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Municipal Solid Waste Management Course: A Case Study in Xaltianguis, Guerrero, México

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ABSTRACT

Municipal solid waste management becomes a problem when governmental authorities are little involved in solving the pollution that the generation of solid wastes causes. This situation turns more complex in marginalized communities. However, environmental education and training are two available tools to an efficient manage municipal solid waste. The aim of this research was to train the community to develop skills and abilities and to change attitudes for the efficient management of municipal solid waste in Xaltianguis. Interviews to key actors were conducted; workshops designed on efficient municipal solid waste management were piloted and implemented; and the intended learning outcomes of the first and the last workshop were assessed. Twenty-five participants integrated the object population. The implementation of this course was evaluated in a participative way. The final outcomes showed better knowledge, skills and attitudes related to municipal solid waste management; more participation in community activities and higher concerning among women in this issue. Besides, four community committees were created to work on future activities to solve the community's issues related to municipal solid waste generation and management.

Keywords: Municipal solid waste, waste management, waste disposal, community, course, environmental education.

INTRODUCTION

The generation and the pollution of municipal solid waste (MSW) is a problem that becomes more complex when the schemes of the Municipal Department of Sanitation Services (MDSS) lack of training and information to carry out the proper management of waste [1, 2, 3, 4]. This situation happens in urban cities as well as in far-from-urbanization locations [5, 6, 7] although in these last ones, the problem may be bigger for their technical and financial resources for efficient management are limited. That pollution and damage of natural resources were not the only problem, but also the impact on the population's health [8]. The situation gets worse due to the community's scarce participation and organization in municipal solid waste management (MSWM), as it has been pointed out by some authors [9, 10, 11].

In a study in 2017, it was reported that 23 open dumps (OD) have been found in the community of Xaltianguis, Guerrero [12]. This situation evidences the inefficient MSWM that prevails in the community, mainly due to the lack of municipal collection services and the insufficient population's management capacity, causing environmental, social and economic consequences [13].

Diverse authors state that the responsibility is not only of the governmental authorities but of the different actors involved as well; thus, collective not isolated efforts and resources are needed, giving priority to the emerging of training and environmental education [14, 15]; and also, the implementation of recycling [16, 17, 18] and making composting with organic waste [19] to reduce space pollution and its consequences.

Some authors [20, 21, 22] suggest that marginalized communities can undertake favorable actions such as implementing workshops to improve their MSWM and to train the population, in order for the community to get organized to achieve an efficient MSWM. This is why the aim of this course was to train the community to develop skills and abilities and change attitudes towards MSWM, by implementing a Community Participation on Municipal Solid Waste Management Course (CPMSWMC).

MATERIALS AND METHODS

Description of the study area

For its population density, with a resident population of 6, 965 inhabitants, Xaltianguis is considered an urban location by INEGI[1] [23], while in the Municipal Development Plan (Plan Municipal de Desarrollo) 2015-2018, as it is located in the rural area, it is described as a high-level-of-marginalization community [24]. Located northwest of the Municipality of Acapulco de Juárez, between the parallels 17°05'58" Latitude North and 099°42'51" Longitude West from the Prime Meridian, and at an altitude of 532 meters above sea level. It is subdivided in twelve zones called

[1]Instituto Nacional de Geografía y Estadística. The "National Institute of Statistics and Geography" (INEGI for its name in Spanish) is an autonomous agency of the Mexican Government dedicated to coordinate the National System of Statistical and Geographical Information of the country.

'colonias' (Figure 1) that are located at an approximate distance of forty kilometers of Acapulco, the seat of the Municipality [23].

