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The Sustainable Future: Solid Waste Management and Sustainable Development in The Peruvian Amazon

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Abstract

The research is important because it allows us to reflect and seek successful management of solid waste to achieve sustainable development in the Amazon region of Peru, as a constant form of protection of health and life; at the same time, becoming an incentive for family economies. The study sought to establish a relationship between solid waste management and sustainable development in the Peruvian Amazon. The type of basic research, with a non-experimental design, correlational scope and cross-sectional, whose population was 8,000 thousand users and the sample was 1,000 thousand. The data collection technique was the survey and the questionnaire was used as an instrument. The results found: The level of solid waste management is low at 60.1%. The level of sustainable development is low with 52.5%. There is a low and significant positive correlation between the dimensions permanent external conditions, institutional condition, waste treatment, collection - transportation and final disposal of the variable solid waste management and the variable sustainable development with a Spearman's Rho coefficient of 0.342; 0.325; 0.063; 0226; 0.239 and a p-value of 0.000, significance level of 0.001. It was concluded that, There is a low and significant positive correlation between the solid waste management variable and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.309 and a p-value of 0.000, which is < 0.01; Others, it only has a variability of 30% between variables.

Keywords: *Solid Waste, Peruvian Amazon, Successful Management, Health Protection, Life Protection.*

Introduction

Nowadays, greater interest and demand has been placed on caring for the health and life of citizens by avoiding environmental pollution, which has led governments to carry out a correct treatment and disposal of waste, since waste is a polluting element in cities that has become a major social 1269ólice12691269. As cities grow and develop, at the same time they experience overpopulation and as a consequence generate a greater 1269ólice1269 of waste, which affects the comfort of life of the population due to inadequate waste management, where the different mitigation plans to counteract the disorder and over-accumulation of waste in landfills and to appease the negative 1269ólice1269 soil and atmospheric pollution need to be elaborated with results that are sustainable and flexible to be optimised over time, associated with continuous improvement that changes focus, to keep improving and adjusting to the needs of cities and small communities

Several countries have implemented mechanisms for waste treatment to reduce solid waste through the use of sanitary landfills, recycling methods, among others; these practices have been seen to improve in some countries such as: Latvia 72% of their waste is revalued, in Belgium 77% and Italy 79%; while in Bulgaria and Greece 95% of waste ends up in landfills, and about 48% of the countries in the 1269ólice practice recycling and composting, while 57% of countries burn their solid waste; however, having almost 50% that still burn their rubbish (Carbajal et al., 2022). As can be seen, there is still a long way to go to 1269ólice a culture of health care by avoiding polluting cities with waste.

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In Mexico, the rubbish treatment and handling office in Guadalajara, Mexico, has been affected by low government identity and lack of institutionalisation, leading to a lack 1270ólic operational procedures manual, lack of 1270ólice and human resources, among others, which represents 1270ól institutional performance. Consequently, a 1270 ól administration policy, confusing goals and non-standardised procedures, among others, when institutional identity and a sense of patriotism are not 1270ólice1270 a government's management philosophy, this ends up leading to unsuitable officials or those with 1270ólice interest in citizen service, which is reflected in untimely attention to citizens (Toledo and Quintero, 2022).

In Peru, by means of D.L. N° 1278 – 1270ólice Integral Solid Waste Management (2016), the 1270ólice and duties of citizens were established in order to contribute to the sustained optimisation of productivity in the treatment of waste, in order to guarantee an economically profitable, sanitary and environmentally friendly management. In addition, with the approval of D. S. N° 014-2017-MINAM (2017) the regulation was regulated in order to carry out actions to reduce waste production in households, 1270ólic and companies. Local governments are empowered to manage domestic, 1270ólice127012701270, 1270ólice cleaning, food market and other similar waste, which must be disposed of in sanitary landfills, as determined by the Ministry of Environment (MINAM). However, the coverage of finishing the waste in legal landfills is 51.2% of municipalities in Peru, where 1270ól 1270ól 75% of municipalities are unsupplied and 30.3% of municipalities do not have documents and instruments for the operation and treatment of garbage/waste, so the gap in this sector is challenging, according to figures from the National Registry of Municipalities – 2019 (ComexPerú, 2020). 1270ólice12701270 the harsh Peruvian reality, the OEFA, as a pilot district, implemented the mobile application Reporta Residuos (Report Waste), so that citizens can immediately and directly report the storage of waste on public roads in the district of Jesús María, and then gradually replicate the service to the 1270ólice1270 the country's municipalities (OEFA, 2021).

