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Traditional knowledge about the influence of the Moon on agricultural activities: practices and routines of producers of Paraná region, Brazil

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Abstract - One of the possible contributions to sustainable development and reducing environmental damage is the rescue of traditional folk knowledge, especially regarding the phases of the Moon and their influence on terrestrial events, which tends to be common knowledge among communities around the world. One hundred rural producers from 15 municipalities in the region of Guarapuava - PR, Brazil, were interviewed about the existence, transmission and use of knowledge related to the influence of lunar phases in field activities. It was found that 100% of respondents believe that the lunar phases influence activities such as planting, logging, fishing or animal husbandry, and 94% of the properties use this knowledge frequently, receiving orally transmitted instructions from previous generations.

Keywords: Agriculture. Animal husbandry. Moon phases. Sustainability. Traditional knowledge.

Conhecimentos tradicionais sobre a influência da Lua nas atividades agrícolas: práticas e rotinas de produtores de região do Paraná, Brasil

Resumo - Uma das formas de se contribuir para o desenvolvimento sustentável e redução dos danos ambientais é o resgate dos conhecimentos tradicionais dos povos, principalmente no que diz respeito às fases da Lua e sua influência nos eventos terrestres, conhecimento comum entre as comunidades ao redor do mundo. Cem produtores rurais de 15 municípios da região de Guarapuava - PR, Brasil, foram entrevistados sobre a existência, transmissão e uso de conhecimentos relacionados à influência das fases lunares nas atividades de campo. Verificou-se que 100% dos entrevistados acreditam que as fases lunares influenciam atividades como plantio, extração de madeira, pesca ou pecuária, e 94% das propriedades utilizam esses conhecimentos com frequência, recebendo instruções transmitidas por via oral de gerações anteriores.

Palavras-chave: Agricultura. Criação animal. Conhecimentos tradicionais. Fases da Lua. Sustentabilidade.

Conocimientos tradicionales sobre la influencia de la Luna en las actividades agrícolas: prácticas y rutinas de productores de la región de Paraná, Brasil

Resumen - Una de las formas que se puede aportar desarrollo sostenible y la reducción de los daños ambientales es el rescate del conocimiento tradicional de los pueblos, especialmente con respecto a las fases de la Luna y su influencia en eventos terrestres, conocimiento común entre comunidades alrededor del mundo. Se entrevistó a 100 productores rurales de 15 municipios de la región de Guarapuava - PR, Brasil, sobre la existencia, transmisión y uso del conocimiento relacionado con la influencia de fases lunares en las actividades del campo. Se descubrió que 100% de los encuestados cree que fases lunares influyen en actividades como siembra, extracción de madera, pesca o ganadería y 94% de las propiedades utilizan este conocimiento rutinariamente, recibiendo instrucciones transmitidas oralmente de generaciones anteriores.

Palabras clave: Agricultura. Cría de animales. Conocimientos tradicionales. Fases lunares. Sostenibilidad.

Introduction

The experience of observing the sky allowed early human communities to mark the time, gradually dividing it into days, weeks and months. Moreover, the influence that people attributed to the stars, especially the Moon, after empirical observations of their role in nature, allowed them to organize their ordinary activities, principally those related to agriculture (Virgatchik 1983; Rivera 2005).

Even today, generations-passed knowledge about the moon phases guide many communities in farming and animal husbandry (Crepalde et al. 2017; Grando and Little 2017). However, with the advancement of new technologies in rural areas, much of this knowledge has fallen into disuse or has already been lost, either by abandoning traditional activities or by changing or losing natural environments (Leff 2002; Bullitta 2018).

After World War II, agriculture began to have as its mainstream the Green Revolution, which would be spread by governments, international organizations, universities, agricultural research centers and input companies. This stream has spread the use of hybrid seeds, synthetic fertilizers and pesticides, financed by the World Bank and the Inter-American Bank. However, in its objective of maximizing production, it was not concerned with the effects that the new technology employed could have on the surrounding environment (Zamberlam and Froncheti 2012).

From then on, the advancement of technologies in conventional agriculture was based on agrochemical (pest control), motomechanization (labor costs reduction) and genetic manipulation (an adaptation of animals and plants to chemical inputs). Although this culminated in an unprecedented increase in productivity, it was also responsible for damage to the environment, biodiversity and people's life quality (Costabeber 2004; Mazoyer and Roudart 2010).

Then, in response to the environmental degradation resulting from this conventional production model, the themes "sustainability" and "agroecology" emerge, which seek a sustainable development of the production means taking into consideration the planet's resources finitude and the balance of agroecosystems (Leff 2002; Altieri 2021). In this line, one of the principles of agroecology is the preservation of traditional knowledge, since it provokes the exchange of experiences and a dialogue between different knowledge, through interdisciplinarity and hybridization of traditional and modern techniques with sciences (Leff 2002). For this, a meeting space must be created, where it is recognized that each one has their own epistemology, languages and methods, so each one must maintain their spaces of production, reproduction, transmission and development (Villamar and Ruiz 2019).

More than just "popular beliefs", there are researches suggesting the influence of different lunar phases on some plant species cultivation (Santos et al. 2013; Menin et al. 2015), on fishing activities (Godefroid et al. 2003; Bastos et al 2017), in animal reproduction (Dixon et al. 2006; Zimecki 2006; Grant et al. 2009; Marinho et al. 2015; Yonezawa et al. 2016), in medical complications (Sok et al. 2001; Takagi and Umemoto 2004; Bunevicius 2017) and also on animal behavior (Bhattachargee 2000; Wells et al. 2007). Therefore, it is possible that the traditional knowledge of various human groups could serve as a basis for future research and the advancement of modern science.

