moderate metabolic rate, developed during the night shift; and (E) 9.5 h resting or sleeping.

The total energy expenditure corresponding to the sum of the activities described (A + B + C + D + E) corresponds to 5124 kcal per day considering the ISO 7243: 2017 (ISO International Standard 2017) method, or 5684 kcal by FUNDACENTRO NHO 06 (FUNDACENTRO 2002) method. These figures correspond to about 86.0% of the caloric expenditure of slaves on 19th-century farms.

According to the literature, in contemporary Brazilian enslaved rural labour, the supply of alcoholic beverages focuses on reducing these workers' cognitive abilities as a strategy to help maintain social control and economic dependence (Lopes 2009; Silva 2009; Soares 2017). In fact, in the sample (5.9%), alcoholic beverages were supplied on a

regular and controlled basis as a form of payment for alcoholic dependents, who were also, consequently, dependent on the situation of neo-slavery.

There is an apparent correspondence in energy replenishment conditions between the enslaved Brazilians of the 19th Century and the modern enslaved people in the same country in the 21st Century. Although the energy deficit is not significant, the available data indicate that it continues on many farms where neo-slave labour is used. Besides, the quality and nutrition of the diets offered also do not appear to be substantially different. In reality, food is a secondary concern in the contemporary version of slave labour.

4.2.4. Caloric Expenditure—Free Rural Work

Comparing the energy expenditure between the free population of workers (non-slave) and the enslaved population was carried out using Brazilian labour rules (Brasil 1943). This comparison is not direct since these rules include the working days, breaks, paid rest, meals, and accommodation.

Despite the differences mentioned, the average energy expenditure of rural workers in the countryside was calculated under current labour rules. This activity can be quantified as follows: (A) eight working hours with a moderate metabolic rate (average of the rural activities usually carried out), developed in the plantations; (B) two hours of low metabolic rate activities during meals; (C) one hour of low metabolic rate activities, attributed to seated transportation to and from the field; (D) three hours of various activities of low metabolic rate, especially personal hygiene and recreational activities; and (E) ten hours resting or sleeping.

The total energy expenditure of rural workers corresponds to the sum of the activities described (A + B + C + D + E). It was calculated as 3668 kcal per day using the ISO 7243: 2017 (ISO International Standard 2017), and 3370 kcal using the standard NHO 06 of FUNDACENTRO (FUNDACENTRO 2002), considerably less than the caloric expenditure exerted by the enslaved workers.

4.2.5. Supply of Psychoactive

The controlled supply of psychoactive drugs was substantially less in the analysed sample of neo-slavery than in reports on classical slavery. While in the 19th Century, there was a widespread supply of alcoholic beverages to enslaved workers (Imbert 1839; Pinsky 1988; Schwartz 1988), in contemporary slavery, this supply accounted for only 5.9% of the sample.

The purpose of supplying psychoactive substances, particularly alcoholic beverages and tobacco, also has significant differences. In classical slavery, this supply was considered a way to stimulate labour (Imbert 1839; Pinsky 1988; Schwartz 1988), probably also an energy supplement. On the other hand, this supply was observed only to take advantage of the work of psychoactive substance addicts in contemporary slavery.

4.3. *The Limitation of What Is Comparable*

The analysis corresponding to food in various forms of caloric intake, water replenishment, and psychoactive agents consumption is composed of the following parameters: food (quantity, quality and water) and psychoactive supplements.

4.3.1. Food

Feeding Was Analysed from Two Different Perspectives, Food Quality and Food Quantity

The quality of the food is another important parameter that has a substantial similarity with classic slavery. Despite government control over the quality of promoted food, neo-enslaved workers usually lose adequate sanitary characteristics due to the lack of minimum storage, conservation, and preparation conditions. There is a lack of essential equipment in the facilities where contemporary slave workers are accommodated, such as cabinets, sealed tanks, and necessary kitchen apparatus like a sink, refrigerator, and stove.