In the Peruvian Amazon, the municipalities in these regions are not efficiently managing waste and/or rubbish, inexperience for efficient planning and a shortage of logistical and financial resources, as most municipalities do not have a plan for segregation at source, They do not have their own waste disposal or treatment infrastructure, so they share final disposal sites with other provinces or districts, with distances of several kilometres, which would clearly be increasing the low 1270ólice costs for the population. Waste management should be analysed from a multidisciplinary approach, from a social, health and tourism perspective, which is why, in accordance with the information obtained.

Theoretical Framework

Several studies have been carried out on the variables, such as: Huamán, et al. (2020); Segura, et al. (2020) and Artarz (2022), indicated that the transformation of organic solid waste from paper, cardboard, plastics, glass and metals including the production of compost can contribute to sustainability, improve the income of all direct and indirect actors, as well as contribute to the environment and human health, and that the leadership in solid waste management in the world is marked by the ability to make recovery and proper use of unusable waste, and that progress towards a sustainable global future is too slow. In the case of Cordero (2018); Espinoza et al. (2020) and Machaca (2020); concluded that, for municipalities to start the process of local development, instruments of management innovation and an administrative system are needed in order to perform high levels of economic competences so that they can elaborate, carry out and disseminate public development policies, as well as, the participation and mobilisation of local stakeholders that have the appropriate resources and rules to direct actions to achieve concrete objectives; and that the environmental economic valuation is influenced by the socio-economic factor.

Likewise, Azevedo et al. (2021); Cárdenas et al. (2019) and Azevedo et al. (2020), concluded that, for municipal authorities, solid waste is not a sanitary, legal and environmental priority for society, despite the fact that the most common deficiencies are the lack of segregation at source, poor operation and collection, deficient valuation method in the municipal landfill and lack of environmental education. There are no clear environmental policies, which weakens the initiatives of NGOs and organisations that aim to restore disadvantaged environments destroyed by companies and citizens, which does not guarantee adequate treatment of household waste and rubbish. For Sánchez et al, (2019) and Rojas (2020) state that Bogotá has deficiencies in the management of solid waste, so it is necessary to plan training in the different aspects of

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the collection, treatment and disposal of solid waste, in order to achieve the benefits of these good practices for the good of the population; They also indicate that it is important to design, implement and apply teaching strategies in educational institutions in Colombia and throughout Latin America, with the purpose of achieving the goals in terms of environmental management, such as environmental awareness, from which to propose a proper management of all environmental management, which helps to give life to healthy and pleasant cities, but also to provide the necessary benefits to their populations.

This study focuses on the Ecological Theory of Urie Bronfenbrenner (1948), who proposes an ecological perspective on the development of human behaviour. Bronfenbrenner (1987) argues that the formative capacity of a system depends on the existence of social interconnections between systems. Gallicchio Enrique's theory, sustainable development must start from the people and communities themselves, which subsequently relates to the state and the market, as the empowerment of citizenship takes prominence in the context of globalisation, with local actors being the protagonists, and values and actions are not limited to the present, but continue into the next generation (Gallicchio, 2002).

The Economic Commission for Latin America and the Caribbean (ECLAC), framed in the 'Citizen Participation', establishes that public leadership must be shared, institution and citizenship, as a democratic state, dialogue and popular agreement translates into an integrating tool of interests with public entities in order to achieve inclusion with access to information and intervention in state environmental policies to improve governance in institutions (ECLAC, 2019). The UN, through the guide 'Protecting the environment: The power is in your hands, indicates that citizen participation starts with access to information on environmental matters, where they should know the risks and dangers in their localities, and that the State is the main manager of implementing mechanisms for citizens to be part of decision-making (UNECE, 2019).

