https://dx.doi.org/10.22161/ijaers.6.5.2 ISSN: 2349-6495(P) | 2456-1908(O)

Proposal for the Implantation of Forestry System in a Small Rural Property Located in the Municipality of Nanuque-Mg

Rogéria de Santana Pinto Mendes[1]; Wanessa Soares Luiz Silva[1]; Juscélio Clemente de Abreu[1]; Lamara Laguardia Valente Rocha[1]; Bruno Augusto de Rezende[1] and Daniel Rodrigues Silva[1]

[1]University Center of Caratinga, Caratinga - MG, Braz

***Abstract*— *Deforestation and the irregular use of the soil in Brazil has produced several areas degraded and without utility for the breeding of animals, the recovery of degraded areas with the beans can be an excellent alternative for the improvement of the quality of small producers, the property will not render it unproductive and it is still possible to use the beans as food. The aim of this study was to diagnose a farm as their chemical, physical and climate and develop a silvopastoral system deployment proposal in order to ensure balanced environmental management area. The study area is situated between the towns of Nanuque and Carlos Chagas in the state of Minas Gerais. The area is in an advanced process of degradation. The same was diagnosed through technical visits, conducting photographic survey and satellite imagery, and soil samples were taken for analysis, to environmental assessments of the local situation. With the completion of all analyzes and evaluations, was obtained as a result, the possibility of deploying a silvopastoral system within that area, so it will be proposed the planting of trees in the area of the spring.*

Keywords*— *silvopastoral systems. Recovery of degraded areas.

I. INTRODUCTION

One of the sectors that stand out in the Brazilian agribusiness is dairy farming, whose important feature is the fact that most of their herd raised on pasture, which constitutes the most economical and practical way to produce and provide food for cattle. This crop is extremely appreciated by the Brazilian population and an important source of protein (Domingues, 2018)

Despite the reduction of costs, this type of management generates very negative impacts on the environment. The degradation of pastures in Brazil because many environmental and economic damage. As Almeida et al (2011) degraded pasture forage cause lower productivity and decreased soil organic matter, and consequently, lower animal productivity.

The recovery of productivity of these areas should be increasingly a priority. In agricultural production systems, sustainability can be considered as the continuation of production over time, though without the degradation of natural resources on which production is dependent (Graças; 2018).

In the search for alternatives to the multiple use of the land, different modes of production are necessary in view of the ecological consequences of inadequate practices in the use of natural resources. Against this background the implementation of silvopastoral systems is seen as one of the options for the recovery of degraded pastures. The system is silvipastoral an embodiment of agroforestry, which relates to production techniques in which integrate animals, forage crops and trees, in the same area.

The silvopastoral systems represent a form of land use where forestry and livestock activities are combined to generate production so complement the interaction of its components. These systems bring many benefits to the environment, some of these advantages are listed by Ibrahim et al. (2001) and PAGIOLA et al. (2004) are soil conservation, conservation of water resources, the promotion of carbon sequestration and increased biodiversity.

The aim of this study is to diagnose a farm as their chemical, physical and climatic characteristics; draft a silvopastoral system deployment, assessing the advantages and disadvantages, and verify the feasibility of the system implementation, in order to ensure the balanced environmental management area and proposed action plans aimed at sustainability of rural properties analyzed.

II. LITERATURE REVIEW

Dairy farming history

According to Almeida et al (2011), until the mid-twentieth century, the Brazilian cattle industry was composed of natural pastures, mainly in areas of cerrado and country. From the 60's, there was an increase in areas with cultivated pastures mainly in the Cerrado and Amazon forest biomes, reflecting a significant increase in productivity, to meet the demands, which were becoming more frequent, for products of animal origin, especially meat and milk.

The dairy farming is considered a traditional activity in the country and is present in almost all the national territory. Besides its importance in the economic area, it is presented as one of the most complex sectors of Brazilian agribusiness, as Martins (2004) and Carvalho (2010). To produce milk, demand a series of inputs for agriculture and other sectors, such as those from the chemical, machinery and equipment, for example.

According to the Brazilian Institute of Geography and Statistics (IBGE, 2014), Minas Gerais has become, over the years, the largest milk producer in Brazil, with 24.5% of its cattle herd toward this activity. In 2014, the 100 largest dairy farms, 44 were located in Ontario (MILKPOINT, 2015).

The process of establishing the first cultivated grassland, however, started with the felling of native vegetation through the use of fire. This process led to the development of extensive livestock production systems, based on the natural fertility by high levels of soil organic matter and the ash from the burning of natural vegetation. These production systems, purely extractive, characterized by minimal use of materials and technologies, introducing, over time, low performance indexes and contributing to the degradation of natural resources (Almeida et al, 2011; hamawaki; 2018).

Pasture degradation

The concept of grassland degradation, according to Macedo & Zimmer (1993), refers to the evolutionary process of losing vigor, productivity, natural recovery capacity to sustain production levels, and quality required by the animals, and the ability to overcome the harmful effects of pests, diseases and invasive, culminating in the advanced degradation of natural resources, due to inadequate management.