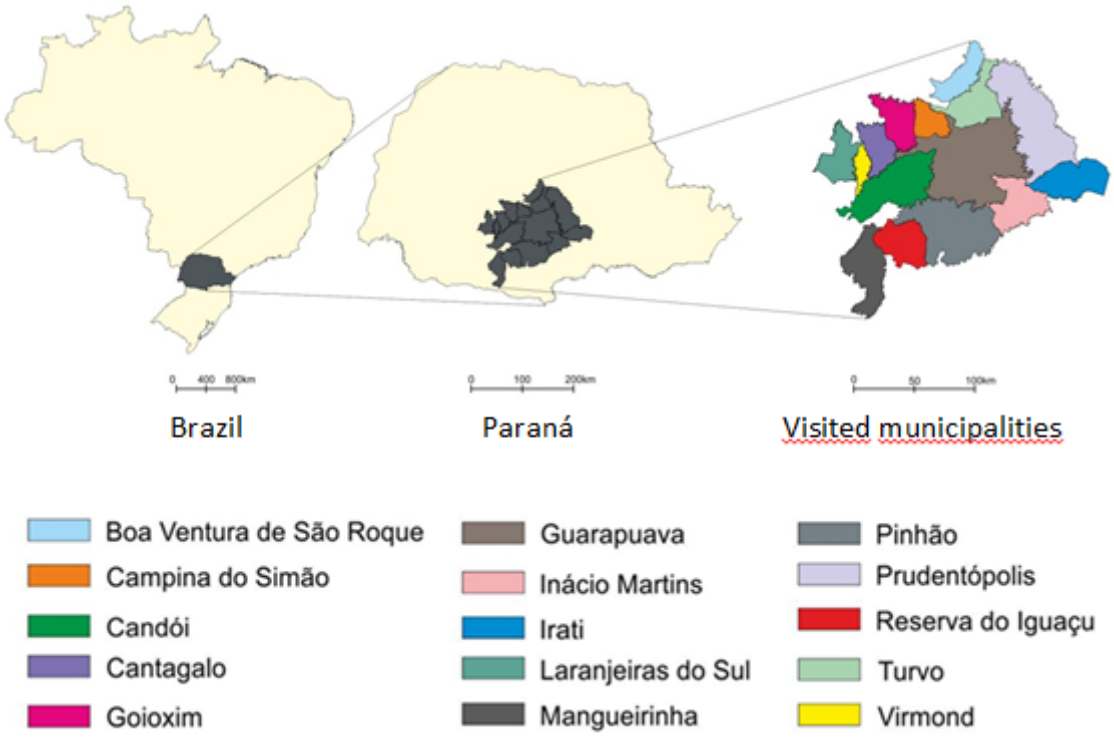
This work aimed to collect data on the knowledge related to the Moon and its importance for farmers today. The specific aim was to survey data associated with animal husbandry and particular routine activities, while additional data was collected according to the interviewees' speech, taking into account the hypothesis that the changes in the moon phases influence country life. Although there are some works carried out in small traditional communities that mention knowledge about the Moon influence on their activities, no reports of this nature were found in relation to farmers from Paraná, South of Brazil. Therefore, it was proposed to rescue the traditional knowledge about the Moon with rural producers in the Center-South and Southeast regions of Paraná, Brazil, aiming to enhance the local culture and contribute to sustainable development.

Material and Methods

Study Area

The interviews were performed in the Paraná state, located at South of Brazil, mainly in the Guarapuava region and its bordering municipalities, Mid-West of the Paraná state (Figure 1). The option for the Guarapuava region is justified by hosting the Postgraduate Program in Veterinary Sciences of the Universidade Estadual do Centro-Oeste (UNICENTRO), facilitating the realization of the project, as well as being the largest municipality in territorial extension of the state and a regional development pole. Most of the territory has a Mesothermal Humid Subtropical climate (Cfb), with cool summers, frequent and severe frosts, without dry seasons. The region is especially explored for agricultural production, mainly occupied by cyclical crops of grains, such as soybeans and corn, and intensely colonized by European descendants (IPARDES 2004; Rodrigues et al. 2018).

Figure 1. Location sketch of the regions visited during the survey.



Preparation: Aquino, 2019.

Sampling and interviews

A field research was chosen in order to reach the proposed objectives, aiming integration between qualitative and quantitative methods. According to Flick (2009), this integration occurs through plans of approach that consist in the use of semi-structured interviews (qualitative method), followed by a quantitative study of the questionnaire, which constitutes an intermediate step, before the deepening and evaluation of results obtained from both stages in a second qualitative phase.

Based on an initial bibliographic review, a semi-structured questionnaire was elaborated, which was applied to rural producers in 15 municipalities of the Center-South and Southeast Mesoregions of Paraná, Brazil (IPARDES, 2004), for data collection. Since this procedure is a research involving humans, it was submitted and approved by the Research Ethics Committee, COMEP-UNICENTRO. The intention of applying a semi-structured questionnaire was to help them describe if they have any knowledge regarding the possible influence of moon phases on terrestrial events, especially in animal husbandry, as well as to describe the use of this knowledge to direct routine activities, listing specific situations.

The survey was conducted between December 2018 and April 2019, and consisted of interviews reaching 100 farmers (Table 1). The choice of properties was conditioned to the existence of animal creation while driving on the rural roads of the visited municipalities, being the absence of any animal husbandry the only exclusion criterion.

Table 1. Number of interviews conducted by municipality.

Municipality	Interviews	Municipality	Interviews
Boa Ventura de São Roque	5	Laranjeiras do Sul	5
Campina do Simão	5	Mangueirinha	6
Candói	8	Pinhão	5
Cantagalo	5	Prudentópolis	4
Goioxim	5	Reserva do Iguaçu	1
Guarapuava	31	Turvo	5
Inácio Martins	5	Virmond	5
Irati	5	**TOTAL**	100

Results and discussion

Regarding the profile of the properties visited, taking into account Law 8.629 of 1993, which provides for the regulation of agrarian reform in Brazil, small rural properties are those with less than four fiscal modules. Over four to fifteen fiscal modules are considered medium-sized rural properties, and large when over fifteen fiscal modules (Brazil, 1993). Considering that the fiscal modules in the municipalities visited vary from 16 to 24 hectometers of land, according to the portal of the Paraná Environmental Institute (IAP, 2019), 76 small properties, 16 medium-sized properties and 8 large properties were visited. .

All of the small properties visited correspond to the family farming profile (Table 2). Family farming is considered to be a rural establishment that does not exceed four fiscal modules, wherein the workforce is predominantly family owned and the enterprise is family-driven (Zamberlan and Froncheti, 2012).

