Land use planning methodology to improve the regulation of the hydrological cycle

Diana Hincapié, PhD (c)

Environmental – Risk management consultant

Content

1. The problem: exposing the case of Dagua – Valle del Cauca.
2. Context of landscape planning in the municipality of Dagua
3. Landscape planning, ecological process, and ecosystem services for Dagua
4. The experiment…
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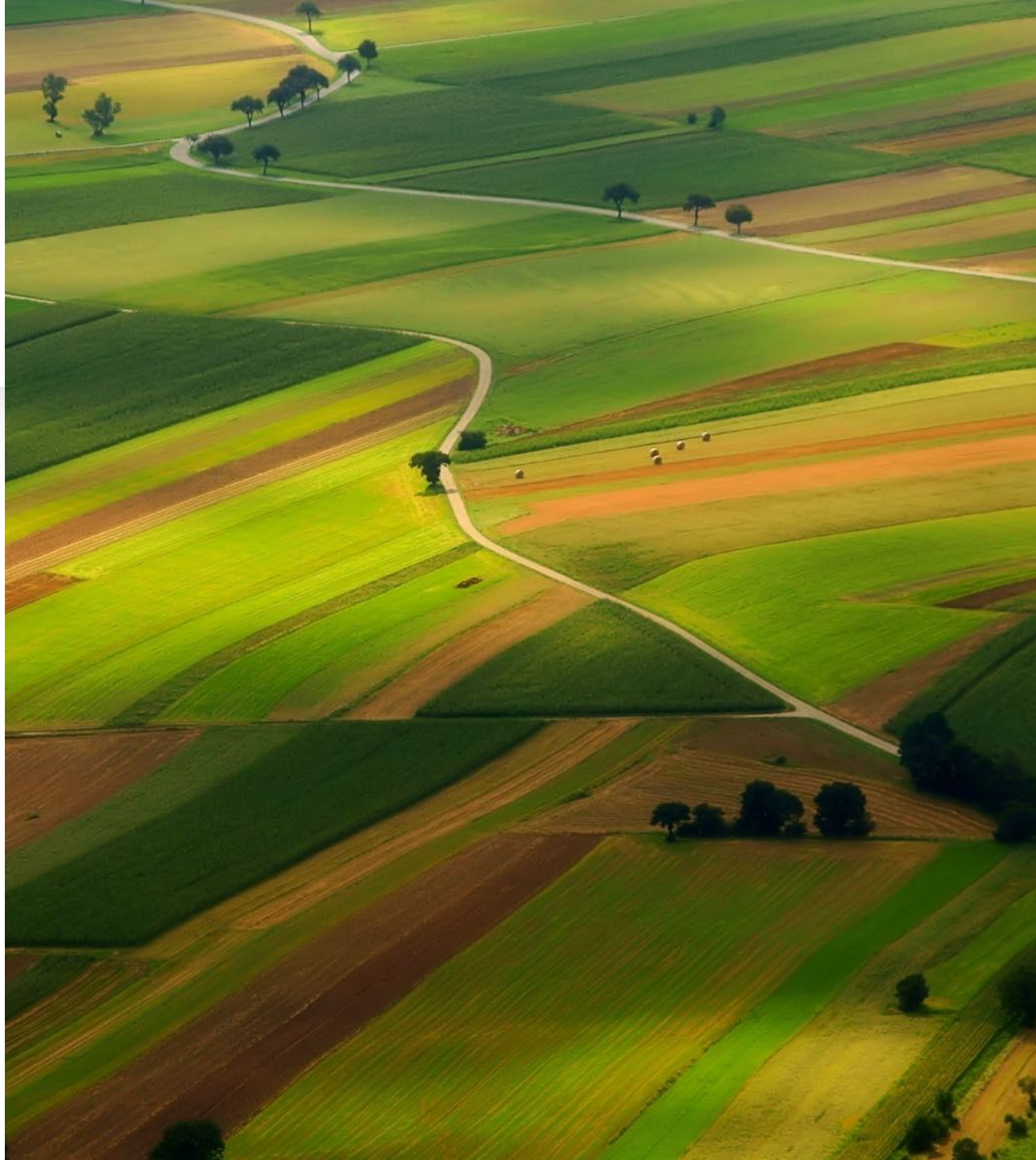
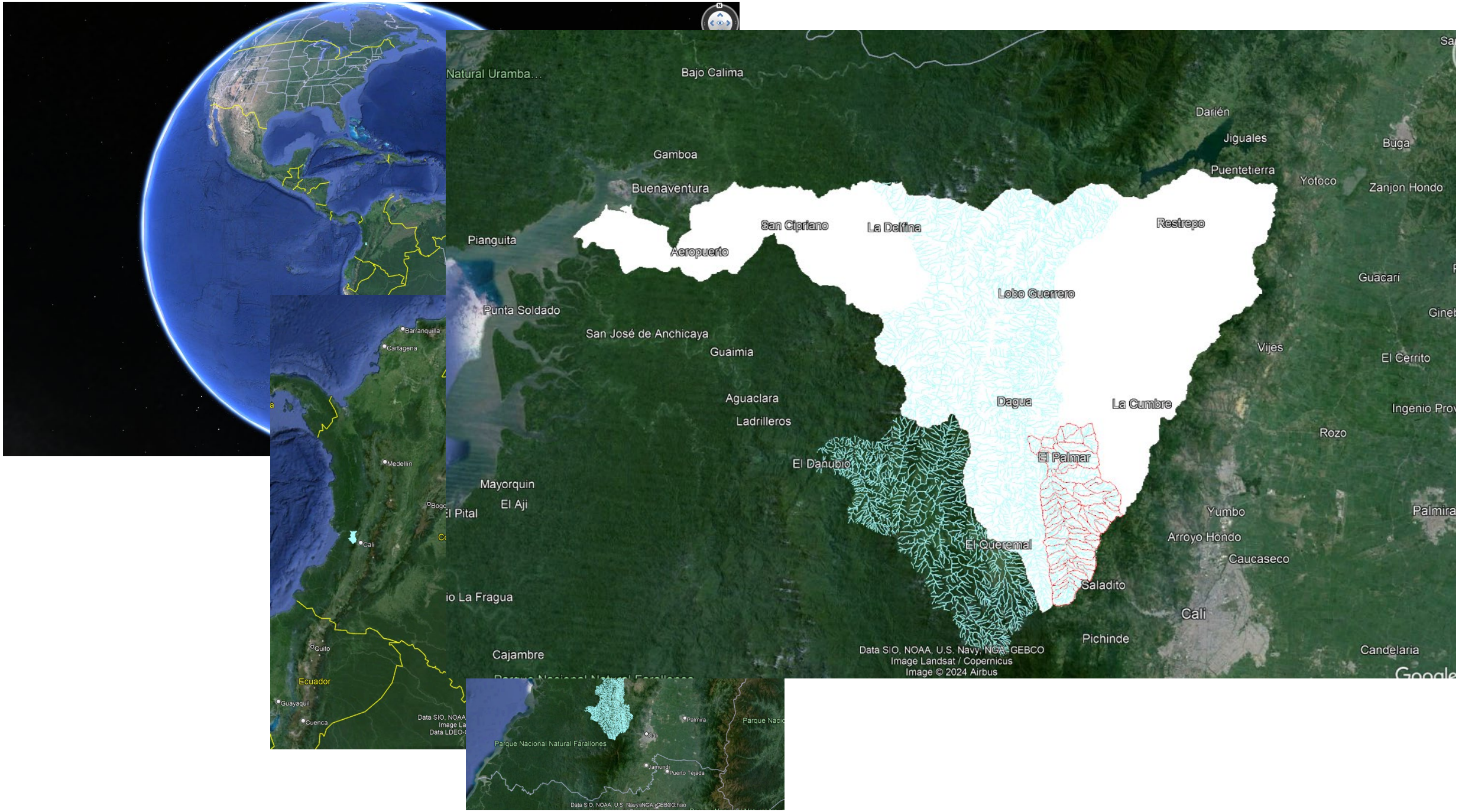
6. Conclusions