However, according to kichel et al. (2011), degraded pasture is one that is producing below 50% of their productive potential, in relation to the soil and weather conditions of the place where it was located. It may be noted that not only is the improper management itself that has increased the degradation of pastures, but also the lack of proper planning, even before its establishment, which is enhancing the factors involved in the degradation process (Almeida et al., 2011). Due to the strength of the degradation of pastures process sometimes it can be difficult to predict the time of the need to intervene in the process and choose the alternative recovery or renewal to be implemented. Either way, the degradation process must be controlled in the early stages, or in agricultural degradation stage, in order that, over time, the process tends to be more dramatic, reaching soil degradation, or biological degradation (Dias-Filho, 2007).

In this case, the difficulty and cost of recovery / renewal of pasture are much larger and, as a final result, the recovered pasture can not reach previous levels of productivity, the first cycle (Dias-Filho, 2007).

In this context, tropical forage breeding programs and edafoclimático zoning fodder, aiming at diversification and intensification of the use of pastures, are important tools to minimize the problem of pasture degradation in Brazil. However, the adoption of appropriate formation technology, management, and retrieval is another pasture renovation neck that needs to be solved for effective development of Brazilian cattle. (Almeida et al., 2011, p. 387).

The causes of degradation vary according to the situation of each pasture. According to the above author, the main causes of degradation are:

- Inadequate grazing practices;
- Inadequate pasture management practices;
- Failures in establishing the pasture;
- Pests, diseases and physiological problems;
- Abiotic factors.

Pasture recovery

The recovery of a pasture is characterized by restoring the fodder production, maintaining the same species or another cultivating (Macedo et al., 2000). The degraded pasture recovery strategies should be planned based on knowledge of the main causes of degradation. According to Dias-Filho (2007), the pastures recovery strategies (Figure 1) could be classified as:

- Renewal (reform) of pasture;
- Implementation of agricultural and agroforestry systems; and
- grazing fallow.

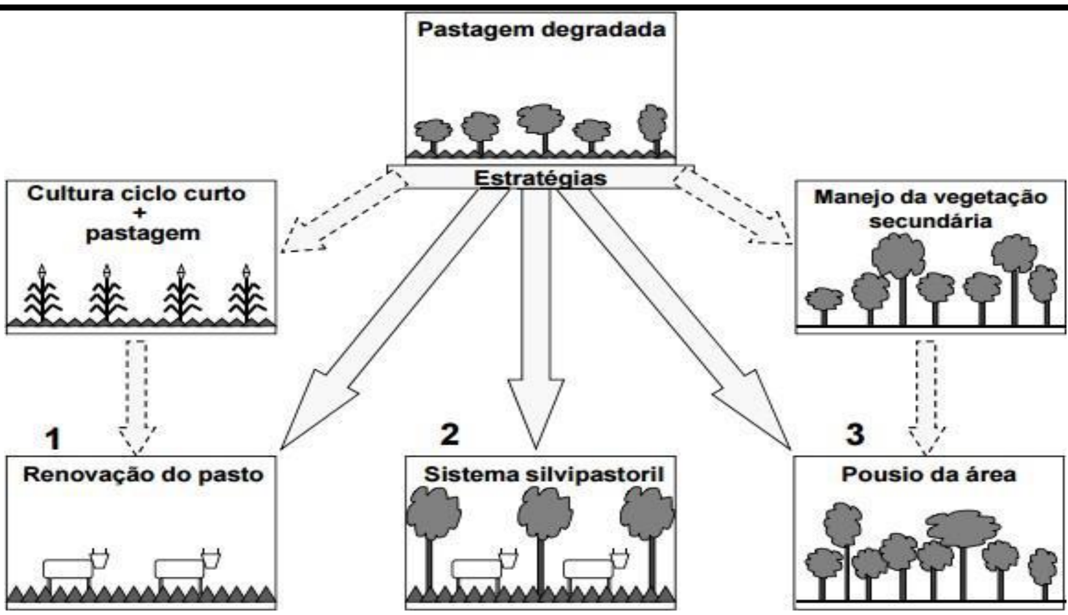

Fig.1: Strategies for the recovery of productivity of degraded pastures

Source: Dias-Filho (2007)

The integration and interaction of trees, pastures and livestock are of vital importance for sustainable development. All in order to include appropriate inquiries to mitigate their environmental impacts and providing the maximum possible biodiversity, moderate land use, production and conservation of water resources (Dias-Filho, 2007).

Silvopastoral systems

According to Silva (2004), Silvopastoral System is the purposeful combination of forestry, agricultural and livestock components in the same area at the same time and practiced so

integrated, in order to enhance productivity per unit area. These systems have great capacity for financial and environmental benefits to producers and to society. They are multivalent, where there is the opportunity to increase the production by the joint management of natural resources, preventing their degradation, as well as to recover their productive efficiency.

As the aforementioned author, the integration and interaction of trees, pastures and livestock is of vital importance for sustainable development. All in order to include appropriate inquiries to mitigate their environmental impacts and providing the maximum possible biodiversity, moderate land use, production and conservation of water resources. The insertion of the forest component in production systems should give an approach that no longer accept the dismemberment of agricultural and forest, but all of these components in the countryside, in favor of quality of life, sustainability and yield stability.

