CONTROL AND MONITORING OF HUMAN CONSUMPTION WATER IN RURAL ZONES. CASE STUDY SAN ISIDRO AREA- CÓMBITA, BOYACÁ- COLOMBIA.

STHEFANY QUIROGA CABALLERO - JUAN PABLO VANEGAS VILLAMIZAR

Eng. MSc Diana Carolina Ospina Mora

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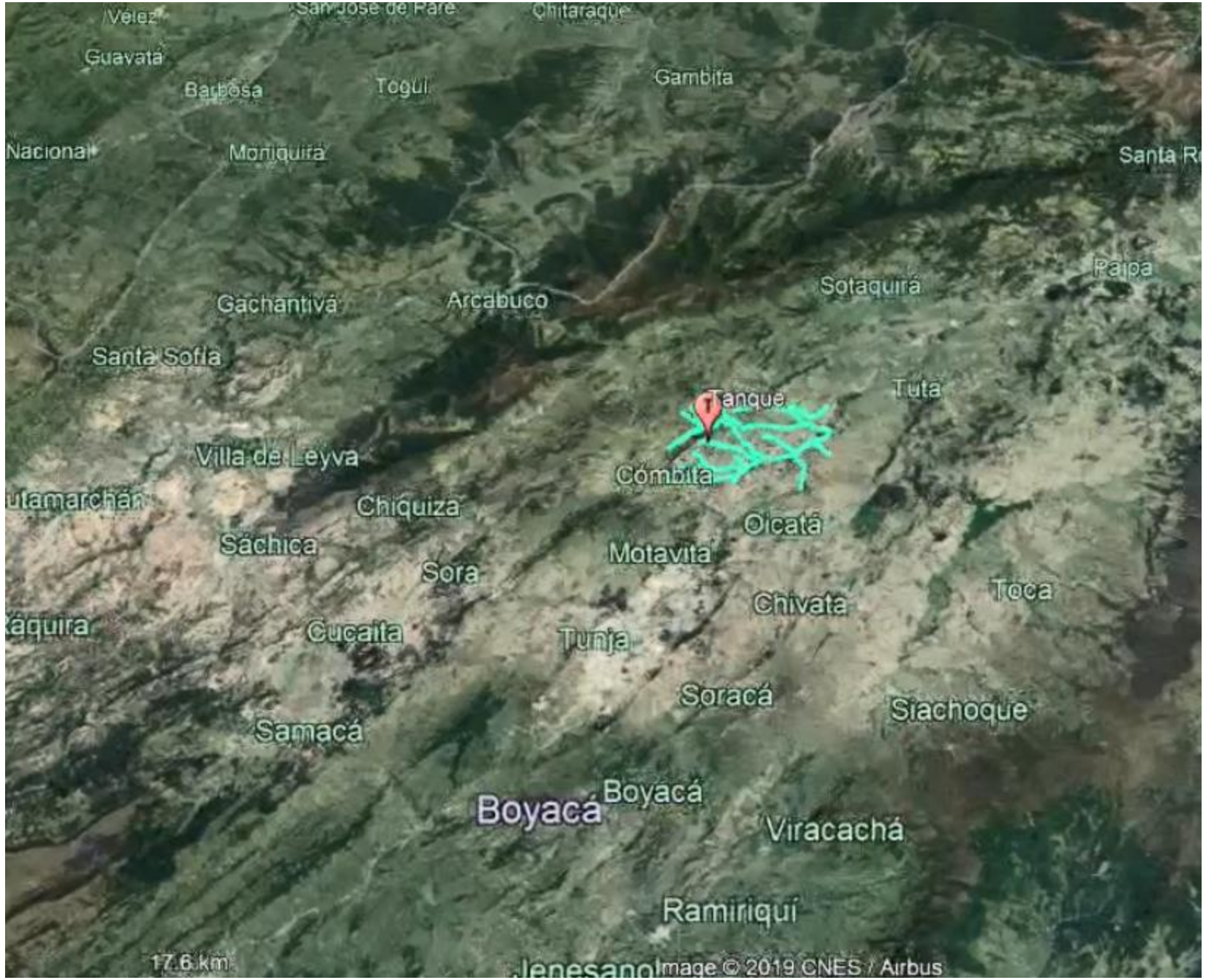