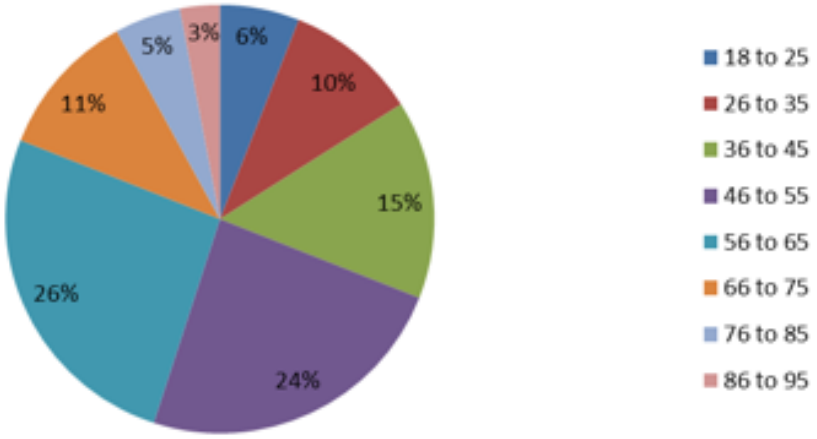
Table 2. List of activities carried out in the rural establishments visited, considering only the main activity.

Main activity	Properties	Main activity	Properties
Poultry farming	1	Organic strawberry farming	1
Seed beneficiation	1	Olericulture	9
Beef cattle	20	Sheep farming	3
Dairy cattle	42	Pisciculture	1
Horses breeding and taming	1	Colonial products	1
Agriculture	36	Reforestation	1
Meliponiculture	1	Pig farming	3
		TOTAL	100

Both agriculture and animal husbandry were framed as the main activities on the properties, with a highlight for dairy farming, present in 42% of the establishments (Table 2). According to Embrapa - Brazilian Agricultural Research Corporation (2018), in 2017 Paraná consolidated itself as the second largest milk producer in the country, behind only Minas Gerais, and it is estimated that its milked herd is 1.5 million heads, which explains this significant number of dairy in the visited properties.

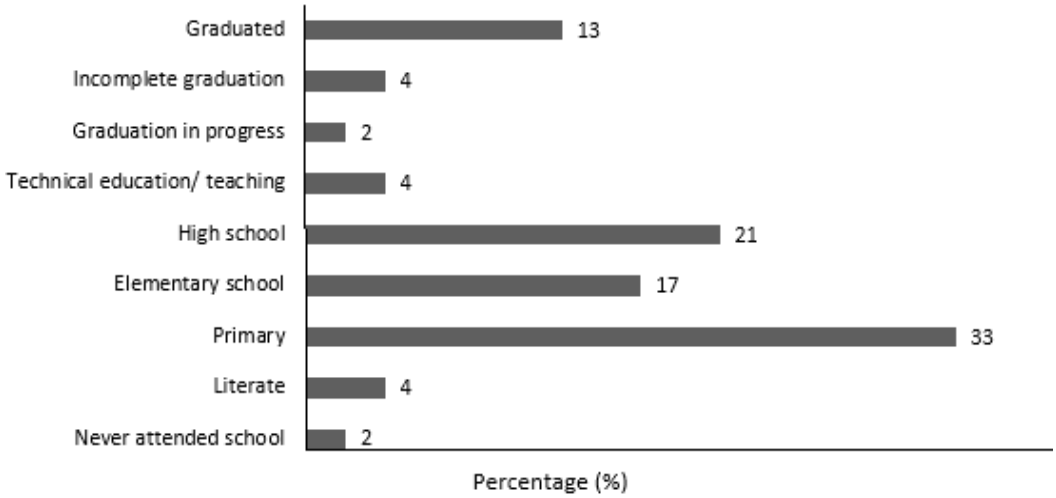
In total, 64 men and 36 women aged between 18 and 93 years were interviewed and the average age of the respondents was 53.16 years (Figure 3). The results were similar to those pointed out by the 2017 Agricultural Census in Paraná, whose survey found that 60% of producers in the state aged between 30 and 60 years old, 34% were over 60 years old and 5% were under 30 years old (IBGE, 2017).

Figure 3. Respondents' age distribution.



As pointed out by the state's latest Agricultural Census, most respondents attended only the former primary school (Figure 4), however this study evidenced a slightly higher level of education among producers compared with the 2017 survey (IBGE, 2017). Of those who completed higher education, four graduated in veterinary medicine, three in agronomy, two in business administration, two in law, one in history and one in mathematics.

Figure 4. Interviewees' educational level.