Natural Uramba…
Bajo Calima
Darién
Jiguales
Buga
Gamboa
Puentetierra
Yotoco
Zanjon Hondo
Buenaventura
San Cipriano
La Delfina
Restrepo
Pianguita
Aeropuerto
Guacarí
Lobo Guerrero
Punta Soldado
San José de Anchicaya
Guaimia
Vijes
El Cerrito
Aguaclara
Dagua
La Cumbre
Ladrilleros
Rozo
El Danubio
El Palmar
Mayorquin
El Aji
Yumbo
Palmira
El Queremal
Arroyo Hondo
Caucaseco
Saladito
Cali
Pichinde
Candelaria
Cajambre
Ecuador
Barranquilla
Cartagena
Medellin
Cali
Quito
Guayaquil
Cuenca
Palmira
Parque Nacional Natural Farallones
Jamundi
Puerto Tejada
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
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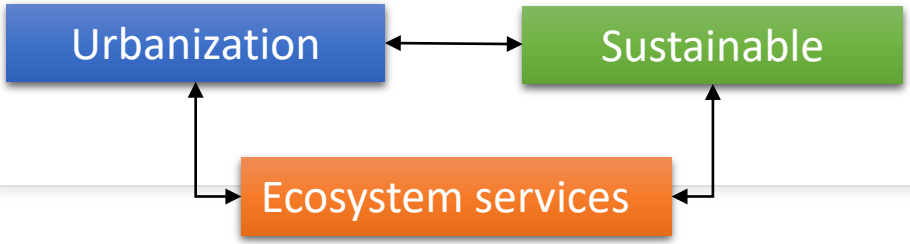
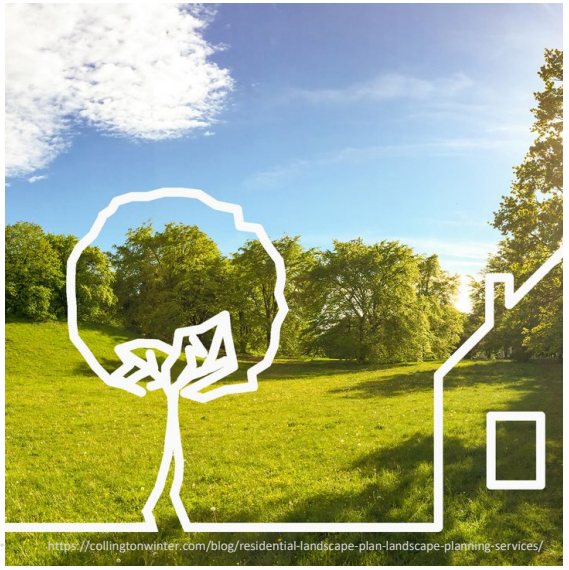
Environmental determinants