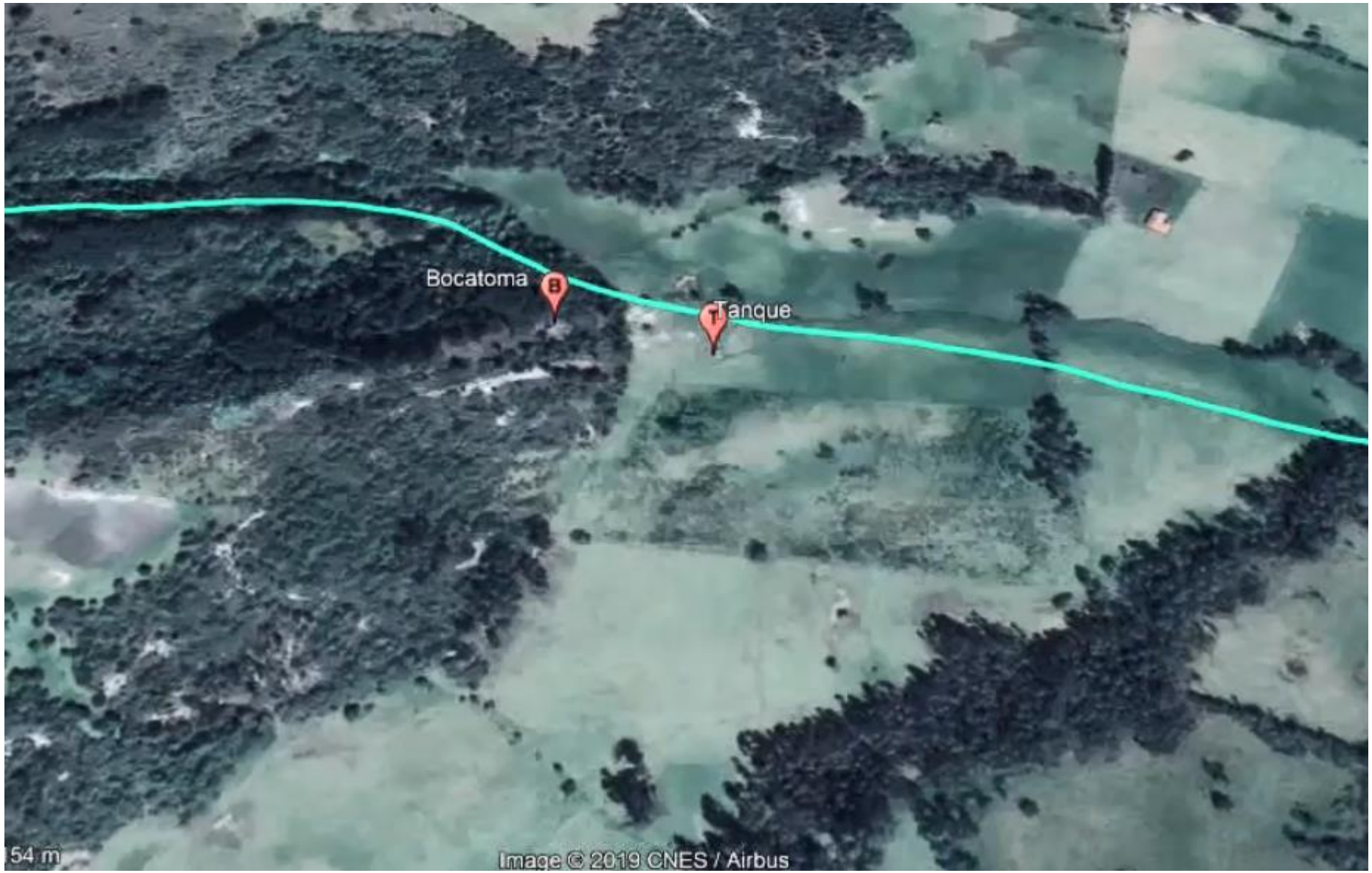
amá
Cesar
Bolívar
Córdoba
Norte de Santander
Antioquia
Santander
Risaralda
Boyacá
Cundinamarca
Bogotá
Valle del Cauca
Colombia
Meta
Huila
Portuguesa
Barinas
Venezue
371 km
US Dept of State Geographer
© 2018 Google

