

Labor Use Dynamics from Family Coffee Farms of Zona Da Mata—Region of Minas Gerais State, Brazil

Adalgisa J. Pereira, Felipe C. Santana, and Ricardo H. S. Santos

ABSTRACT

Labour is an important factor for the viability of coffee farming and other family-owned agricultural activities in the Zona da Mata of Minas Gerais, Brazil. Labour shortages reflect on decision-making and the logic of agricultural management, which influences regional agricultural diversity. The objective of this work was to identify the dynamics of the labour adopted by family farmers, as well as to analyze the panorama of labour use of pluriactivity that favours agrobiodiversity. For data collection, it was applied a semi-structured interview script and visited all properties studied. The methodologies of the activity matrix and labour allocation in 25 properties were applied. The labour allocation matrices provided information and structural scenario of labour distribution for the main activities (coffee, maize, livestock, and horticulture) that occur in the properties throughout the year. The results indicate that coffee crops demand more labour from April to July, according to the harvesting and drying of fruits. Maize cultivation requires more labour from October to December, time of tillage, planting, and initial crop treatment. Activities such as livestock and vegetable production tend to require less labour; however, such demands are more constant throughout the year. Assuming that the dynamics of labour allocation follow a seasonal pattern of activities and tasks, farmers can maintain high diversification through the availability of family labour across different agricultural systems.

Keywords: Agricultural Crops, Decision Making, Diversity.

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I. INTRODUCTION

The presence of men in rural areas can be seen as a resource that has become scarce. Especially when, due to aging or lack of productive and economic stimulus, labor in the field becomes increasingly scarce. The Zona da Mata of Minas Gerais is an essentially agricultural region and the most common activities, annual crops such as maize and beans; vegetables, and coffee-growing (Mattos, 2016). This last activity has become one of the most important from a social, economic, and environmental point of view (Vilela & Rufino, 2010).

In the Zona of Minas Gerais, 75% of the arable land on properties considered small (between 3 and 20 hectares) is cultivated with coffee and about 90% of the labor is from direct relatives and represents available labor applicable to coffee farms. In this region, 58% of the properties use small machinery such as cutting machines, motorized sprayers, and/or brush cutters, which assist in the execution of tasks such as harvesting and weeding. Thus, the coffee families carry out all or most of the coffee crop management operations. The farmer does not keep full-time employees and dependence on outside labor is occasional for most of the work performed. Exceptions occur at peak work demands during harvest and occasionally at times of weeding and coffee fertilization (Vilela & Rufino, 2010).

Family coffee-growing carried out in the Zona da Mata of Minas Gerais (ZMMG) also uses the practice of day-of-service exchange. This practice consists of verbal agreements between farmers and their families for joint efforts to collect coffee. The harvests occur in a staggered manner, depending on the maturation of the crops, until the group's crops are harvested. Occasionally, they also establish sharecropper-partner labor relations. This relationship refers to the granting of coffee for another farmer to harvest and produce to be divided into variable percentages between them (Caixeta & Teixeira, 2009).

The methods of use of labor in the ZMMG (exchange of days, partnerships, and use of small machinery) are justified by the fact that the region has rugged and sloping relief, as well as the sharp decapitalization of family producers, making it difficult to make larger machinery viable (Vilela & Rufino, 2010).

Thus, labor is an important factor for the viability of coffee and other agricultural activities of family properties in the Zona da Mata of Minas Gerais. This feature interferes and is able to modify the landscape of a farm. More capitalized properties have greater possibilities for using machinery, while less financially-

owned properties use labor as a factor for species diversification through the management and direct contact with species (Weil *et al.*, 2017). In this way, agricultural landscapes change as location characteristics change. The anthropic action imprinted on the environment, through working tools, a greater or lesser diversity of species (Weil *et al.*, 2017).

The efficient management of small farms seeks to identify the demand and supply of labor in each activity, which reflects on agricultural activities and, consequently, on the rural landscape. This is important because it allows the determination of periods of inactivity or scarcity of productive activity that could be avoided (Wilson, 2003; Stephen, 2006). In this context, the use of tools such as the matrix or labor allocation chart allows a more efficient overall planning of a given production or activity (Stephen, 2006; Trietsch & Baker, 2012; Dayani & Gelbard, 2015). Its simplicity allows its use and application to any area of knowledge effectively (Wilson, 2003). For tasks that require a high degree of an organization such as time staggering of labor and machine work, the chart makes activities organized and thought out in a timely manner, knowing roughly their starting and ending times (Stephen, 2006; Trietsch & Baker, 2012).

The operation of family properties is linked to the availability of labor (Gomes & Rosado, 2005). In family coffee farms, the farmer is often responsible for performing the functions of an agronomist, trader/merchant, agricultural worker, and administrator, and is responsible for most tasks (Duminelli *et al.*, 2016). To this end, the family, as a whole, focuses on this activity (Meira *et al.*, 2018). However, the farmer's multitasking capacity may jeopardize the efficiency of other activities that require more dedication.

