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Health evaluation by water consumption characterized by the index of quality environmental

Evaluación de la salud por consumo de agua caracterizada por el índice de calidad ambiental

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ABSTRACT

The research evaluated the effects of water on the health of the population of Jamancajirca through the Environmental Quality Index (ICA). The methodology applied was, correlational, descriptive, longitudinal design. The s ample consisted ofphysicochemical and microbiological parameters at three points: catchment, reservoir and home pool, during rainy and dry seasons, in addition to surveys and morbidity data. The results indicated deficiencies in the drinking water system, with parameter values outside the limits established by the General Directorate of Environmental Health. The ICA classified the water as unsuitable for human consumption (level V), associated with diarrheal diseases such as dysentery, gastroenteritis, infectious colitis.

Keywords: *Water consumption, diarrheal disease, physicochemical, microbiological, health.*

RESUMEN

La investigación evaluó los efectos del agua en la salud de la población de Jamancajirca a través del índice de Calidad Ambiental (ICA). La metodología aplicada fue, corelacional, descriptiva, de diseño longitudinal. Se muestrearon parámetros fisicoqupimicos y microbiológicos en tres puntos: captación, reservorio y sumidero domiciliario, durante épocas de lluvia y sequía, además de encuestas y datos de morbilidad. Los resultados indicaron deficiencias en el sistema de agua potable, con valores de los parámetros fuera de los límites establecidos por la Dirección General de Salud Ambiental. El ICA clasificó el agua como no apta para el consumo humano (nivel V), asociada a enfermedades diarreicas como la disentería, gastroenteritis, colitis infecciosa.

Palabras clave: Consumo de agua, enfermedad diarreica, fisicoquímica, microbiología, salud.

INTRODUCTION

Water is a vital and important resource for human beings, which allows us to satisfy our needs. needs you may have. However, he has long been employed by inappropriately in daily life, generating alterations in its physicochemical quality due todifferent activities anthropogenic, as waters residual domestic, waters industrial,mining effluents, due to chemical substances from agricultural products, among others(Anantha *et to the.* , 2021); where by lack of the water healthy and the insufficient depuration, expose to the population to the intake of water contaminated with pathogens as the AND. coli , causingdiseases gastrointestinal, cramps, pain abdominal, vomiting, etc (Mohan and Lyons , 2022), of which it is estimated that 842,000 people die annually due to unhealthiness of the water resource, poor sanitation and lack of cleanliness when washing hands hands with contaminated water in places where access to drinking water is difficult (Organization World of the Health [WHO], 2022).

The town of Jamancajirca is not immune to this problem; because it has a system of catering of water built in 1993 low he project of the Background of Cooperation forSocial Development (FONCODES), administered by the Administrative Board of Services ofAcovichay Sanitation (JASS Acovichay), where the main problem lies in theage of its structures (completed useful life) and limited maintenance that it has received over the years until today, which led to the development of deficiencies important in their processes of treatment and removal of pollutants, giving as result, he supply of water of very low quality; with high quantities ofsediments, presence of color and flavor in different cases, arriving in those conditions to 700families, of of which 108 are from the town of Jamancajirca .

Therefore, it is essential to know the state of the water resource, in order to manage it correctly. sustainable and equitable manner (United Nations United Nations [UN], 2021), and prevent he impairment of the health of the people to cause of diseases related. For to achieve this purpose, it is intended to use the environmental quality index as an input important to evaluate the occurrence of diseases due to water consumption, as a practical and suitable method, which allows analyzing elements that influence the quality of the water resource and its suitability for various purposes, acting as a means to communicate and express his state. Is say, synthesize information in a worth numeric simple and logical, facilitating his comprehension for the population and authorities in the take of decisions(Marin et. al, 2018).

In consequence, the present investigation had the purpose of assess the effects to the healthmost likely due to water consumption in the town of Jamancajirca, through the Environmental Quality Index, where the objectives were set: (a) carry out the diagnosis of the system of water potable, (b) determine the concentrations of parameters physicochemical and microbiological, (c) calculate the values of the Index of Quality Environmental, (d) determine the effects toward the health that can cause he consumption of water and (and) proposea design to improve the drinking water system. For the diagnosis, field visits and review of related local government documentation; the parameters of assessment were analyzed in he Laboratory of Quality Environmental (LCA) of the University National Santiago Antunez of Mayolo (UNASAM), to exception of the parameter chlorine that was carried out in the field with a chlorine comparator with DPD; for the calculation of ICA applied the weighted arithmetic index, which is a methodology used by Marín et. al (2018) and for health effects the morbidity report issued by the Microgrid Palmira (MP, 2023) during the period 2017 until April from 2023.

