

SCIENTIFIC ARTICLE

The landscapes from Ouro Preto, Minas Gerais State: decoding in space and time

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Abstract

Landscapes are formed by physical elements of material order and abstract elements of immaterial order, so their management and planning should consider these two aspects. Aiming to understand the landscapes of Ouro Preto, Minas Gerais State, the appropriation by the actors who work in the landscape was identified and classified, and also its dynamics from 1973 to 2015. The research analyzed the current landscape and its historical evolution, distinguishing material and immaterial dimensions, from field trips, soil types, relief, slope, drainage, conservation units, administrative zoning, urban areas, natural resources, transport and building infrastructure, satellite images, and semi-structured interviews. As a result, a map with the landscape units and their subunits, which have distinct characteristics, with their proper settings was obtained. The landscape has continuous boundaries with various operating scales, posing a major challenge for its proper management. The number of generated ecosystem services are difficult to measure, but its benefits are used by everyone. The dynamics of the landscape has been shaped by a slow evolution, set by mining activities, including revegetation areas after clear cuts and currently the inclusion of tourism in certain regions.

Keywords: landscape elements, natural landscape, built landscape, land use.

Resumo**As paisagens de Ouro Preto, Minas Gerais: decodificação no espaço e no tempo**

As paisagens são formadas por elementos físicos de ordem material e por elementos abstratos de ordem imaterial, assim sua gestão e planejamento devem considerar estes dois aspectos. Com o objetivo de compreender as paisagens do município de Ouro Preto, Estado de Minas Gerais, foram identificadas e classificadas as apropriações pelos atores que atuam na paisagem, e ainda sua dinâmica entre 1973 até 2015. A pesquisa analisou a paisagem atual e sua evolução histórica, distinguindo as dimensões materiais e imateriais, a partir de viagens de campo, tipos de solos, relevo, declividade, drenagem, unidades de conservação, zoneamentos administrativos, áreas urbanas, recursos naturais, infraestruturas de transporte e de construção, imagens de satélite, e de entrevistas semiestruturadas. Como resultado obteve-se um mapa com as unidades de paisagens e suas subunidades, as quais possuem características distintas, com suas devidas definições. A paisagem possui limites contínuos, com várias escalas operacionais, impondo um grande desafio para a sua correta gestão. Os vários serviços ecossistêmicos gerados são de difícil mensuração, porém seus benefícios são utilizados por todos. A dinâmica da paisagem foi moldada por uma evolução lenta, ajustada às atividades minerárias, com inclusão de áreas revegetadas após cortes rasos e atualmente observa-se a inserção do turismo em determinadas regiões.

Palavras-chave: elementos da paisagem, paisagem natural, paisagem construída, uso do solo.

Introduction

The landscape is recognized by its various forms and breadth. There are some landscapes of extraordinary or rare beauty, the everyday landscapes, which according to Roger (1995) may pass by most people's sense of reality, and there are the degraded landscapes. When recognizing these differences, all the landscapes should be considered, exposing the areas which require greater attention by the managing agents and competent authorities (Raymond et al., 2015), thus improving the decision making.

The municipality of Ouro Preto, Minas Gerais State, Brazil, has unique architectural characteristics, rare natural beauties, minerals of relevant economic interest, as well as forests inside and outside preservation areas, which are extremely important for conservation (Silva et al., 2015). The conservation management and planning of the environment, whether forests, fields or any other physiognomy, must comply with the broad range of data collection, including the specificities of each landscape, in order to conserve the environment effectively.

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In the present research, the bases of the main approaches on the composition and characterization of the landscape in the municipality of Ouro Preto, Minas Gerais State, Brazil, were created. For this purpose, a picture of the main communities was elaborated, identifying and classifying the representation types and the appropriation of landscapes from the municipality by the individuals, besides the dynamics of the historical transformations and land use from 1973 to 2015.