Given the above, it is assumed that the family coffee-growing in the Zona da Mata has dynamics that fit the crop cycles and their needs, especially the availability of labor for coffee cultivation. It is interesting, therefore, to analyze the dynamics of labor availability in the context of coffee and other activities that compete with it for productive resources.

Thus, the objective of this work was to identify the dynamics of the labor adopted by family farmers, as well as to associate the influence of this resource on the diversity of activities of the properties.

II. MATERIAL AND METHODS

A. Study Area

The research was conducted in family coffee farms that meet the description of Federal Law No. 11,326, of July 24, 2006, located in the Zona da Mata of Minas Gerais in municipalities of the Viçosa microregion (Fig. 1). The Law provides that the farmer does not hold, in any capacity, an area larger than 04 (four) fiscal modules; predominantly uses family labor; that he has a maximum percentage of family income from property economic activities and directs his agricultural activities with direct relatives (Torres & Silva, 2016). The region is in the morphoclimatic domain called Mares de Morro, in English, hill seas (Vittoreto, 2010). The region has as its main characteristics the humid climate and strongly undulating relief. The average temperature of the region is 18 °C, the annual precipitation varies between 1,200 and 1,800 mm and the dry period lasts from 2 to 4 months (Reboita *et al.*, 2015).

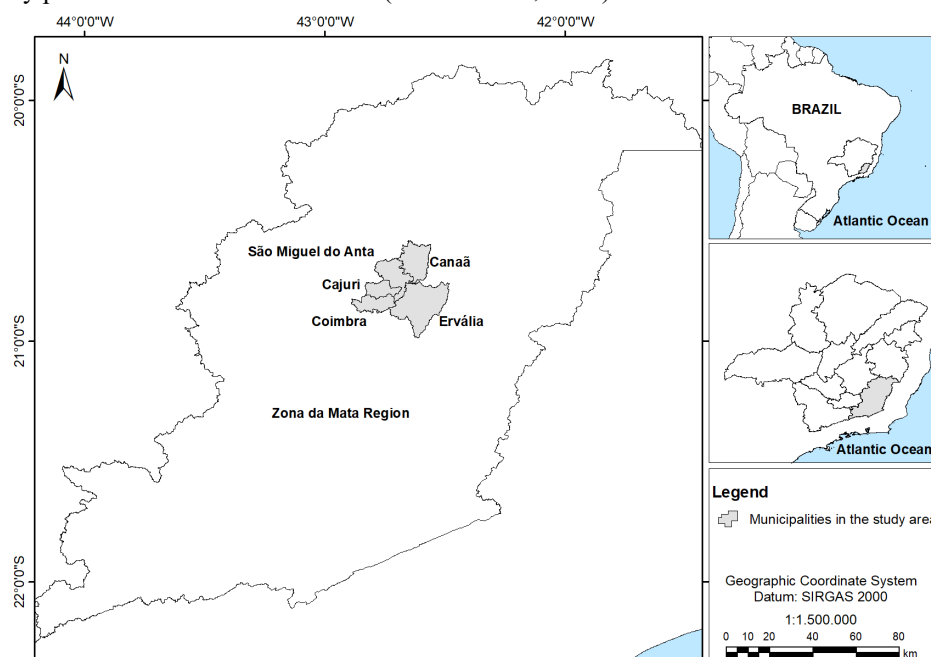


Fig. 1. Map with the municipalities where data were collected, Zona da Mata of Minas Gerais, Brazil. Source: Geoprocessing Laboratory – UFV.

In general terms, the main soils of the elevations are the dystrophic Red-Yellow Latosols and the predominantly eutrophic Red-Yellow Latosols. In the highest areas of the general landscape, there is the humic Red-Yellow Latosol. There are, still in specific places, Nitosols, associated with mafic rock dikes. On the terraces are found the dystrophic and eutrophic cambic Red-Yellow Argisol; in the larger beds of the watercourses, eutrophic soils can be found, and in the lower parts, the hydromorphic soils, usually dystrophic (UFV *et al.*, 2010).

B. Data Collection and Analysis

For data collection, a semi-structured interview script with open and closed answers was applied. Initially, the approach was exploratory, in which the researcher went to the field and explained the research and invited the farmer to participate if he fit the profile of a family farmer. The inclusion of respondents was also based on initial information from farmers' trade unions, which indicated the farmers in each municipality.

The evaluations were carried out by visiting the entire property. The matrix of activities and labor allocation methodologies were applied to record the occupation and use of resources associated with activities in 25 properties distributed equally in 05 townships (township 1- Cajuri, township 2- Canaã, township 3- Coimbra, township 4- Ervália, and township 5- São Miguel do Anta). To register farmers' participation in social organizations, participation in trade unions, workers' associations, and affiliation with regional or national rural-agrarian federations were considered. To record the receipt of government assistance, the following were considered: pensions, loans with Pronaf (National Program for Sustainable Family Agriculture), and its credit lines (Young, Woman, Cost, More Food, Investment, Agribusiness, Agroecology, Eco, Forest, Costing and Marketing of Family Agro-Industries, Quota-Share, Rural Microcredit), and non-governmental loans as personal loans to banks.