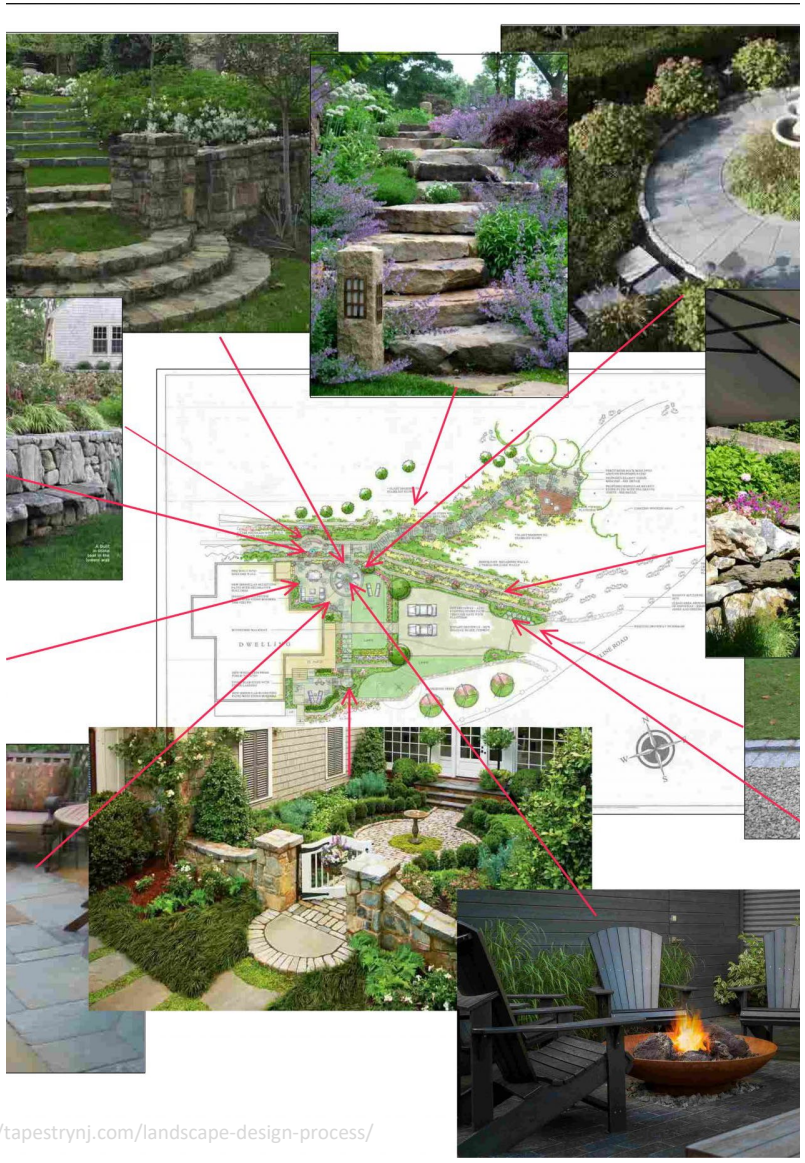
- It is a category of soil protection imposed by the environmental authority.
- Dagua has a category all over its territory → soil protected by the second law from 1959.
- Under this legal act, the municipality is not able to execute sanitation projects in consequence there are several environmental problems related with water pollution.
- To solve this, landscape planning must be done.

2. The context of landscape planning

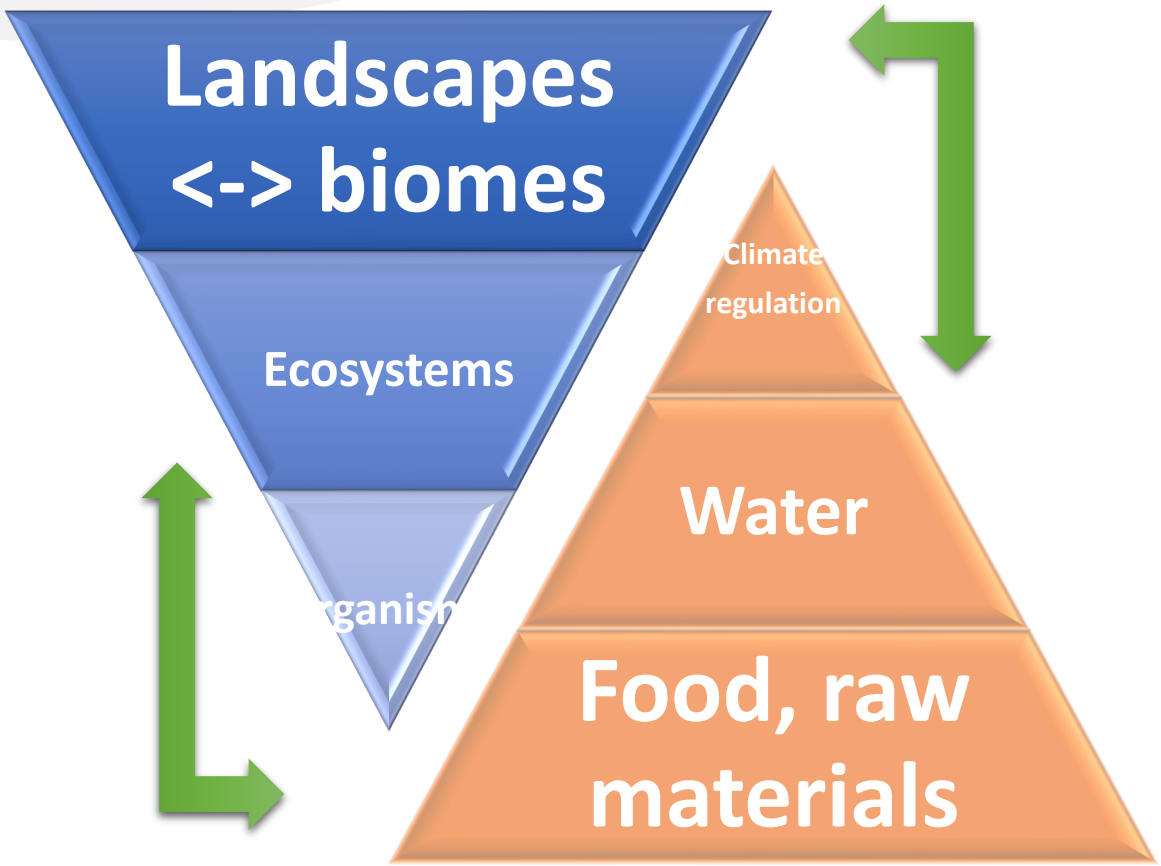
- How do we occupy biophysical space?
- How much respect do we have for the flora and fauna species of that space?
- Can we know the impact that these space occupation decisions have in terms of the impact on human requirements such as the amount of water?