Material and Methods

Initially, the current landscape was analyzed in order to differentiate the homogeneous areas according to criteria of the material dimension (Raymond et al., 2015), where the landscapes from the municipality of Ouro Preto were defined. For this stage, images from the RapidEye satellites of the year 2011, field trips, data of geology, pedology, relief, slope, drainage, protected areas, administrative zoning of Ouro Preto City hall, urban areas, natural resources, infrastructures transport and construction were used.

Thereafter, the landscape dynamics was evaluated based on historical surveys along with interviews with the population in order to identify and characterize local

experiences. In this way, it was possible to understand the appropriation of the landscape by individuals in their immaterial dimension (Luginbühl, 1998; Raymond et al., 2015).

The interviews were semi-structured with key informants (Laforest, 2009). Ideally, data collection from key informants should end after achieving data saturation, i.e., when interviews do not provide new ideas or additional information because the information collected is being repeated. When conducting the interviews, the regional actors were chosen according to the following criteria: politicians involved in space management, active and retired farmers, foresters, regional teachers, managers of rural associations, managers of conservation areas, tourists and residents of diverse age groups, social and cultural levels. The interviews were fully recorded and then transcribed.

Regarding the recent landscape evolution, the dynamics of the spatial organization of landscapes was evaluated based on the information previously described together with analyses from the Landsat satellite imagery (Table 1) between 1973 and 2015. A visual interpretation and analysis of the images (Jin et al., 2016) were chosen due to the great differences in the technical characteristics of the images and the sensor technologies for each period.

Table 1. List of Landsat images in the research conducted in the municipality of Ouro Preto, MG.

Satellite	Orbit / Point	Sensor	Year
Landsat 8	217-74 e 218-74	OLI	2015
Landsat 8	217-74 e 218-74	OLI	2014
Landsat 8	217-74 e 218-74	OLI	2013
Landsat 7	217-74 e 218-74	ETM	2011
Landsat 7	217-74 e 218-74	ETM	2006
Landsat 7	217-74 e 218-74	ETM	2001
Landsat 5	217-74 e 218-74	TM	1996
Landsat 5	217-74 e 218-74	TM	1991
Landsat 5	217-74 e 218-74	TM	1984
Landsat 1	233-74 e 234-74	MSS	1973

Results

The municipality of Ouro Preto

The Ouro Preto region has its origin linked to the mining activity since the foundation of the old Vila Rica during the gold cycle. In the municipality, there are agricultural activities, exuberant natural beauties in the mountains and valleys, besides the large volume of historical patrimonies

which promote tourism. There are also many conservation units, formed by semi-deciduous seasonal forest montane, rock fields and natural fields (Silva et al., 2015). The companies Alcan - Alumínio do Brasil S/A and Vale (Romano, 2000), as well as Gerdau and Samarco, stand out in the region. Ouro Preto is officially subdivided into thirteen districts presented in Table 2, which shows their area, population density and the official date founded.

Table 2. Districts of Ouro Preto-MG, with information on area, population and creation data.

	District	Habitants	Area (km ²)	Density (inhabitants/km ²)	Foundation Date
1.	Headquarters (Ouro Preto)	40,916	101.82	401.85	8 jul 1,711
2.	São Bartolomeu	730	145.70	5.01	16 fev 1,724
3.	Cachoeira do Campo	8,923	51.91	171.89	8 abr 1,836
4.	Antônio Pereira	4,480	108.90	41.14	3 abr 1,840
5.	Glaura	1,418	64.80	21.88	7 abr 1,841
6.	Amarantina	3,577	59.56	60.06	23 set 1,882
7.	Miguel Burnier	809	177.40	4.56	30 ago 1,911
8.	Santo Antônio do Leite	1,705	34.15	49.93	7 set 1,923
9.	Santa Rita de Ouro Preto	4,243	167.60	25.32	17 dez 1,938
10.	Engenheiro Correia	403	41.16	9.79	12 dez 1,953
11.	Rodrigo Silva	1,080	81.57	13.24	30 dez 1,962
12.	Santo Antônio do Salto	1,068	49.10	21.75	30 nov 1,992
13.	Lavras Novas	929	38.59	24.07	14 out 2,006

Data Source: Instituto Brasileiro de Geografia e Estatística (2010).