III. RESULT AND DISCUSSION

In the event of the availability of labor, it is expected that most farmers would have a similar type of priority setting.

The differences in the demand for labor regardless of the agricultural activity reflect the diversity of choices (main agricultural activity). The choice of managing coffee and cattle is generally driven mainly by the family culture and the economic return generated by the activity. On the other hand, the choice of managing horticulture and corn crops is justified mainly because they are crops used more immediately in family food, in addition to family farming and economic return. Given their limitations (labor), they are different because some focus more on coffee than others, while others may focus on maize as a food crop.

A. Labor Demand

Data from semi-structured interviews focused on the labor demand of each task in the main agricultural systems internal to the property (coffee, maize, livestock, and horticulture). Labor matrices were elaborated for the coffee plantation system, maize cultivation, dairy cattle breeding, and for horticultural activities (horticulture conduction).

The matrices were analyzed by means of a schematic representation of the farmer's labor based on working person-day (1 d.h. equals 8 hours of working performed by one person) for each activity. The data were organized considering the area in hectares and the number of head of cattle. Conversions to d.h. were obtained considering the total area of each activity and the total activity requirement in that area. Data were obtained over a period of one agricultural year for each system. From there a graph was generated with the labor demanded for the production of coffee, maize, livestock, and horticulture.

The schematic representation of the allocation of labor in each activity considered the amount of labor for each activity and listed tasks. Coffee cultivation was organized into tasks such as weeding or mowing, harvesting, drying, fertilizing, disease control, and pruning. The coffee plantations were established and did not require planting or replanting. For maize cultivation activity, the tasks were organized into soil preparation, planting, weeding, fertilization and harvesting. Regarding the activity of dairy farming, the tasks were organized in milking, sanitation, feeding / grazing and cheese manufacturing. Finally, the horticulture tasks were systematized in soil preparation, fertilization, planting, irrigation, harvesting and sale. The durations of each activity developed during the weeks would be grouped for monthly data. Subsequently, the quantities of d.h. were grouped for monthly time interval and in annual demand.

B. Dynamics of Annual Allocation of Labor by Activity on Coffee Family Properties in the Zona Da Mata of Minas Gerais

The agricultural activities carried out in the family properties studied reveal both a high demand for labor at specific times of the year and the simultaneous demands of various activities for labor (Fig. 2a, 2b, 2c and 2d).

Livestock and horticulture management are activities in which there is greater regularity in the dynamics of labor allocation during the year. Farmer's layout scales and allocate available labor so as not to compromise the main economic activity (coffee) and the subsistence food production systems (horticulture, milk, and meat).