The amount of food provided, which in classical slavery was a fundamental responsibility of the slave owner, is, in neo-slavery, sometimes found to be the responsibility of the enslaved worker themselves. When the verbal contract of employment with the recruiter does not include the provision of food, the workers can purchase food in a way that is most suitable to their needs. However, in the analysed sample was almost impossible to purchase food outside the farm due to the great distance to commerce points, lack of transport, isolation, short or non-existent days off, lack of freedom, or a chronic failure to receive the salary agreed with the recruiter. Unlike classical slavery, the amount of food provided for the neo-slave cannot always be considered minimally adequate; however, it is an essential parameter for characterising degrading work conditions.

4.3.2. Water

Another aggravating food factor is water, which is usually untreated and contaminated. Water is supplied in conditions similar to those of classic slavery. The water is collected at the nearest source, which is usually hundreds of meters away. It can be a weir, river, lagoon, hollow of the tree where rainwater is collected, or well. It is stored in the containers available on the farm, often packages of pesticides or oils. This water serves all needs, including drinking and food preparation. It is another crucial parameter for the characterisation of degradation.

4.3.3. Psychoactive

Of this group of parameters related to food, only the supply of psychoactive substances was discarded to compare the 19th and 21st Century realities. The supply of psychoactive drugs for contemporary slavery is much less than during classical slavery. Based on the sample, it can be said that it is a rare situation despite its presence. This condition can be justified by the fact that a worker dependent on psychoactive substances has, in general, less productive capacity. The supply of alcoholic substances is also no longer provided for energy replenishment. In the cases analysed, the only intention when providing psychoactive agents was to use addiction to servile work as a form of conditioning.

5. Conclusions

This research sought to create a comparison between slave labour, particularly that of the 19th Century, and modern slavery to find parameters that could be used for technical comparison purposes. For this, a bibliographic review was developed on which it was possible to identify detailed and concise descriptions of the work carried out by slaves. In parallel, an analysis was carried out on a sample of reports combating modern slave labour in Brazil. In both situations, a calculation of the caloric expenditure and the calories supplied was carried out. Also, an assessment of the general conditions of food and water supply was made. These calculations and assessments made it possible to identify enslaved workers' food and water replenishment conditions from the two historical periods. Studying these two realities made it possible to identify comparable parameters, allowing an explicit identification of the conditions analogous to slavery.

There is a parallel in the general conditions of food (quantity and quality) and water replenishment between Brazilian slaves of the 19th Century and modern slaves in the same country in the 21st Century. The available data point to a continuing energy deficit as a reality on many farms where slave-like conditions are used. Diet quality, water supply, and health conditions do not appear substantially different in the two historical periods.

Consequently, the parameters' quantity of supplied food (energy), food quality (disease vector), access to drinking water (hydration), and water quality (disease vector) were defined. The comparison parameters were defined and supported by technical and scientific evidence. Together, these parameters may support the characterisation of working conditions analogous to slavery, helping authorities identify and punish those responsible for these situations.

However, more research is needed, not only in order to identify other variables but also in the application of approaches of this type to other work situations, both in Brazil and in other countries and continents. Identifying a sufficiently large number of parameters can allow the development of a robust tool for the unambiguous identification of modern slavery situations.

Author Contributions: Conceptualisation, G.G., J.S.B. and M.V.; methodology, G.G. and J.S.B.; validation, G.G. and J.S.B. and A.M.; formal analysis, J.S.B.; investigation, G.G.; resources, G.G. and J.S.B.; data curation, G.G.; writing—original draft preparation, G.G.; writing—review and editing, G.G., J.S.B., M.V. and A.M.; supervision, J.S.B.; project administration, G.G. and J.S.B.; funding acquisition, G.G. and J.S.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão, grant number BD-08445/17 and The APC was funded by University of Porto grant demsso.GOG. PD9986.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Acknowledgments: This research is supported by: Foundation for Research and Scientific and Technological Development of Maranhão (FAPEMA)/State Secretariat for Science, Technology and Innovation (SECTI), Maranhão State Government; Division for Eradication of Slave Labour—DETRAE, of the Brazilian Ministry of Labour. Associated Laboratory for Energy, Transports and Aeronautics (LAETA); University of Porto.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study, in the collection, analyses and interpretation of data, in the writing of the manuscript, or in the decision to publish the results.

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