The native forest areas are currently derived from a long period of natural regeneration of forests in last years, especially in the State Environmental Protection Area of Cachoeira das Andorinhas (EPA Andorinhas) and the Uaimii State Forest. According to the survey, the lands of Ouro Preto are used for agriculture and livestock, eucalyptus forestry, large natural areas with dense forests and fields, mining activities and infrastructure related to transportation, and housing in urban and rural areas.

Urban and rural areas are very distinct in most districts. Historically, the landscapes of these sites were directly influenced by the infrastructure developed with the railway activities, the production of hydroelectric power and the mining industry. Their landscapes were also determined by the land use, the various housing architectural styles and the large industrial facilities. Moreover, there was a marked dynamic in some landscapes defined by operations related to economic activities.

Acting directly on the urban agglomerations of the Ouro Preto region, the population movements and urbanization occurred in several periods of famine, which devastated the region in the past, influenced the current shape and positioning of these urban agglomerations.

The urban and rural areas are officially delimited from polygons defined in the master plan of the municipality.

The Ouro Preto road network is composed of both paved and unpaved roads present in all its extension. There are several districts with little traffic, which are not always connected directly to the headquarters by large highways, either by the lack of pavement or by not connecting directly to the economically active centers of the municipality, reducing its flow. There are active railroads, whose trains are currently used almost exclusively in the mining industry, although there is one for tourism and many structure indications of the old railroad.

The main industries established in Ouro Preto are related to the mining, which have higher share in the city revenue. The other important sectors of the economy are tourism, forestry linked to the steel industry, grazing and family farming or subsistence agriculture, and education, which moves a large contingent of students to headquarters.

Landscape units

In the Municipality of Ouro Preto, seven units and 19 subunit landscapes were identified (Figure 1) using a 1:50,000 scale. The names referring to each unit (Table 3) were premised on their use by the population.

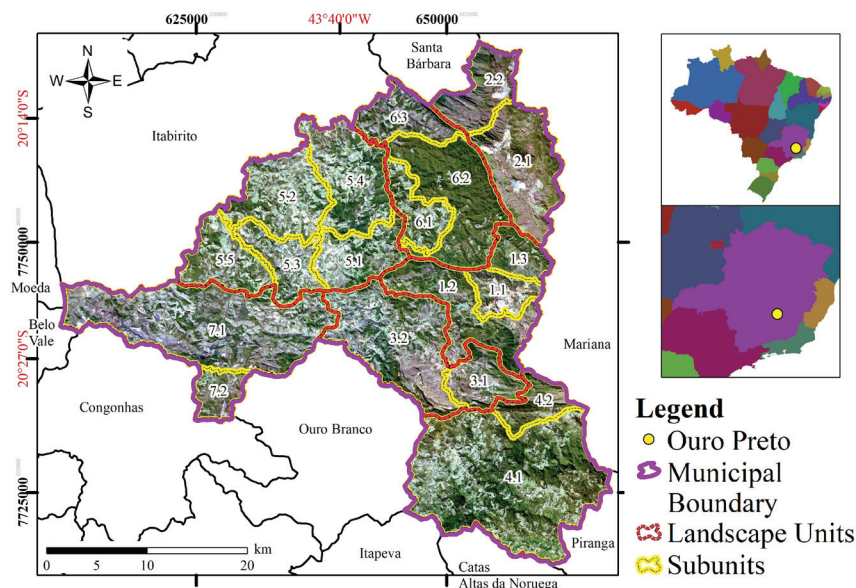


Figure. 1 Landscape units and their subunits in the municipality of Ouro Preto, Minas Gerais State. Background with RapidEye Satellite Imagery, in the year 2011.

Table 3. Nomenclature used for the Units and Subunits of Landscapes, in the municipality of Ouro Preto, MG.