3. Landscape planning, ecological process, and ecosystem services



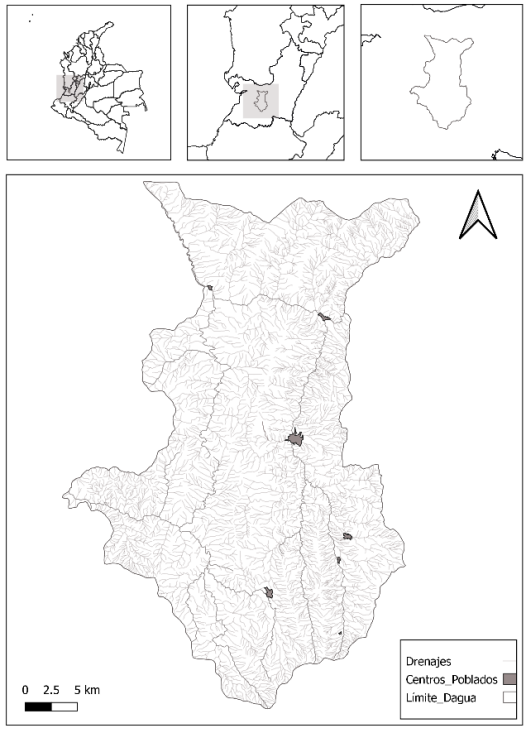
But… we need to make decisions right now..