Santander
Casanare
Boyacá
Caldas
Cundinamarca
Bogotá


Vélez
San José de Pare
Chitaraque
Guavatá
Barbosa
Togüí
Gambita
Nacional
Moniquirá
Santa R
Paipa
Sotaquirá
Gachantivá
Arcabuco
Santa Sofía
Tanque
Tuta
Villa de Leyva
Cómbita
Chiquiza
Oicatá
Sáchica
Motavita
Sora
Toca
Chivata
Cucaita
Tunja
Soracá
Siachoque
Samacá
Boyacá
Boyacá
Viracachá
Ramiriquí
17.6 km
Image © 2019 CNES / Airbus


Bocatoma
B
Tanque
T
54 m
Image © 2019 CNES / Airbus

PROBLEM

Organic material from the surroundings

Vegetation

Intake

Photos: Quiroga & Vanegas, 2019

PROBLEM

Reservoir: lack of maintenance

Photos: Quiroga & Vanegas, 2019

PROBLEM

Cattle accessing water structures

Dung on top of water reservoir

Fuente: Autores, 2019

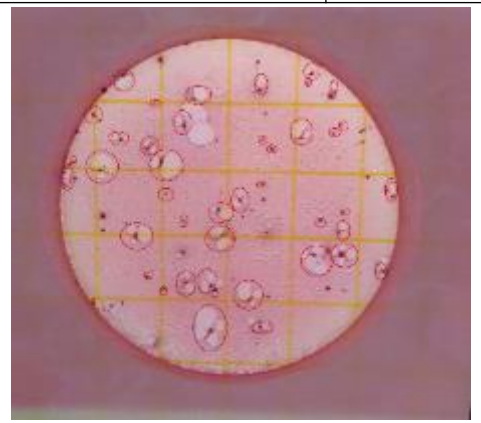
LAB ANALYSIS. 8 parameters

Sample 1

Sample 2

Sample 3

RESERVOIR							
PARAMETER	**SAMPLE 1**	**SAMPLE 2**	**SAMPLE 3**	**Res.2115/2007 máx value**	**Guidelines EPA**	**Guidelines WHO**	**Reported as**
Color	20	20	10	**15**	**15**	**15**	Units PtCo
Turbidity	1,41	4,61	1,92	**2**	**5**	**5**	NTU
pH	6,8	7,36	7,17	**6,5 - 9**	**6,5-8,5**	**6,5-8,5**	Units of pH
Free Chlorine	0	0	0	**0,3 - 2**	**4**	**0,2 -0,5**	mg/ L Cl2
Total Alkalinity	15	21,5	20,5	**200**	**200**	**200**	mg/L CaCO3
Nitrites	0,002	0	0	**0,1**	**1**	**0,2**	mg/L NO2-
Total Coliforms	8	31	29	**0**	**0**	**0**	CFU/mL
Escherichia coli	0	0	0	**0**	**0**	**0**	CFU/mL