Units	Subunits	Name	Id.
1		PAISAGENS NATURAIS E PATRIMÔNIO HISTÓRICO DE OURO PRETO	PNP.
	1.1	Sede Histórica Ouro Preto	PNP.SH
	1.2	Zona Rural da Sede de Ouro Preto	PNP.ZR
	1.3	Parque das Andorinhas	PNP.PA
2		SERRAS DE ANTÔNIO PEREIRA	SAP.
	2.1	Vale de Antônio Pereira	SAP.AP
	2.2	Pico do Frasão e Serras de Antônio Pereira	SAP.FS
3		FLORESTAS E CAMPOS DE LAVRAS NOVAS E RODRIGO SILVA	FCL.
	3.1	Lavras Novas	FCL.LN
	3.2	Rodrigo Silva	FCL.RS
4		PAISAGENS NATURAIS E PLANTADAS DE SALTO E SANTA RITA	PSS.
	4.1	Santa Rita de Ouro Preto	PSS.SR
	4.2	Santo Antônio do Salto	PSS.SS
5		REGIÃO MAIS PLANA DE OURO PRETO	RMP.
	5.1	Cachoeira do Campo	RMP.CC
	5.2	Amarantina	RMP.AM
	5.3	Santo Antônio do Leite	RMP.SL
	5.4	Glaura	RMP.GL
	5.5	Engenheiro Correa	RMP.EC
6		PAISAGENS FLORESTAIS – APA DAS ANDORINHAS	PAA.
	6.1	São Bartolomeu	PAA.SB
	6.2	Floresta do Uaimii	PAA.FU
	6.3	Campos da APA Andorinhas	PAA.CA
7		PAISAGEM MINERÁRIA DE MIGUEL BURNIER	PMM.
	7.1	Minerações de Miguel Burnier	PMM.MB
	7.2	Limítrofe de Ouro Branco e Congonhas	PMM.OC

The first PNP unit (1) is related to the historical issues of Brazil, mainly in the subunit PNP.SH (1.1), which has a large protected area by the landmark of the architectural and urban complex of the city of Ouro Preto. This region is differentiated from the subunits PNP.ZR (1.2) and PNP.PA (1.3) due to its large urban and historical framework. The subunit PNP.ZR (1.2) stood out by having the rural area of the municipality linked to economic activities. In contrast to the others, the subunit PNP.PA (1.3) is within the limits of the EPA Andorinhas, having a place with relief adequate to the urban expansion as well as extremely important for the conservation of the Rio das Velhas due to the presence of its headwaters.

The second landscape unit, SAP (2) has the great mountain of the EPA Andorinhas as main differential in all its western extension. The subunit SAP.AP (2.1) stood out because it is located in the lower part, where two urban agglomerations, Vila da Samarco and Antônio Pereira, are present. Taking into account that Antônio Pereira is the oldest village, such subunit was named as Vale de Antônio Pereira. The subunit SAP.FS (2.2) is a region with high intensity of mining activities. It is limited on one side at the top of Pico do Frisão and, on the other, at the top of the bordering mountain of the municipality of Ouro Preto.

The third landscape unit, FCL (3) has representative natural areas and therefore received two subunits. In the subunit FCL.LN (3.1), there is a small urban area in the upper part of the mountain that, although historical, was recently recognized as a district. The whole area has fields and provides a lot of tourist activity. Differently, the subunit FCL.RS (3.2) has a larger urban area with more forest areas and its historical evolution linked to the railroad, remaining only the train station.

The fourth landscape unit, PSS (4) shows great representativeness of eucalyptus forestry amidst the mountains and natural forests. The subunit PSS.SR (4.1) has a high concentration of eucalyptus plantation, besides being recognized by soapstone handicrafts. The subunit PSS.SS (4.2) presented a great valley, a small village amidst the mountains and few economic activities, which resulted in a good state of conservation.