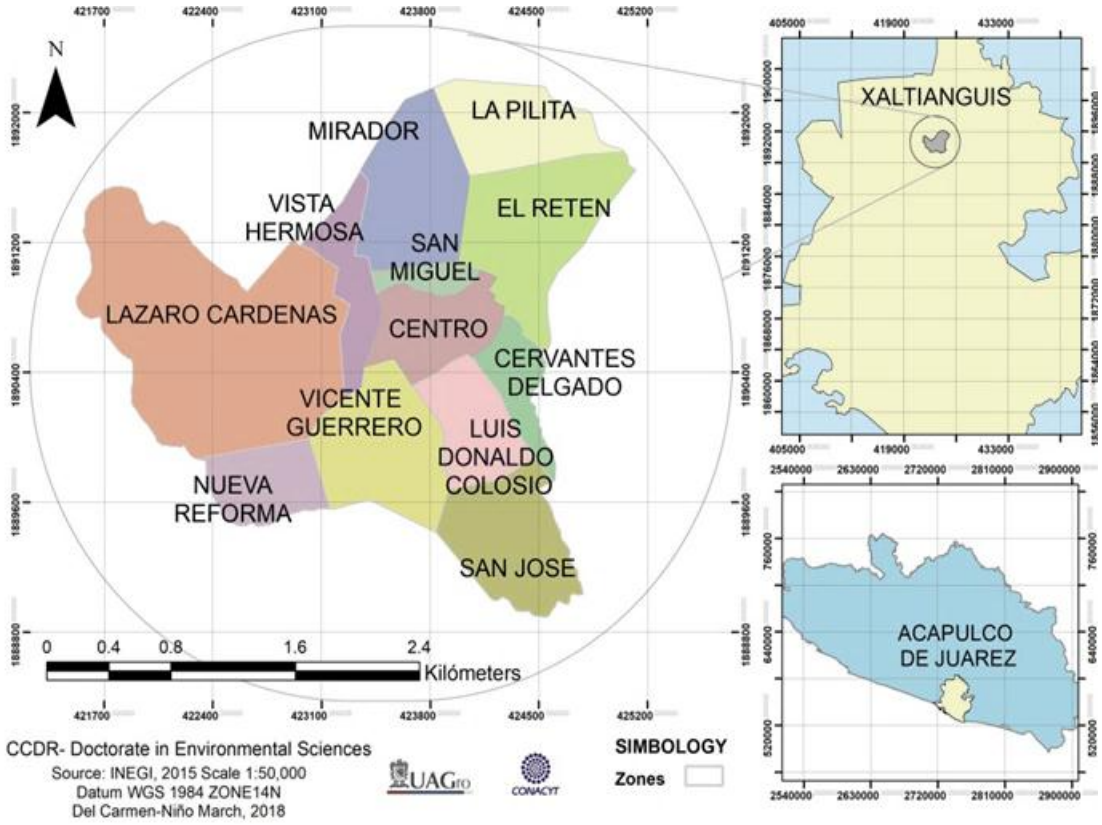

Figure 1. Xaltianguis, Municipality of Acapulco de Juárez, Guerrero

Methodology

-Before the application of the CPMSWMC, interviews, on how the community managed MSW, were conducted to key actors, such as the municipal commissioner and the *ejidal* commissioner[2], governmental authorities, representative members of the informal sector of waste collection and to the population, to get reliable information.

-The methodology of the CPMSWMC was designed (Figure 2) in order for the community to learn how to organize and develop a participatory program on MSWM.

[2] In the Mexican system of government, an *ejido* is an area of communal land used for agriculture, on which community members individually farm designated parcels and collectively maintain communal holdings.