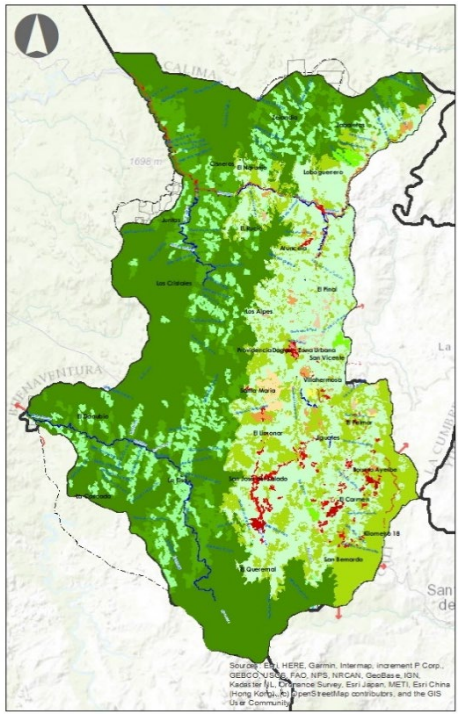
Landscape level → minimum 20 years…

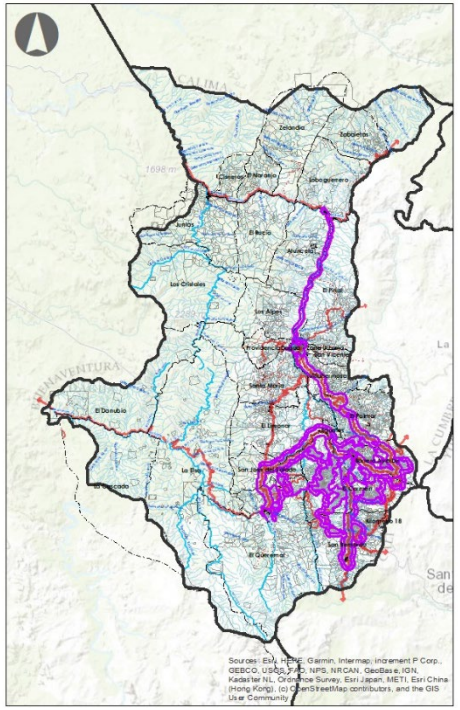
To understand ecological process at this level requires a specialized tool

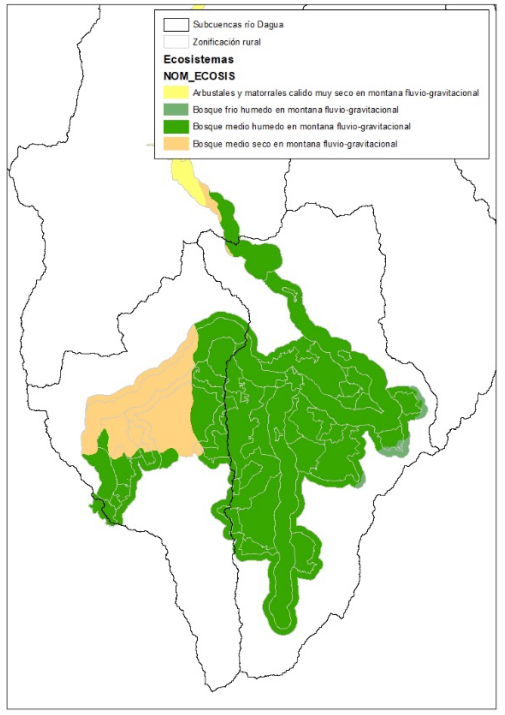
1. Working scale
2. Type of experiments that we can perform
3. Time of experiments