In terms of the theoretical basis, management is the process of administering the resources of an organisation in which efficiency is sought in each process of the system (Green Ecology, 2020). Waste is any object or good resulting from the production of the main product or development of the primary activity. The type of waste varies; waste that is waste for one sector can be raw material for another (Campins, 1994). Therefore, in terms of solid waste management, it falls to local municipalities, where part of their attributions is directed to the management of household waste generation, cleaning of green areas and public areas, waste from commercial and industrial origin and all those productive levels that produce equivalent waste; in addition to the waste generated in the construction of housing and other types included in the construction sector concerning the demolition or remodeling of buildings (D.L. Nº 1278, 2017). Therefore, the importance that citizens should participate in the management of their municipalities, being responsible with their taxes and active participation in environmental programmes.

On the other hand, regarding local sustainable development, sustainability is a relative concept because of the approach that can be attributed to it, which consists of meeting the needs of people today, without putting at risk future generations; therefore, it is important to ensure a balance between economic prosperity, environmental care and social welfare (Santander, 2022). It is true that sustainability is not new, but so far it has not been demonstrated in the implementation of projects, which has been observed several opposing elements such as corruption, lack of professionalism, lack of values and ethical principles that undermine the enthusiasm of those who persevere and claim that it is the pillar of economic development of the people.

When there is an initiative to seek improvement, especially if one lives in the place where the problems are a reality and the scenario is the communities, one must manage improvement plans for the quality of life of the people, coordinating with all levels of government (Vázquez, 1988). Local sustainable development is the process where both public and private local authorities must coordinate their efforts to analyse and implement an action strategy to protect the environment, economic strength and social wellbeing within the territory, making use of the potential of local resources and competitive advantages (Monterroso, 2014).

With regard to the solid waste management variable, the increase in waste is alarming and if the current rate of neglect continues, it will increase by 70% by 2050. Therefore, the need to give due importance to

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controlling the level of waste, in addition to reducing the levels of plastic through recycling incentives, since plastic is the primary waste. Therefore, it is required to join global efforts to reduce the problem that will affect the future population by employing clear strategies (World Bank, 2018).

The Ministry of Environment issued the Legislative Decree N°1278, Law of integral waste management in which it is specified that the integral management of solid waste has as main axis to diminish and appease the increase of solid waste from origin. This refers to the recovery and valorisation of waste materials, which means the reuse, recycling, composting, processing, among other alternatives of these materials and thus reaching adequate levels of healthiness in the population. In this regard, Ochoa (2018) indicates that solid waste management must guarantee a healthy life in the present and a totally healthy environment for future subsistence. In addition, solid waste management helps to improve, ensure good habits and living standards will increase in the community; therefore, it is important to indicate that as time goes by, waste management systems become more tedious, especially when environmental policies force entities to have more sustainable options in order to reach the goals of recycling and decrease in solid waste entering treatment landfills (Espinoza et al., 2020).

Regarding the sustainable development variable, ECLAC (2020) states that the development of communities is related to the fulfilment of public policies and the achievement of goals with the participation of social actors. As sustainable development is a latent issue worldwide, it is managed from macroeconomic levels through international policies to ensure that economic growth can be sustained and be transparent, so there are institutions that finance the initiatives of governments that adapt to the innovative form of governance (European Commission, 2018); Likewise, the 2030 Agenda guides the achievement of the development of environmental, economic and social factors of the different countries that comprise it (Meza, 2017).

Likewise, Sapaico et al. (2021) refer to the havoc that the pandemic has wreaked, altering the deficiencies in the area of health, affecting the economic movement; in addition, its impact has also affected the care of the environment. For these reasons, the achievement of the Sustainable Development Goals (SDGs) by 2030 and 2050 has become a little slower. In this regard, Pérez (2019) suggests that human beings should act at the three levels of caring for other inhabitants of the territory in order to seek sustainability that will allow them to develop and grow as a species. According to Sandoval and Albuja (2020), it is necessary to give due importance to sustainable development in which strategies are applied that have a positive impact on the environment; and therefore, the community.

Finally, it is specified that this research was developed under the results-based management (RBM) approach since; through local sustainable development and solid waste management it can improve the quality of life of the population, achieve sustainable growth through good habits, overcome poverty and extend the life expectancy of the inhabitants of the Peruvian Amazon and the planet in general; all this taking into account that governmental operating costs are reduced in order to achieve the desired results for governmental and non-governmental entities (Flores and Delgado, 2020).