The results indicated deficiencies in he system of water potable, with parameters out ofthe limits established by DIGESA, where the ICA classified the water as not suitable for consumption human (level V), associated to diseases diarrheal as the dysentery, gastroenteritis, colitis infectious, between others. Finally, HE concluded that he water supplied is not safe for human consumption and that leads to negative effects on the health, by what i know proposed engineering measures to your solution.

METHODOLOGY MATERIALS AND METHODS

The locality of Jamancajirca HE locate in Peru, in he district of Independence, province ofHuaraz of the department of Ancash; The water supply system is located there.and the population that consumes it, where both will be objects of analysis for the present investigation. The methodology employee was of guy applied, correlational and descriptive, of non-experimental and longitudinal design, where in general, information was obtained relevant through water analysis in the LCA (2022) and a survey, with 4 dimensions (D1: to demonstrate water use, D2: to diagnose the supply system, D3: to verify the quality of water provided and D4: to

evidence contracted diseases by consumption of water) of 27 questions and answers: "Always" with a worth of 2, "TO times" with a worth of 1 and "Never" with worth 0. Bliss survey HE performed to 51 users of 108, thewhich ranged from 22 to 50 years of age, with the largest number being women. surveyed, with a reliability of 95% and a margin of error of 10%. Next, itwill explain of shape succinct, the sequence followed for each proposed objective.

Diagnosis of the system of catering of water

This objective was achieved through field visits in the company of the operator of thewater; where the coordinates, photographs and measurements (cell phone and 50-inch winch) were taken meters) to obtain data on the dimensions of system components, which after the carrying out calculations, were processed with the AUTOCAD software for the proposal of measures correctives. Besides, HE complements with data obtained of the survey and information obtained from an evaluation report of the system studied, issued by the District Municipality of Independence (MDI, 2019).

Parameters physicochemical and microbiological

This objective included the sampling of evaluation parameters (Chlorides, temperature, color, conductivity, hardness total, pH, solids dissolved totals, sulfates, turbidity, coliforms totals and thermotolerant) in 3 points: catchment, reservoir and sink domiciliary;in time of rain (March and April) and low water (May and June). For it which, HE continued he protocolmonitoring of RD 160-2015-DIGESA (DIGESA, 2015), where bottles of 250 mL amber sterilized glass for microbiological parameters and packaging plastics of 1 l of ability for the parameters physicochemicals; that then were labeledand conditioned in a cooler at 4 °C, to be transferred and analyzed in the laboratory, according to APHA and other related methods (see table 1). However, the chlorine analysis It was carried out in situ, using a chlorine comparator with DPD. Furthermore, it was complemented with data obtained of the survey. For finish, HE process the information with he programMicrosoft Excel for obtain tables and graphics, that then were analyzed and interpreted.

Table 1. Points sampling.

Place of Sampling	Coordinates UTM		No. of samples by spot		
	x	AND	Bacteriological(250 ml)	Physical (1000ml)	Chemical (1000ml)
Catchment	224593.6	8949200	4	4	4
Reservoir	224189.6	8948880	4	-	-
Home	222568	8948314	4	4	4

Index of quality environmental (ICA)

For he calculation of the ICA, HE used the method of the index Arithmetic Weighted employee by Marin et. al (2018), which consisted of assigning a weight (wi) to each parameter (Chlorides, color, conductivity, hardness total, pH, solids dissolved totals, sulfates, turbidity, total and thermotolerant coliforms) according to their importance in relation to the quality of the water, with values ranging from 1 to 4, from least to most relevant respectively. Then we continue with the calculation of the relative weight (RW), where the sum of all the R.W. they must arrive to the unit (see equation 1 and board 2). HE precise that the temperature No wasconsidered in the calculation of the ICA, because in DS N° 031-2010-SA (DIGESA, 2011), not consider as a parameter assessment.

$$RW = [Wi / (\sum^{n}_{i=1} Wi)] \ldots\ldots (1)$$

Where:

- R.W. = relative weight
- Wi = weight of each parameter
- n = number of parameters

Table 2. Weight relative by each parameter evaluation.