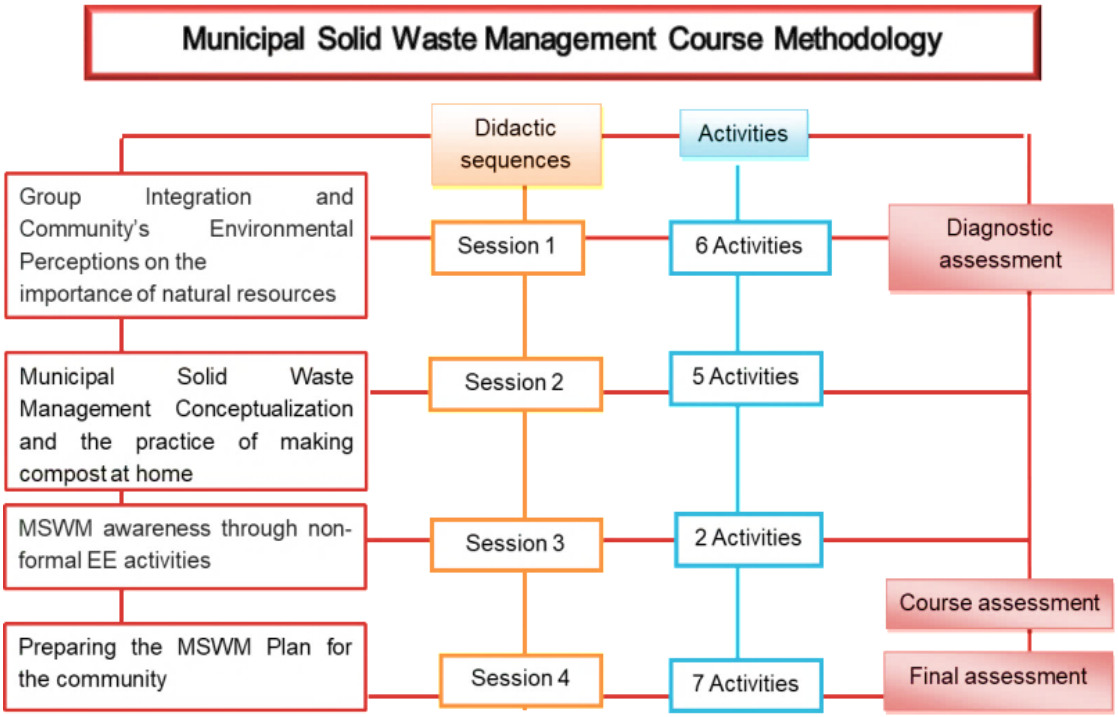

Figure 2. Municipal Solid Waste Management Course Methodology

-Didactic sequences were designed; one sequence for each one of the four course's five-hour sessions (Figure 2) [25, 26, 27]; that were implemented from May 20 to June 2, 2018, from 3:00 PM to 8:00 PM, which was the timetable set in a participative manner, to cover the twenty hours of in-class work. Among the twenty-five attendants were housewives, students, teachers, peasants, medical doctors, merchants, informal-sector-waste collectors, school-administrative personnel, people in general and, some members of the 2015-2018 City Town Hall in office who only attended the first session.

-Written questionnaires for the diagnostic and the final assessments were administered prior and after the course was implemented. Each one had 20 items that included: general data, knowledge, attitudes and skills on MSWM, with topics on integrating and building MSW concepts, awareness and formulating alternatives to solving Xaltianguis' MSWM [28, 29].

-Regarding the assessment of the CPMSWMC, four aspects were considered: the cntents' ease, activities' appropriateness, course's organization and broadly participation [30]. It was administered in a participative way, in the end of the course.

Later, to process and analyze the data, simple frequencies were calculated to measure the studied variables by using the Statistical Package for the Social Sciences (SPSS), version 18.

RESULTS AND DISCUSSION

The outcomes of the interviews showed that the formal collection of the MSW in Xaltianguis is made by the MDSS, once a week, using a 7-tonne- side-loading truck with a driver and two helpers. This service is available for six zones *(colonias)*. However, when the truck needs to be taken to the garage or during holidays, this service stops for as long as two or three weeks in a row, eliciting the people's annoyance and the inadequate disposition of the waste.

There is also an informal collection service that is provided through four private pick-up trucks; three of them provide this service to the population, and only one to the merchants in the market. Even though the service runs two or three times on a daily base, it is still not enough for it covers only eight zones, leaving out four without any coverage. This kind of informal collection services were already appointed by Aleluia y Ferrão [7], in marginalized places in Asian developing countries. In 2014, Sampedro-Rosas *et al.,* [31] noted the lack of public services and infrastructure in the City of Acapulco, Guerrero, but also its population's lack of environmental education to manage solid waste. Bertanza, *et al.,* [29] stated that an efficient collection is that one that serves a larger number of people at a low cost and avoids the proliferation of ODs that generate leachates, noxious fauna, odors and pollution.