Material and Methods

The type of research was basic because it sought to increase knowledge about the study variables. In this regard, CONCYTEC (2018) indicates that it strengthens the current theories of the variables. The non-experimental design (Valderrama, 2010). It is used because the research subjects will not be subjected to an experimental procedure, with a quantitative approach because the results are presented in tables and statistical data (Ramos et al., 2018). The population consisted of 8000 thousand users and the sample of 1000 users from the Peruvian Amazon. According to Hernandez and Mendoza (2018), as a technique the survey was used, as an instrument was the questionnaire, which Hernandez and Mendoza (2018) indicate is an organized list of questions with a logical order, coherence and logic, as well as suggestions. answers and open answers. Each instrument had 20 items.

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The instruments were validated through expert judgement, who assessed consistency and relevance based on three criteria of the instruments: clarity, coherence and sufficiency with a Likert-type scale: 1=Always, 2=Almost always, 3=Sometimes, 4=Almost never, 5=Never. Cronbach's alpha was used for reliability.

Ethics was taken into account in this study based on several principles: Autonomy, each employee showed willingness to contribute to the research when participating in the questionnaire application. Beneficence, as a result of timely waste collection services, the research will contribute to managers and employees improving their skills in solid waste management. Non-maleficence, no problems were caused to any user who answered the research instruments.

Results and Discussion

Table 1. Level of Solid Waste Management in the Peruvian Amazon

Levels	Interval	N.°	Percentage
under	20 – 47	601	60,1 %
medium	48 – 73	395	39,5 %
high	74 – 100	04	0,4 %
Total		**1000**	**100 %**

Note: Questionnaire applied to the inhabitants of the Peruvian Amazon.

Solid waste management was found to be at a low level, according to 601 of the total number of respondents, which constitute 60.1%. 395 citizens surveyed indicated that it is at a medium level, which constitutes 39.5%. Only 4 respondents, constituting 0.4%, indicate that it is at a high level. The results, according to the perception of the users, clearly reveal that solid waste management is not a priority for local governments in the Peruvian Amazon due to budgetary and planning restrictions, lack of training of authorities, civil servants and other public servants, or simply because of their culture.

Table 1. Level of Sustainable Development in the Peruvian Amazon

Scale	Interval	frequency	Percentage
under	20 – 47	525	52,5 %
medium	48 – 73	475	47,5 %
high	74 – 100	00	0,0 %
Total		**1000**	**100 %**

Note: Questionnaire applied to the inhabitants of the Peruvian Amazon.

The table shows that sustainable development in the Peruvian Amazon was rated low, according to the opinion of 525 of the total number of respondents, which constitutes 52.5%. 475 citizens rated it as medium, or 47.5 per cent. It follows that the proposal for sustainable development is not supported for the full implementation of public policies that seek to promote and achieve these objectives in local governments.

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Table 3. Relationship Between the Dimensions of Solid Resource Management and Sustainable Development

Correlaciones								
			Permanent external conditions	Institutional status	Treatment of solid waste at source	Waste collection and transport	Final waste disposal	V2. Sustainable development
Spearman's Rho	Permanent external conditions	Correlation coefficient	1,000	,723**	,191**	,556**	,467**	,343**
		Sig. (bilateral)	.	,000	,000	,000	,000	,000
		N	1000	1000	1000	1000	1000	1000
	Institutional status	Correlation coefficient	,723**	1,000	,133**	,319**	,452**	,325**
		Sig. (bilateral)	,000	.	,000	,000	,000	,000
		N	1000	1000	1000	1000	1000	1000
	Treatment of solid waste at source	Correlation coefficient	,191**	,133**	1,000	,310**	,372**	,063*
		Sig. (bilateral)	,000	,000	.	,000	,000	,046
		N	1000	1000	1000	1000	1000	1000
	Waste collection and transport	Correlation coefficient	,556**	,319**	,310**	1,000	,119**	,226**
		Sig. (bilateral)	,000	,000	,000	.	,000	,000
		N	1000	1000	1000	1000	1000	1000
	Final waste disposal	Correlation coefficient	,467**	,452**	,372**	,119**	1,000	,239**
		Sig. (bilateral)	,000	,000	,000	,000	.	,000
		N	1000	1000	1000	1000	1000	1000
	V2. Sustainable development	Correlation coefficient	,343**	,325**	,063*	,226**	,239**	1,000
		Sig. (bilateral)	,000	,000	,046	,000	,000	.
		N	1000	1000	1000	1000	1000	1000

**. The correlation is significant at the 0.01 level (bilateral).

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*. The correlation is significant at the 0,05 (bilateral).

