Socio-environmental analysis of the rural zone of Espírito Santo do Dourado/MG: a perspective for future integration policies

Marielle Rezende de Andrade[1], Fábio Geraldo Ávila[2], Roosevelt Heldt Junior[3], Mireile Reis dos Santos[4]

[1] Instituto Fernando Bonillo de Pesquisa e Conservação Ambiental. Engenheira Ambiental. marielle@ifbonillo.org.br.

[2] Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais (IFSULDEMINAS) – *Campus* Poços de Caldas. Assistente Social. fabio.avila@ifsuldeminas.edu.br.

[3] IFSULDEMINAS – *Campus* Poços de Caldas. Tecnólogo em Gestão Ambiental. heldtjr@gmail.com.

[4] IFSULDEMINAS – *Campus* Poços de Caldas. Professora. mireile.santos@ifsuldeminas.edu.br.

Received in: October 13, 2020 | **Accepted in:** May 27, 2021

Abstract

Issues referring to environmental conservation and diagnosis of rural zones are still scarce topics inside public policies and this aspect still requires greater attention. That being, the goal of this research was to present a diagnosis of the rural area of a small city in the South of the Minas Gerais State, with typical agricultural characteristics and large availability of water in order to verify possible socio-environmental inconsistencies. The data was gathered from secondary information of the federal, state, and town public databases, besides face-to-face questionnaires, rapid assessment protocols and high-definition satellite mapping of land use for the last few years. It was possible to assess that conservation actions and Permanent Preservation Areas (APPs) are reduced and that interviewed people present limited knowledge about public policies of family farming stimulation. As per rural basic sanitation, practical action by local governments must be prioritized. The conclusion of this diagnosis is to suggest that further investments should be prioritized to assist social and environmental segments.

Keywords: Environmental education. Conservation. Rural sanitation. Public policies.

Introduction

The issue of environmental sanitation in Brazil affects a whole cyclical, historical, political, and economic context, built upon the interests that shaped the society of the time. While at the beginning of the 20th-century Brazilian environmental sanitation was centralized in the federal executive branch of power, in later years and in present times, those issues were returned to municipal spheres, in a more decentralized and collective manner (SOUSA; COSTA, 2016). That being, current environmental and social situations in rural areas require bigger attention from public management, education institutions, non-governmental organizations, and the community in general, because communities in these regions, in addition to being geographically distant from municipal headquarters, also face limited, or often absent, access to the public education system. This function ends up being the responsibility of a few institutions, which in its majority cannot reach all the public needing guidance and technical support.

The universalization of basic sanitation services in Brazil amounts to one of the principles of the National Basic Sanitation Plan - PLANSAB established by Law 11.445/2007 and Decree nº. 7.217/2010. That means that basic sanitation services must serve the entire population, including those residing in rural areas; the new Legal Framework for Basic Sanitation, Law 14.026/2020, aims to universalize and qualify the provision of services in the sector, with the Federal Government's goal of reaching universalization by 2033, ensuring that 99 % of the Brazilian population has access to drinking water and 90 % to sewage treatment and collection. However, basic sanitation services in rural zones of Brazil, in general, are unsatisfactory regarding coverage and efficiency of actions. According

to data from the National Program for Rural Sanitation- PNSR (FUNASA, 2019), the percentage of homes without adequate services of solid waste management is 55 %. As for water supply services, 33,5 % of rural populations have precarious assistance and 26 % do not have adequate assistance. Rainwater management presents a less severe scenario, with 60.4 % of the population receiving adequate care. Concerning sanitary sewage, 54.1 % of the rural population has precarious care and 25.3 % do not receive care. These data demonstrate a dangerous reality and low health standards in these rural areas, compromising the health, well-being, and quality of life of these populations, in addition to the contamination of water sources.

In order to correct this deficit of rural sanitation, all actors involved must be protagonists in the design, implementation, and management of actions, which must be territorialized and adjusted to local realities (MACHADO; MACIEL; THIOLLENT, 2021). According to Renaud *et al*. (2018), mental models, values, and human attitudes vary in time and space and are key elements in the relationship between humanity and nature, being able to promote changes towards sustainability. In other words, social aspects must be incorporated in sustainability models, even more so regarding the conservation of natural resources. That being, the integration of roles of different social actors, i.e. research and education institutions in the sanitation services developed by the National Rural Sanitation Program (PNSR) is a fundamental part of the implementation of public policies focused on this scenario (FERREIRA *et al*., 2019).

It is important to emphasize that the precarious situation regarding environmental sanitation contributes directly and indirectly to public health, as it is responsible for rising infant mortality rates, besides reducing the quality of life of unserved populations (TEIXEIRA; GUILHERMINO, 2006; BELLIDO *et al*., 2010; SOUZA *et al*., 2020).

Sanitation actions in rural zones intend to reverse this situation and promote environmental benefits, besides stimulating the inclusion of minority groups through the implementation of integrated public policies in health, habitation, racial equity, and environmental areas (FUNASA, 2019; MACHADO; MACIEL; THIOLLENT, 2021).