Participants' general data

In this study, 60 percentage of the participants were female, similar to what was reported by Rojas *et al.,* [20] when referring that 85.2 percentage of females had participated in their research, which according to these authors is due to the fact that it is women, the ones who are in charge of domestic activities, and therefore, they are the ones who are most interested in topics related to hygiene at home.

Within an 18-70 range of age, 48 percentage said to have attended basic education, 24 percentage high school, 16 percentage college or university studies, one with master studies (four percentage) and the rest (eight percentage) said to have not attended school at all. Regarding the marital status, 56 percentage were married and about the place of residence, 92 percentage said they have been living in Xaltianguis for more than ten years.

Knowledge, attitudes, skills on waste management (commonly referred as garbage)

On session 1, the participants admitted that solid waste and its inefficient management were the problem that caused environmental pollution and that besides being a negative visual aspect because many people threw waste on the streets or ravines or burnt it, although some others hired the services of private pick-up trucks (informal collection) to collect their waste. At the time, they did not realize that waste collected by informal refuse collectors was not a solution, because waste ended at a clandestine OD anyhow, because there are no controlled ODs in Xaltianguis.

Regarding the environment's negative effects, the participants identified odors,

noxious fauna, air pollution from burning as it was noted by Palermo *et al.,* [32] who also include among these, the lack of the population's involvement in the analyzing of the problems related to MSWM.

At the beginning of the course, most of the participants (84 percentage) identified garbage as a polluter. They also mentioned the damage garbage causes to health, mainly because of the proliferation of infectious disease vectors, the inhalation of greenhouse gases emitted by the intentional burning of waste and odors. In the end of the course, all the participants agreed that the main problem is waste (Figure 3), besides they also reflected that this problem and pollution get worse due to the fact that the population lacks of knowledge on the issue. About this scenario, in a study of perception, Borroto *et al.,* [28] showed that 70.7 percentage and 79.4 percentage of the population of two Cuban communities described the environmental problems of their environment, as it happened in this study, which indicates that the population has the capacity to identify environmental problems. And respect to the MSW, Palanca-Tan [33] showed that the citizens of Manila, Philippines, were deeply concerned with solid waste, as 92 percentage of respondents of his survey identified MSW as one of the main environmental problems, in town.

