



Importancia de la Autosustentabilidad Comunitaria en el Manejo de Desechos Sólidos Domiciliarios del Cantón Daule

Importance of Community Self-Sustainability in the Management of Household Solid Waste in the Daule Canton

Importância da Autosustentabilidade Comunitária na Gestão de Resíduos Sólidos Domésticos no Cantão de Daule

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Resumen

El objetivo de este artículo es analizar el manejo de residuos sólidos en el cantón Daule, para el desarrollo de estrategias de emprendimiento, entre la comunidad, el GAD municipal y la empresa privada, el tipo de investigación es mixta, para recolectar, analizar, e integrando una investigación cuantitativa y cualitativa, para lo cual se realizaron encuestas a la población de Daule, tomando una muestra de 510 personas, se establecieron seis factores de análisis: Determinantes Socioculturales o Disposicionales, Determinantes Afectivos, Determinantes Cognitivos, Sostenibilidad Ambiental, Sostenibilidad Económica y Desarrollo Comunitario, los resultados obtenidos afirman que para los encuestados es importante la autosostenibilidad permanente a partir del manejo de los residuos sólidos domiciliarios.

Palabras clave: Autosostenibilidad comunitaria; Gestión de residuos domésticos; Sostenibilidad del medio ambiente; Desarrollo comunitario.

Abstract

The objective of this article is to analyze the management of solid waste in the Daule canton, for the development of entrepreneurship strategies, between the community, the municipal GAD and the private company, the type of research is mixed, to collect, analyze, and integrating quantitative and qualitative research, for which surveys were carried out on the population of Daule, taking a sample of 510 people, six analysis factors were established: Sociocultural or Dispositional Determinants, Affective Determinants, Cognitive Determinants, Environmental Sustainability, Economic Sustainability and Community Development, the results obtained affirm that for the respondents, permanent self-sustainability through the management of household solid waste is important.

Keywords: Community self-sustainability; Domestic waste management; Environmental sustainability; Community development.

Resumo

O objetivo deste artigo é analisar a gestão de resíduos sólidos no cantão Daule, para o desenvolvimento de estratégias de empreendedorismo, entre a comunidade, o GAD municipal e a empresa privada, o tipo de pesquisa é misto, para recolher, analisar, e integrando pesquisas

quantitativas e qualitativas, para as quais foram realizados inquéritos à população de Daule, tomando uma amostra de 510 pessoas, foram estabelecidos seis factores de análise: Determinantes Socioculturais ou Disposicionais, Determinantes Afectivos, Determinantes Cognitivos, Sustentabilidade Ambiental, Sustentabilidade Económica e Desenvolvimento Comunitário, os resultados obtidos afirmam que para os inquiridos é importante a auto-sustentabilidade permanente através da gestão dos resíduos sólidos domésticos.

Palavras-chave: Autosustentabilidade comunitária; Gestão de resíduos domésticos; Sustentabilidade ambiental; Desenvolvimento comunitário.

Introduction

The generation of household solid waste in recent years has had a significant growth at a global level, generating 2,010 million tons of municipal solid waste (MSW) in the world, an amount that could fit in 822,000 Olympic swimming pools (Mena, M 2022). Thirty-three percent of them are not managed without environmental risk, hence by the year 2023 the rate rises to 2.5% reaching 2053 million tons and only 13.5% of this waste is recycled worldwide, data obtained from the year 2022. (PNUMA, 2021). In the 1970s, awareness of the seriousness of environmental degradation was expressed at the United Nations Conference in Stockholm in 1972, where the term sustainable development was coined (Vladimir Velázquez Álvarez & Vargas-Hernández, 2012). Of the countries with the highest generation of solid waste, China is in first place with 395 million tons/year, followed by the USA with 265 million tons/year, the latter being the largest creator of municipal solid waste per capita with an approximate 812 kg/year per inhabitant, i.e. 2 kg/day, this is similar to Denmark, Monaco, Mongolia, Moldova and Liechtenstein, making it an alarming problem, especially due to population and economic growth, which is estimated to increase up to 70% by 2050 according to World Bank figures. (Tecno Humanismo 2022). Given the alarming figures predicted in these years, it is analyzed that by 2050 there will be an increase from: 2.3 billion tons in 2023 to 3.8 billion tons in 2050 (ONU, 2024), it is recorded that in 2020 the direct cost of waste management amounted to 252 billion of dollars, without taking into account other costs that are not objectively calculated due to subjective factors and that include issues of unhealthiness, climate change and general pollution. (Mena, M 2022) generated by the lack of effective management of these wastes, the cost could rise to 361 billion dollars and could reach 640.3 billion dollars by 2050, if immediate control and reduction measures are not established for