Many pieces of research seek to elucidate such issues and solutions to this huge political and strategic management impasse (MACIEL; FERNANDES, 2011; MADRID *et al*., 2015; FIGUEIREDO, 2019), as well as disseminating alternatives that are replicable and easy to implement related to social technologies (TONETTI *et al*., 2018) or even evaluate existing technologies and their economical and socio-environmental viabilities (COSTA; GUILHOTO, 2014). Such scenario is aggravated due to the rural midst being quite heterogeneous, constituted of diverse communities, with peculiar characteristics in each region, demanding individual techniques for intervention in basic sanitation, whether regarding environmental, technological, or educative issues, such as management and sustainability of measures (FUNASA, 2019; MACHADO; MACIEL; THIOLLENT, 2021).

Besides aspects relating to rural sanitation, it is important to evaluate the environmental scenario in which those rural communities are inserted, aiming at decision-making and support for effective public policy implementation and relevant socio-environmental projects (MACHADO; MACIEL; THIOLLENT, 2021). It is required to consider local environmental potentialities, as well as risks of use, defining ecological and economic zonings that allow optimization and thrifty use of natural resources and land. In that sense, the definition, characterization, and protection of Permanent Preservation Areas - APPs are fundamental in socio-environmental projects focusing on environmental sanitation and in the quality of life of social actors from these regions. Therefore, some quick tools and practices can

be utilized, for instance, diagnostic protocols and fast assessment of aquatic ecosystems such as water springs and streams, important areas for underground water recharge and protected by law (Forestall Code - Law 12.651/2012). Those tools, if adapted to local reality and associated with fast training for applicators, may assist on-site data collection and constitute low-cost technologies, effective in territorial planning and rural area zoning.

Utilizing the southern Minas Gerais municipality of Espírito Santo do Dourado as a reference, the current research had the goal of diagnosing the socioeconomic profile of rural inhabitants, as well as investigating how town water management occurs and how land is used in those rural regions. The research happened through semi-structured questionnaires with social actors, associated with bibliographical consultation in public documentation fonts from town, state, and federal databases regarding the municipality as well as historical temporal analyzes of satellite images of land use. The city was chosen for the diagnostic due to its environmental potentials, the growing increase in strawberry culture and other short-cycle crops, with a vast contribution to the rural public in municipal economic actions, and due to its lack of environmental sanitation, especially in rural areas.

Materials and methods

Characterization of the municipality and sampling periods

The municipality of Espírito Santo Dourado is located in the south-southwestern mesoregion of Minas Gerais, it has a territorial extension of 263.89 km^2 and a population of 4,712 people distributed among 2,387 residents in urban areas and 2,325 in rural areas (PLANO DE SANEAMENTO BÁSICO DO MUNICÍPIO DE ESPÍRITO SANTO DO DOURADO - MG, 2017). Presenting large water availability due to its geographic location (mountainous region), it has several streams and waterfalls within urban and rural perimeters. It is part of the Rio Sapucaí Hydrographic Basin, a tributary of the Rio Grande Basin that is a contributor to the Federal Hydrographic Basin of Paraná (IGAM, 2021). The municipality is named after the Dourado River, which is the municipality's main water source, in addition to the Machado, Machadinho and Cervo rivers and Embiruçu, Gonçalves, Pompéu, Poço D'anta and Paciência streams (PLANO DE SANEAMENTO BÁSICO DO MUNICÍPIO DE ESPÍRITO SANTO DO DOURADO - MG, 2017).

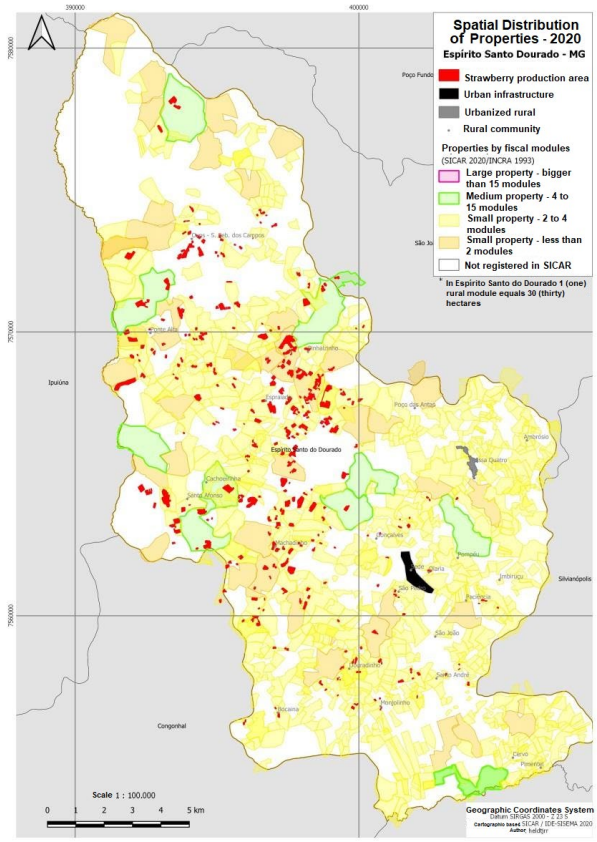
Regarding water management and conservation, one of the factors that most attracted attention is the situation of the public supply system, which is currently under the responsibility of the city management and does not perform any type of charge for water collection, treatment, and distribution services. According to the Basic Sanitation Plan of the municipality of Espírito Santo do Dourado (2017), the municipal public water supply system has poor service due to intermittence in water distribution and difficulty in implementing hydro metering for users. Despite the great local water availability, the planning tools regarding use and management of water resources are still less than ideal and the city still does not have a sewage treatment system that serves the community, *in natura* sewage being released into the small watercourses that run along the margins of the urban perimeter in river Dourado, streams Embiruçu, Paciência, Pompéu, and Gonçalves. Among the main deficiencies presented by the municipality in the issue of sewage treatment are the lack of network registration, little regulation in the implementation of networks, lack of manholes, absence of sewage connections to the rainwater network and vice versa, deficiency of interceptors, and non-existence of treatment system (PLANO DE SANEAMENTO BÁSICO DO MUNICÍPIO DE ESPÍRITO SANTO DO DOURADO - MG, 2017). As there is a known relationship between the absence/poor sanitation