Parameters	Units	Required limitby the norm (Yeah)	Weight Assigning (wi)	Weight Relative R.W.
Chlorides	mg/L	250.00	1.00	0.044
Color	UCV ScalePt/Co	15.00	2.00	0.089
Conductivity	µ mho /cm	1500.00	2.50	0.111
Hardness Total	mg/l CaCO3	500.00	1.00	0.044
pH	Unit pH	6.5 – 8.5	2.00	0.089
Total solidsdissolved	mg/L	1000.00	1.00	0.044
Sulfates	mg/l SO4	250.00	1.00	0.044
Turbidity	UNT	5.00	4.00	0.178
ColiformsTotals	CFU/ml	1.80	4.00	0.178
Coliforms Thermotolerant	CFU/ml	1.80	4.00	0.178
			22.50	1,000

The procedure continues with the calculation of the quality rating scale (Qi) for each parameter, except pH (see equation 3); dividing the concentration of each one of them with the respective limit value, multiplied by 100; said value that comes established by any standard with which you wish to compare and use, which in the case our was he DS No. 031-2010-SA (See equation 2).

Q = [Ci / Si] * 100 ..... (2)

$Q\ pH$ = [Ci – Vi / Si- Vi] x 100 ... (3)

Where:

- Qi = quality assessment
- Ci = concentration of the parameter
- Yeah = worth limit either standard of the regulations used
- I saw = Worth suitable, for pH score of 7.0

t is specified that if Qi = 0, it indicates that there is no contamination; while if Qi = 100 it signals that the concentration of the parameter is equal to his limit permitted. AND Yeah the values of the Qi they goin increase, indicate that the water resource is more contaminated.

Sli, of each parameter is found (see equation 4) and the The sum of these would give us the final value of the ICA (see equation 5), which is classified as 5 levels, that goes from excellent to No suitable for human consumption (see board 3).

SIi = RW*Qi .... (4)

ICA = $\sum^{n}_{i=1}$ SIi .... (5)

Table 3. Classification of the quality of the water according to he ICA.

Value of ICA	Class	Quality of the water
<50	Yo	Excellent
50-100	II	Good
100-200	III	Poor
200-300	IV	Very poor
>300	V	No fit for human consumption

Note: Obtained by Ramakrishnaiah et. al (2009).

The achievement of this objective was complemented with information obtained from the survey; where all was processed with he software Microsoft Excel, for then beanalyzed and interpreted.

Effects to health by consumption of water

HE executed to through of the survey and to through of the information obtained of the M.P. (2023) withmorbidity data from 2019 to April 2023, which is the health center where the Jamancajirca

population meets their needs. The information obtained was processed through the software Microsoft Excel, for then be analyzed and interpreted.

Design of improvement of the system of supply of water

The fulfillment of this objective was achieved through Ministerial Resolution 192- 2018-HOUSING (MVCS, 2018), to design the grate chamber and filter bed; and calculate the frequency and amount of the chlorination process. Likewise, the method was used de Melo and Herrera (2016) for the preparation of a flocculator and the procedure Frisancho (2018) for the conformation of a settler. For he prosecution HE use he AUTOCAD software and in others, only calculations for dimensioning with illustrations that represent them.

RESULTS

Diagnosis of the system of catering of water

As part of the on-site visits, it was obtained that the water supply system is receiving processes of cleaning general each 15 days, the filters to the 6 months and the chlorination a time by week. Besides, waters above of the catchment, exists a fish farm and effluent of domestic wastewater discharged into the Casca River (the system is supplied from this river) without treatment previous.

Also, relevant limitations were identified in components of the water system, such as: the lack of a grate chamber in the catchment, an inadequate landfill for the sand trap, the lack of a flocculator and settler, an inappropriate filter bed and deteriorated, inadequate chlorination; and limited maintenance processes in each system process. In addition, from the survey, the residents stated: that within the system HE find some deficiency (37.25%), that HE needs of some process of maintenance or replacement of system components (62.75%), that the relationship exists direct between the quality of water supplied and he state of the system of water (62.75%), and thatHE comes trying to shape inadequate the water provided (96.08%).