One of the main barriers to adoption of silvopastoral systems would be its low initial profitability. The establishment of these systems needs essential investments of time and money that it decreases the speed at which profits would be obtained (Dias-Filho, 2007).

According PAGIOLA et al. (2004) in the early years after the implementation of a silvopastoral system, the income of rural property can be much smaller that the traditional system. This would happen because of the higher initial investment in time and capital required by the system and the time needed for the tree component grow enough to generate financial benefits. According to yet PAGIOLA et al. (2004), a study conducted in Nicaragua, only after the fifth year of investment with the system implementation, the income of the property began to exceed the income of the conventional system of pasture. The result of that there is the low economic rate of return that commonly characterize silvopastoral systems in the first years after establishment.

On the other hand, cultural aspects also hinder the adoption of the systems because they require the adoption of knowledge and, consequently, management practices that could be quite different from those conventionally used in traditional grazing systems (DIAS-FILHO, 2006). The implementation of silvopastoral systems is highlighted as one of the key strategies recommended for the recovery of productivity of degraded pastures. According days- Son (2005), the choice of a particular recovery strategy would be conditioned to local agro-ecological conditions, the purpose of the project and the availability of capital and labor-intensive. In this case, both pastures have suffered agricultural degradation, and biological, could have recovered productivity through the implementation of this system.

The recovery of degraded pasture through silvipastoral system implementation, i.e. where the planting of trees or shrubs to be incorporated into the pasture recovery process, or where she was encouraged natural regeneration of native species (handling the secondary vegetation) , could be a viable alternative to increase the economic and agronomic efficiency, enhance biodiversity and promote conservation of nutrients and water in these unproductive areas, the agronomic or biological point of view (SON days-, 2006).

The likelihood of success of a silvipastoral system can be increased with the use of better adapted species. Thus, both the tree component as the feed would have to be relatively tolerant to stress linked to this system. The theoretically ideal tree for the system would have to have relatively rapid initial growth, to facilitate the establishment, reduced or sparse canopy and long shaft, to decrease the shading in the pasture, and the ability to rapid regeneration, when partially damaged. Economically, it would be desirable that the tree offered products (wood, oil, coal or fruit etc.) with high potential for commercialization.

Many silvopastoral systems are recommended for implementation in degraded pastures. Some of these models adequariam the degraded pasture recovery process are described below (Figure 2) (Oliveira et al. 2003; days-SON, 2005; DIAS-FILHO, 2006)

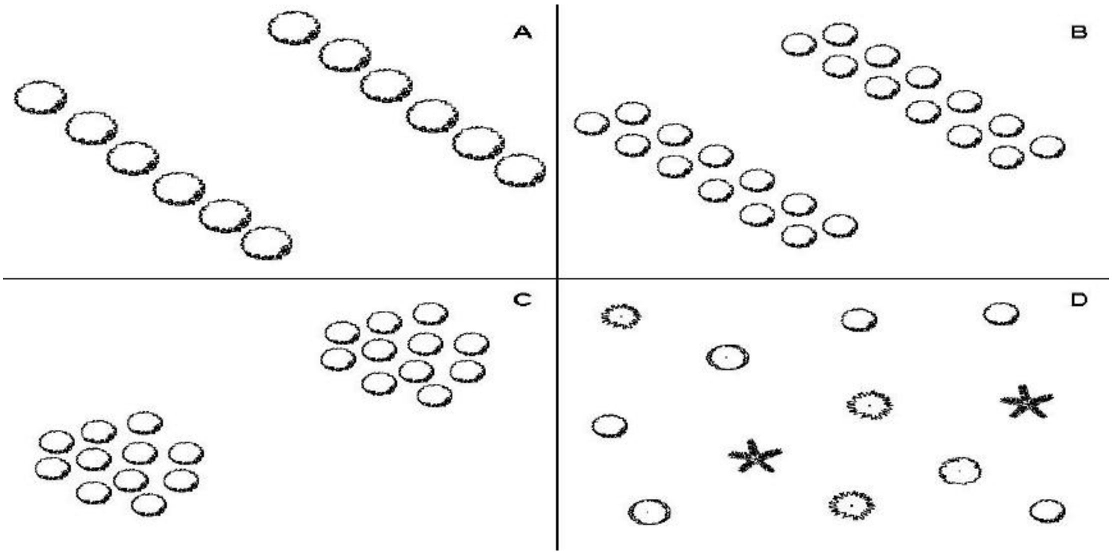

Fig.2: Schematic view of air SSP four models potentially useful in recovery of degraded pastures: simple lines (A), double lines (B) groves (C) and random planting (D)

Source: Dias Filho, 2006

Advantages and disadvantages of the implementation of silvopastoral systems

Theoretically, silvopastoral systems can bring many benefits to the environment when compared to traditional grazing without the planned integration of trees or shrubs in the livestock system. Some of these benefits, shown by Ibrahim et al. (2001) and PAGIOLA et al. (2004), are soil conservation, conservation of water resources, the promotion of carbon sequestration and increased biodiversity.