the management of these wastes (ONU, 2024). Therefore, several countries have sought the implementation and increase by 14% of new recycling policies and programs that have favored in previous years, such is the case that by 2022, the recycling sector generated 11 million jobs worldwide, contributing significantly to the global economy (PNUMA, 2021). These figures are not enough to overshadow the effects of the great impact of these wastes, such as the contamination of primary resources essential for human life: air, water, soil, and in general the degradation of ecosystems and the negative contribution to the planet's climate change; all of which causes more resistant infectious and contagious diseases that affect the health of humanity and other living beings (World Bank 2022).

There are estimates that 46% of households separate this waste (Techno Humanism, 2022). The final disposal that households give to batteries that have reached the end of their useful life is to dispose of them with the rest of the common waste (81.6 %). (Arguello, J 2023). In view of this situation, there are several strategies implemented worldwide to motivate and raise awareness among the population, such as the plans and programs implemented by Switzerland in which citizens pay a fee for garbage disposal (Carvajal et al. 2022). Garbage is only collected if it has a payment stamp, but recycling is free, this and among so many strategies that according to the Environmental Protection Agency of the United States (EPA), in 2022 were generated, also in North America, about 292 million tons of solid waste. (Negash et al. 2021). Of this amount, 63% corresponded to municipal waste, 20% to industrial waste and 17% to hazardous waste.

The countries of North America are facing a growing population, hand in hand with an increase in waste generation, for which governments have implemented a variety of strategies, such as carbon reduction, strategic alliances with other countries to promote recycling microenterprises, redesign of cities to be more environmentally friendly, implementation of renewable energy, requirements established in the participation of private companies with the community, optimization of fuel in the automotive resource, recycling processes with the participation of the community, among others, in order to lower the level of environmental pollution. With partners around the world, the United States is moving forward in terms of climate solutions, countries such as Germany, Austria, Belgium and some low countries have applied to lower the rate of environmental pollution ("Integrated Household Waste Management for Territorial Development, (Bao et al. 2021). In North America, according to the U.S. Environmental Protection Agency (EPA), 292 million tons of solid waste was generated in 2022 (Arroyo, F 2018). Of this amount, 63% corresponded to

municipal waste, 20% to industrial waste and 17% to hazardous waste (Frioni & de los Santos, 1998). Faced with a growing population, waste generation has a proportional growth, so governments have implemented strategies, such as carbon reduction, strategic alliances with other countries to promote recycling micro-enterprises, redesign of cities to make them more environmentally friendly, implementation of renewable energy, requirements established in the participation of private companies with the community, optimization of fuel in the automotive resource, recycling processes, among others, to lower the level of environmental pollution. With partners around the world, the United States is moving forward on climate solutions (Alcocer et al. 2020).