Fuente: Autores, 2019

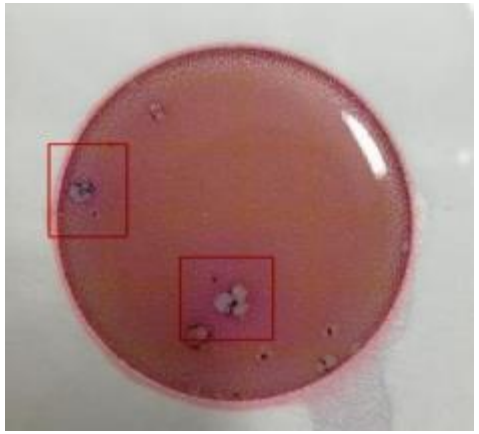
LAB ANALYSIS

Sample 1

Sample 2

Sample 3

HOUSE							
PARÁMETRO	**SAMPLE 1**	**SAMPLE 2**	**SAMPLE 3**	**Res.2115/2007 máx value**	**Guidelines EPA**	**Guidelines WHO**	**Reported as**
Color	39	30	30	**15**	**15**	**15**	Units PtCo
Turbidity	1,39	3	2,23	**2**	**5**	**5**	NTU
pH	7,2	7	7	**6,5 - 9**	**6,5-8,5**	**6,5-8,5**	Units of pH
Free Chlorine	0	0	0	**0,3 - 2**	**4**	**0,2 -0,5**	mg/ L Cl2
Total Alkalinity	23	21	18	**200**	**200**	**200**	mg/L CaCO3
Nitrites	0,004	0	0	**0,1**	**1**	**0,2**	mg/L NO2-
Total Coliforms	12	35	9	**0**	**0**	**0**	CFU/mL
Escherichia coli	1	1	2	**0**	**0**	**0**	CFU/mL



Fuente: Autores, 2019

CALCULATION. WATER QUALITY RISK INDEX- WQRI

22 parameters / 8 measured in this project

WQRI per sampling

$$\boldsymbol{WQRI}(\%) = \frac{\Sigma \text{ Risk points no aceptable parameters}}{\Sigma \text{ Risk points all analyzed parameters}} * 100$$

Total WQRI

$$\boldsymbol{WRQI}\ (\%) = \frac{\Sigma \text{ WQRI per sampling}}{\text{Total Sampling made}}$$

Source: Resolución 2115 de 2007. Colombia

CALCULATION

22 parameters / 8 measured in this project

PARAMETER	RISK POINTS
Color	6
Turbidity	15
pH	1,5
Free Chlorine	15
Total Alkalinity	1
Nitrites	3
Total Coliforms	15
Escherichia coli	25
∑ Total score	**81,5**