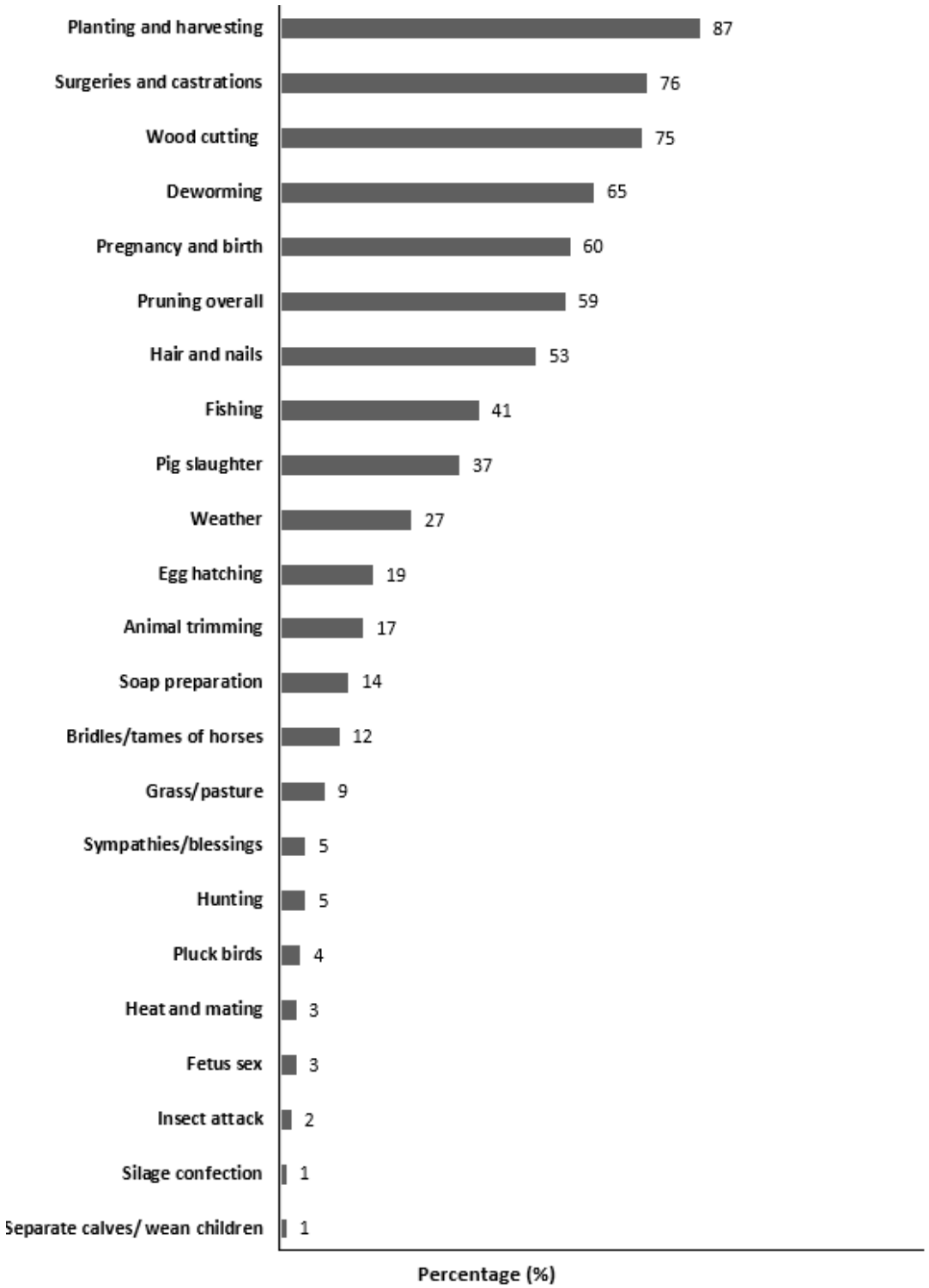


When asked about having heard of possible influences of different lunar phases on agricultural activities, all 100 respondents said that they believe in the influence of Moon phases in at least some aspect of the field routine, 94 mentioned that they use this knowledge in at least one type of activity, and 96 claim to have already observed differences in some experience. Darroz et al. (2013), when interviewing people from different levels of education about their knowledge of the Moon, also

found that all 80 survey participants credit some of their everyday events with lunar phenomena, demonstrating that these beliefs are not restricted to rural communities.

From cultivation practices to soap preparation, the activities cited by the interviewees as somehow influenced by the Moon were the most varied. In addition, 25 respondents made a point of mentioning that the Moon "influences everything" (Figure 5).

Figure 5. Distribution of popular knowledge about the Moon associated to each area, according to the respondents use of it in daily routine.



It is important to highlight that 98 interviewees believe in some interference of lunar phases over the development of plants, whether in their growth, maturity or attack of insects, and 87 use this information in practice. It is also affirmed that some crops, such as corn and beans, should be taken care of according to phases including in harvesting and storage. This traditional knowledge bases biodynamic agriculture, developed by Rudolf Steiner in the early twentieth century, whose agricultural calendars are formulated taking astrological phenomena into account (AABDA, 2018).

In his book "*La Luna: el sol nocturno en los trópicos y su influencia em la agricultura*", Rivera (2005) explains that the Moon influences the cultivation of plant species due to the sap movement dynamics, as well as the tides dynamics respond to its gravitational force on Earth. Besides, there is also the lunar luminosity, which according to the author would be directly related to seed germination and increase in photosynthesis intensity. The author claims that on the new moon the sap flow descends and concentrates at the root; in the crescent phase the sap begins to rise and concentrates in the stem and branches; at full moon the sap flow concentrates in the treetop, branches, leaves, fruits and flowers; and in the waning phase the sap flow begins to fall and concentrates in the stem and roots.

Some respondents referred to crops dividing them broadly between "what grows up the earth", such as vegetables and grains, and "what grows below the earth", like roots and tubers. For the last ones, 38 mentioned the waning moon as the best moon for planting. The results were similar to those found by Costa et al. (2018), interviewing 8 families from a community of Pará, Brazil, which also claimed that the best phase for planting roots and tubers would be the waning one. Similarly, researchers from Embrapa (Schiedeck et al. 2007), interviewing 49 rural producers from Rio Grande do Sul, Brazil, in a survey about traditional knowledge, among which the knowledge related to the Moon phases were the most cited, obtained the information that "the vegetables that grow below the earth must be sown in the waning moon."

Furthermore, 41 interviewees mentioned the new moon phase as not good for cultivation, claiming that majority of species planted in this phase suffer greater insect attack or flourish unwanted. They draw attention to the fact that this is the phase of greatest production but also the greatest loss from pest attack. In this sense, 9 producers mentioned the waning phase as the best for agriculture, precisely due to the lower occurrence of losses. When researching the lunar influence on agricultural practices of a Tupinambá indigenous village in Bahia, Brazil, Marques et al. (2007) obtained the same information, as did Grando and Little (2017) when studying the traditional knowledge of a rural black community in the countryside of Goiás, Brazil: corn, beans and cassava should be planted in the waning phase.

Respondents also highlighted the importance of the waning moon for food harvesting and storage because of the lesser pest attack, knowledge that goes back to the times when, according to them, families planted mainly for their own consumption and took better care of food storage. Rivera (2005) also makes this indication of the waning phase for harvesting and storage by delaying the production deterioration.

Most farmers cite this knowledge about the best stages for planting as a way to reduce the pest attacks, in order to obtain a healthier food for their families, free of conventional pesticides. Even if they use inputs in crops, they avoid doing it to crops for their own consumption. In the words of the 47 year old olericulturist A.H. from Laranjeiras do Sul, who also trades his production in the municipality markets: "taking care with the Moon, we removed 50% of the inputs, poison on the plantation… I already did the tests…". Also in this sense, producer I.N.O., 60 years old, from Turvo, comments: "we who have fewer resources need to go by the Moon, because the poison is expensive and bad for health".

The concern with the large-scale use and the consequent high consumption of pesticides is not only a concern of the rural man, but of the whole society, in a manner that the subject is always brought to debate. According to Hess (2018), Brazil is the champion country in the use of pesticides, and the presence of their residues in food and water has been related to a series of serious and common diseases in the population, such as cancer, infertility, chronic kidney diseases and liver dysfunction, for example. Besides, for the field worker there is also the risk of poisoning by direct contamination due to the applications. Thus, it is believed that any knowledge that may contribute to the reduction of such substances use in agriculture should be taken into consideration by researchers from all over the country, leading to studies that investigate their effectiveness.