The case of Latin America is different since climate change, sustainable fisheries, sustainable blue economies, marine protected areas, maritime safety, marine pollution, commitments with the governments of different countries for the culturalization of the community in the collection of solid waste, has been helpful to counteract pollution (Bao et al. 2021; Peña 2012). In Latin America and the Caribbean, the region generates about 540 million tons of solid waste per year, and this figure is expected to increase to 680 million tons by 2050. In 2022: 5.5% of waste was composted globally. (PNUMA, 2021), in 2023: an increase to 6% is projected, driven by the growing demand for organic fertilizers and the promotion of composting at the community level. (Palacios, 2017). In Ecuador, since 2010, INEC has begun its work of generating information for management, expenditure and investment in environmental protection through the GADs, through a census (Arguello, 2023), and according to data from the same institution refers that each Ecuadorian inhabitant produces 0.58 kg of solid waste in the urban area, average of years 2014 and 2015. (INEC, 2018), being around 12,897.98 tons only with a neighborhood of 88.7% in an area of 14,344.80 km during 2016 and only 37.1% of municipal governments, perform a process of separation at the source. (Tseng et al., 2021). The estimated generation of solid waste at the national level for the year 2022 was 13,981.06 tons/day, which in turn corresponds to 5,103,087.59 tons/year. (Rojas, 2014). Among the results of this research, it is evident that at the national level 62.8% of the 4.93 million Ecuadorian households reported sorting some type of waste (organic or inorganic), plastic is the material that is most mentioned plans and programs implemented by Switzerland, in which citizens pay a fee for garbage disposal. (Bao et al.2021).

In Ecuador, the treatment of household solid waste is key to community sustainability and the implementation of a circular economy, the strategy of implementing circular systems of municipal

waste management and recycling household waste influences household recycling, e-waste, source separation, life cycle assessment, sustainability, organic waste and circular economy becomes a post-consumption, a challenge in urban areas, but can contribute to the circular economy through organic recycling. (Martínez González & Fernández Álvarez, 2017).

Given the current situation of the high generation of solid household waste and the scarce management for its reuse or control, which has a negative impact on health and the environment, the circular economy can be an alternative applied to favor the reduction of this waste, being different from a traditional linear production model and rather refers to an economic system that allows closing loops, conserving resources by being a new relationship of the goods obtained, saving resources and generating jobs. (Hendriks, 2024). This need to consider new economic models is imperative due to the environmental degradation and volatility of the global economy, which currently many companies have applied in order to reduce the environmental footprint (Bittner et al., 2024), with only 8.6% of the estimated 100 billion tons of resources consumed globally per year returning to the economy (Agyapong et al., 2024). Environmental sustainability is an approach that seeks to balance economic and social development with environmental protection in order to meet present needs without compromising the ability of future generations to meet their own needs. It is a broad concept that includes various dimensions, such as biodiversity conservation, carbon footprint reduction, responsible management of natural resources, and promotion of sustainable production and consumption practices. (Vladimir Velázquez Álvarez & Vargas-Hernández, 2012)

One of the major problems that make the effects of climate change more harmful is undoubtedly the generation of solid waste not managed properly, this is the deliberate mixing of various types of waste (plastics, used edible oils, cardboard, organic, batteries, light bulbs, among others) which produces GHG and CO₂ gases into the atmosphere and especially the lack of knowledge and awareness in the inhabitants in relation to measures or strategies to be implemented to reduce the generation and reuse of waste by applying circular and sustainable economy techniques. A first step would be for each household to keep containers in their facilities to classify the waste generated and to establish municipal collection centers to store waste in a classified manner and manage it for reuse. This would contribute, for example, that oils are not poured into the effluents of each household but rather are delivered for final management and in exchange for this, each family can receive a representative income for each gallon collected correctly and delivered, which

will benefit and contribute to environmental care and the other waste already classified can be reused in the creation of new products that can be used at the urban and industrial level. For this reason, it is a priority to participate as a community and together with the GAD Parroquiales del Cantón Daule, in the sustainable development applied from the urban and rural scenario, constituted as an intrinsic factor between the construction of a community approach and relevant authorities, which in the end is repaid as an economic and social advantage to the cantonal municipality, through the formation of sustainable enterprises for the families of the canton Daule.