Source: Resolución 2115 de 2007. Colombia

*No chlorine is added

CALCULATION

WQRI per sampling

SAMPLING POINT	SAMPLING 1	SAMPLING 2	SAMPLING 3
RESERVOIR	26%	44%	18%
HOUSE	56%	75%	75%

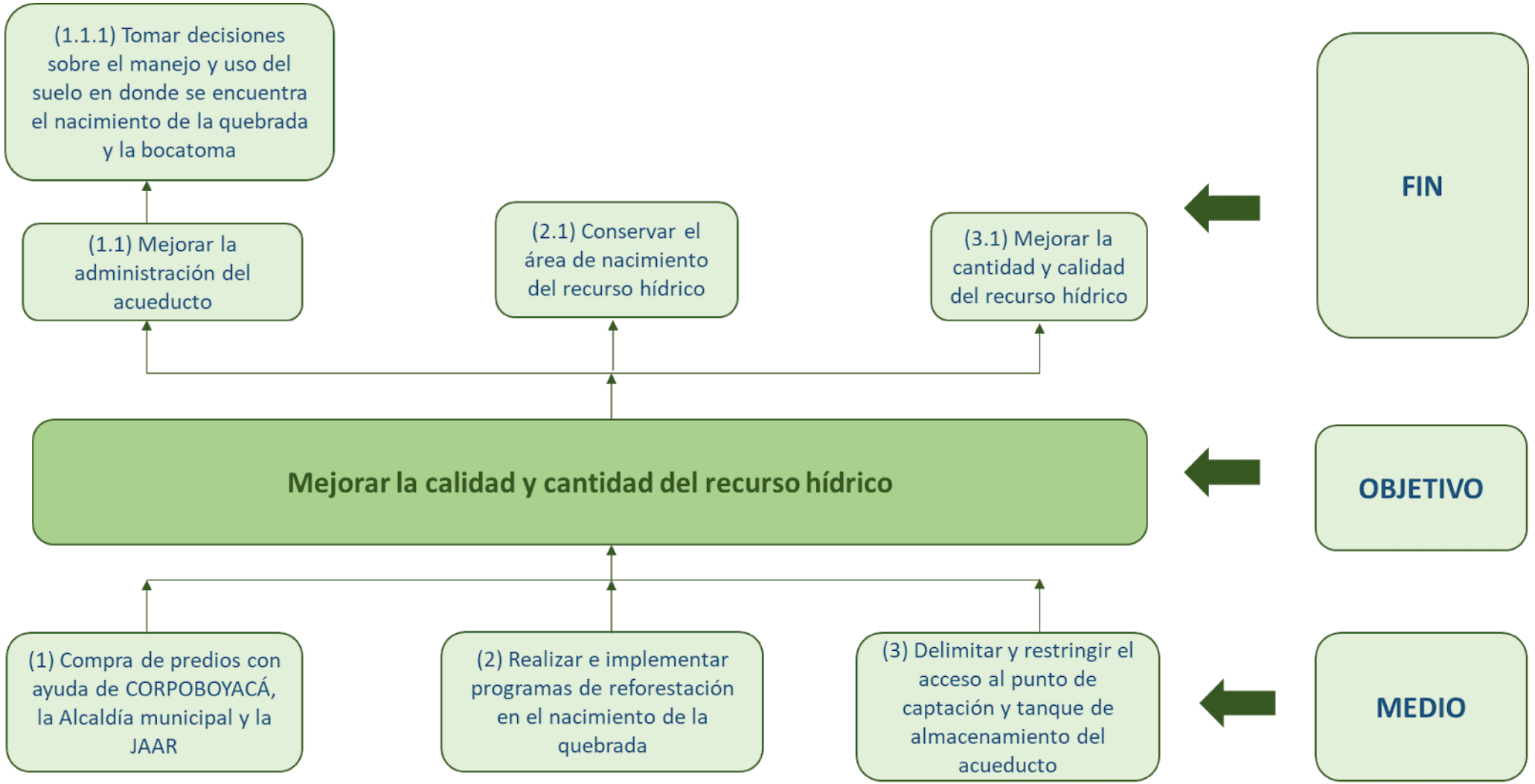
Total WQRI

SAMPLING POINT	Total WQRI	RISK LEVEL	DESCRIPTION
RESERVOIR	69%	HIGH	**NO WATER CONSUMPTION**
HOUSE	29%	MEDIUM	**NO WATER CONSUMPTION**