There is a low and significant positive correlation between the permanent external conditions dimension and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.343, with a significance of 0.000, which is < than 0.01; which leads to rejecting the Ho and accepting the Ha. Concluding that there is a significant relationship between permanent external conditions and sustainable development; that is, the dimension only has a variability of 34% with the sustainable development variable. There is a low and significant positive correlation between the institutional condition dimension and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.325, with a significance of 0.000, which is < 0.01; which leads to rejecting the Ho and accepting the Ha. This concludes that there is a significant relationship between institutional condition and sustainable development; that is, the dimension only has a variability of 32% with the sustainable development variable.

There is a very low positive correlation between the dimension of solid waste treatment at source and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.063, with a significance of 0.046, which is < than 0.05; which leads to rejecting the Ho and accepting the Ha. The conclusion is that there is a significant relationship between the dimension of solid waste treatment at source and sustainable development, i.e. the dimension has no variability with the variable sustainable development. There is a low and significant positive correlation between the dimension waste collection and transport and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.226, with a significance of 0.000, which is < than 0.01; which leads to rejecting the Ho and accepting the Ha. Concluding that there is a significant relationship between waste collection and transport and sustainable development; that is, the dimension only has a variability of 22% with the sustainable development variable. There is a low and significant positive correlation between the dimension waste collection and transport and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.239, with a significance of 0.000, which is < than 0.01; which leads to rejecting the Ho and accepting the Ha. Concluding that there is a significant relationship between final waste disposal and sustainable development; that is, the dimension only has a variability of 23% with the sustainable development variable.

Table 4. Relationship Between Solid Waste Management And Sustainable Development Variables

			V1. Solid waste management	V2. Sustainable development
Spearman's Rho	V1. Solid waste management	Correlation coefficient	1,000	,309**
		Sig. (bilateral)	.	,000
		N	1000	1000
	V2. Sustainable development	Correlation coefficient	,309**	1,000
		Sig. (bilateral)	,000	.
		N	1000	1000

**. The correlation is significant at the 0.01 level (bilateral).

There is a low and significant positive correlation between the variable solid waste management and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.309, with a significance of 0.000, which is < 0.01; which leads to rejecting the Ho and accepting the Ha. Concluding that there is a significant relationship between solid waste management and sustainable development; that is, it only has a variability of 30% between variables.

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Conclusions

There is a low and significant positive correlation between the variable solid waste management and sustainable development in the Peruvian Amazon, with a Spearman's Rho of 0.309 and a p-value of 0.000, which is less than 0.01; moreover, there is only a 30% variability between variables.

The level of solid waste management was found to be low with 60.1%, followed by medium with 39.5% and high with only 0.4%; in other words, solid waste management is not a priority for local governments in the Peruvian Amazon due to budgetary restrictions, planning restrictions, lack of training of authorities, civil servants and other public servants, or simply because of their culture.

The level of sustainable development is low with 52.5%, followed by medium 47.5%, i.e. the proposal for sustainable development is not supported for the full implementation of public policies that seek to promote and achieve these objectives in local governments.

There is a low and significant positive correlation between the dimensions permanent external conditions, institutional condition, waste treatment, collection - transport and final disposal of the solid waste management variable and the sustainable development variable with a Spearman's Rho coefficient of 0.342, 0.325, 0.063, 0.066, 0.239 and a p-value of 0.000, significance level of 0.001, which is < 0.001, which is < 0.001. 001, which is < than 0.01, leading to reject the Ho and accept the Ha, concluding that there is a significant relationship between the dimensions of solid waste management and sustainable development in the Peruvian Amazon.

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