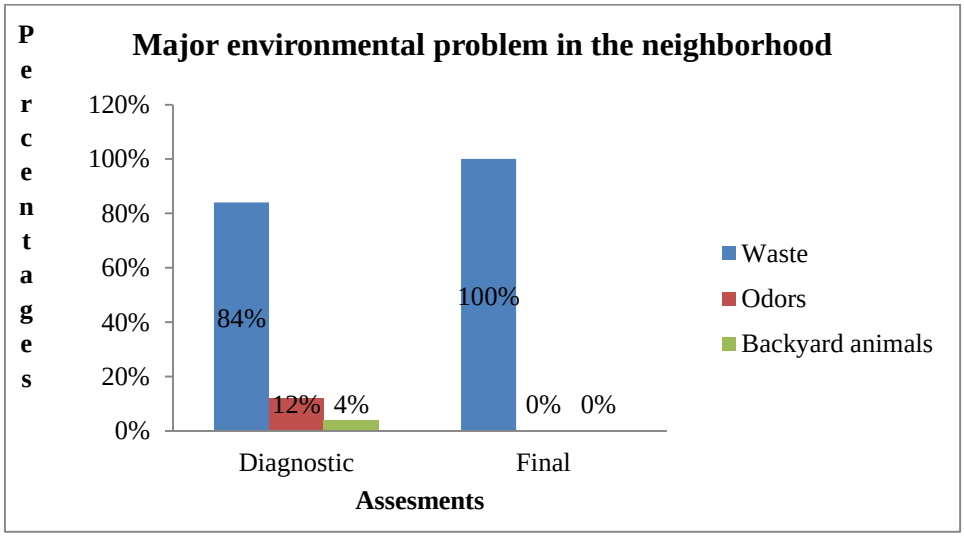

Figure 3. Major environmental problem in the neighborhood

In the diagnostic assessment, when asked who the main responsible of the MSWM was, 32 percentage of the participants answered that municipal and local authorities were the ones; also 32 percentage said that they were all responsible; while in the summative evaluation, the highest percentage was for the 'It is everybody's responsibility' answer that was given by 64% of the participants (Figure 4). These outcomes coincided with the study conducted by Abarca *et al.,*[14] which indicated that, without environmental education or training on MSWM, the population holds the municipality responsible, therefore, society needs to be included in the decision-making process in a participatory manner, in order to achieve an appropriate operation of the MSWM.

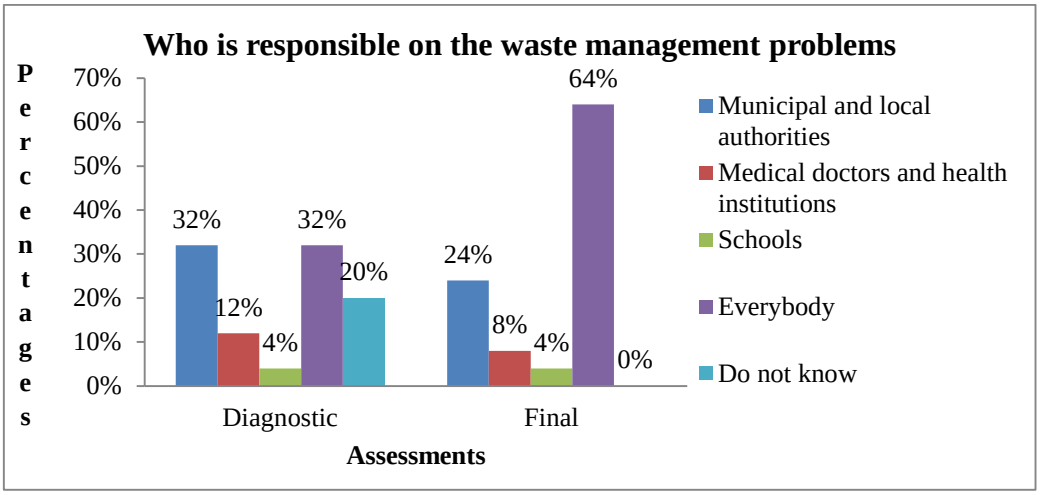

Figure 4. Participants' perceptions on who is responsible of the waste management problems

On session 2, the object population attributed the greatest generation of MSW to business and market merchants, but in the end of the course they realized that it is at household level because there are more homes than businesses. They also realized that every day, as the population grows and more disposable products are incorporated in daily life, there are more MSW. According to Chamizo *et al.,* [4] there are other factors that influence the generation of waste, such as: the total members of the family and the household's economic level. They also add that courses should be given in the community's schools and health institutions because waste and its management is an unknown issue (Figure 5). It is in this sense that Couto and Hernández [1] assure that education and knowledge on waste management can help reduce the generation, recover and reuse MSW by getting government, producers, generators and community involved.