services and the loss of health with an increase in infant mortality (TEIXEIRA; GUILHERMINO, 2006; BELLIDO *et al*., 2010, SOUZA *et al*., 2020, MACHADO; MACIEL; THIOLLENT, 2021), it is possible that the inefficiency in the provision of these services reflects in the growing infant mortality rates recorded between 2012 and 2016 (IBGE, 2010).

According to Atlas Esgotos (ANA, 2013), the service rate of the sewage network in the city's urban area is 94 % with collection but without treatment, 5 % without collection and without treatment, and 1 % with individual solutions. However, according to IBGE (2010), only 49.3 % of the municipality is served by sewage services and rural neighborhoods do not have sewage collection networks. Residents discharge sewage directly into rivers and small streams or build cesspits (PLANO DE SANEAMENTO BÁSICO DO MUNICÍPIO DE ESPÍRITO SANTO DO DOURADO, 2017).

With the Municipal Human Development Index - IDHM of 0,68 (IBGE, 2010), the municipality occupies a median position in relation to other municipalities in Minas Gerais, and its economy is predominantly based on the sectors of services and agriculture. Considering the direct relationships between socioeconomic status and proportional mortality from diarrheal disease and others caused by water or lack of basic sanitation, the municipality of Espírito Santo do Dourado may be under high socio-environmental vulnerability. Also, with a large part of its economic activities concentrated in rural areas, the lack of environmental sanitation in these can become a problem of a superlative order. With rural modules fixed at 30 hectares, most rural properties registered in the Rural Environmental Registration System - SICAR are classified as small (≤2 to 4 hectares) and medium (4 to 15 hectares), as shown in Figure 1.

Figure 1 – Distribution of properties and their sizes in the municipality, with emphasis on strawberry production. Espírito Santo do Dourado – MG, 2021.



Source: The authors (2021).

Field sampling for the socio-environmental diagnosis of the municipality of Espírito Santo do Dourado – MG took place during actions under the "Expedition Program" of the Extension Pro-Rectory of IFSULDEMINAS, in July 2018 and 2019.

Socio-environmental diagnosis

In order to diagnose how municipal water management and land occupation occur in rural regions, a bibliographic research was carried out in municipal and state public document sources, referring to administrative, territorial, sanitation, and rural areas in general. The city hall website was used for municipal data; the Instituto Mineiro de Gestão das Águas – IGAM and the Technical Assistance and Rural Extension

Company – EMATER for state data, and the National Water Agency - ANA, the Brazilian Institute of Geography and Statistics - IBGE, and the National Rural Environmental Registry System – SICAR for federal data.