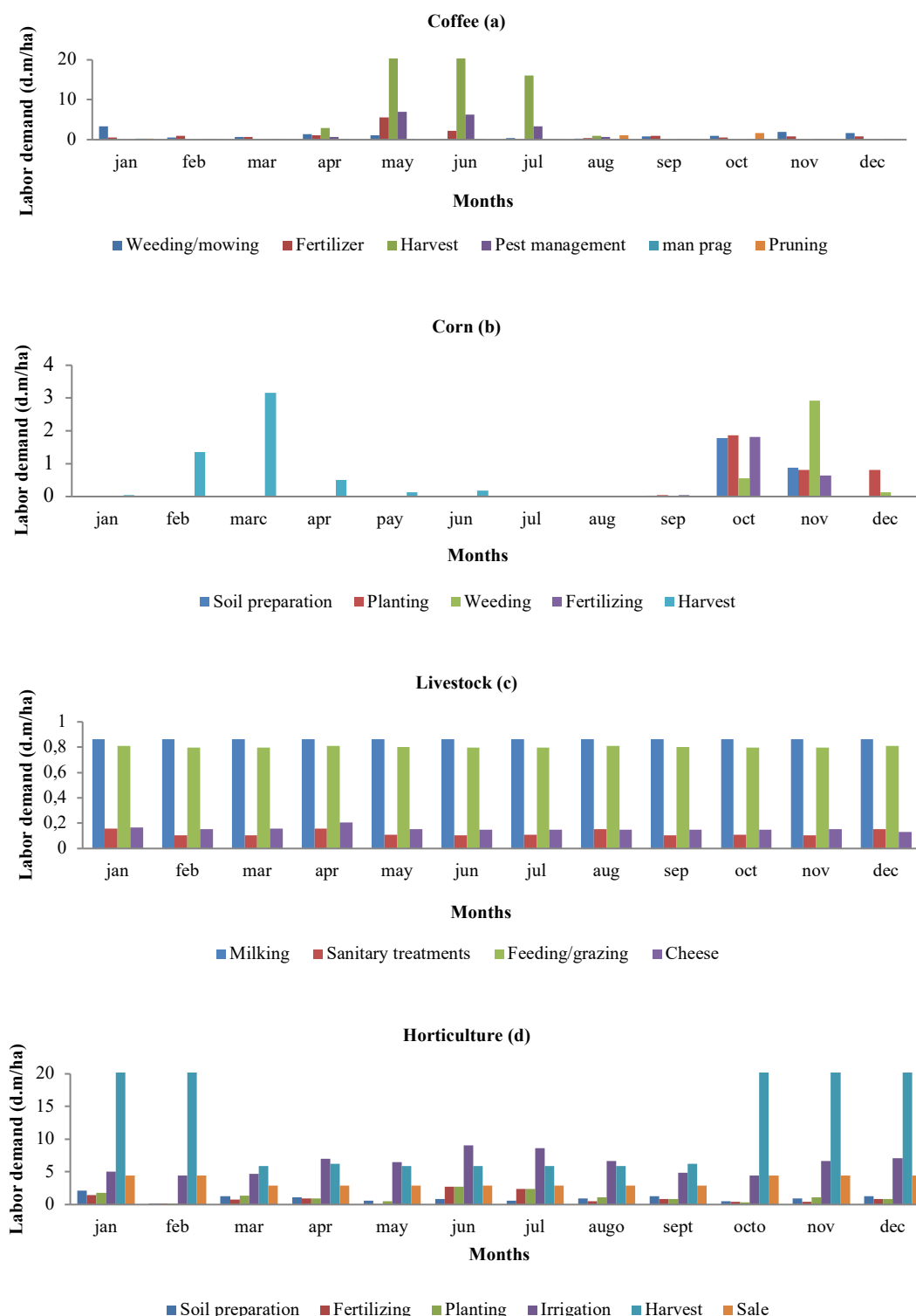


Fig. 2. a) demand for an agricultural year (2016-2017) for activities coffee-growing, b) corn, c) livestock, backyard/horticulture d) of 25 family farmers in the Zona da Mata of Minas Gerais.

C. Coffee

The coffee activity requires a larger amount of labor from May to July with approximately 40 d.m / ha per month, which corresponds to the harvesting and drying period of the beans. From the analysis of the labor allocation dynamics of the coffee plantation agricultural activities, it can be inferred that from January

to April, the tasks consume approximately 5 d.m / ha per month. High demand for labor happens at a specific time, harvest, for example, and, at another time, this demand decreases making it possible to organize tasks for coffee-growing, such as weeding and pruning.

The amount of labor demanded in the harvest can be explained by the low use of coffee harvesting machines and the rugged topography of the region, making it difficult to use coffee harvesting machinery (DoVale *et al.*, 2014). In addition, there is also the need to remove fallen fruits from the crop, so that the coffee borer beetle does not proliferate (Ribeiro & Rufino, 2018). Likewise, the explanation for the high labor requirement for operations post-harvest may be that most family farmers are deprived of equipment such as pulpers or dryers and dry the coffee in coconut in cement backyards (Ribeiro & Rufino, 2018), which consumes many days, with intensive use of labor each day.

In the summer period (December to March) weeding and fertilization are demanding from an operational point of view and require labor. However, all of these activities can be performed more efficiently with the aid of machinery. Brushcutters and herbicides are used for weed control (Silva *et al.*, 2018). Some tasks have already been performed mechanically. Farmers with the use of motorized brush cutters perform weeding as reported in this research. The brushcutter reduces the need for workers and improves operation in a short time. This and other small machinery facilitate cultural handling. In the Zona da Mata of Minas Gerais, about 64% of small properties make use of this type of machinery (Vilela & Rufino, 2010).

Understanding that family coffee farms are diversified in terms of production, that is, they develop other agricultural activities, the labor required by coffee starts to influence management dynamics among other activities (Buainain *et al.*, 2005). Thus, the dynamics of labor are governed by the phenological demands of the coffee crop, the main economic crop, which demands a large amount of labor, especially in harvesting and drying, is the model of the labor scenario found in family properties (Junior, 2013).

In a family coffee scenario in the South of Minas Gerais region, similar to Zona da Mata, in evaluations of potentialities and barriers of mountain coffee production, the reduced supply of labor in times of peak demand and the difficulty of mechanization have been pointed out as factors that hinder coffee production tasks (Guaraldo *et al.*, 2018).

The allocation of labor may reflect the dynamics of the agricultural diversity of family farms. While the use of machinery facilitates cultural treatment and substantially reduces the need for labor, it simplifies agricultural systems. It can also be said that the reduction of labor time in single agricultural systems such as coffee allowed partitioning the labor in activities such as maize crop management, livestock and horticulture (Weil *et al.*, 2017).