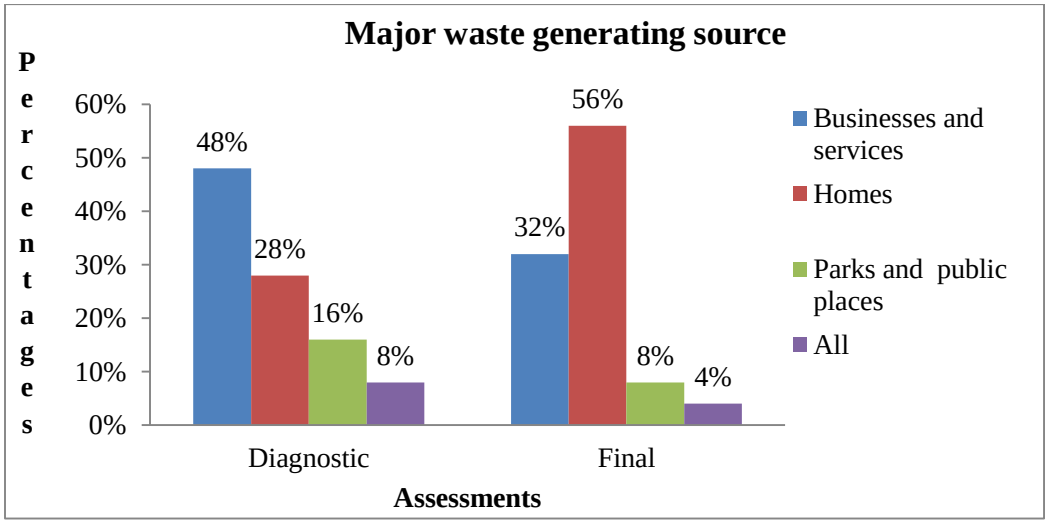

Figure 5. Major waste generating source

About waste management, they achieved knowledge and skills to be able to separate waste (Figure 6) and how temporary storage, composting and collection centers for recyclable materials are related in this process. Some of them said they separated food waste to feed their backyard animals and to make compost. Some authors, like Armitaño *et al.,* [19] and Aleluia and Ferrão[7], maintain that it is feasible to develop these activities in rural communities with similar conditions as those of Xaltianguis.

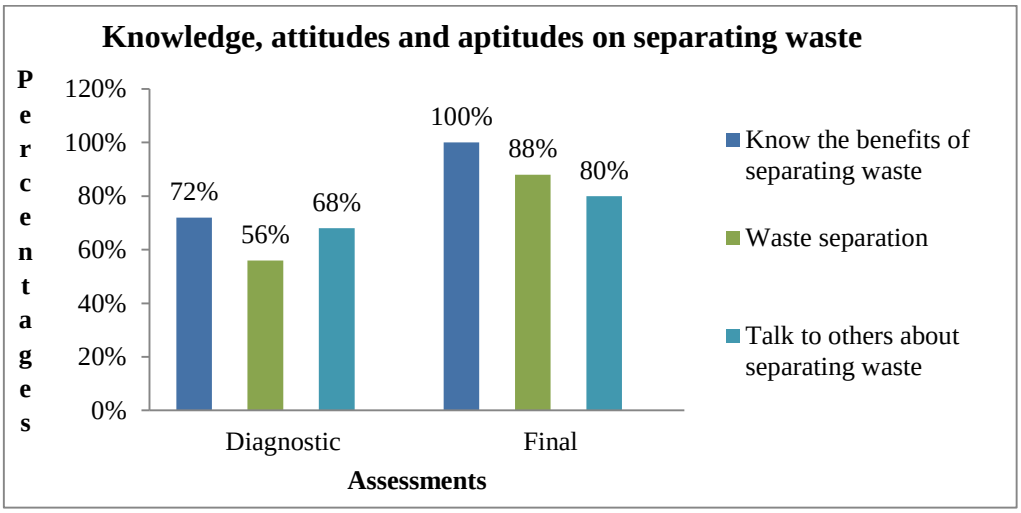

Figure 6. Knowledge, attitudes and skills on separating waste

Most of the participants recognized that women, while being in charge of the household management, are the main actors who separate waste but all family members should participate in separating waste, as well as the community and the governmental authorities, considering the inefficiency of these last in the process of waste management. They also identified recycling inorganic waste as an employment source for scavengers and agreed that an efficient management contributes to conserve natural resources, as some authors have suggested in the their studies [17, 6, 18].