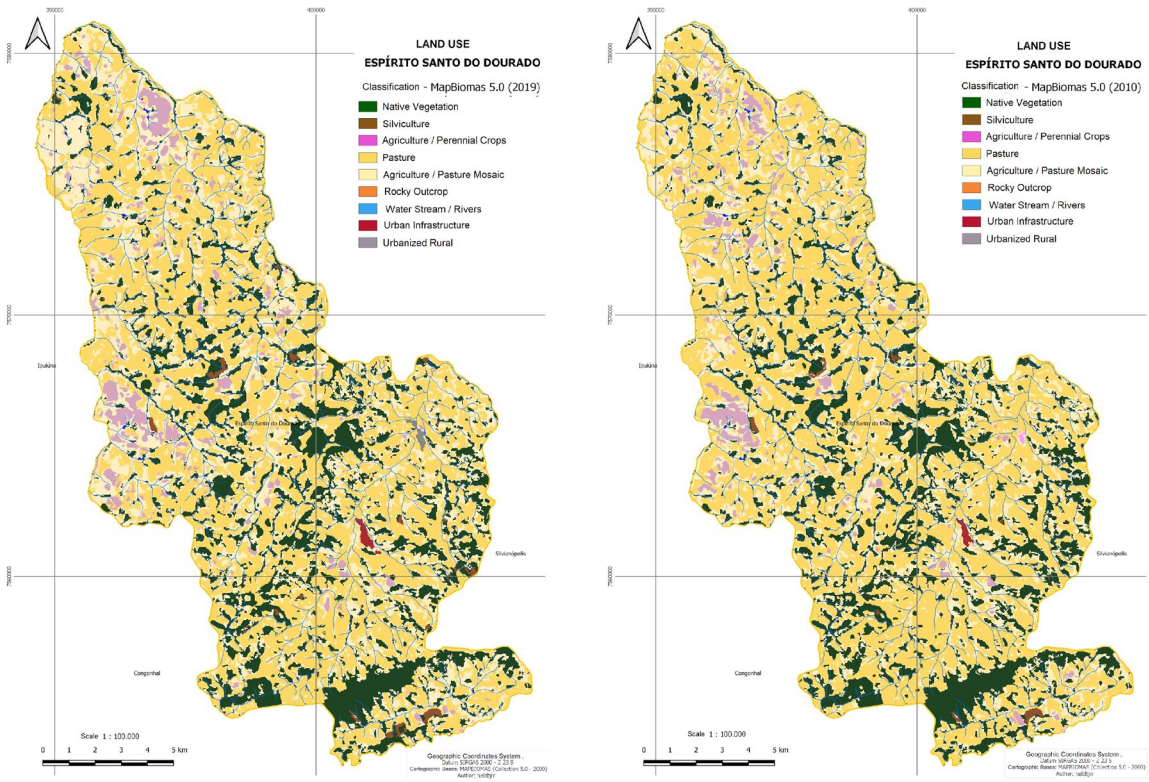
After this step, the methodology for selecting the properties interviewed followed the non-probabilistic tool "*snowball sampling*" (BIERNACKI; WALDORF, 1981), in which a chain of informants was formed and indicated to answer the questionnaire in the rural municipal districts, based on initial structuring axes composed of influential actors in the municipality. Thus, and consecutively, each respondent also indicated another social actor, so that at least one rural social agent from each neighborhood was interviewed. It is noteworthy that the CEP - Research Ethics Committee of IFSULDEMINAS was consulted about the need for evaluation by its body, however they replied not being necessary since this work was part of an extension project. The interventions were carried out following a semi-structured questionnaire composed of pre-defined questions, aiming to know the issues related to land use and occupation, water management and conservation, sewage treatment, agroecological systems, and access to public policies to encourage rural producers. As a complementary tool to the socioeconomic diagnosis, and with the objective of georeferencing and diagnosing the environmental quality of some water springs in rural neighborhoods, as well as the land uses in their immediate surroundings, a Simplified Environmental Characterization Protocol was applied (CALLISTO *et al*., 2002). The results are presented in a categorically adapted form (score from 1 to 5 = being 1 the worst identified environmental quality, and 5 the best identified environmental quality). This protocol addresses quali-quantitative issues related to the degree of impact and conservation of the water resource in the analyzed patch. Finally, all the information collected was properly tabulated, organized and geospatialized, in order to support the socio-environmental analysis of the studied municipality. For this, Google Earth - Pro and Quantum Gis (Q-Gis) image processing software, as well as Excel for data tabulation were utilized. For analysis in the QGis software, satellite images from the MapBiomas program were used.

Results and discussion

The comparative analysis of the municipality's land use in the years 2000, 2010, and 2019 evidenced the growth and expansion of agriculture in Espírito Santo do Dourado (Figure 2). It is possible to notice over the years the increase of areas destined for agriculture, especially close to water streams, a fundamental factor in guaranteeing the irrigation process of crops. Cultivated land, comprised of "agriculture" and "agriculture and pasture mosaic" used to occupy in 2000 an extension of 6,358.54 hectares, presenting an increase of 19 % from 2000 to 2010 and 24 % from 2000 to 2019. At the same time, it is noted that there is a retraction of 1.5 % in 2010 and 2.13 % in 2019 of native forest areas. Planted forests (Silviculture) are also worthy of notice, being mostly composed of eucalyptus. In Espírito Santo do Dourado, this land use increased 600 % from 2000 to 2010 and 1,200 % from 2000 to 2019.

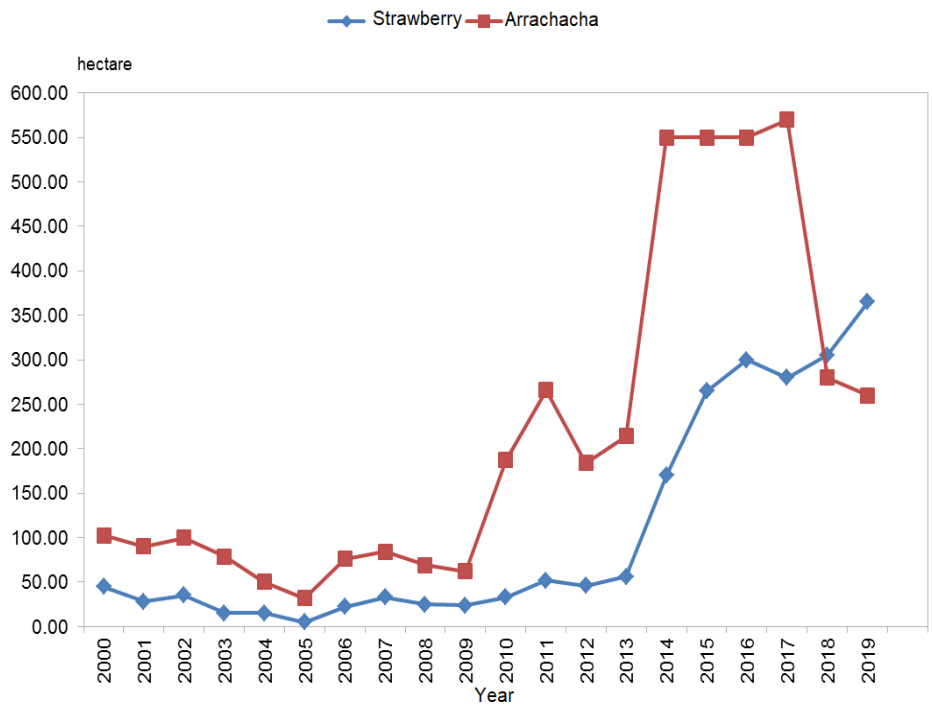
Specifically from the year 2014, the municipality showed a growing increase in cultivated areas, with the cultivation of strawberries and arracacha being the most relevant occupations, according to data available by the local office of the Technical Assistance and Rural Extension Company – EMATER (FIGURE 3).