4. The experiment…(methodology)

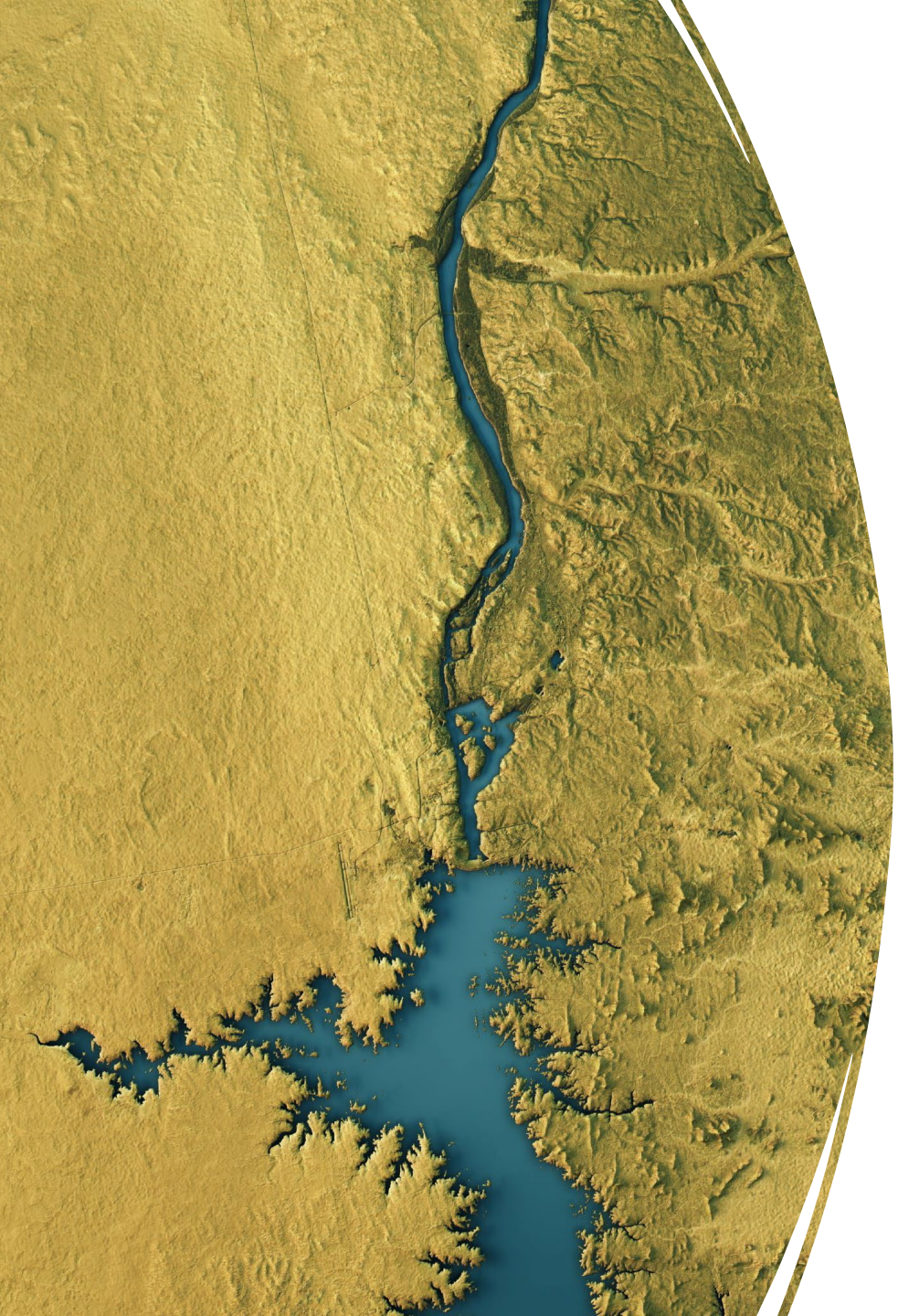






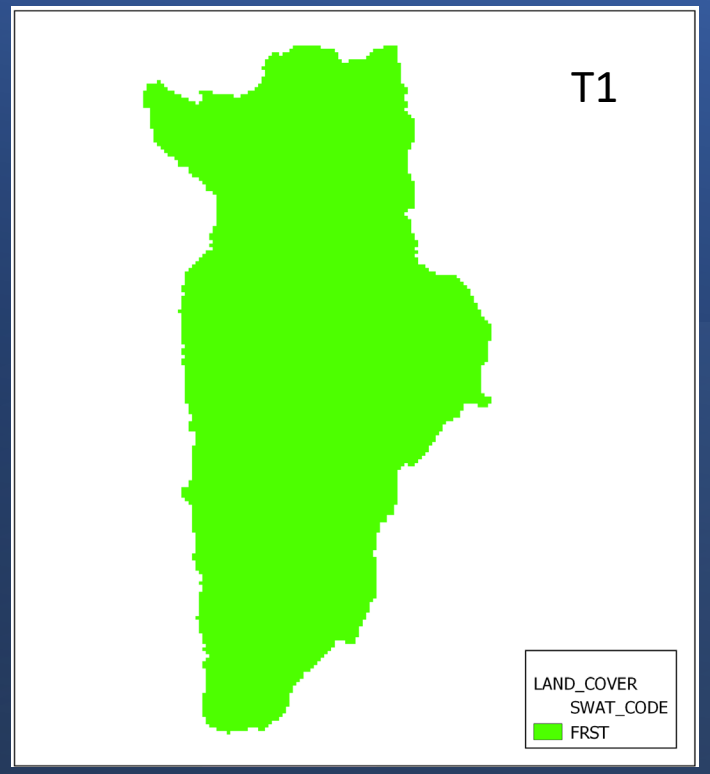


Where do we invest the money, on what areas?