Coffee-growing is the main agricultural system within family property, thus requiring the farmer considerable ability to make efficient use of labor resources. All properties studied develop agricultural subsystems for marketing and / or supplying internal needs of the property. In parts of coffee plantations, it is common to find crops of beans, maize, fruit trees, as well as occasional native species with shading purposes for work breaks (Pelegrini *et al.*, 2017).

D. Corn

The intercropped cultivation of maize and coffee in the Zona da Mata region of Minas Gerais occurs through the strictly family labor, among other factors, due to the volume of production generated. Maize requires a large amount of labor from October to November, the time of soil preparation and planting. Later, the crop will require more labor at harvest, which in the Zona da Mata of Minas Gerais can occur from January to April for silage production or from May to June for grain production, respectively (Cardoso *et al.*, 2010).

From the analysis of the labor allocation dynamics of the maize production agricultural activities, it can be inferred that from January to April for crop harvesting for silage production, and April for the harvesting of maize for grain yield, demand in both seasons 4 d.m / ha per month, during these periods.

In the Zona da Mata of Minas Gerais, there is regular maize cultivation between coffee trees (Souza *et al.*, 2017), as well as flat areas under single cultivation. For the cultivation of maize between coffee trees, there is the difficulty of using machinery and intensifying the use of the labor. When grown single, grain maize can be planted with leased machines, but it still depends on family labor for other crop treatments.

In the Zona da Mata of Minas Gerais, for the summer harvest (November to March) in the properties studied, the crops began in mid-October with the tillage and in November with the sowing, occurring after the first rains. These are the most demanding moments in labor for this activity and also the moment of greatest expense with this item (Pereira Filho, 2002).

Maize grown in intercropping with coffee may generate competition among species, but coffee may benefit from crop treatments for maize such as fertilization, weeding, and deposition of organic matter into the soil. In addition, maize is an important product for reducing costs. Maize, on family farms, serves as household food for poultry, pigs and beef / dairy cattle, as well as the marketing of grain or its by-products (Galata *et al.*, 2017).

Operational cost assessments of labor intended for maize cultivation tasks performed in the state of São

Paulo show that crop deployment (tillage and planting) requires more workers (Garcia *et al.*, 2012). An analysis of the economic viability of the maize intercropped with coffee in the semi-arid region of Minas Gerais revealed that the labor intended for planting maize was the highest in relation to other cultivation operations such as animal husbandry or other crops (Silva *et al.*, 2017).

The cultivation of maize in the properties studied, the labor used is exclusively familiar and no hiring or exchange of working days is necessary. Diagnosing Sete Lagoas, Minas Gerais, weeding demands a large amount of labor, since the average duration of this task is approximately 8 working days of one person per hectare, higher values than what was found in this research (Pereira Filho, 2002; Silva, 1987). By comparing the demand for coffee production with maize, it is clear that there is competition for labor between these two crops. This competition occurs mainly in early summer when maize cultivation is started and coffee cultivation demands labor for tasks such as fertilization, pest control and weeding. The competition for labor between these two activities can compromise the full development of the crops, leading to the reduction of the cultivated area and consequently the grain production. For coffee production, it could be delayed in fertilization and weeding, for example, resulting in reduced production. Coffee still has the aggravation of bienniality in which, in the event of delays or not performing one of these tasks, in a year of lower productivity, this phenomenon may be aggravated.

E. Livestock

Milk production is not dissociated from beef cattle and was an activity common to all farms. In general, tasks such as milking and feeding constantly require the same amount of labor throughout the year. It was identified that some properties benefited milk through cheese manufacturing, requiring a larger contingent from October to March (Fig. 2). Dairy farming is important for family farming because it is a source of income in marketing cheese and fresh milk to local dairy products, as well as its use in household food (Silva & Junqueira, 2018).

The labor that coordinates milk-producing activities is also responsible for beef animals. Beef cattle ranching for family farming is important because it is an economic reserve (Ferreira *et al.*, 2012). The same animals used for milk production may be marketed as beef cattle (Moreira *et al.*, 2019). The economic reserve in this mold occurs as the producer markets the animals at specific times of financial need. Failure to intentionally dissociate dairy farming and beef farming shows that family labor is capable of varying the level of participation between different tasks by managing labor in two activities simultaneously (Coelli & Fleming, 2004).

The demand for labor for this activity may vary depending on the season, as most herds are grazed. The supply of food in the trough is restricted to the dry season (May to October). This same time can cause a decline in labor demand by decreasing productivity, which decreases the workload on cheese-making tasks (Silva *et al.*, 2018).

Internally, the food processing and cheese production operations demand more labor. In the period from October to March (summer) there are higher volumes of rain that favor the adequate establishment of pasture. Due to the better pasture quality, milk production increases and along with it cheese production. However, due to the cold and dry period from April to September, the quality of the pastures decreases and the supply of roughage in the trough is necessary. As pasture quality declines, milk and cheese production also decreases. This work scenario allows labor to be allocated to other agricultural tasks or activities.