Similarly, according to the MDI (2019), the water system under study clearly needs The construction of new structures is urgent, due to the deterioration it presents and the culmination of its useful life, which exceeds the 20 years of the design period according to what established in the Ministerial Resolution No. 192-2018-HOUSING.

Parameters physicochemical and microbiological

From the survey, 94.12% of the population indicated that the water they consume sometimes has presented an odor, color or taste; and regarding the results obtained in the laboratory, the evaluation parameters were compared with DS N° 031-2010-SA, as sample to continuation (support yourself with board 2, values limits required by the rule).

Parameters physical

The parameters of color and turbidity exceeded the boundaries of the rule, with levels elevatedin May, at the study address with 87.8 UCV Pt/Co scale in the color parameter and 95 UNT of turbidity. The rest of parameters not were surpassed (see board 4).

Table 4. Analysis physical of the water consumed in the locality of Jamancajirca.

Place of sampling	month of sampling	Parameters physical				
		Color (UCV scale	Temperature(°C)	Conductivity(µ mho /cm)	SDT (mg L^{-1})	Turbidity(UNT)
Catchment	March	18.0	11.02	31.7	46	13.35
	April	9.8	17.60	28.8	7	10.99
	May	24.9	14.60	32.5	41	20.90
	June	21.0	16.30	38.3	21	24.60
Home	March	4.6	14.52	27.6	51	44.35
	April	9.5	17.70	28.2	10	10.50
	May	87.8	14.90	29.0	34	95.00
	June	22.4	16.80	38.2	7	23.25

Note: to adapted with information of the LCA (2022).

Parameters chemicals

No parameter exceeded the regulations related current (see board 5).

Table 5. Analysis chemical of the water consumed in the town of Jamancajirca.

Place of sampling	month of sampling	Parameters chemicals			
		pH (Und.pH)	Total Hardness (mg CaCO3 L^{-1})	Chlorides (mg CL - L^{-1})	Sulfates (mg SO4= L^{-1})
Catchment	March	7.24	8.0	3.0	12.1
	April	7.05	0.9	2.0	12.4
	May	7.34	7.0	6.0	12.9
	June	7.02	2.0	5.0	13.8
Home	March	7.14	0.9	4.0	11.3
	April	6.89	0.9	3.0	12.2
	May	7.38	0.9	16	13.1
	June	7.13	5.0	4.0	13.7

Note: to adapted with information of the LCA (2022).

Likewise, the residual chlorine concentrations at all sampling points, were minimal or none, just as it is sample to continuation (see table 6):

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Table 6. Results of the assessment of chlorine residual.

Place of Sampling	Months of sampling	Concentration of Chlorine residual
Reservoir	March to June	0
Sink Home	March to June	0

Parameters microbiological

Thermotolerant and total coliforms exceeded the limit required by the standard in all the sampling points during all months, highlighting the month of June with 2760 CFU/100mL in the capture and 660 CFU/100mL in he home of study (see table 7).

Table 7. Microbiological analysis of the water consumed in the town by Jamancajirca.

Place of sampling	month of sampling	Parameters microbiological	
		Coliforms thermotolerant(CFU/ mL)	Coliforms Totals (CFU/ mL)
Catchment	March	15	145
	April	15	90
	May	280	660
	June	145	2760
Reservoir	March	25	55
	April	55	145
	May	55	145
	June	660	1440
Home	March	55	145
	April	55	90
	May	145	280
	June	660	1440

Note: *to* adapted with information of the LCA (2022).

Index of quality environmental (ICA)

From the survey, 100% of the sample population stated that the water they consume is not is of quality. By other side, regard of the calculation of the ICA, in all the months showed, that hewater supplied to the study population is class V, considered unsuitable for consumption human, with an average value of 7951. (see table 3 and 8).

Table 8. Results of the ICA by every month of sampling.