The benefits to the ground due to the implantation of silvipastoral systems result from the improvement in the medium and long term, the nutrient cycle, caused by the absorption of these elements by the roots of trees, of deeper layers of soil and the subsequent deposition of topsoil these nutrients (Dias-Filho, 2006).

silvopastoral systems have also the ability to use water from the deeper layers of the soil, which would normally be lost in traditional grazing systems (GYENGE et al. 2002) .Another benefit is the improvement in biological activity of the soil, caused by microclimate changes due to shadowing from trees or for improving fertility, especially if the tree is able to be associated to microorganisms that fix nitrogen from the air, as occurs with certain leguminosas.O shading can still interfere with improved quality nutritional some forage plants. When planted in strategic locations, such as contour in hilly terrain, trees can also help control erosion (Carvalho et al. 2002). In economic terms, the silvopastoral systems have the potential to diversify the income of rural property by the marketability of the products generated by the trees as timber, fruits, oils, resins etc., as well as add value to the area. In some cases, silvopastoral systems can also be directed to supplementation of livestock diet, during periods of low pasture productivity through the use of foliage and fruit (green pods of legumes) produced by the trees (HOLGUÍN et al., 2003). According to Dias-Filho (2006), despite the direct and indirect benefits attributed to silvopastoral systems, it is important to point out that this system does not represent a solution to the

https://dx.doi.org/10.22161/ijaers.6.5.2 ISSN: 2349-6495(P) | 2456-1908(O)

various problems linked tropical pastures. For example, the presence of trees and shrubs in the pasture may also hinder the development of the pasture. This would occur, mainly due to shading and, in some cases, competition for water and nutrients to the tree and shrub species exert on herbaceous forage pasture. In the case of tree and shrub species with abundant falling leaves, whose decomposition is slow, the accumulation of this litter can harm or regrowth germination and grass growth. In some situations, excessive shade or the constant assembly and movement of animals under the canopy of trees may cause thinning or total soil cover loss. These areas are more susceptible to compaction and consequent erosion and loss of nutrients, which have been identified as one of the main problems related to silvopastoral systems (BAGGIO, 1983; Daniel and Couto, 1999). On the other hand, frequent congregation of animals can still result in the trend towards greater accumulation of feces and urine in the soil under the trees, increasing the uniformity problem in the distribution of waste in the area of pasture. This fact contribute to reduced soil fertility, since the constant and excessive deposition of nutrients (such as found in areas affected by urine and feces) into restricted areas of pasture would hinder the absorption efficiency and the use of these nutrients by plants, making them more susceptible to losses. The competition exerted by grazing animals and interference can also impair the development and survival of trees. Finally, the presence of trees inpasture could in some situations hinder its mechanization (Traffic machines). This would happen, especially when there was no proper planning of the spatial distribution of trees in the pasture (DIAS-FILHO, 2006).

III. METHODOLOGICAL APPROACH

General description of the study area

The work of this study area is located between the municipalities of Nanuque and Carlos Chagas in the state of Minas Gerais. Located in the Stream Thirty-Seven (Figure 3 and 4), is distant about 55 km from the city of Nanuque, and about 5 km from the District of Vila Gabriel Passos, also in Nanuque. Os its north and south ends are, respectively, the -17º35'29 coordinates, 81332 "and -17º35'44,88443"; and its extreme east and west are respectively -40º32'11,36908 coordinates "and -40º32'29,94372". Occupying a total area of 12.3812 ha. With a perimeter of 1.677 km.