For the care required by livestock, the hiring of labor is not performed. The family copes with work peaks without changing days or other practice. In the properties studied, it can be seen that the periods of increased demand for labor (approximately October to March) coincide with periods of high demand for maize and coffee (Fig. 2 B and C, respectively). Perhaps for this reason, in general, the female labor force is in charge of tasks such as milking and feeding the animals. Sanitary operations, in general, are male responsibilities.

The division of labor is intended to operationalize the task prioritizing the reduction of execution time. A case study conducted in the region of Lavras, MG, on milk production considered the influence of labor on production cost and found that family labor represents the smallest portion of total costs. One possible explanation for the lower expenses associated with family labor may be due to the quantities of milk or beef produced since family labor production systems have smaller production scales (Lopes *et al.*, 2007).

Due to the diversification of activities, family farms generally show the productivity of specific farms smaller than those observed in specialized livestock farms. However, small family properties have positive production values and net profitability, as labor is capable of enabling long-term activity (Lopes *et al.*, 2007).

For example, according to data from IBGE (2017), the average number of cattle per hectare of pasture was set at approximately 1.15 in 2017, the last agricultural survey carried out in areas with a higher technological level. In case of this research, small family properties with a low technological level, this statistic is even lower, they are no more than 1 animal per hectare. However, this is not the case in practice, in Brazil, up to 10 animals per hectare are used. This type of scenario is therefore influenced by the availability and demand for labor on the farms.

F. Horticulture

Contrary to expectations, the horticulture labor does not decline significantly from May to July (Fig. 2D). This season coincides with the coffee harvesting season, the main income-generating crop. At the end of coffee harvesting and drying, horticulture management is the activity that guarantees a portion of the family's staple food supply such as vegetables, tubers, starch and grains, and the supply for small animals breeding. Therefore, this activity is not completely abandoned because it plays an important role in terms of household food security (Fig. 2D).

In northern Minas Gerais, the yard / horticulture labor requirements constitute 40% of the operating costs that make the activity in that region feasible. Management is conducted, as in this research, concomitantly with beef and / or dairy farming (Xavier *et al.*, 2016).

The greatest demand for labor in the backyards / horticultures is from January to March, with a drop in demand from that month. From March onwards, the labor moves to the maize fields and preparations for coffee harvesting begin. Backyards / horticultures play an important role in the life of family farming and the activity does not suffer from the diversion of labor to activities such as coffee and annual crops (Morais *et al.*, 2014).

In general, the labor in the horticulture is exclusively from the family and its costs are not accounted for by the farmer. The activity involves reducing tasks that need more dedication, such as weeding and planting, in times of demand for personnel in another agricultural activity, such as coffee. The cultural treatments with the horticultures have a facilitator of the location / positioning of the crops. Horticulture and orchard are nearby the house (backyard), which is a place where women and children stay longer. The female labor facilitates weeding, planting and irrigation processes in the horticulture. Proper allocation of labor to the activity reduces the constraint on required family labor and ultimately reduces costs, even if they are unaccounted for (Pipolo *et al.*, 2010).

Farmers are able to scale labor for horticulture activities. This is because the crops essential to the family's food (maize and beans) occur in an intercropping of species and, through this technique, can maintain their productive efficiency. With intercropped crops it is possible to rationalize the use of labor for various food species and reduce the risk of damage to agricultural activity: if one crop presents problems, the other can compensate for the loss of the previous one (Silva & Junqueira, 2018).

The present research found that the labor allocated in the backyards / horticultures requires little time for dedication and is done only with the family labor. Similarly, in research conducted in the city of Belém, Pará state, with family horticultures, it was found that the labor is only family, these enable backyards / horticultures for self-consumption and local marketing purposes. In this region, these areas of agricultural use have a constant specific labor demand throughout the year (Martins *et al.*, 2015).

G. Labor dynamics and contribution to pluriactivity

Part of family coffee plantations in the Zona da Mata is historically developed in intercropping with species such as maize, beans and fruit trees. This system occurs in areas of coffee in full sun, which allows intercropping (Ferreira *et al.*, 2017).

The attention for labour use is based on the idea that labor availability is more constraining agricultural activity than the size of the agricultural properties.

So it seems that the average size of 3-20 hectares limits choices, either the balance between the activities or the priority setting.

Not only is the management of coffee farms handled by family labor, obviously, this force manages the entire property. The family members are therefore responsible for the cultural treatments of the intercalary species that follow the planting schedule if they were cultivated in a single system. Activities such as livestock and horticulture management have a constant demand for labor (Table I).