The fifth landscape unit, RMP (5) has the largest subdivision mainly due to the land use, which established major differences among subunits. Called the flatter region of Ouro Preto due to the relief aspect, this unit was highlighted by the greater amount of anthropic activities, urban agglomerations, tourism, mining and, in addition, conserved areas outside the protected units. The subunit RMP.CC (5.1) has the greatest political influence, the highest population density, economically active and located on the margins of the Inconfidentes Highway. The subunit RMP.AM (5.2) follows the margins of this highway, has a lot of agricultural activity, the relief favors the horticultural and livestock production, besides the tourism, with the Museum of Reductions as the main attraction. The subunit RMP.SL (5.3), just as the previous one, has an economy based on agriculture, with many pastures along the roads. It has medium traffic due to its proximity to the Inconfidentes Highway. The subunit RMP.GL (5.4) is notable for the

beautiful landscapes and houses the village with the same name, which is a sought after place for ecological tourism and for those who seek peace and tranquility. The subunit RMP.EC (5.5), despite being in a flatter place, has only a small urban agglomeration, beautiful conserved landscapes and nevertheless, there is little tourism in this place.

The sixth landscape unit, PAA (6) encompasses the entire EPA Andorinhas together with the Uaimii Forest area, providing the greatest differential in relation to the other units. The subunit PAA.SB (6.1) stood out by the village with the same name, which has a foundation date very close to the headquarters of Ouro Preto. Although without landmark of the architectural complex as in the headquarters, there are many individual landmarks, favoring the protection of a large conglomerate. This village is small, holding a high amount of historical and natural heritage, very conserved, besides owning a production of handcrafted sweets internationally recognized. The subunit PAA.FU (6.2) is formed almost entirely by native forests, with little road access and rare urban constructions. The subunit PAA.CA (6.3) shows high altitude as major characteristic, with its lowest part at 920 m and reaching up to 1900 m, with few accesses, many waterfalls and some forest fragments.

In the seventh landscape unit, PMM (7) is mainly characterized by the large open pit mines, the high traffic of trucks, the lack of pavement to access the headquarters of Ouro Preto and the low population density (Table 2). The use of public services in neighboring municipalities by the resident population and the lack of tourism are also some particularities of this unit. The subunit PMM.MB (7.1) is characterized by the landscapes of the pits in the rural and forest regions. Regardless of the strong visual impact caused by the bare areas of mining or erosion, this subunit boasts places of natural beauty. The subunit PMM.OC (7.2) was differentiated in all parameters of the other landscape units from this municipality. Located very close to the municipalities of Ouro Branco and Congonhas, the site is used as support area for the mining activities performed in the subunit PMM.MB (7.1).

Transformations of landscapes based on satellite imagery between 1973 and 2015

The evaluation of Landsat images showed the upkeep of forest masses throughout the period analyzed. Forestry maintained a planting and harvesting pattern, especially in the PSS.SR subunit (4.1).

The urban centers showed structural maintenance, with a great increase of expansion areas in the last decade, concentrated mainly in the district of Cachoeira do Campo and in the headquarters of Ouro Preto.

In the 1980s, the mines were expressed with specific spatial patterns, but with a great increase in activity from 1990 to 2015, especially in the region of Miguel Burnier and Antônio Pereira.

However, agriculture and livestock activities were not well evaluated by these images due to the low resolution in the 1970s. In the 1980s, 1990s and 2000s, information can be inferred based on the cross-referenced data collected

in the research. Thus, from the observation of the forest masses, forestry and mining, it is known that the agriculture maintained the spatial pattern in the unit RMP (5) and the subunit PAA.SB (6.1) throughout this period.

Discussion

The landscape has multiple ecosystem services, which are produced in several regions simultaneously (Millennium Ecosystem Assessment, 2005). This fact challenges the definition of actions necessary to manage the Landscape Units and the return maximization of these goods to society (Troy and Wilson, 2006). Another factor is the difficult measurement of multiple ecosystem services, which is partially applied in the municipality and beyond the geopolitical and landscape borders of the region.

Why landscape units?

Understanding the landscape leads the individual to question the environment in which he or she lives and the reasons for having such economic events. The present research identified that mining is rooted in the construction of the city's landscapes, directly influencing the population movements, the conformation of forest masses, the agricultural and livestock areas, the urban areas, besides affecting the social conflicts of the municipality. For Raymond et al. (2015), the operationalization for gathering knowledge about the landscape prevents the occurrence of several conflicts when considering the individual's cultural values and their representations of landscapes. In other words, to understand all the services that drive the economy and transform the landscapes.