Other knowledge widely used in the routine of rural producers concerns the cutting of wood. It was mentioned in 80 interviews that the best phase for logging is in the waning phase. Of these, in 31 conversations this practice was related to the smaller amount of water found in the wood, since the waters are "at the root" in this period according to the interviewees, a relation also made by Rivera (2005). The waning phase cut would make the wood more resilient and, according to 38 respondents, less prone to insect attack, generically treated by producers as "wormwood".

> "Wood, if not cut in the waning Moon, attract termites and worms everything... and it always works" (J.M.J.S., male, 49 years old - Turvo);
> "Wood for construction is cut in the waning, when there is no water, and doesn't worm… if it is cut in the full Moon the wood get full of drops… and in the old days they cut in the waning and in the months that don't have 'R'" (J.K., female, 72 years old - Prudentópolis).

The ones interviewed by Costa et al (2018) in Pará also stated that the waning moon would be the best choice for cutting wood used in the construction boards, tool handles and fences. This is because the lower amount of sap would reduce the possibility of attacks by drills and termites. Marques et al. (2007) obtained the information that the new moon phase would not be recommended for wood cutting, which was also warned in this work by 10 producers, claiming that in the new moon "worms everything".

Pruning in general according to the producers also should be carried out in the waning phase, either shrubs, rose bushes or fruit trees, for example. The same is indicated by Rivera (2005) and the biodynamic calendars (AABDA, 2018).

Regarding insect attacks, Rivera (2005) relates lunar luminosity to the development of many insect species, possibly interfering with both their reproduction and the various stages of their life, including their predatory activity (Mikulecký and Zemek 1992), since some respond better to brightness and others to darkness, which some interviewees observed in their routine:

> "the leaf-cutting ants, in the days of the full moon it is easier to find the nests, they stay more 'up the earth' ... and in the waning they get deeper, it's harder to meet"(J.I.G., male, 64 years old - Guarapuava);
> "louse and flea riot at full moon" (J.A.R., male, 62 years old - Guarapuava);
> "in the new moon more insects come ... mosquitos ..."(R.C.M., male, 36 years old - Guarapuava)

In addition, there is a belief among producers that the Moon may be related to climate change, a belief also reported by Grando and Little (2017), in a way that through their satellite-related observations, they can make climate predictions and organize their field activities:

> "when the Moon is with the right bowl shape it doesn't rain, but when it is pouring it rains" (J.A.P.P., female, 54 years old - Turvo);
> "if the Moon is made from midnight to noon it is more likely to rain, if from noon to midnight it is sunny" (E.A.M., male, 51 years old - Cantagalo);
> "in the new moon it rains more" (V.S., male, 87 years old - Guarapuava);
> "dad did it this way: if on the September new moon, on the day, it needed to thunder and rain to be good for agriculture. If it doesn't rain, it's six months of drought, little rain " (A.R.S., female, 71 years old - Irati);
> "circle around the Moon means rain is coming... if the circle is near it comes faster ... if it is far it takes longer" (M.C.F., female, 64 years old - Campina do Simão).

Other widespread knowledge, among those who work or simply enjoy the activity, are related to fishing. Although some statements were obtained such as "tilapia does not come on the new moon hook" (J.J.G., male, 43 years old - Prudentópolis), and "waning phase is wasting time" (K.C.Z.K., female, 22 years old - Irati), the respondents reported that the best phase for the fishery is chosen according to the desired species and the place of activity (river, sea or weir). Similar reports were obtained by Costa et al. (2018).

Relations have been found between the lunar cycle and the sexual development of fish and seafood, apparently caused by melatonin secretion in response to moonlight intensity (Rivera 2005; Zimecki 2006), which also influences the eating behavior of the fish (Rivera 2005). Researchers from Japan concluded that some fish use moonlight-related periodicities as reliable information to synchronize the timing of reproductive events (Ikegami et al. 2014), while in Brazil studies have shown the influence of moon phases on fertility, egg incubation time. and hatching rate of larvae of a shrimp species (Bastos et al. 2017). Grant et al. (2009) also found relations between moon phases and amphibian reproductive processes. This indicates that there may be some interference of the lunar phases in the life of aquatic animals, besides the one mentioned by Godefroid et al. (2003) as the result of the tides, which eventually interferes with fishing activity.

The preparation of soap, according to the producers, achieves better results when performed in the waning phase, because in the others phases it raises boiling "rising the foam" in the pan and pouring. Regarding hair and nail cutting, cited plenty of times by respondents, it is noticed that men preferred to cut in waning phase, for them to grow less, while women prefer the growing phase, precisely to grow more, according to the interview. Such knowledge is consistent with the one mentioned by Mattos (2018), bringing the influence of the Moon on hair growth: cutting during the crescent moon accelerates growth, but the hair grows thinner; in the full phase the wire grows stronger and with more volume; cutting in the waning phase conserves the cut. In the new moon interviewees do not recommend the cutting of nails and hair, because according to them "flourishes", in other words, the cuticles become weak, with lint, and the hair strands create split ends.

When asked how they identify the phases of the Moon, only 49% of respondents are able to identify them by spotting the star in the sky, either by its shape or by the time it rises, sets, or is "halfway through". They explain that the crescent moon rises at noon and sets at midnight, while the waning moon rises at midnight and sets at noon, and the full moon rises at six in the afternoon and sets at six in the morning. Such information is corroborated by Pimenta et al. (2018). Although most respondents claim not to be able to distinguish moon phases by observation, all said they check the phases in the calendar for routine use.

Influence of Moon phases on animal husbandry

Since all the farms visited had some kind of animal husbandry, among the species raised, the interviewees mentioned cattle (*Bos taurus*), horses (*Equus caballus*), pigs (*Sus scrofa domesticus*), sheep (*Ovis aries*), goats (*Capra hircus*), buffalo (*Bubalus bubalis*), rabbits (*Oryctolagus cuniculus*), fish, bees and birds of different species, especially chickens (G*allus gallus domesticus*). Most properties also included dogs (*Canis lupus familiaris*) and cats (*Felis catus*).

Of the practices cited by the producers when asked about the influence of Moon phases on the routine with animals, observed in Figure 5, the castration of animals was the most cited. Some respondents, although citing the lunar influence in a given activity, did not remember the most appropriate phase, either because they do not use the property routine or are not responsible for the practice.