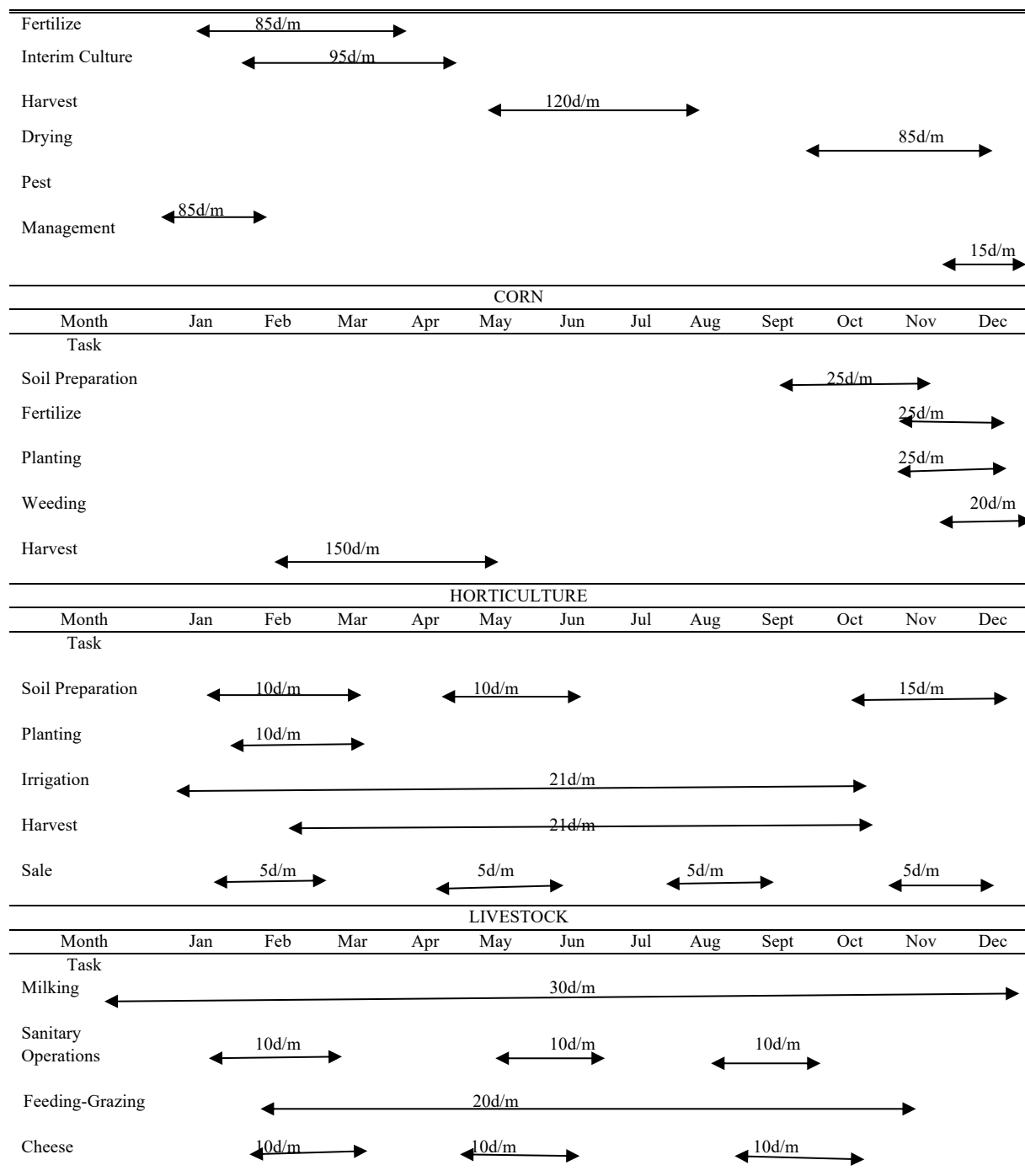
All property management activities are performed by available labor. Labor is the factor that inserts or extracts from the agricultural environment plant species, enabling the pluri-activity that the properties maintain (Suess-Reyes & Fuetsch, 2016).

The reproducibility of family farming is associated with the conduction of various crops. The economic, political, social, and ecological changes that family activities are exposed causes farmers to organize innovative strategies in the viable and sustainable use of labor as a resource in pluri-activity (Suess-Reyes & Fuetsch, 2016).

TABLE I: TASK ALLOCATION DYNAMICS OF THE PRODUCTIVE ACTIVITIES STUDIED IN THE ZONA DA MATA OF MINAS GERAIS, BRAZIL, PERIODS DIVIDE IN MONTHS (THE DEMAND IN NUMBERS CAN BE FOUND IN FIG. 2)

COFFEE												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Task												
Weeding												

75d/m



Souza *et al.* (2003) report that for family farming, activities such as livestock and horticulture do not require costly or intense labor but are constant. This behavior was observed in this research (Table I).

In general, family farms surveyed seek to scale tasks or operations based on seasonal variation in labor demand in other agricultural activities such as maize crops, horticulture and livestock. That is, there is a concentration of labor demand at certain times (harvest, planting, cultural treatment) interspersed with livestock, which demands intense labor throughout the year. Thus, the allocation dynamics based on this type of information reveals that in the studied properties a labor allocation pattern is adopted.