Social participation and participation in the management of solid waste

On session 3**,** the people's participation in church activities, soccer games and school work was discussed, but comparing with the difficulty of getting everyone to collaborate, due to the different conflicts in the community. However, the participants emphasized that it is usually young people and women who participate in the different activities of the community. Regarding the participation in the MSWM, they claimed that the beneficiaries of the *Prospera* program[3] collaborate in the cleaning of the streets because they have to, otherwise they would not get the *Prospera* bonus. And they also referred that the low mobilization of other members of the community

[3] *Prospera* is a government social assistance program in Mexico founded in 2002, based on a previous program called Progresa, created in 1997.

derives from the lack of this kind of courses, resources and materials that should be implemented to motivate the participation of the population. Concerning this, Kanchanabhandhu and Woraphong [10] point out the need to implement training and Environmental Education, as it is an important tool to provide knowledge in order to promote awareness and behavior changes, in search of collective participation towards waste managenmt. This is the reason why in this study, the participation of the target population was analyzed by comparing the outcomes of the diagnostic and final assessments, and it showed the participant's interest in participating in the waste management process had increased significantly, by the end of the course (Figure 7).

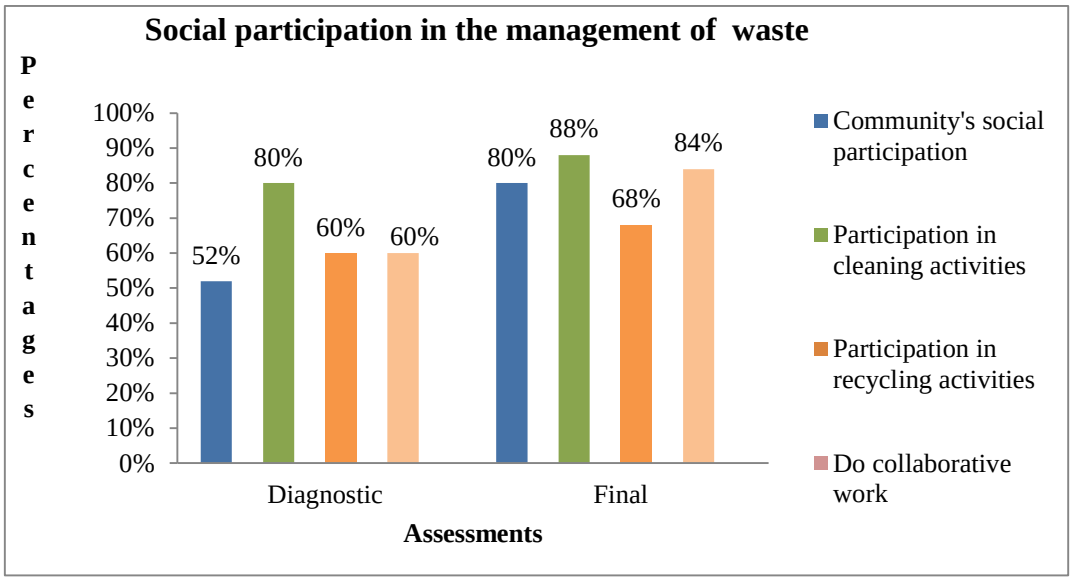

Figure 7. Participation

Among the proposals to keep the streets clean, they mentioned: campaigns supported by schools, to call meetings to organize neighbors and subscribe agreements among them, integrate committees, encourage everyone to participate or punish those who do not. Moreover, they empathized that those who did not sweep the front area of their house should pay a fine, as it is stated in the *Bando de Policía y Buen Gobierno* (Enforcement and Good Governance Law) of the Municipality of Acapulco.

On the fourth and last session, the participants decided and prioritized [34] four problems related to an inefficient MSWM of the community: deficient collection service, inadequate separation, intentional open burning of waste and OPDs**.** They also established four committees in order to structure the following projects: Improvement of the collection service, Separation and use of organic waste at home to make compost, Reduction of intentional open burning of waste, Collection of inorganic recyclable waste, Reduction of ODs, Preparation and validation of MSWM regulations in Xaltianguis. Each committee signed an agreement on how it might be organized, formed by a president, vice-president, secretary, treasurer and members.