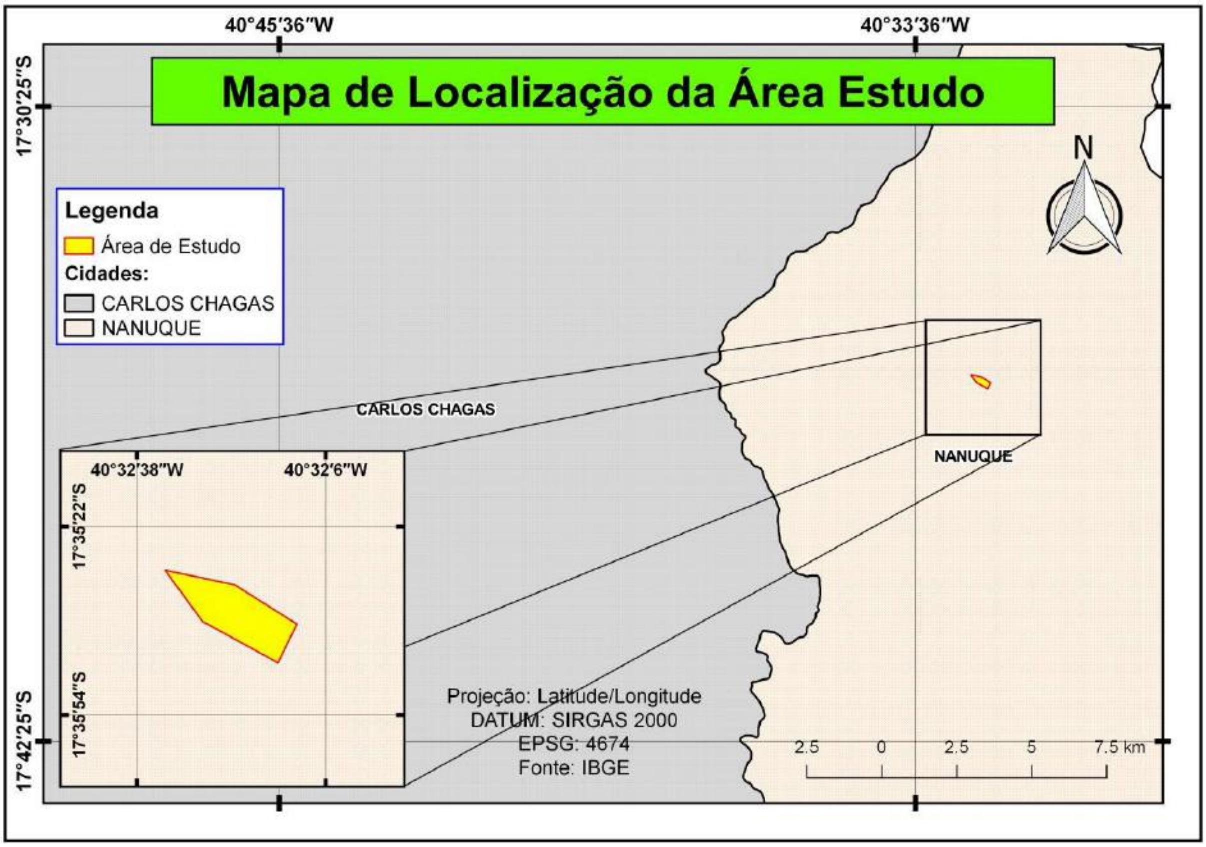

Fig.3: Location of the study area

Source: MENDES, 2017

https://dx.doi.org/10.22161/ijaers.6.5.2 ISSN: 2349-6495(P) | 2456-1908(O)

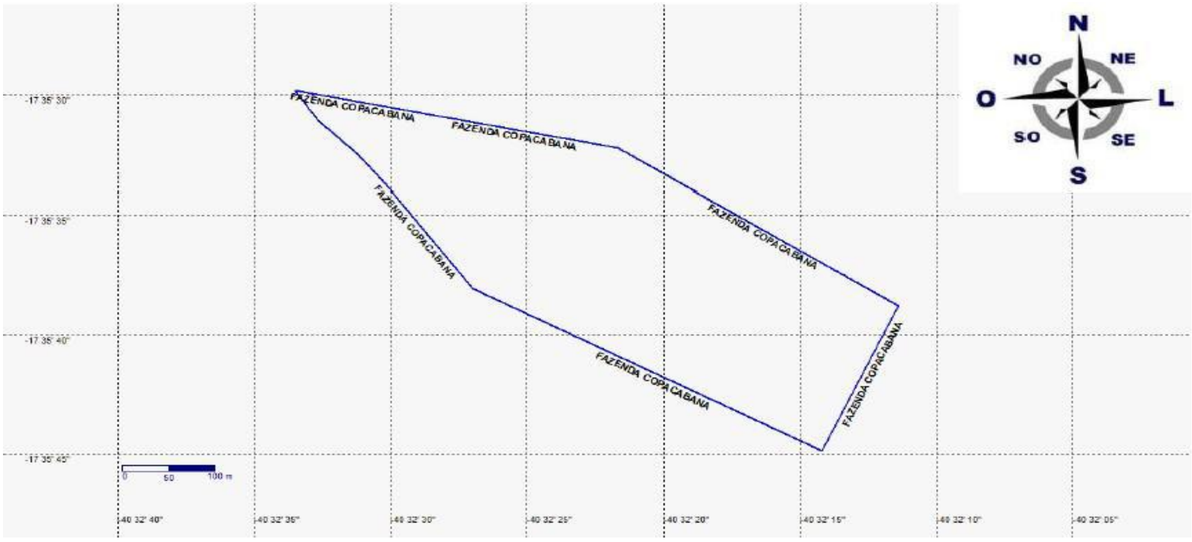

Fig.4: Polygon property (study area)

Source: L & N ENTERPRISES SERVICES, 2017

On the property, the predominant activity is dairy farming, keeping also small areas of agriculture, for livestock keep in times of drought. The area includes the degradation of historical deforestation caused by farming, cultivation of forage monocultures and soil compaction caused by animal trampling, and the traffic machines for whiffs purposes in the area.

General diagnosis area

The area was diagnosed through technical visits for the evaluation of the study area, it was also carried out a photographic survey with the use of GPS to obtain coordinates. Chemical analysis of soil were carried out in some parts of the study area, to assess the needs of acidity corrective and possible fertilizers. It conducted surveys through visits for assessment of the situation of tree species present in the area where will be the proposed implementation of silvopastoral system. Using satellite images, a survey was conducted of the Permanent Preservation Areas (PPAs) and the demarcation of waterways. Was calculated runoff coefficient of the area, runoff coefficient definition is the ratio of the total volume of runoff in the event and the total volume precipitate (Tucci, 2000) (Equation 1) and using Table 1, which presents the values of the flow coefficient (C), depending on the soil type, slope and vegetation.

$$C = \frac{\text{total volume drained}}{\text{total volume precipitate}}$$

Table.1: Values of the flow coefficient (C).