Presence of vegetation in the landscape

The report of deforestation in Minas Gerais State between 2012 and 2013 obtained the highest rate of the country. However, in the following report, between 2013 and 2014, it was decreased by 34% (Fundação SOS Mata Atlântica; Instituto Nacional de Pesquisas Espaciais, 2015). In the analysis of these surveys is shown that the Ouro Preto area has deforestation under control when compared to other regions of the state. In this respect, forestry areas have historically constituted a stable pattern for these settlements in the last decades, as well as the historical architectural heritage, especially in the historical, headquarter and within the urban groups of the villages from the municipality.

The mosaics formed in the landscape of the municipality of Ouro Preto have a preserved structure due to aspects related to the rugged relief (Hermuche and Felfili, 2011) and the presence of Federal, State and other conservation units in the municipality. Such protected areas have very active management in Ouro Preto, which ensured the maintenance of large natural forest masses (Silva et al., 2015), although it was verified in the research that there is currently a great dismantling of the management system of these areas, generating insecurity in its preservation.

In this regard, in view of the current forest structure and geographic position of the Rio Doce and Rio São Francisco subbasins in the municipality of Ouro Preto, the proper management and planning of the landscape is highly relevant (Silva et al., 2018). Regions with a high level of conservation should prioritize the preservation (Rappaport et al., 2015) since the resources available for these purposes will be smaller, and the benefits of maintaining ecological processes are far superior in relation to the benefits derived from degraded areas which have been restored.

In the case of Ouro Preto, the subunits PNP.PA (1.3), PSS.SS (4.2), RMPEC (5.5), PAA.SB (6.1) and PAA.FU (6.2) remained with a denser forest structure, and the unit PMM. (7), although having a great forest cover, showed a temporal pattern of total vegetation removal in large areas during mining activities. Silva and Peroni (2015) commented that, when comparing areas under the influence of mining and agriculture activities, the mined areas show less fragmentation in the landscape, which is also noticeable in the subunit PMM.MB (7.1). Even with lower forest fragmentation, it should be emphasized that ecological processes, biodiversity and endemic species become deficient or non-existent after mining.

Provided that the basis of life and human activities is in balance with ecosystems, it is necessary to plan and manage rationally the goods and services offered. Thus, the ideal characteristics of ecosystems are essential for keeping the well-being of individuals, as well as economic and cultural development (Millennium Ecosystem Assessment, 2005). Conversely, human activities, mainly the mining of Ouro Preto, are partially destroying the biodiversity when removing all the vegetation of certain sites. Nevertheless, there are cases such as those described by Barros et al. (2012), which occur with low environmental impact and can be compared to the subunit PSS.SR (4.1). Additionally, changes in the forest structure alter the capacity of ecosystems to produce large quantities of goods and services, which is extremely difficult to measure.

In the past, ecosystems were not relevant for Ouro Preto societies, so they were constantly underestimated and much degraded. These facts led the old populations to experience several periods of famine which led to the foundation of various districts and induced migration to neighboring municipalities (Schwarcz and Starling, 2015). However, the demands of societies for food, water and energy can now be more accurately predicted. Diaz et al. (2015) also state that it is possible to integrate these demands on the benefits of nature and improve their relationship with the population. Promoting the conservation of landscapes and their biodiversity will protect societies, avoiding the need for economic investments arising from the scarcity of environmental goods and services, besides providing a better quality of life.

According to the Landsat images, the forest fragments from the subunits PSS.SS (4.2), RMPEC (5.5) and PAA.FU (6.2) remained stable in the research period, showing the densest structures of the municipality. In the unit PMM.

(7), despite the recent expansion of mining operations (Vale, 2015), the forest area maintained a partially continuous structure in the vicinity of pits, although with environmental impacts related to the high frequency of truck traffic, noise from mining machinery, dust, and other constant environmental disturbances to the fauna and flora.