Figure 2 – Land uses in Espírito Santo do Dourado - MG in the years of 2000, 2010 e 2019.



Source: The authors (2021).

Figure 3 – Arracacha and strawberry production areas over the years in the municipality of Espírito Santo do Dourado – MG, 2021.



Source: The authors (2021).

These rotating crops, when carried out in a traditional manner and non-compliance with adequate water quantity and quality management techniques, can increase the contamination of regional water resources and even generate conflicts over water demand. The increase in agricultural production can also generate conflicting demands in municipal migration processes (ALVES, 2006), and eventually generate an overload of local sanitation systems (which in this case are already precarious), and increase the load of polluting effluents in aquatic ecosystems.

Interviewed rural producers profile

In total, 28 rural residents were interviewed, all farmers, distributed in 15 different neighborhoods, with at least one representative in each of the main neighborhoods. Most of these producers (59 %) own the land they work, while 30 % rent and other 11 % work for someone else. These data demonstrate the attractive economic potential of small-scale agriculture in rural areas in the municipality. The main crop in the city is strawberry, being present in 68 % of the properties of interviewed owners. In 56 % of them, it was the only productive activity, while 12 % were mixed with other crops such as corn and arracacha, both cyclical and short-term crops, with high potential for physical, chemical, and biological degradation of the soil and seasonal transport of pesticides and fertilizers, contaminating water, soil, and groundwater (MESQUITA; PAULA; ALVARENGA, 2000). Regarding other crops developed, 32 % of the interviewees were divided in banana plantations, coffee plantations, horticulture, and dairy farming.

Another relevant aspect to consider is the interviewees' lack of knowledge about socioeconomic policies to assist family producers. These social actors could improve their socioeconomic conditions through the adoption of these practices, because as Alves (2006) attests family farming is an alternative to rural poverty. The incentive to family agricultural production takes place through access to public school feeding policies (National School Feeding Program – PNAE) or rural financing (National Program for Strengthening Family Agriculture – PRONAF). A very alarming fact is that 79 % of respondents were not registered as family producers or were unaware of such public policies. In other, but similar aspect, 63 % of respondents had never heard of organic agriculture, and 71 % were unaware of the term agroecology or agroforestry systems, highlighting the need to invest in public policies aimed at disseminating agricultural practices with less impact on the environment.

Socio-environmental and Sanitation

Regarding local water availability, more than 80 % of respondents had some water stream within the property. All properties intervened in local water resources for irrigation of their crops, either through abstraction in springs (29 %) and cisterns/wells (18 %), in rivers/streams that ran through their properties (32 %) or in superficial accumulations (21 %), demonstrating the importance and need for managing the quantity and quality of water sources in these locations. Contrary to the scenario of intervention in water resources, we recorded the absence of fines for environmental irregularity and none of the interviewees reported having gone through such an experience. Based on this aspect, it is possible to obtain a relationship between the absence of conservation actions as being proportional to the inspection or legal incentive for these practices. Concerning environmental conservation incentives, payment for environmental services has great potential as a mechanism for generating income and encouraging conservation practices (LAMIM-GUEDES *et al*., 2017).

As for the protection of APPs in springs (50 meters) and around rivers and streams (30 meters), according to Law 12.651/2012, 34 % of properties did not have preserved springs and

74 % of respondents did not know what these areas were, showing a lack of information. The results of the rapid characterization protocol applied in 08 springs, chosen at random, in some interviewed properties, corroborate these results, as shown in Table 1.

Table 1 – Visual diagnostic characteristics of the analyzed streams and land uses in the nearby surroundings. Espírito Santo do Dourado – MG, 2021.

SITE	NEIGH-BOUR-HOOD	CARDINAL DIRECTION	LONGI-TUDE	LATITUDE	ALTITUDE	STREAM ORDER	PREDOMINANT LAND USE OF SURROUNDINGS	[1]RIPARY VEGETATION AREA(m²)	[2]QUALITY OF ENVI-RONMENT
PT1D	Douradinho	South	397633	7555693	1108	2	Forest	31400	5
PT2D	Douradinho	South	396769	7555312	1151	1	Forest	31400	5
PT1BG	Brejo Grande	Center-South	397237	7559265	1331	1	Forest/ Pasture	25003	4
PT1PA	Ponte Alta	Center-South	396809	7560533	1168	2	Agriculture/ Pasture	16509	3
PT1GM	Grota da Mineira	Southeast	405060	7565164	949	1	Agriculture	14350	3
PT2GM	Grota da Mineira	Southeast	405288	7565336	968	1	Agriculture	8240	2
PT1BO	Boquira	South	396055	7557171	1242	1	Agriculture	6673	1
PT2BO	Boquira	South	397164	7556852	1243	1	Pasture	5677	1
PT1PQ	Passa Quatro	Southeast	404408	7564856	884	3	Agriculture	0	0

[1]Area calculated within a radius of 100 meters from the central geographic coordinate of the demarcated location

[2]Comparative analysis between locations according to field and laboratory observations. Scale from 1 to 5, with 5 = best and 0 = worst quality

Source: The authors (2021).