Source: Quiroga & Vanegas, 2019

RESULTS. Decision trees

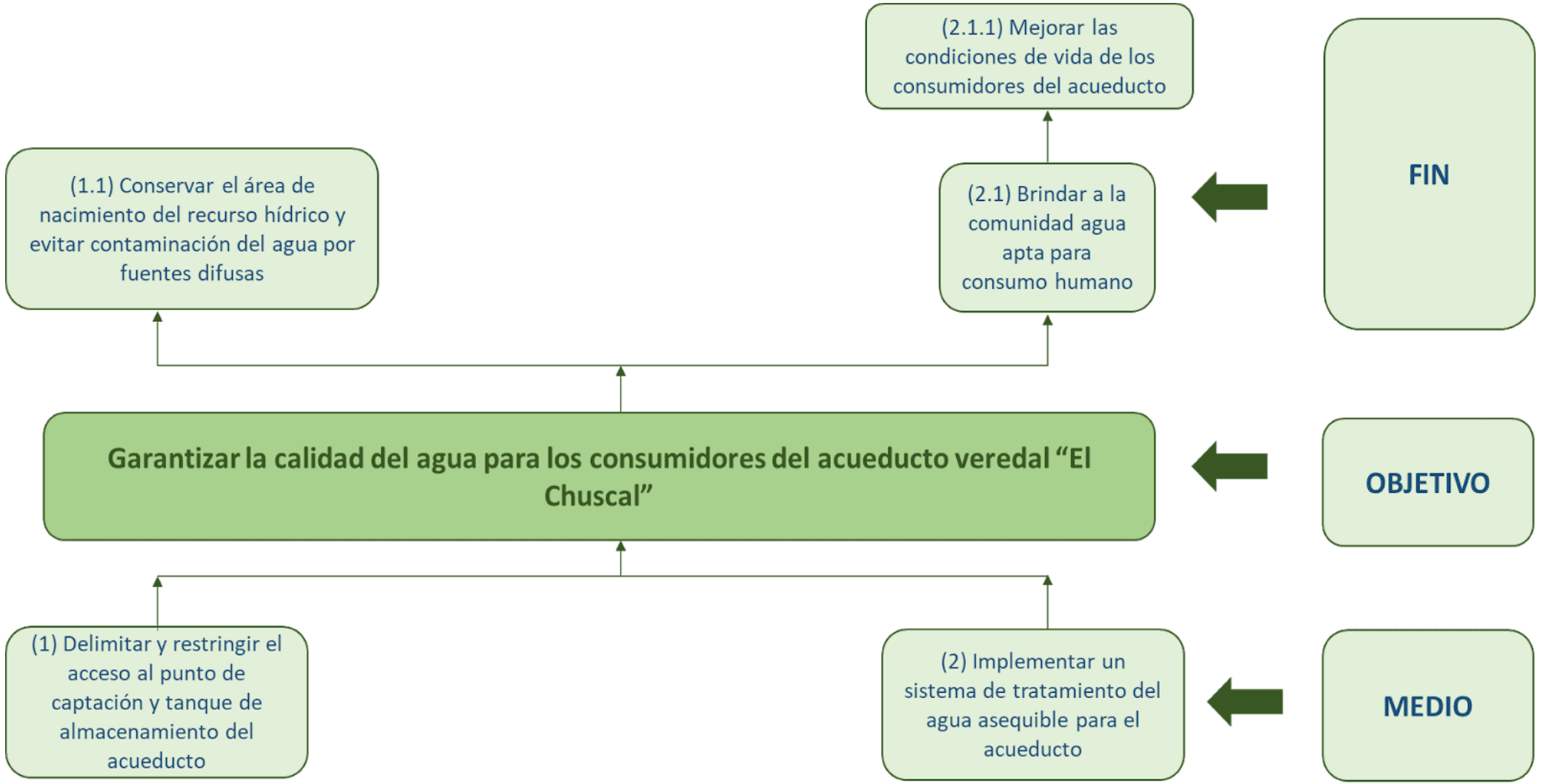
ENCLOSURE AND DELIMITATION OF RECHARGING AREA



Quiroga & Vanegas, 2019

RESULTS

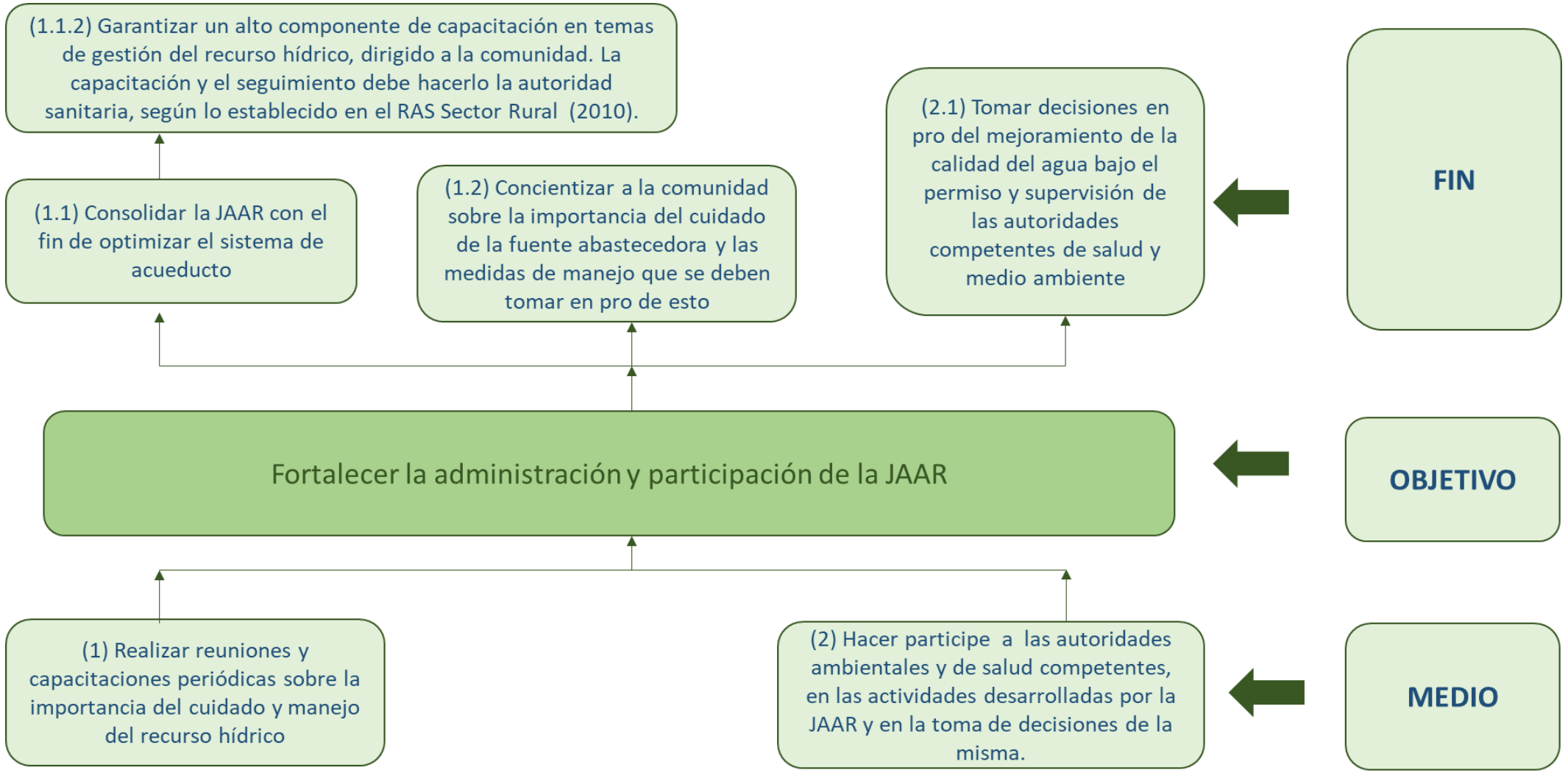
WATER QUALITY



Quiroga & Vanegas, 2019

RESULTS

MANAGEMENT FAILURES



Quiroga & Vanegas, 2019

RESULTS. ACTIONS

PEOPLE

- **CONTROL**
  - Capacity Building for Aqueduct's Board
  - Users education
  - Government involved
- **MONITORING**
  - Users Board meeting (at least 1 per year)
  - Strategies for tracing habits

Source: Quiroga & Vanegas

RESULTS

MAINTENANCE

Source: Quiroga & Vanegas, 2019

CONTROL

- Network disinfection
- Household habits
- Flow measurement
- Reservoir house cleaning

MONITORING

- Frequent network disinfection
- Frequent checking

RESULTS

PROCEDURES

Source: Quiroga & Vanegas, 2019

CONTROL

- Controlling the Q taken (Weir installation)
- Infrastructure maintenance
- Establish sampling frequency (kits)
- Proportional payment

MONITORING

- Daily measurement intake
- Updating users census

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