Landscape dynamics with a historical basis

The landscapes of Ouro Preto were shaped by the productive logic (mining, forestry, handicrafts and industry), aesthetics (the great areas protected by the various types of conservation units), philosophical (the municipality is a cultural pole) and economic development (always related to mining), as well as the development of recreation and tourism. As described by Schwarcz and Starling (2015), this is based on historical practices dating from the foundation of Vila Rica by the discovery of gold, resulting from a slow evolution.

The generation of new practices for the use of the natural space, such as rural, cultural, discovery and sports tourism, contemplation, hiking or recreation parks, among others, are a growing need in the culture (Carneiro et al., 2015), which transform the landscape. Such use of space, with the necessary interventions and care, can improve the landscapes of Ouro Preto, especially in the subunits PNP.SH (1.1), SAP.FS (2.2), FCL.LN (3.1), RMP.GL (5.4), PAA.SB (6.1), PAA.FU (6.2) where tourism is already present. Furthermore, new practices for the use of the natural space can maximize the various ecosystem services provided by landscapes. There are cases as in the subunits PSS.SS (4.2), RMP.EC (5.5) and PAA.CA (6.3) where tourism activities can be encouraged due to natural beauty and state of conservation, contributing to the generation of financial resources. Tourism became one of the main revenues for local individuals, being more significant for the resident population than mining, an activity that serves only a specific portion of the municipality.

In the subunits PSS.SR (4.1) and PSS.SS (4.2), the greatest differences occurred between the limits of the administrative units and the landscape units of Ouro Preto. This occurred due to the land use, which detected large differences between the activity level of grazing and forestry, which are predominant in the subunit PSS.SR (4.1). Also in this context, according to the road structure, the district of Salto and its urban area are practically isolated from the rest of the municipality of Ouro Preto. Although there are two unpaved accesses, only one is often used by the population since residents of the subunit PSS.SS (4.2) reported lack of security in the other way. In the village of Salto, this geographic isolation was manifested in the feeling of the population and verified during the interviews. The young population of this subunit lacks employment and income opportunities in order to enable them to stay, thus leaving an elderly population in place.

Due to the low spatial and radiometric resolution of the Landsat images available, the agricultural activities were analyzed indirectly. Throughout the last decades of this research, the forest masses were maintained, the mining activity increased, and the agricultural activities

remained approximately in the same proportion. This activity had greater representativeness in the flatter regions of the municipality, unit RMP. (5), with a lower proportion mainly in the subunits FCL.RS (3.2), PSS.SR (4.1) and PAA.SB (6.1). The category agriculture and livestock were characterized as small farms or subsistence after verification in the field.

The representations of the mining in the landscapes were expressive mainly in the subunits PNP.ZR (1.2), SAP.AP (2.1), FCL.RS (3.2) and PMM.MB (7.1), although minor mining was found along the municipality. Considering Miguel Burnier, one of the largest districts in the area, the favoring of this activity is evidenced by the distancing of the population contingents. Its population density is 4.56 inhabitants km⁻² (Instituto Brasileiro de Geografia e Estatística, 2010), which diminished the political strength of its residents, besides the lack of active zones of urban expansion and tourism. For Costa and Engler (2008), the understanding about democracy is given by its elected officials through the vote, a circumstance that maintains this landscape under the influence of groups which have greater representation in the municipality. The described reality of Unit 7 led it subjected to non-residents.

The cases of the units SAP. (2) and PMM. (7) are the most relevant in relation to the mining activity since there are almost no other significant economic activities in these areas. In the unit SAP. (2), there is still housing and leisure infrastructure. In the unit PMM. (7), respondents expressed a sense of abandonment due to the lack of attention to the district (Miguel Burnier) regarding the quality of life and well-being of the population in that region. According to Silva and Peroni (2015), iron mining activity is essential to the existence of modern society and has high investments in research and development of new techniques to minimize environmental impacts. However, although the mining activity is strong and actively participate in the municipality's revenue, is verified in the subunit SAP.AP (2.1) and mainly PMM.MB (7.1) that few local individuals are directly benefited, most are the only burden provoked by activity, such as dust, noise and the feeling of being rejected by the environment where they live.