The castration of animals on most farms is carried out by the producers themselves or by the "practitioners" of the region, and there are rare occasions when the services of a veterinarian are hired for this purpose. The full (45%) and waning (29%) phases were the phases of choice for most interviewees, being related to better healing and recovery of the animal, as well as a better physical constitution of the adult animal, as shown in the examples below. Follow:

> "right after the full moon that you castrates ... two, three days later, which is better, the blood is no longer 'so messy' '(S.L., male, 83 years old - Guarapuava);
> "cannot castrate in the new moon, which swells the cut and creates worms or dies" (A.T., male, 92 years old - Guarapuava);
> "castration takes place two days after the full moon ... ox and pig ... then swells less" (J.C., male, 42 years old - Candói);
> "to castrate is three days after the full moon, when the moon is waning, then does not swell ... if cut in the full moon it swells a lot and takes time to heal" (J.M.J.S., male, 49 years old- Turvo);
> "castration of cattle and pigs is in the full moon, because for waning already heals" (J.C.S., male, 62 years old - Cantagalo);
> "in the new bleeds and swells a lot, and does not fatten evenly ... fattens up front" (D.L.S., male, 49 years old - Goioxim);
> "horse for wagon has to castrate 2 days before the full moon, to embody; if for riding, which needs to be thinner, it has to be 2 or 3 days after the full moon" (F.A.M., male, 62 years old - Campina do Simão).

Such claims, although no corroborating scientific articles have been found, are supported by astrology-related publications such as The Moon Book 2019 (Mattos 2018) and the United States Farmer's Almanac (Lange et al. 2014). Regarding the latter, Lange et al. (2014) conducted three studies comparing the recommendations of the manual and found significant differences related to the healing of piglets during castration, suggesting further studies.

Of the respondents who prefer the full moon phase for castration, 12 state that the animal gets fatter, 9 mentioned that it should be done two days after the Moon enters this phase, 9 mentioned that it should be done between 2 days before and 2 days later, avoiding the "turning day". Also, 10 reported that castrations performed in the waning phase cause less postoperative complications, and it is clear that new and growing phases are avoided, being related by respondents to a higher risk of bleeding and insect attacks, extending the recovery period.

Slaughter of pigs according to lunar phases was also widely cited, mentioned in 51 interviews and used in 37 farms. The waning phase was indicated as the best by 26 respondents; 15 claimed to know about the influence, but not the ideal phase; 1 mentioned the full moon; and 9 only claimed that pigs cannot be slaughtered during the new moon. It should be remembered that knowledge in this sense comes from generations that had no access to refrigeration and had the habit of keeping pork meat in lard, conditioned in cans (Maciel 2019). This custom still remains among many families in the region, since most farms keep pigs for their own consumption.

> "pork is meat in the waning so as not to froth the lard and not to ruin the tinned meat" (J.F.D., male, 27 years old - Guarapuava);
> "killing pork is better in the waning, to melt the lard it does not rise up and the meat does not ruin to store in the can; in the new moon everything soon becomes rancid and the lard rises in the pan " (J.I.G., male, 64 years old - Guarapuava);
> "slaughter pork is in the waning ... if it is full moon the blood is all in the meat and gets darker" (R.M., male, 46 years old - Irati);
> "in the new moon, when the pork is meat and goes to fry the lard, it goes up in the pan" (M.L.B.H., female, 63 years old – Pinhão);

Although no scientific articles addressing this issue have been found, Rivera (2005) mentions in his book that the crescent moon would be the best for the sacrifice of animals for immediate consumption, while the waning phase would be the least recommended as meat would require a longer cooking time. However, the author deals with animal sacrifice in a generalized way, and the interviewees particularized the issue of slaughtering pigs, noting the interference of the Moon phases in the lard, which they believe contain more or less water according to the phase. In this sense, the producers and Rivera come to a consensus: the period between the crescent and full phases is the "up water period", resulting in higher water content in the carcass, while between the waning and new phases, the "down water phase", there would be a lower water content in the carcass.

In Veterinary Medicine, more specifically in the Inspection of Animal Products, there are very common terms used in relation to the water retention capacity of pork, when it deviates from the standards: PSE (pale, soft and exudative) when it comes to a pale, soft, exudative flesh; and DFD (dark, firm and dry), for dark, hard and dry meat. According to Maganhini et al. (2007), PSE meat represents the main quality problem in the pork industry and is undesirable for both the processing industry and the consumer due to its pale color, flabby texture and high water losses in processing. Its incidence is related to the pre-slaughter factors such as genetics, nutrition and management, and the main cause of development of this condition is an accelerated decomposition of glycogen after slaughter, which causes a suboptimal muscle pH value even at elevated temperature, resulting in protein denaturation and alteration of meat characteristics. Further research would be needed to relate or rule out a possible influence of lunar phases on water retention capacity of pork.

Regarding the slaughter of birds, mentioned by 5 producers, they relate the phases of the Moon with the easiness and/or difficulty of removing the feathers, as exemplified by interviewees from Guarapuava and Irati, respectively: "chicken is better to be slaughter in the waning moon"; "in the new moon is bad to kill chicken, because it is full of down, bad to pluck, in the crescent moon too."

The waning phase of the Moon stands out again by being the only one cited for child and animal deworming, horse bridling and animal hoofing. Although Rivera (2005) indicates the full moon phase

for both treatment and coproparasitological examinations for humans and animals, regarding the option for deworming in the waning phase, below there are some interviewee reports:

> "dewormer is better in fasting and during the waning moon, which is when they are not not so agitated. I think ... on the crescent moon they are so agitated (V.S., male, 87 years old - Guarapuava);
> "medicine for worms is taking in the waning moon, when they, the worms, are too calm" (E.A.M., male, 51 years old - Cantagalo);
> "dewormer is never given in the new moon, only in the waning moon ... during the new moon, the worms and the children get more agitated" (I.F.B.L., female, 53 years old - Boa Ventura de São Roque);
> "in the waning moon it is good to give dewormer, to clean" (S.F.B., female, 49 years old - Pinhão);
> "For children, dewormer is given on the waning moon of May. It can't be given in August and September, which is when the worms are all sprouting up... they are growing their family, so if it given could be dangerous and to kill the children. In months with 'R' they are growing, then it would not be good" (F.A.M., male, 62 years old - Campina do Simão).