Slope (%)	Sandy soil	Solo frank	Soil argillaceous
		forests	
0 - 5,	0.10	0.30	0.40
A 5 - 10	0.25	0.35	0.50
10 - 30	0.30	0.50	0.60
		pastures	
0 - 5,	0.10	0.30	0.40
A 5 - 10	0.15	0.35	0.55
10 - 30	0.20	0.40	0.60
		cultivated land	
0 - 5,	0.30	0.50	0.60
A 5 - 10	0.40	0.60	0.70
10 - 30	0.50	0.70	0.80

https://dx.doi.org/10.22161/ijaers.6.5.2 ISSN: 2349-6495(P) | 2456-1908(O)

Source: CARVALHO E SILVA, 2006.

IV. RESULTS AND DISCUSSIONS

Diagnosis of Property

The pasture area has degraded, because according to Kichel et al. (2011), degraded pasture is one that is producing below 50% of their productive potential, in relation to the soil and weather conditions of the place where it was deployed, and the same is with these conditions. In assessing the tree situation of the property can be identified that the area has only about 5% of its area with some tree species (Figure 5), an important fact for the proposition of the system implementation. The area has a spring at one of its ends, and this has little amount of components for its preservation tree as shown in Figure 6.

Fig.5: Overview of the property

Source: Mendes, 2017.

Fig.6: Rising

Source: Mendes, 2017.

Was calculated from the runoff coefficient, the area has a loam soil a 5-10 slope (%) and the pasture is predominant in this field, there was thus obtained the result that 35% of the volume precitado location is disposed on the surface as surface runoff values of the author table Carvalho and Silva (2006). After the results of soil analysis (Table 2) performed by the agronomic laboratory LABOMINAS it was found that the soil of the area is with its median nutritional levels, based on data from the Fertility of Soil Commission of the State of Minas Gerais.

Table.2: Result of soil analysis

Parameters	**Unity**	**Average of samples**
MO Mat. Organic (Oxi-Red.)	dag / dm3	1.7
pH (Water - Ratio 1: 2.5)	Items.	5.3
P (Mehlich 1)	mg / dm3	5.8
K (Mehlich 1)	mg / dm3	117
Here (KCl, 1 mol / L)	cmol / dm3	1.87
mg (KCl, 1 mol / L)	cmol / dm3	0.9
al (KCl, 1 mol / L)	cmol / dm3	0.10
H + Al (Calcium Acetate)	cmol / dm3	4.24
SB (Sum bases)	cmol / dm3	3.07
CTC (CTC)	cmol / dm3	7.3
% V (Saturation bases)	%	42
CTC% K (% K CTC)	%	4
% Ca CTC (CTC% Ca)	%	25.7
% Mg CTC (% Mg CTC)	%	12
CTC% Al (% Al CTC)	%	1.4
% H CTC + Al (M + Al% CTC)	%	58

Action plans

Given the Law 12,651 / 2012, of May 25, 2012, which says that the owner of rural areas is required to hold 20% (twenty percent) of its area to the Permanent Preservation Areas (APP) and / or legal reserve (RL) will be proposed to implement preservation in the areas of springs, these are surrounded, so there is no entry of animals within these areas, even with the lack of mandatory property, its total area, this property is exempt from RL, but will be chosen for preservation, for the recovery of this area will be targeted. The total area to be preserved is 2, 47624 ha. With the completion of all analyzes and assessments, the result was obtained, it is possible the implementation of a silvopastoral system within that area will be proposed planting trees in the area of the spring, causing it to be preserved, and so may favor the system mentioned above. Thus, the proposal will be the recovery of the spring by planting species such as banana (Musaceae), Inga (Inga sp.), Soursop (Annonamuricata) and ipe (Tabebuia), totaling 200 seedlings, species those that will be purchased and / or local nursery was purchased would cost on average $ 1,840.00 also be performed in the same enclosure, so that no cattle treading area and consequently soil compaction and difficulty in retention of stormwater in the enclosure cost average R $ 560.00.

Will be proposed the planting of native and pioneer tree species, as they are more resistant to sun exposure and the nutritional conditions found in the soil, and are species that have fruits and products that may be marketed, species such as Inga (Inga sp.), Aroeira- do-field (Astroniumfraxinifolium Schott) and annatto (Bixaorelana L.) was chosen for the simple line method for planting, with a spacing of 5 x 10m, preferably arranged in the east-west direction in order to reduce the shading on pasture, these trees have an average of three years to achieve growth and fruit start, will be planted around 500 saplings, they will be obtained through purchase and / or supply of municipal nursery, it bought the species would cost on average $ 3,250.00 . The grass species to be used is *Bhachiaria humidicola* because when shaded has relatively more efficient photosynthetic behavior within the system (DIAS-FILHO, 2002). They would be used on average 20 grass seed bags, costing on average $ 2,200.00. For matter of implementation should also take into consideration the costs of land preparation, conducting pits, seedling planting, monitoring and follow them. Calculating the hand labor to perform all activities, considering the work done by the owner, it is estimated that will be spent on average $ 4,000.00. It is anticipated that will be spent a time of 90 days for the deployment process, after this process will be periodic monitoring every 15 days, to combat possible pests and insects, and for observing the development of the species.