The sites analyzed had altitudes ranging between 884 meters and 1,331 meters, characterizing the high regional slope. The predominant land uses in the surroundings near the streams (100-meter buffer at the place where the Protocol was applied) were agriculture and pasture, except in the places evaluated in the Douradinho district, where the predominant vegetation is composed of forest fragments. The relationship between the percentage of forest surrounding the streams and the environmental diagnostic quality detected by the applied protocol is noticeable. We also noticed that in places where there is a predominance of agricultural activities, there is a tendency to remove the vegetation cover around streams and hilltops, precisely to expand the cultivation areas. This practice of land use is characterized as not complying with environmental norms and legislation regarding the conservation of APPs (stream margins, springs surroundings, hilltops, among others).

It is important to highlight that the places sampled in the Douradinho neighborhood are located in a valley region with a high slope, called by residents as “Paredão” and which has been used, in a very discrete way, by local tourism. It is a geological fault region with very steep peaks, low agricultural potential, and an apparent aptitude for ecotourism. Even though tourism is a sector that increasingly contributes to the Gross Domestic Product - Brazilian GDP (BRASIL, MINISTÉRIO DO TURISMO, 2018), some municipalities are still unable to effectively implement actions that reconcile environmental conservation and income through sustainable tourism. Therefore, the establishment of a municipal economic ecological zoning can be a useful tool to organize land use actions and quantitatively attest to the suitability of rural tourism in the region.

Another worrying result recorded in this survey was that 39 % of respondents did not

have the Rural Environmental Registry - CAR and 21 % did not even know the legal status of the properties on which they worked. This scenario is corroborated by data from the National Institute of Colonization and Agrarian Reform - INCRA (2019), in which 1,575 rural properties are registered in the municipality, representing 57,671.83 hectares, while there are only 1,013 registered in the SICAR (2021) for the municipality, representing 19,819.20 hectares. This incongruity demonstrates that 35,68 % of rural properties in Espírito Santo do Dourado are still in an irregular situation about their CAR.

The CAR was created by Law 12.651/2012 (Forest Code) and regulated in 2014 and refers to an electronic public registry, mandatory for all rural properties, with the purpose of integrating information from rural properties related to APPs, restricted use, legal reserve, forest remnants, and consolidated areas. Its objective is to compose a database for control, monitoring, environmental and economic planning, in addition to combating deforestation from a computerized and geospatialized system on a national scale (SICAR, 2021). The absence of registration of rural properties in the CAR implies the lack of information, which in the future will subsidize environmental protection policies.

As for rural sewage, about 46 % of respondents did not have any type of treatment, discharging the waste directly into the soil or into nearby streams. The discharge of untreated sewage into a water body can cause a loss in water quality and consequently affect the health of the population, with a reduction in quality of life (TEIXEIRA; GUILHERMINO, 2006; RESENDE; BELLIDO *et al*., 2010; FERREIRA; FERNANDES, 2018; SOUZA *et al*., 2020; MACHADO; MACIEL; THIOLLENT, 2021). This percentage is well above the national average of 25.3 %, presented by the PNSR (2019). Among the interviewees who had treatment, 53 % of them used the so-called "fossas negras" (cesspits), which are rudimentary methods of sewage allocation, with a high probability of soil and water table contamination. Only 7 % of respondents had a biodigester septic tank.

Reality and perspectives

Espírito Santo do Dourado – MG is a small municipality with apparent potential for the development of ecotourism, given its geographic location and natural characteristics. However, it is noticeable that the municipal agricultural vocation is not integrated with socio-environmental issues that focus on sustainability. As advocated by Madrid *et al*. (2015), an integrative vision based on the principles of complexity inherent to environmental issues is needed to solve the precariousness or absence of basic sanitation. These issues permeate technical, social, and cultural aspects, including Environmental Education. It is necessary to make citizens aware of the programs and socioeconomic benefits available, as well as to promote expressive campaigns for the dissemination of efficient and appropriate environmental management tools and techniques. The authors advocate an approach that meets the needs of the affected population, including decentralized sanitation systems with the implementation of social technologies for sanitary sewage, research of the innate skills of each region, water treatment, proper management of solid waste and improvements in drainage infrastructure.

Conclusion

From the results obtained in this research, it was possible to observe that the rural areas sampled in the municipality of Espírito Santo Dourado - MG are in a situation of considerable socio-environmental vulnerability. Agricultural activities proved to be the main source of income, but they are still developed in a traditional way, with a high potential for environmental impact and with little knowledge of the population about more sustainable alternatives for food production.

Also, in this aspect, the adoption of protective practices for the environment are practically imperceptible through the approach of this work, highlighting the importance of effective quali-quantitative management of local water resources and optimization of the basic sanitation system, which is still lacking in investments and attention. Thus, it is necessary to prioritize more integrative social and environmental public policies, including encouraging the proper use of the soil, conservation of APPs and, above all, carrying out environmental awareness campaigns, so that the rural population is aware of actions in favor of soil management, proper governance of water resources and environmental adequacy.