The increasing demand for minerals in the last decades worldwide (Vale, 2015) has influenced the local economy, placing mining as the dominant variable in the modifications of the Ouro Preto landscapes. For Sachs (2012), the economic development of the coming decades will be very complex due to the factors related to climate change, since some regions will possibly suffer from large environmental impacts, intense heat waves, droughts or floods. These factors can drastically change the behavior of individuals, who have no control over these events. Such fact is corroborated in the neighboring municipality of Mariana, where a great environmental impact in the Rio Doce instantly transformed the whole routine of the population along the river. Ouro Preto, Mariana and many other Brazilian municipalities are not prepared for these major environmental impacts, regardless of being caused by human or not.

In this sense, global economic development cannot be defined solely based on political institutions; just as

local economic development cannot allow de-structuring the cultures rooted throughout its history. This is a very complex variable that requires an exceptional analysis so that it is possible to infer which other factors play an important role in economic development (Sachs, 2012). According to this author, political matters and bad governments can destroy economic development, although points out that understanding development depends on maintaining rationality in relation to the truthfulness of the difficult understanding of global and local processes of evolution and propagation of ideas. Ideas influence the flow of technology developments around the world through a myriad of political, geographical, economic, and cultural environments. These modifying factors have their roles perceived from observations in the transformations of local landscapes, where the effects are strongly felt, presenting the actual insertion difficulties of the management policies.

In the present study, a 1:50,000 scale was used to demarcate the landscape units, where data were integrated on each landscape in loco, allowing a better discernment of these units and subsequent detailing of their subunits. The analyses used different groups of data, which for Berardi et al. (2015) aid perceiving the functioning of systems along the scales in the characterization of organizational systems of interest, leading to understand the productive or synergic situations that maintain or overturn the viability of the perceived systems. Work scales influenced directly the setting of landscape limits, which the more detailed the information, the more information can influence its boundaries.

When considering the landscape limits as being continuous, it can be affirmed that the various polygons when demarcated can be modified from the linkage of new activities, or by increasing and decreasing the existing activities, just as the regional culture can be altered, thus leading to landscape evolution. It can be observed that the landscapes are dynamic and change eventually fast and sometimes slowly. For Berardi et al. (2015) and Ison et al. (2015), the promotion of institutions responsible for integrating and mediating at different scales of landscapes should be emphasized. Thus, managers should be required to monitor assessments over time in order to determine whether the directions taken in the past are in accordance with the principles and guidelines of the municipality of Ouro Preto. These ideals must be based on sustainable development, thus avoiding future mistakes, which cannot be recovered depending on the extent.

Conclusions

The landscape dynamics expose the same mechanisms of land use responsible for establishing the landscape since the emergence of the old Villa Rica. In the municipality of Ouro Preto, the transformations in the landscape are still shaped by the structure of the mining. Currently, a new dynamic was created with the insertion of tourism activity, with few changes in the landscape in relation to other economic activities and conservation of the municipality's forests during the period of the present research.

Although there are currently greater planning and better management to minimize the problems of ecosystem

degradation, which therefore affect the biodiversity of the region, the revenue generated by the mining activity is far from local residents.

Author Contribution

R.A.A. ⁰⁰⁰⁰⁻⁰⁰⁰¹⁻⁸⁶⁵⁵⁻⁸⁵⁷¹: development of the idea, research, interviews, data processing and analysis, photographs and writing of the manuscript. **J.A.A.P.** ⁰⁰⁰⁰⁻⁰⁰⁰¹⁻⁶⁶⁰²⁻⁰⁵⁰⁴: development of the idea, research, adaptation of the methodology, critical reading and editing of the manuscript. **S.F.N.S.C.A.** ⁰⁰⁰⁰⁻⁰⁰⁰³⁻¹²⁹³⁻⁶⁸⁰²: project development, research, methodology, interviews and critical reading of the manuscript.

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