Advantages and disadvantages

The implementation proposal of a silvopastoral system will target the use of the farm in a sustainable manner, so that the property get their profits also recovering degraded areas. The implementation will have an estimated cost of approximately R$ 12,000.00. Given that is a small property will be a large investment for the producer, but with a positive return. The property could face problems with the return to profitability of the traditional system of time that was previously used in the area because the silvopastoral system get a higher profitability this system after medium and long term, the cost of deployment will be relatively high, because according PAGIOLA et al. (2004), only after the fifth year of investment with the system implementation, the income of the property began to exceed the income of the conventional system of pasture. Given that is a small property, and their activities are to support themselves, they may experience some adversity in relation to the complexity of the union of the tree, forage and feed components, such as problems related to excessive shading, the litter of some types of trees, it may take a long time to decompose, and this will generate low productivity in these areas, and also the competition for water and nutrients from grasses and bushes, but all these problems will not come to pass, because the proposal will be made by a rigorous planning, analyzing all the criteria for its implementation.

In contrast to these adversities, the property will possibly after a period of medium to long term, greater profitability than the traditional system, the soils are more fertile and have a site erosion control, water resources are more abundant and moreover It has a possible diversification of income and if necessary, you can use the trees as a form of bovine dietary supplementation, favoring thus indirectly to the economic value of the property.

V. CONCLUSIONS

The silvopastoral systems represent a land-use technology that ensures greater biodiversity and sustainable ecosystems compared to any monocultures. Interest in such systems has increased significantly across the country, but it is necessary to carry out public policies for the implementation of silvopastoral systems because this deployment has a high cost, yet the advantages are evident in relation to the disadvantages. the need to drive systems in soil favor, the environment in which we live and of present and future human generations is recognized.

The results of this work suggest that it is possible to recover degraded areas by applying this methodology, it can be an alternative of recovery with low cost, without use of synthetic products.

REFERENCES

[1] ALMEIDA, R. G. et al. Recuperação de pastagens degradadas e impactos da pecuária na emissão de gases de efeito estufa. **SIMPÓSIO INTERNACIONAL DE MELHORAMENTO DE FORRAGEIRAS**, v. 3, p. 384-400, 2011.

[2] ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **NBR 6023**: informação e documentação: referências: elaboração. Rio de Janeiro, 2002.

[3] BAGGIO, A. J. **Sinopse de algumas vantagens e desvantagens dos sistemas silvipastoris com *Pinnus* spp.** Curitiba, EMBRAPA-URPFCS, 1983. 10p. (EMBRAPA-URPFCS. Circular Técnica, 7).

[4] CARVALHO, G. R. **A indústria de laticínios no Brasil: passado, presente e futuro**. Juiz de Fora: Embrapa Gado de Leite, 2010 (Circular Técnica).

[5] CARVALHO, M. M.; FREITAS, V. P.; XAVIER, D. F. Início de florescimento, produção e valor nutritivo de gramíneas forrageiras tropicais sob condição de sombreamento natural. **Pesquisa Agropecuária Brasileira**, Brasília, v.37, n.5, p. 717-722, 2002.

[6] COMISSÃO DE FERTILIDADE DO SOLO DO ESTADO DE MINAS GERAIS. **Recomendaçõesparausode corretivos e fertilizantes em Minas Gerais**; 5ª Aproximação. Viçosa: 1999. 322p.

[7] DANIEL, O.; COUTO, L.; VITORINO, A.C.T. Sistemas agroflorestais como alternativas sustentáveis à recuperação de pastagens degradadas. In: SIMPÓSIO – SUSTENTABILIDADE DA PECUÁRIA DE LEITE NO BRASIL, 1, Goiânia. **Anais**...Juíz de Fora: Embrapa-CNPGL, 1999. p.151-170.

[8] DIAS-FILHO, Growthandbiomassallocationofthe C4 grasses Brachiariabrizantha e B. humidicolaundershade. ScientiaAgricola, Piracicaba, v. 59, n.1, p.65-68, 2002.

[9] DIAS-FILHO, M. B. Degradação de pastagens: processos, causas e estratégias de recuperação. 3. ed. Belém: Embrapa Amazônia Oriental, 2007. 190 p.

[10] DIAS-FILHO, M.B. Degradação de pastagens: processos, causas e estratégias de recuperação. 2. ed. Belém: Embrapa Amazônia Oriental, 2005. 173p.