Month of sampling	ICA
March	1522
April	1511
May	5312
June	23457
Average	**7951**

Effects to health by water consumption

Of the survey, HE got that the population does use of the resource water in diverseactivities, as: prepare food (86.27%), toilet staff (94.12%), cleaning of the home (96.08%), washing clothes (88.24%), irrigation (82.35%) and drinking for animals (76.47%). Besides, they manifested that exists a relationship of causality between he consumption of water contaminated and its effects, where 45.10% indicated the probable relationship and the other 54.90% therelationship direct; in addition, he 100% gave their opinion that No they had of water that guarantee your health.Of the same questionnaire, it turned out that the diseases of elderly recurrence in the populationwere the diseases diarrhea (78.43%).

In shape equivalent, chord to the report of the M.P. (2023), HE revealed that, the diseases ofelderly recurrence in the population were the gastroenteritis and colitis of origin infectious, with208 cases in 2017, 166 cases in 2018, 177 cases in 2020, 67 cases in he year 2021 and 334 cases in he year 2022; to difference of the year 2019 that were originated byintestinal infections with 50 cases and in 2023 with 84 cases, having greater incidence in people younger than 4 years and older to 30 years (see table 9).

Table 9. Report of morbidity of the 2017 to April from 2023.

Diseases	Amount of cases by year						
	2017	2018	2019	2020	2021	2022	2023
Poisoning food bacterial	0	0	6	21	5	21	7
Gardiasis (Lambliasis)	0	0	12	10	8	11	10
Infection intestinal viral	11	0	0	8	21	10	0
Dysentery amoebic acute	7	0	0	8	7	8	0
Gastroenteritis and colitis	5	0	0	5	63	5	1
Amebiasis	4	0	0	4	0	5	2
Others infections intestinal	4	4	0	4	0	4	0
Poisoning food staphylococcal	5	3	0	0	0	3	0
Intestinal disease due toprotozoans	0	3	0	0	0	3	0
Infection due to Escherichia ColiEnterohemorrhagic	0	2	0	0	0	2	0
Enteritis due to salmonella	0	1	0	0	0	1	0
Others poisonings food due tobacteria	0	1	4	0	0	1	1
Fever paratyphoid	0	0	0	0	1	0	0
Other gastroenteritis and colitis of origininfectious	208	166	30	177	67	334	53
Infections intestinal due to othersorganisms	156	153	50	0	0	222	113
Infection intestinal bacterial	0	59	0	36	0	66	0
Total of cases for year	400	392	102	273	172	696	187

Note: to adapted with information of the M.P. (2023).

Design of improvement of the system of supply of water

As part of this item, HE developed criteria technicians for the implementation of:

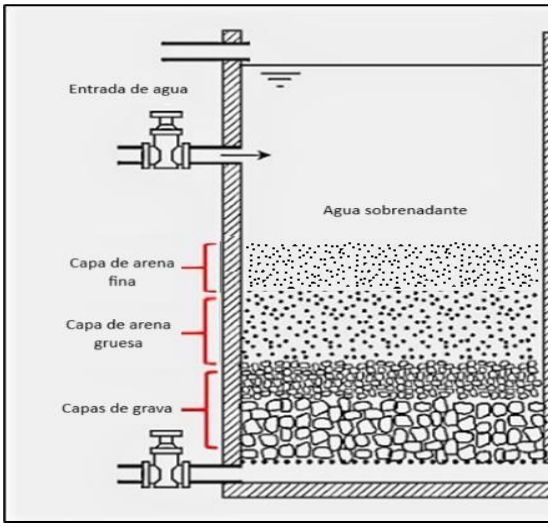
- Camera of bars in the catchment: HE they proposed bars fine metallic guy barring fixedwith diversion channel, with separation between bars of 2 to 4 cm, with a structureof concrete with a minimum f'c =210 kg/cm ^{2}. Likewise, a gate must be included, for regulate the entry of water during processes of maintenance.
- Filter bed: a filter composed of layers of gravel, coarse sand and fine sand, made up of compact and circular grains of sand, free of matterorganic and clay with a composition minor to the 2% of CaCO3 and Mg (see figure 1).

Table 10. Composition ideal of the litter filter.

Layers	No. of layers	Thickness	Size (D)
Layers gravel	2	0.10 - 0.15 m	10 - 40mm
		0.05m	2 - 9mm
Layer of coarse sand	1	0.05m	4 - 15mm
Layer of fine sand	1	0.8	1.5 - 4mm

Note: The table indicates the recommended composition for a filter bed, adapted from MVCS (2018).