Methodology

Study area

The canton of Daule is located in the province of Guayas, in the southwestern part of the country. Daule dates from pre-Hispanic settlements through colonial times and independence. After independence, Daule expanded and several communities and towns were established. The inhabitants are mostly mestizos with traditions and customs unique to the canton.

The canton Daule is considered the rice capital, thanks to the fertility of their land which allows it to maintain a very active productivity is divided into six urban parishes and four rural parishes, has an area of 475 km and has approximately 173,684 inhabitants.

Methods for estimating pro-environmental behavior and self-sustainability

To determine the pro-environmental behavior of the inhabitants of the canton of Daule, socio-cultural, affective and cognitive determinants were analyzed; at the same time, for the analysis of self-sustainability, the factors of environmental sustainability, economic sustainability and community development were considered through a survey of the population of Daule, taking a random sample of 510 people.

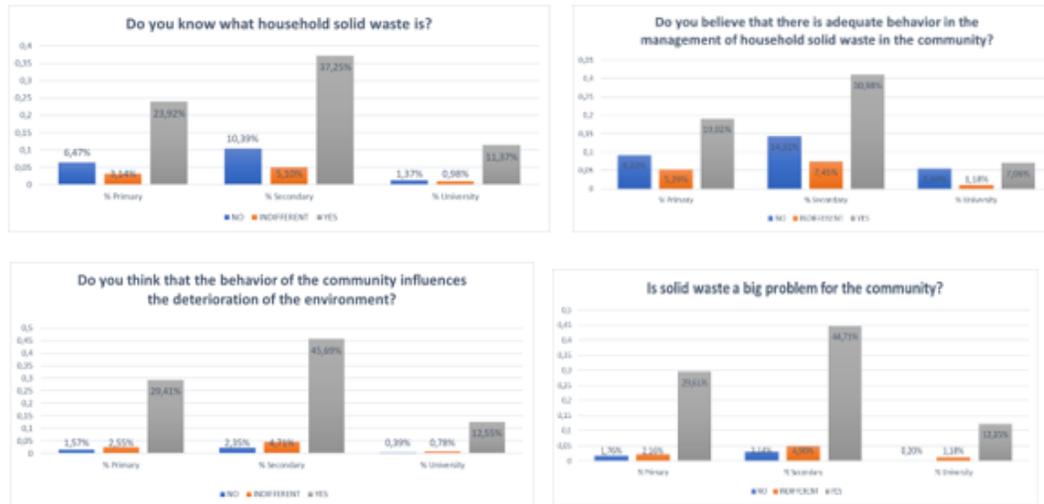
The Statistical Analysis of the survey is developed based on the questions for each of the determinants indicated above, as well as for each level of response and for a variable for each determinant, which is demonstrated through bar diagrams.

Results and Discussion

Results

The following is the analysis of the sociocultural determinants versus the qualitative variable: Type of Employment.

Figure 1: Sociocultural or Dispositional Determinants



Source: Own elaboration, with data obtained from the survey applied in Daule, 2024

According to the analysis of the data on the sociocultural determinants, 72.55% of those surveyed state that they have knowledge about household waste, while 18.24% do not know and for 9.22% it is indifferent; Furthermore, in this same aspect in figure 2, 57.06% state that they have adequate behavior in the management of household waste, but 29.02% and 13.92% are indifferent, 87.65% consider that the behavior of the community does influence the deterioration of the environment, likewise 85% point out that solid waste is a problem for the community.