It is suggested the establishment of municipal ecological-economic zoning through studies of strategic planning such as the master plan, rural sanitation plan, sustainable rural development plan, the creation of an environmental secretariat, the implementation of continuous environmental education programs, creation of a fund for payment for environmental services and implementation of water quality monitoring programs. These are potential tools for this end and can be considered as suggestions for optimizing the current situation.

References

ALVES, E. (org). **Migração rural–urbana, agricultura familiar e novas tecnologias: coletânea de artigos revistos.** Brasília, DF: EMBRAPA Informação Tecnológica, 2006. 181 p. ISBN 85-7383-382-3.

ANA – Agência Nacional de Água. **Atlas Esgoto**. 2013. Disponível em: http://atlasesgotos.ana.gov.br/. Acesso em: abril/2021.

BRASIL. **Plano Nacional de Turismo**. Brasília: Ministério do Turismo, 2018. Disponível em: http://regionalizacao.turismo.gov.br/images/PNT_2018-2022.pdf. Acesso em: abril/2021.

BRASIL. **Decreto nº 7.217**, **de 21 de junho de 2010.** Regulamenta a Lei nº 11.445, de 5 de janeiro de 2007, que estabelece diretrizes nacionais para o saneamento básico, e dá outras providências. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/decreto/d7217.htm. Acesso em: abril/2021.

BRASIL. **Lei nº. 11.445, de 05 de janeiro de 2007**. Estabelece diretrizes nacionais para o saneamento básico. Disponível em: http://www.planalto.gov.br/ccivil/leis/ Acesso em: abril/2021.

BRASIL. **Lei nº 12.651, de 25 de maio de 2012.** Institui o Novo Código Florestal Brasileiro. Diário Oficial da União - Seção 1 - 28/5/2012, Página 1. Brasília, DF 2012. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm. Acesso em: abril/2021.

BRASIL. **Lei nº 14.026, de 15 de julho de 2020.** Atualiza o marco legal do saneamento básico e altera a Lei nº 9.984, de 17 de julho de 2000. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2020/lei/l14026.htm. Acesso em: abril/2021.

BELLIDO, J. G.; BARCELLOS, C.; BARBOSA F. S.; Bastos F. I. Saneamiento ambiental y mortalidad en niños menores de 5 años por enfermedades de transmisión hídrica en Brasil. **Revista Panamericana de Salud Pública.** 2010. n. 28, v. 2, p. 114–120.

BIERNACKI, P.; WALDORF, D. Snowball sampling: problems and techniques of chain referral sampling. **Sociological Methods & Research**, Thousand Oaks, CA, v. 10, n. 2, 1981.

CALLISTO, M.; FERREIRA, W.; MORENO, P.; GOULART, M. D. C.; PETRUCIO, M. Aplicação de um protocolo de avaliação rápida da diversidade de hábitats em atividades de ensino e pesquisa (MG-RJ). **Acta Limnologica Brasiliensia**, v. 14, n. 1, p. 91-98, 2002.

COSTA, C. C.; GUILHOTO, J. J. M. Saneamento rural no Brasil: impacto da fossa séptica biodigestora. **Engenharia Sanitária e Ambiental**. Edição Especial, p. 51-60. 2014.

EMATER – Empresa de Assistência Técnica e Extensão Rural do Estado de Minas Gerais. Consulta pública ao escritório local, Espírito Santo do Dourado/MG, abril/2021.

ERREIRA, L. A. F.; RIBEIRO, P. S. C.; ANDRADE, I. C. M.; GUIDES, R. M.; SANTOS, L. O. L.; CRUZ, L. M.; SANTOS, M. R. R.; REZENDE, S. Saneamento rural no planejamento municipal: lições a partir do Programa Nacional de Saneamento Rural (PNSR). **Revista DAE**. v. 67, n. 220, São Paulo, Edição Especial, nov. 2019.

FIGUEIREDO, I. C. S. **Tratamento de esgoto na zona rural: diagnóstico participativo e aplicação de tecnologias alternativas**. Tese (doutorado) – Universidade Estadual de Campinas, Faculdade de Engenharia Civil, Arquitetura e Urbanismo. Campinas, SP: 2019.

FUNASA – FUNDAÇÃO NACIONAL DA SAÚDE. **Programa Nacional de Saneamento Rural – PNSR/Ministério da Saúde, Fundação Nacional de Saúde**. Brasília: FUNASA, 2019. 260 p. Disponível em: http://www.funasa.gov.br/documents/20182/38564/MNL_PNSR_2019.pdf. Acesso em: abril/2021.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. 2010. Disponível em: https://www.ibge.gov.br/cidades-e-estados/mg/espirito-santo-do-dourado.html. Acesso em: abril/2021.

IGAM – INSTITUTO MINEIRO DE GESTÃO DAS ÁGUAS. 2021. Disponível em: http://comites.igam.mg.gov.br/conheca-a-bacia-gd5. Acesso em: abril/2021.

INCRA – Instituto Nacional de Colonização e Reforma Agrária. **Sistema Nacional de Cadastro Rural:** Cadastro de Imóveis Rurais – Consulta Pública. Disponível em: https://sncr.serpro.gov.br/sncr-web/consultaPublica.jsf?windowId=fe4. Acesso em: abril/2021.

LAMIM-GUEDES, V.; FERREIRA, L.; CARVALHO, P. P. P.; CAMARGO, P. L. T. Pagamento por serviços ambientais como instrumento para políticas públicas de conservação ambiental. InterfacEHS – **Saúde, Meio Ambiente e Sustentabilidade**. São Paulo: Centro Universitário Senac. v. 12, n. 1 – jun./2017.