Figure 1. Illustration of the litter filter appropriate for he system water.



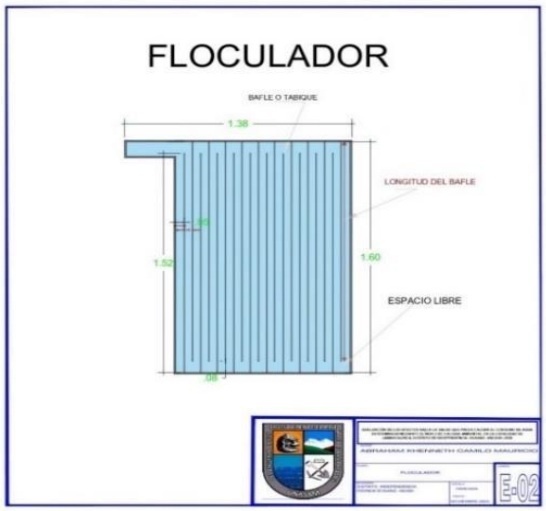
Note. The figure sample the ideal composition of a litter filter, adapted from Bruni and Spuhler (2018).

Of shape parallel, to through of calculations, HE generated prototypes of a settler andflocculator, both of horizontal flow, just as it is sample to continuation:

Table 11. Parameters of design calculated for he settler of flow horizontal.

Parameters design	Symbol	Amount	Unit of extent
Broad of the settler	b	3.50	m
Length total of settler	l	13.21	m
Length of the area sedimentation	L2	13.01	m
Distance between curtain and the wall of entrance	L1	0.80	m
Height	h	1.50	m
Height maximum (hopper of sludge)	H1	2.15	m
Earring	Yes	5.00	%

Figure 2. Prototype of flocculator.



Similarly, through calculations, the amount and frequency of chlorination were determined. suitable, showing that HE has that carry chlorine each 3 days with 2.9 kg and has to drip 138.9 mL per minute. Complementary to all of the above, the strengthening of capabilities to their administrators, he supply prompt of materials and teams necessary, for the operation and maintenance of the system; and monitoring continuous.

DISCUSSION

The physical results of the sampling indicate that the levels of conductivity and solids Dissolved totals were within the limits established by DIGESA (2011). Without However, color and turbidity levels exceeded these limits, especially during May, with 87.8 UCV in color and 95 UNT in turbidity in a home studied, coinciding with the rainy season where these parameters tend to increase. Theseresults agree with the perception of the population local, where he 94.12% reported odor, color or taste problems in the water. Furthermore, discrepancies were observed in the levels of turbidity and color between the entrance and exit from system, indicating possible deficiencies such as an inadequate baghouse, lack of flocculator and settler, and limited system maintenance, which could contribute to recontamination of the water during the whole process.

Chemical analyzes show that the levels of pH, total hardness, chlorides and sulfates are they kept within the limits required by DIGESA (2011).

The analyzes of microbiological parameters reveal that the concentration of coliforms thermotolerant and total temperatures exceeded the limits required by DIGESA (2011), in all months, highlighting June with 2760 CFU/100mL in the collection and 660 CFU/100mL in the study address; which indicates that temperature conditions are occurring conducive to its proliferation (15.3 °C of the average temperature obtained), since according to Rahayu (2020), he range optimum of growth is of 14°C to 45°C. In that sense,Previous research by Atencio (2018), Duarte and Mendoza (2018), Esquivel and Murga (2019), Vicuna (2019), Vidal and Carreno (2018), and Uriburu (2018) support these findings, indicating that he water No is fit for consumption human due to the presence of coliformsabove legal limits. Furthermore, discrepancies were identified in the levels of coliforms between different points of sampling, as: lows concentrations in the catchment, that were increasing in the reservoir up to the home pool, possibly due to cleaning problems in components of the supply system that contributed to the recontamination of the water; either concentrations similar in he reservoir and the sink, associatedto inadequate chlorination processes, confirmed by measurements of residual chlorine

(with concentrations tiny or null) and, corroborated by Duarte and Mendoza (2018).