Below is the analysis of the affective determinants versus the marital status variable:

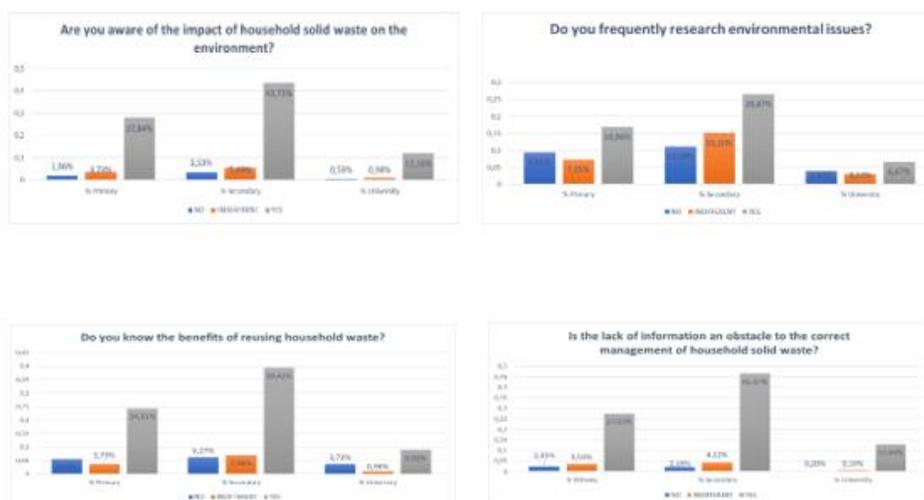
Figure 2: Affective Determinants



Source: Own elaboration, with data obtained from the survey applied in Daule, 2024

According to the analysis of the affective determinant, it is determined that 89.41% state that they are concerned about the generation of solid waste, as well as 87.45% consider that climate change is due to the same cause, likewise 80.98% state that there is a lack of significant actions to mitigate waste generation, 91.57% believe that it is important to improve environmental conditions. Below is the statistical analysis of the cognitive determinants versus the education level variable.

Figure 3: Cognitive Determinants

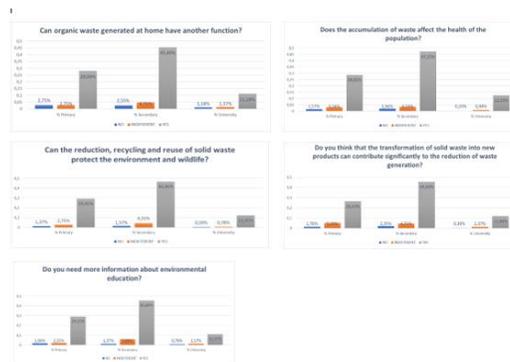


Source: Own elaboration, with data obtained from the survey applied in Daule, 2024

The level of education is a relevant factor to acquire the commitment to correct collection and treatment of solid waste. According to the analysis of cognitive determinants, 83.73% of respondents are aware of the negative impact of household solid waste on the environment. Likewise, 50% of those surveyed said that they are interested in environmental issues while the other 50% are not interested or are indifferent, while 72.75% say that they have knowledge about the benefits of reusing household waste., 87.06% of those surveyed stated that the lack of information is an obstacle to the correct management of household solid waste.

For the analysis of Environmental Sustainability, the variable number of Members of each household surveyed was taken with respect to the 5 questions that make up this group.