MACHADO, G. C. X. M. P.; MACIEL, T. M. F. B.; THIOLLENT, M. An integral approach of ecological sanitation in traditional and rural communities. **Ciência & Saúde Coletiva**. 2021. v. 26, n. 4, p. 1333-1344. Portuguese, English. DOI: 10.1590/1413-81232021264.08242019.

MACIEL, A. L. S.; FERNANDES, R. M. C. Tecnologias sociais: interface com as políticas públicas e o serviço social. **Serviço Social & Sociedade**. São Paulo, n. 105, p. 146-165, jan./mar. 2011.

MADRID, F. J. P. L.; FIGUEIREDO, I. C. S.; FERRÃO, A. M. A.; TONETTI, A. L. Metodologia de desenvolvimento eco-sistêmico aplicado ao paradigma do saneamento descentralizado. **Revista Monografias Ambientais - REMOA**. Revista do Centro do Ciências Naturais e Exatas – UFSM, Santa Maria, v. 14, n. 1, Jan-Abr. 2015, p. 101-105. Disponível em: https://periodicos.ufsm.br/remoa/article/viewFile/16771/pdf. Acesso em: abr./2021.

MESQUITA, H. A.; PAULA, M. B.; ALVARENGA, M. I. N. Indicadores de impactos das atividades agropecuárias. **Informe Agropecuário**, Belo Horizonte, v. 21, n. 202, p. 57-62, 70-71, jan./fev. 2000.

PREFEITURA MUNICIPAL DE ESPÍRITO SANTO DO DOURADO/MG. **Plano de Saneamento Básico do Município de Espírito Santo do Dourado/MG**. 2017. Disponível em: http://www.espdourado.mg.gov.br/planos/PMSB.pdf. Acesso em: abril/2021.

PROJETO MAPBIOMAS. **Coleção da Série Anual de Mapas de Cobertura e Uso de Solo do Brasil**. Disponível em: https://mapbiomas.org/download. Acesso em abril/2021.

RENAUD, P.; ROQUE, F. O.; SOUZA, F. L.; PAYS, O.; LAURENT, F.; FRITZ, H. FISCHER, E; FABRICIUS, C. Towards a Meta-Social-Ecological System Perspective: A Response to Gounand *et al*. **Trends in Ecology & Evolution,** maio/2018. DOI: 10.1016/j.tree.2018.04.005.

RESENDE, R. G.; FERREIRA, S.; FERNANDES, L. F. R. O saneamento rural no contexto brasileiro. **Revista Agrogeoambiental**. v. 10, n. 1, mar. 2018. Disponível em: http://dx.doi.org/10.18406/2316-1817v10n120181027. Acesso em: abril/2021.

SICAR – Sistema Nacional de Cadastro Ambiental Rural**. Consulta Pública.** Disponível em: https://www.car.gov.br/publico/municipios/downloads?sigla=MG. Acesso em: abril/ 2021.

SOUSA, A. C. A.; COSTA, N. R. Política de saneamento básico no Brasil: discussão de uma trajetória. **História, Ciências, Saúde** - Manguinhos, Rio de Janeiro, v. 23, n. 3, jul.-set. 2016, p. 615-634.

SOUZA, H. P.; OLIVEIRA, W. T. G. H.; SANTOS, J. P. C.; TOLEDO, J. P.; FERREIRA, I. P. S.; ESASHIKA, S. N. G. S.; LIMA, T. F. P.; DELÁCIO, A. S. Doenças infecciosas e parasitárias no Brasil de 2010 a 2017: aspectos para vigilância em saúde. **Revista Panamericana de Salud Pública**. 2020, v. 44, n. 10. Disponível em: https://doi.org/10.26633/RPSP.2020.10. Acesso em: abril/2021.

TEIXEIRA, J. C.; GUILHERMINO, R. L. Análise da Associação entre Saneamento e Saúde nos Estados Brasileiros, empregando dados secundários do Banco de Dados indicadores e Dados Básicos para a Saúde 2003 – IDB 2003. **Revista Engenharia Sanitária e Ambiental**. v. 11, n. 3, jul./set. 2006, p. 277-282. Disponível em: https://doi.org/10.1590/S1413-41522006000300011. Acesso em: abril/2021.

TEIXEIRA, C. P. **Produção de mudas e frutos do morangueiro em diferentes sistemas de cultivo**. 2011. 74 f. Tese (Doutorado) – Curso de Agronomia, Fitotecnia, Universidade Federal de Lavras, 2011. Disponível em: http://repositorio.ufla.br/bitstream/1/2054/1/TESE_Produção de mudas e frutos de morangueiro em diferentes sistemas de cultivo.pdf. Acesso em: abril/2021.

TONETTI, A. L.; BRASIL, A. L.; MADRID, F. J. P. L.; FIGUEIREDO, I. C. S.; SCHNEIDER, J.; CRUZ, L. M. O.; DUARTE, N. C.; FERNANDES, P. M.; COASACA, R. L.; GARCIA, R. S.; MAGALHÃES, T. **Tratamento de esgotos domésticos em comunidades isoladas: referencial para a escolha de soluções**. Campinas, SP.: Biblioteca/Unicamp, 2018.