In addition to the Moon phase, there is a belief among, at least, 19 interviewees that the dewormers should be provided in months "without R", which means, months not having the letter "R" in their name: May, June, July and August. The waning moon of May was the most cited, being used by 14 producers. These would be the right periods, because, according to them, the worms would be less agitated. This knowledge is possibly related to what technically can be called "strategic control of worm diseases", which advocates the application of dewormer in the driest months of the year, since parasites during this period do not find favorable conditions for survival in the pasture, being in greater quantity in the gastrointestinal tract of animals and, consequently, more exposed to the action of antiparasitics (Vieira 2003).

Rivera (2005) also cites the waning moon phase for the hoofing, as well as the producers, in order to make the hulls more resistant and healthy: "in the waning moon the hoof is done, to 'match' and not crack the hoof... and it is softer to cut" (INO, male, 60 - Turvo), "to make the hoofs is during the waning moon, then it would not give "drill" and hardens" (JS, male, 42 - Pinhão). Similarly, the shear follows the hair and nail growth principles mentioned above. With regard to the taming and brake placement in horses, there are no reports in the literature that can corroborate or contradict the interviewees' belief, but below there are some shared knowledge in this regard:

> "Putting a brake on a horse, it is done in the new moon so the horse would not become "drooling"; then the mouthpiece is placed in the waning moon in order to be soft " (J.C., male, 42 years old - Candói);
> "Putting a brake on the horse is done during the waning moon, to keep the meat firm, so it doesn't cut the animal so much" (A.M.P., male, 77 years old - Inácio Martins);

Regarding both human and animal deliveries, but especially of the latter, 66 interviewees stated that deliveries occur mainly in phase changes, commonly referred to as "moon turn". The occurrence of more full moon births was mentioned by 8 producers, while 2 reported that most births occur in the crescent and full phases. It was also mentioned by 10 respondents that in the waning phase deliveries are more difficult, longer, while in full moon they are easier and faster. The relationship of the phases of the moon to childbirth, in the words of some producers:

> "[childbirths] happen easier in the full and new moon, in the waning there is need of helping" (A.K., female, 67 years old - Guarapuava);
> "The waning moon is the 'dry birth', there is less liquid, so it's harder to 'create'; doesn't dilate right and has less mucus" (J.C., woman, 47 - Guarapuava);
> "There are more births in the 'Moon revolutions', and babies move more" (B.S.P., male, 84 years old - Inácio Martins);
> "At Moon turns, the child moves ... moves the children throughout the pregnancy" (M.L.B., female, 50 years old - Laranjeiras do Sul);

Research is conducted around the world on this ancient belief that the Moon would influence childbirth. Each year, according to Bueno et al. (2010), there are papers that discard and others that find this relationship, and although most research results are inconclusive, the belief prevails even in the medical field. For the authors this reveals that regardless of the results, in all societies this superstition continues and will continue to be passed down from generation to generation.

A connection between the distribution of spontaneous births and the lunar month was found by Italian researchers (Ghiandoni et al. 1998) in a retrospective analysis of 1248 human births. These found that especially for multiparous and twin pregnancies the average day of delivery corresponded to the first or second day after the full moon. Staboulidou et al. (2008) studied 6,725 deliveries without induction and found no significant differences relating the deliveries to the moon phases. However, as in other research (Bueno et al. 2010), the research was driven by the belief that there are more deliveries in the full moon, which does not correspond to the knowledge most often cited in this paper, that births occur mostly on the days of change from one phase to another.

Researchers at the University of Tokyo, Japan, investigating the distribution of 428 spontaneous births in Holstein cows, also observed a significant peak of calving between the crescent and full phases compared to the waning crescent and new moon phases, but this was only among multiparous cow deliveries, not being evident in nulliparous cow deliveries (although they showed a tendency to increase, there was no statistical difference). The authors argue that the frequency of births could be increased by reducing melatonin secretion at the time of the full moon, as animals are easily exposed to moonlight and without artificial illumination. This would also explain why no differences were observed in human births, which constantly exposed to artificial lighting could have the influence of the annulled lunar cycle. Non-observation in primiparous cows, according to them, could have been due to dystocias, which may last several days and are more common in these cases (Yonezawa et al. 2016).

Regarding the influence of Moon phases on the sex of puppies (and even babies), although many believe that there are right phases to inseminate animals, in order to obtain a desired sex, there is disagreement among respondents that cited moon-related sex at birth: in the new moon phase 9 cited that more males are born and 9 cited that more females are born; in the crescent 9 cited more males were born, and only 2 who were born more females; in the full phase 4 mentioned more males, while 20 said more females were born; In the waning phase, more males were mentioned by 15 respondents and females by 10.

> "insemination during the new and full moon phases gives female, even to get pregnant too." (M.L.B., female, 50 years old - Laranjeiras do Sul);
> "It is said that if you inseminate the cow during the new phase the tendency is to be 90% female" (S.B., male, 47 years old - Guarapuava);
> "I inseminate in the new moon to be born more females, inseminating in other moons gives more male" (J.R.R., male, 53 years old - Guarapuava);

> "we already noticed ... if the cow gets pregnant before the moon it will be male, and if after the moon turn then it will be a female" (M.K.S., female, 45 years old - Inácio Martins);

Regarding this knowledge, Marinho et al. (2015) found a relation between the lunar cycle and the time of delivery from mares according to the foal sex. They identified a higher birth of females in the new, crescent and full phases, while in the waning phase there was a greater number of male births. Although no other evidence of this moon phases influence has been found on the sex of newborns, either at conception or at birth, according to Virgatchik (1983) this knowledge has been used for centuries.

Egg incubation has also been reported to be influenced by the lunar phases, in a way that most of those who mentioned this interference stated that chicks are more easily peeled between the crescent and waning phases, and that there is greater difficulty between the waning and new phases, with risk of failing to hatch the eggs. Thus, 19 producers have the habit of counting 21 days of incubation to make sure about the hatching phase, or simply put the chickens to incubate at the full moon, so that hatching coincides with the crescent phase. Joseph (2018) and Rivera (2005) also recommend placing chickens to incubate between the full and waning stages, so that eggs hatch in the crescent for greater rate of success. However, no further information on this subject has been found in the scientific literature, revealing that much of the traditional knowledge of human communities still needs further study.