The data in Table I also included the number of days of work required by a single worker. In Brazil, one man day of work is equivalent to 8 hours of work and this number was multiplied by the average number of days a person would need to complete the task of each agricultural activity. In general, tasks are performed by more than one person in the family. This gives us the idea that a given task requires a greater or lesser amount of labor. With that, can see possible labour constraints much better. And that raises the question about solutions to labour constraints:

(1) Hire additional labor; in Brazil, the entire family (women, youth, and children) participates in tasks that demand the greatest amount of labor (coffee harvesting season, for example). The exchange of working days with other farmers also takes place on a smaller scale. (2) Allocate land such that you can manage

labour best, in which case labour allocation would primarily go to coffee (as the most remunerative crop) while reducing land for other activities. (3) Reduce the intensity of management in periods of peak labour without reducing land for that activity; meaning, for instance, less weeding and yield losses, less care for cattle, etc. Now such farmer decisions remain invisible in a general statement that farmers apparently achieve labour allocation in the best possible way.

But what is currently best, may not remain the best for the future. If coffee productivity goes down (climate change) or coffee prices go down, farmers must increase the possibilities for farmers to adaptively change. And so, understanding how farmer diversity might provide various adaptive strategies could be an interesting point of this paper.

The regional characteristics of coffee production in the Zona da Mata of Minas Gerais state that smallholders are knowledgeable about the agronomic aspects of coffee cultivation and integrate it efficiently into their self-consumption agricultural systems (Rosa *et al.*, 2017).

In a resource-poor agricultural production environment, the ability of family members to varying ability to participate between different activities and work tasks helps to overcome difficulties, among others, arising from labor shortages, scarce machinery, and decapitalization (Weil *et al.*, 2017).

The analysis of Fig. 2 and Table I shows a certain pattern of harmony in the dynamics of labor allocation among the studied crops. Variation in the size of agricultural areas may be a factor in the amount of labor required.

It is noticed that times of high demand for coffee labor coincide with lower demands of other crops for this resource. An exception would be the period between April and May, where there is some competition between coffee, livestock, and maize. In this case, it can be expected that some damage to the production practices of these crops will occur to the detriment of the dedication to coffee, which may lead to a lower performance for livestock and maize.

The difficulty of allocating labor on family farms lies in the diversification of agricultural activities (Coelli & Fleming, 2004), as there is a demand for labor between different activities such as coffee, livestock, and backyard and horticulture management.

According to Buainain *et al.* (2005), certain agricultural activities face the problem of labor shortage, whose availability limits their evolution. In family farms, crop yields in isolation tend to be lower than compared to monoculture farms (Soares *et al.*, 2017). The allocation of labor in intercropped systems optimizes the labor required and the resources to do so.

Labor in family farming is capable of managing more than one crop with input of more than one benefit to them, interdependence favors the organized employment of labor (Ferreira *et al.*, 2017).

Family properties are not dedicated to efficiency in specialization but strive to maintain the efficiency of diversification or pluri-activity. This means that the allocation of labor will only be well used if it is capable of performing a task that reaches other crops, if there is diversity. For example, maize canopy fertilization can be cited in an intercropping with coffee or weeding that eventually benefits coffee by fertilizing and / or eliminating competing plants (Souza *et al.*, 2017).

Thus, family farming processes are flexible in that they allow the management of labor without harming other crops. Competition for labor among crops can be circumvented throughout the year by positive interdependencies as facilitators of family labor management and allocation according to reasons of family agricultural and food seasonality (Ferreira *et al.*, 2017).

From May to August, the activities related to the horticulture and animal breeding receive reduced treatment for their maintenance, receiving more attention from December to March. Working in the horticulture activity receives greater attention only after the coffee harvesting period. In the early months of the year (January to March) maize cultivation absorbs most of the labor available for harvesting tasks.

Horticulture can be seen as an environment that allows the reduction of labor due to the fact that cultivated species are rapidly developing. Thus, in the opportunity for species improvements or increases, it will occur without major difficulties. The labor demanded in horticulture is also related to the seasonality of crops such as coffee and maize (Ferreira & Dalla Chieza, 2018). Assuming that there is a scale of importance for allocating labor according to economic and food criteria, these two occupy privileged positions in which horticulture will be supplied through seasonality of these other crops.

Thus, when necessary, the input of labor for the management of backyards/horticulture may be increased to establish the basic crops of family consumption. In the basic operation of horticulture, the contingent of labor may be redirected to the main economic activity, coffee.

IV. CONCLUSION

The largest demands for labor by the family are from April to June and are associated with the coffee crop and this is due to the fact that it is the main economic activity. The lowest labor demand for family farming is in March and later from August to September.

Demand for labor allocated to livestock and horticulture, despite being constant during the year, does not constitute an operating loss to activities such as maize production and coffee production.

The allocation of labor throughout the year to family-owned coffee farms contributes to maintaining pluri-activity and crop diversification.

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CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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