Course's general assessment

This assessment was done in the end of the fourth session. The object population said that the activities were effective. Some of them were first time participants in community's activities and also in the MSWM field. They appreciated the course for the knowledge and socialization. They agreed to share what they had achieved. The course's assessment (Figure 8) was done in a participative way. Participants explained the reasons of their scoring of the aspects to be assessed individually and in front of their peers. Some of the recommendations they made were that the course should be promoted more and that the community's authorities had to be invited. They were informed that local authorities, community's representatives, school and health directors had been invited, but no explanation on why they would not attend the course or at least an apology had been received from any of them, unfortunately.

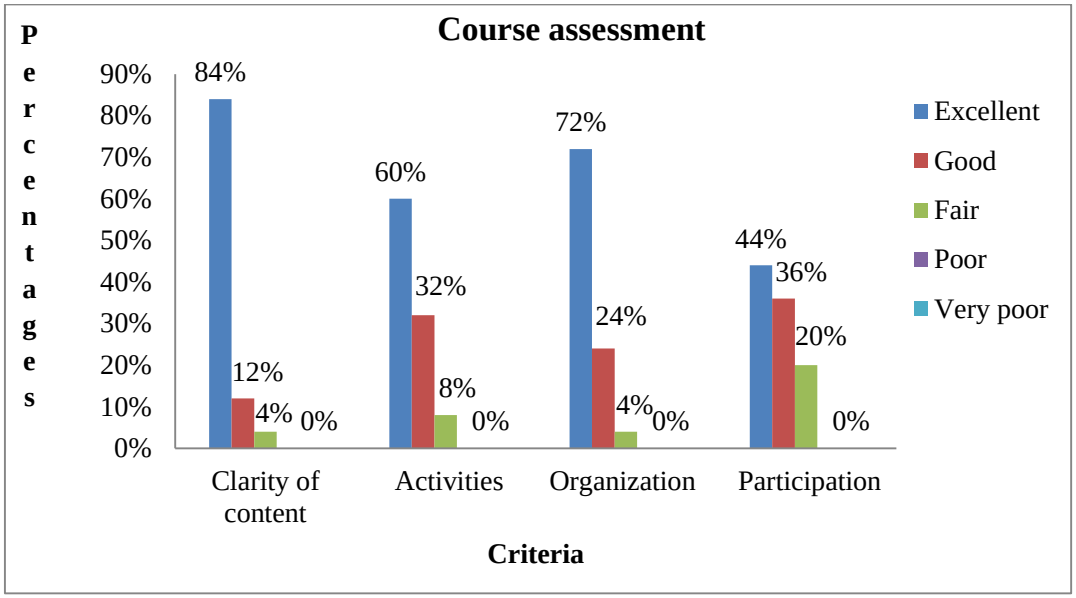

Figure 8. Course assessment

CONCLUSIONS

This research shows that MSWM is a complex topic, with multiple operative, environmental, social, cultural, legal, institutional and economic aspects that should be taken into consideration to make the system work. The work done confirmed that if the population is involved in the diagnose, training process and environmental education for MSWM, not only the waste management problems of the town would be identified, but also their possible causes and solutions. This way, the population would be able to contribute with valuable ideas that the municipal or local authorities and community organizations could use to design actions focused on MSWM.

It is important to emphasize that the financial support of the government and the municipal leaders' interest are essential for MSWM**,** but the participation of the users

and the proper administration of the funds are equally essential in this matter, and the latter can only be achieved with training work and environmental education that can be implemented amongst different types of population, but even better in those with unfavorable conditions particularly when it comes to accessing to public services

The collected information about the interrelated factors and the way to reach this information is useful for the topic of MSWM that is to be developed by the counterparts for the planning of MSWM programs for marginalized localities and municipalities. In addition to this, waste management planning requires from the municipal authorities, formal and informal workers and from the general population for the development of projects. Training and abilities development are needed at all levels. The community must understand the importance of waste management, the effects of inefficient management on the environment and public health, and the role and responsibilities of each individual in managing waste. There might be responsible citizens who would consider waste as a source of opportunities and income.

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