Figure 4: Environmental Sustainability

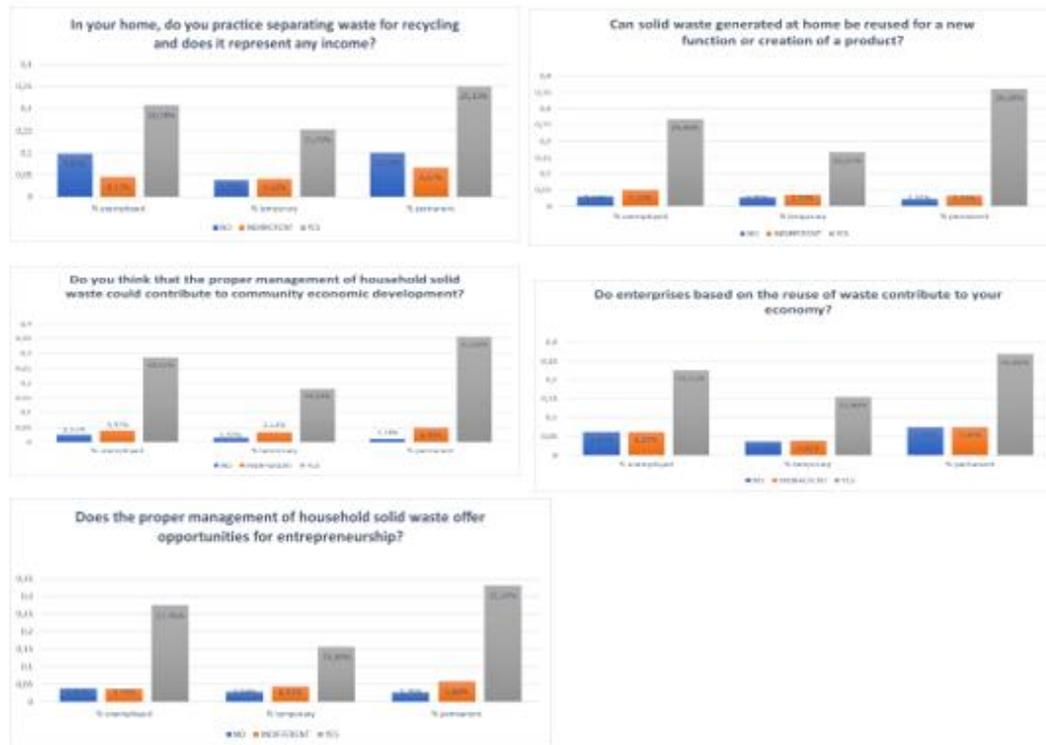


Source: Own elaboration, with data obtained from the survey applied in Daule, 2024

For the analysis of environmental sustainability, the correlation variable was taken, the level of education of the respondents, in order to identify the interest that each individual has in promoting some entrepreneurship with the recycling of household solid waste, regarding the questions that make up this group. Thus, 84.12% of those surveyed state that the organic waste generated in the home CAN have another function, while 15.29% state that it is not useful or they are indifferent to it, as well as 88.63% state that the accumulation of waste affects people's health, when asked about caring for the environment, 88.43% consider that the reduction, recycling and reuse of solid waste are favorable for the environment, 84.12% state that they DO believe that the transformation of solid waste into new products can contribute significantly to the reduction of waste generation while for 11.37% it is indifferent. Finally, 86.08% of those surveyed state that they need more information about environmental education.

For the analysis of Economic Sustainability, the salary variable was taken with respect to the questions that make up this group.

Figure 5: Economic Sustainability



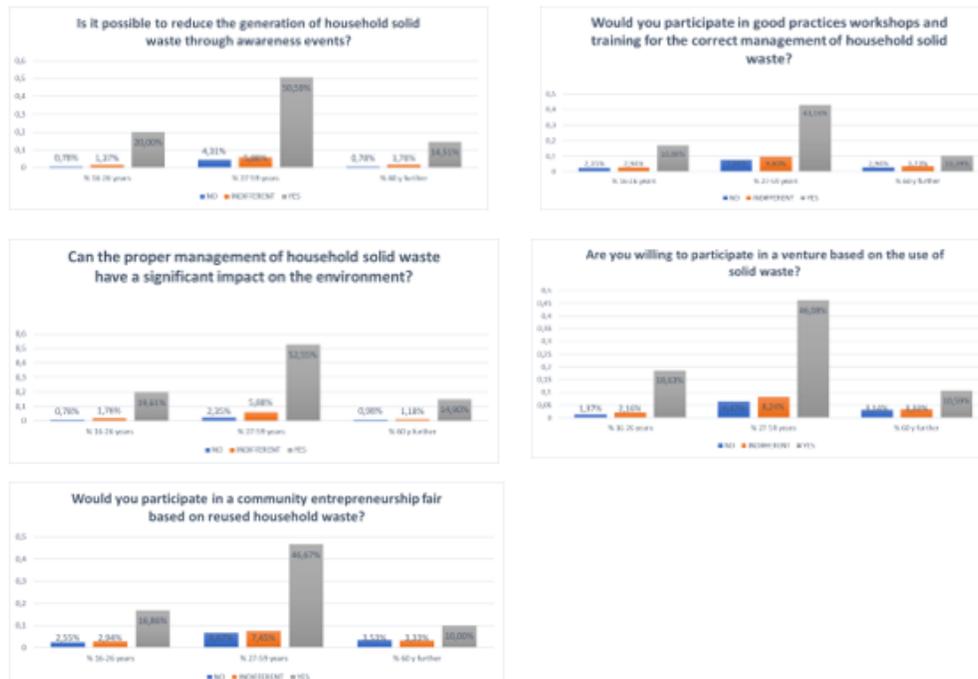
Source: Own elaboration, with data obtained from the survey applied in Daule, 2024