He ICA showed values of 1522 (March), 1511 (April), 5312 (May) and 23457 (June); suggesting that the water supplied to the town of Jamancajirca is not appropriate for human consumption (level V); situation supported by Adimalla and Qian (2019), and Uriburu (2018), who they tried that the presence of a ICA high represents a low quality ofwater. These results, in turn, are consistent with the survey carried out among the population. of Jamancajirca, where he 100% stated that he water that they consume is of quality.

The survey made in Jamancajirca evidence that the population uses he water supplied by JASS Acovichay for various activities such as: preparing food (86.27%), toilet staff (94.12%), cleaning of the home (96.08%), washing of clothes (88.24%), irrigation (82.35%) and animal drink (76.47%); which have resulted in the manifestation of diseases diarrheal with he 78.43% of occurrences. This find HE align with he reportof PM morbidity (2023), where colitis of infectious origin is the most common disease common, with the highest number of cases in 2022 (334 reported), with highest incidence in minors of 4 years and older to 30 years. This incidence, is consistent with Adimalla and Qian(2019), who demonstrated that the you drink and children present elderly risk that the peopleolder, in a proportion of 1.75 and 1.15 times respectively; and according to Zhang et al. (2020), he risk in the children is 2.18 times and 1.71 times elderly that he of men and women. These results support the perception widespread between the respondents of Jamancajirca, where he 100% No consider that he water supplied guarantee his health; where to his time, a45.10% indicate a probable relationship and 54.90% a direct relationship, between the consumption of water contaminated and health problems. In that sense, according to the theoretical framework investigated, it is understood that the aforementioned diseases, although they can be contracted for various reasons, the common cause is the consumption of contaminated water, which suggests a connection between he consumption of water contaminated and the manifestation of diseases in the study population. On the other hand, the results obtained suggest that there is a directly proportional relationship between the occurrence of diseases due to consumption of water and a High ICA.

Important deficiencies were identified in the water system under study, such as lack of key elements, absent processes, and limited maintenance of its components,which led to the supply of water with inadequate and harmful characteristics. These results coincide with the perception of the local population, where 37.25% indicated the existence of some deficiency, he 62.75% the need of some process of maintenance or replacement, 62.75% the direct relationship between the quality of water supplied and the stateof the system, and 96.08% that inadequate treatment is carried out on the water provided. In view of In this situation, it is proposed: implement a chamber of bars (to prevent and reduce the entry of solids of great size), carry out he maintenance continuous of the gritter (cleaning of sludge and concrete landfill construction), the construction of a settler and flocculator, and filter redesign (to reduce solids concentration); finally, improve he system of chlorination (for eliminate coliforms). Are actions are supportedby studies of Alvarez and Chavez (2019), and Gonzales (2019), that stand out the importance of a treatment conventional, with processes that include the chlorination, coagulation, flocculation, filtration and disinfection. All it former has to go accompanied of processes of strengthening the capabilities of system operators, the supply of materials and teams necessary for his operation and maintenance; So as processes of monitoring forguarantee the quality of the water resource supplied. Furthermore, it is recommended that, through of some mechanism, the study population is trained in the management of water resources to level home, it, until that HE have implemented the actions relevant for a proper functioning of the water system. These proposals can be financed and run to through of the government local, through activities of maintenance, IOARRs I projects investment.

In last instance, HE recommends to futures researchers, influence in the effects economic causes caused by a contaminated water resource, mainly in the effects of high sediment concentrations; because during the investigation process, it was noted that many people they had

issues in relationship to the obstruction and failures in bathrooms, showers, washing machines, pipes water, systems drain, between others.

CONCLUSIONS

Based on the findings, it can be concluded that the water system that supplies the population of Jamancajirca, has been supplying a water resource of very low quality (level V), not suitable for human consumption (average AQI of 7951), resulting in effects negative to the health of its users, through various gastrointestinal diseases. Are incidents are attributable to shortcomings significant in several components of thesystem, so relevant structural and non-structural measures were proposed toaddress them. These actions can be financed and executed through maintenance, IOARRs I projects of investment to post of the Municipality District ofIndependence. In that sense, the present investigation, underlines the importance of ensure a safe and reliable water supply, in order to protect public health and improve the quality of life in the community. Besides, HE stands out he worth of the Index of QualityEnvironmental as an effective tool to communicate the status of the water resource, manner simple and understandable, that will involve a suitable take of decisions by part of the local authorities and the general population.

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