[11] DIAS-FILHO, M.B. Sistemas silvipastoris na recuperação de pastagens tropicais degradadas. In: Gonzaga Neto, S.; Costa, R.G.; Pimenta Filho, E.C.; Castro, J.M. da C. (Eds.) SIMPÓSIOS DA REUNIÃO ANUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA,

[12] 43. João Pessoa, Anais…João Pessoa: SBZ: UFPB, 2006 (Suplemento Especial da Revista Brasileira de Zootecnia, v.35, 2006). p. 535-553.
[13] GYENGE, J.E.; FERNÁNDEZ, M.E.; SALDA, D.; SCHLICHTER, T.M. Silvopastoral systems in North western Patagonia II: water balance and water potential in a stand of Pinus ponderosa and native grassland. Agroforestry Systems, v.55, p.47-55, 2002.
[14] HOLGUÍM, V.A.; IBRAHIM, M.; MORA, J.; ROJAS, A. Caracterización de sistemas de manejo nutricional enganaderías de doble propósito de laregión Pacífico Central de Costa Rica. Agroforestería em las Américas, v.10, p.40-46, 2003.
[15] IBRAHIM, M.; SCHLONVOIGT, A.; CAMARGO, J.C.; SOUZA, M. Multi-strata silvipastoral systems for increasing productivity and conservation of natural resources in Central America. In: INTERNATIONAL GRASSLAND CONGRESS, 19., 2001, São Pedro, São Paulo. Proceedings... São Pedro: 2001.
[16] INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). Pesquisa Pecuária Municipal. Disponível em: http://www.sidra.ibge.gov.br. Acesso em: 09 maio 2017.
[17] Jacira Lima da Graça, Flávio de São Pedro Filho, Antonio Vicente da Graça Filho, Marcelo Augusto Mendes Barbosa, Izabel Cristina da Silva. 2018,"Epistemological Character of Sustainability". International Journal of Advanced Engineering Research and Science (ISSN : 2349-6495(P) | 2456-1908(O)).5(3):207-215. Doi: 10.22161/ijaers.5.3.26
[18] KICHEL, A. N.; COSTA, J. A. A.; ALMEIDA, R. G. Vantagens da ILP na recuperação de pastagens degradadas. In: SIMPÓSIO MATOGROSSENSE DE BOVINOCULTURA DE CORTE, 1., 2011, Cuiabá. Anais... Cuiabá: Juscemil Serafim, 2011. p. 63-73.
[19] MACEDO, M. C. M.; ZIMMER, A. H. Sistema pasto-lavoura e seus efeitos na produtividade agropecuária. In: FAVORETTO, V. et al. (Ed.). SIMPÓSIO SOBRE ECOSSISTEMA DE
[20] PASTAGENS, 2., 1993, Jaboticabal. Anais... Jaboticabal: FUNEP, 1993. p. 216-245.
[21] MACEDO, M. C. M.; ZIMMER, A. H.; KICHEL, A. N. Degradação e alternativas de recuperação e renovação de pastagens. Campo Grande: Embrapa Gado de Corte, 2000. 4 p. (Embrapa Gado de Corte. Comunicado Técnico, 62).
[22] MARTINS, P. C. Políticas públicas e mercado deprimem o resultado do sistema agroindustrial do leite. Juiz de Fora: Embrapa Gado de Leite, 2004. 160 p.
[23] MILKPOINT. Levantamento Top 100 2015: os 100 maiores produtores de leite do Brasil. Piracicaba, SP, 2015. Disponível em: HTTP://www.milkpoint.com.br/top100/2015/EBOOK- TOP100.pdf. Acesso em: 09 de maio de 2017.
[24] Rafael Domingues, Luiz Fernando Pires, André Belmont Pereira, Eduardo Augusto Agonellos Barbosa, Luis Miguel Schiebelbein, André Carlos Auller. 2018,"Water regimes and bean cultivar effects on the soil porous system characteristics". International Journal of Advanced Engineering Research and Science(ISSN : 2349-6495(P) | 2456-1908(O)).5(5):141-149. Doi: 10.22161/ijaers.5.5.19
[25] OLIVEIRA, T. K. et al. Sugestões para implantação de sistemas silvipastoris. Embrapa Acre. Documentos, 2009.
[26] Osvaldo Toshiyuki Hamawaki, Raphael Lemes Hamawaki, Ana Paula Oliveira Nogueira, Jacqueline Siqueira Glasenapp, Cristiane Divina Lemes Hamawaki, Fernando Cezar Juliatti, Larissa Barbosa de Sousa, Décio Shigihara. 2018,"Development of Brazilian Soybean Cultivars Well Adapted to Cerrado and Rust-Tolerant ". International Journal of Advanced Engineering Research and Science(ISSN : 2349-6495(P) | 2456-1908(O)).5(7):130-136. Doi: 10.22161/ijaers.5.7.19
[27] PAGIOLA, S., AGOSTINI, P., GOBBI, J., DE HAAN, C., IBRAHIM, M., MURGUEITIO, E., RAMÍREZ, E., ROSALES, M., RUÍZ, J. P. Paying for Biodiversity Conservation Services. In: Environment Department Papers. Washington: World Bank, 2004. 26p.
[28] SILVA, V. P. Embrapa Florestas -Sistemas Silvipastoris, 2004. Disponível em:http://www.cnpf.embrapa.br/pesquisas/safs/index.htm . Acesso em 10 de maio de 2017.
[29] TUCCI, Carlos EM. Coeficiente de escoamento e vazão máxima de bacias urbanas. Revista Brasileira de Recursos Hídricos, v. 5, n. 1, p. 61-68, 2000