In this determinant, the economic sustainability variables were related to the type of employment of the study population, considering 3 ranges: inhabitants with permanent employment (41.76%), inhabitants with temporary employment (23.14%) and unemployed inhabitants (35.10%). In this way, 61.18% of the population does segregate waste for recycling, which represents an additional income, 23.53% do not do so and 15.29% are indifferent. Thus, 79.61% consider that the waste generated can be reused in some way, 8.24% do not consider it so and 12.16% do not know. The following deals with the opportunity to generate businesses based on community solid waste. In this case, 82.35% consider that their effective management can generate additional income, contributing to community economic development, unlike 5.29% who indicate no and 12.35% are indifferent. Likewise, 64.90% believe that these entrepreneurships will contribute favorably to their economy, 17.45% do not consider it that way and 17.65% express that they are not interested.

Finally, 76.27% are sure that this effective management of the waste generated will offer them opportunities for new ventures, 9.61% disagree and 14.12% are indifferent to the issue.

For the statistical analysis of Community Development, the age variable was taken into account.

Figure 6: Community Development



Source: Own elaboration, with data obtained from the survey applied in Daule, 2024

The following analysis is based on the community development presented by the population based on the age of the respondents to know the perception they have in relation to community waste management, considering that of the 510 respondents, the highest percentage in age range is those from 27 to 59 years old, being 60.78%, from 16 to 26 years old, 22.16% and over 60 years old, 17.06% of which it was found that 85.10% of those surveyed indicate that it is important to develop awareness events to reduce the generation of these wastes while 5.88% do not agree with the aforementioned and 9.02% do not have any opinion on the matter. Likewise, 70.39% would participate in workshops and training for optimal waste management, 13.14% would not participate and 16.47% do not fit into either of the two options. Another of the questions established was to know the opinion of the inhabitants regarding the impact generated on the environment by waste, with 87.06% answering that the impact is significant, 4.12% do not consider it that way and 8.82%

are indifferent. The last two questions of this determinant are focused on knowing the participation of the inhabitants in ventures based on the use of solid waste in its original state and once recycled, with 75% being highly willing to participate, 11% are not interested and 14% do not fit into either of the two alternatives.