> "in crescent and full moon, if the chicks come out they grow better ... if born in the waning they get a little skinny" (J.K., female, 72 years old - Prudentópolis);
> "don't put chicken to incubate in the waning and new moon, they do not develop well" (C.K., female, 43 years old - Prudentópolis);
> "the chickens are placed to hatch about four days, five after the full moon ... they will hatch better and make the chicks better" (C.B., male, 59 years old - Campina do Simão);

Other interesting knowledge regarding animal husbandry should be mentioned here, as they are part of what the farmers themselves regard as "field science":

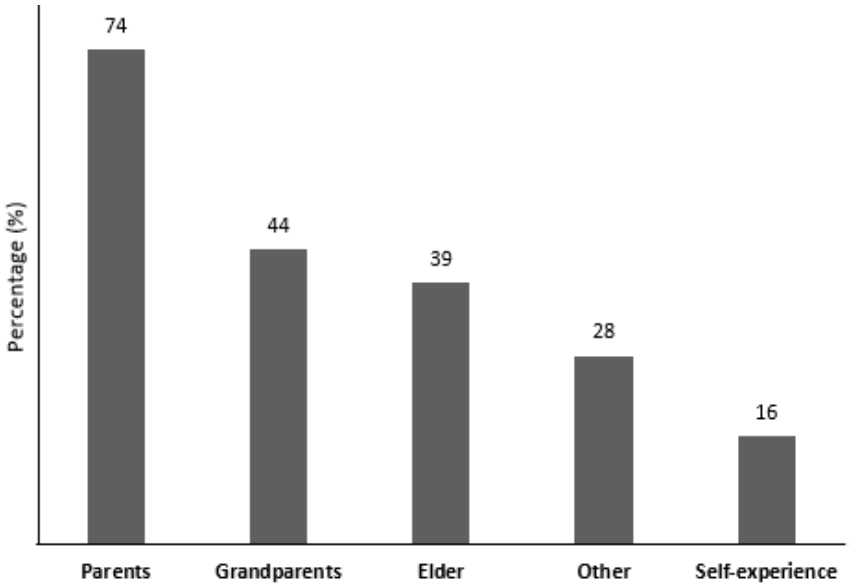
> "enclosing pig for fattening is from crescent to full moon, when they gets fat faster" (A.K., male, 67 years old - Guarapuava);
> "Moon eclipse makes plants die ... burns them all ... Potatoes and beans die overnight ... and cows and sows lose their birth" (J.C., female, 47 years old - Guarapuava);
> "to separate calf is better in the waning, when they do not care ... in the other moons they turn to scream" (I.N.O., male, 60 years old - Turvo);
> "according to the time to set the bait to catch the swarms [bees] is better a few days before and after the full moon ... in dark moons it is more difficult" (C.B., male, 59 years old - Campina do Simão);

Such knowledge, often ignored by technicians, is used in the routine of properties for generations, and remains among the growing technification of agricultural production. Regardless of whether or not they have the backing of conventional science, this knowledge often shapes the routine of field workers and must be respected as it is a cultural "way of doing" and a source from which researchers can draw on the advancement of modern science.

Importance of transmitting traditional knowledge to future generations

Respondents were also asked how they obtained this knowledge, and although a small portion also claimed their own experience in the routine, all mentioned the oral transmission of such knowledge (Figure 6).

Figure 6. Knowledge transmission about moon phases in agricultural activities.



It is noted that 74% of respondents claim to have received this knowledge from their parents and 44% from their grandparents, as illustrated by their words: "My father only did things according to the Moon" (C.A.A.A., male, 76 years old - Guarapuava), or "This since my grandfather" (A.R.S., male, 65 - Turvo), demonstrating the importance given to the transmission of this knowledge to the present day.

Similarly, at the end of the interview, the producers were asked about the importance of transmitting traditional knowledge to future generations, and it was observed that almost all of them - 98 respondents - claim that it is very important to pass on such knowledge, even as a preservation of a culture that has been perpetuated for many years in their lives. Many have also stated that traditions must be kept from oblivion, and that "what works" must be passed on.

In the case of Agroecology, corroborating with what the interviewees think, the recognition and appreciation of popular knowledge is a strategy considered essential. According to Schiedeck, Cardoso and Schwengber (2007), the agroecosystem managers have accumulated experiences and observations about the environment in which they live and passed this information on to subsequent generations to assist them. Since the rescue of traditional knowledge is part of the current agroecological agenda, the information obtained from this work can contribute to sustainable development in order to provoke the dialogue between knowledge proposed by Leff (2002) and enhance the local culture.

Final considerations

Throughout this research it was possible to realize how much the traditions passed between generations and within the rural communities are still present in the Center-South and Southeast of

Paraná State, Brazil. Even after the advent of the Green Revolution and current biotechnologies that are increasingly present in the field, all 100 respondents believe that the Moon has some influence on the earth throughout its different phases.

It was possible to observe the importance that the knowledge related to the lunar influence has for the farmers, however it was also observed through their reports that much of this knowledge has been lost by the disuse. This demonstrates the importance of surveys of this nature, since such knowledge is not usually transcribed, but only transmitted orally between them.

It was found that although there are researches to confirm or refute a possible influence of Moon phases in the most diverse situations, they are still insufficient. This work, for example, raised some information from respondents that deserve to be investigated through the lens of science, demonstrating that much remains to be researched. In this sense, among the activities cited by the interviewees and their relationship with the Moon phases, it was possible to observe a possible influence of the satellite on the fluid dynamics that make up living organisms.

It was also important to note that knowledge related to the Moon and its use are present in the field routine regardless of the age, gender or educational level of the interviewees. In addition, in at least 94 of the properties visited, some of this knowledge is used on a daily basis. For this reason, it is believed that it is necessary to prepare future professionals such as Veterinarians and Agronomists for this rural reality, teaching them to treat with respect this "way of doing" of rural producers.

Therefore, it is hoped that obtaining information on how much traditional moon-related knowledge influences the routine of agriculture and animal husbandry in the Guarapuava-PR region, Brazil, enhances local culture and can contribute to sustainable production, bringing it closer to technicians and producers, and showing them that their knowledge do not need be mutually exclusive.

Participação dos autores: CWH – planejamento do trabalho, coleta de dados, análise de dados e redação do manuscrito; JLF – planejamento do trabalho e correção/aprovação do manuscrito.

Aprovação ética ou licenças de pesquisa: Aprovação do Comitê de Ética em Pesquisa, COMEP-UNICENTRO, sob o número 3.064.861, cujo laudo foi datado de 07 de dezembro de 2018.

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