Discussion

Environmental sustainability is an approach that seeks to balance economic and social development with environmental protection, in order to meet present needs without compromising the ability of future generations to meet their own needs. It is a broad concept that includes various dimensions, such as the conservation of biodiversity, the reduction of the carbon footprint, the responsible management of natural resources and the promotion of sustainable production and consumption practices. (Vladimir Velázquez Álvarez & Vargas-Hernández, 2012). Taking the baseline by the aforementioned authors and the analysis of the demographic variables of this research; the level of education and the number of members per household, as can be seen in figures 9 and 10 respectively, the inhabitants of the Daule canton are aware that there must be a change in the protection of the environment and that household solid waste is may have another functionality, this may be through the development of self-sustainability projects, the results will be positive regarding health, economic, social and environmental factors. The result of the analysis of the two variables responds to sustainability being a balanced approach with the economic, social and environmental development of the Daule canton, on par with what was mentioned in the baseline. In relation to the determinants of economic sustainability in this study, it is observed that the greatest acceptance with the answer “yes” of the determinant of economic sustainability and the employment condition had individuals with permanent jobs with 31%, those with temporary jobs with 16% and the unemployed with 25% and in relation to the answer “no”; both the permanent employees and the unemployed obtained 5% while the temporary employees only 3% with a total of 13% for this response and in relation to those who were indifferent the percentage was 13% (6% permanent employees, 4 % temporary employees and 5% unemployed). These results may occur because the various companies have been establishing environmental measures that reduce GHGs, favoring climate change, and employees, whether permanent or temporary, that become acculturated in solid waste management and at the time apply certain measures in their households, starting with their segregation, classifying them according to their type so that they can be managed

faster and better, contributing to additional income, a practice that is carried out in various parts of the world (Prakash, Gopi, & Ram, 2023). , unlike the unemployed who are not accustomed to this type of actions, which is why they do not get involved or start environmental ventures and are often unaware that solid waste management is essential to achieve sustainable development in the daily life of each individual, as expressed by some SDGs that are the means to achieve other more specific objectives for each community such as sustainable urban and community development, the reduction of climate change by preserving diverse ecosystems and promoting health and responsible production (Mujtaba, Munir, & Shahid , 2024).

Community solid waste generates a high environmental impact that causes damage to various resources or ecosystems, and according to (Amde, Alemayehu, & Embialle, 2024), the most significant are environmental deterioration with 34.2% and air pollution with 31.6% and even impact on health causing various diseases such as respiratory diseases with 49.5%, diarrheal diseases with 15.8%, protozoal diseases with 14.8%, asthmatic diseases with 18.2% and even a low percentage, but no less significant than 1.7% of cancer, which emerges the great need to manage them. By reducing, recycling or reusing them, it will not only cause environmental but also economic sustainability with the application of measures that contribute to or arise from the circular economy, generating community development throughout the world. However, various factors such as age often influence this; according to this study, 78% are in favor of waste management for better community development (being people who are in the age range of 27 to 59 years old with 48%, 18% are under 26 years old and 12% over 60 years old). Likewise, 9% are not aligned with community development through waste management and 13% are indifferent to the issue, which denotes the need to establish various community programs to further strengthen community development considering that 22% of the study population still does not participate in the prevention of environmental pollution in their communities, especially the youngest and the elderly, despite the fact that various studies have been able to demonstrate that there are various technologies for converting waste into energy resources, for agriculture, industry, raising the economic status of these communities and that could be applied in this country and cantons in general. (Hongbin, Haibo, & Mingsong, 2023).

Conclusions

The study carried out in the Daule canton is a sample of what happens in other localities, where the municipal GAD has the responsibility of managing the management of household solid waste that grows as the population grows, however, this is not enough. It is also the responsibility of the population to reduce, recycle, and reuse according to the circular economy.

According to the results obtained in the survey, it is observed that the proper management of household solid waste is a co-responsibility of the population, given that the population's pro-environmental attitude is influenced by sociocultural determinants such as knowledge about the proper management of solid waste; Affective determinants towards caring for the environment; there are also cognitive determinants such as the ability to perceive and solve environmental problems that the population must develop.

At the same time, the population surveyed was highly receptive to how important environmental sustainability is, as a means to a better quality of life. At the same time, they consider that it is possible to participate in the development of businesses as a means for the economic sustainability of households through the proper management of solid waste and that this would not only improve household income but also the economic development of the communities. The self-sustainability of the inhabitants is important as co-responsibility towards caring for the environment and quality of life.

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