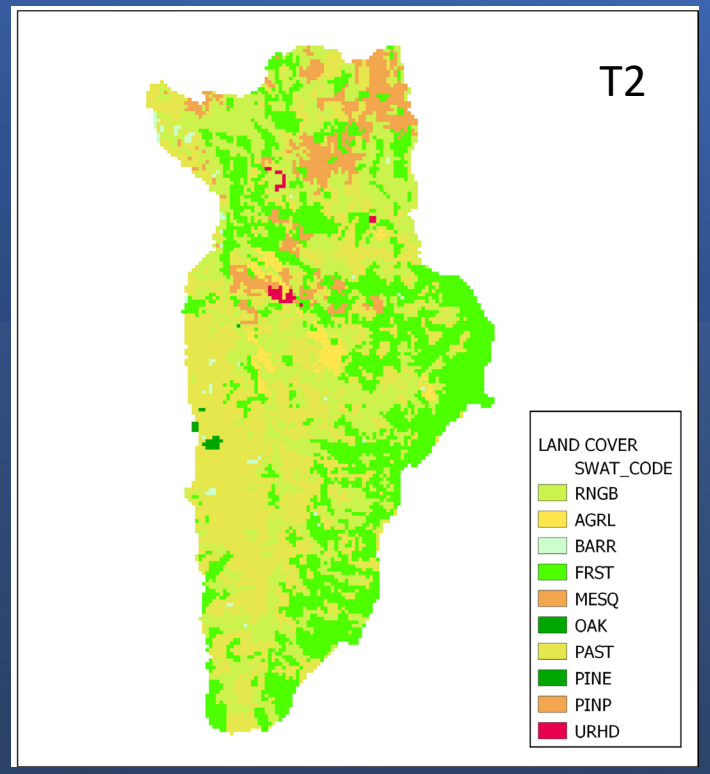


Inputs

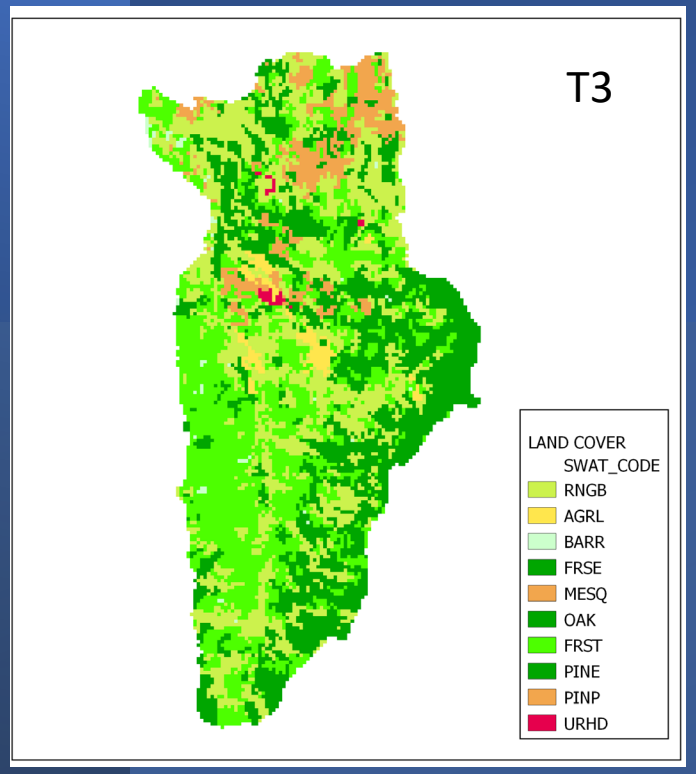
- DEM → 2.5 m given by the environmental authority.
- Hydrological soil map → developed by the environmental authority, 1:25.000 – semi-detailed → adjusted lookup tables to usersoils
- Land use/land cover map → obtained by the municipality, 1:25.000
- Climate data: obtained from SWAT climate databases, monthly values were adjusted from national measures, only for precipitation and temperature.



Class	Landscape Proportion
FRST	100.0%

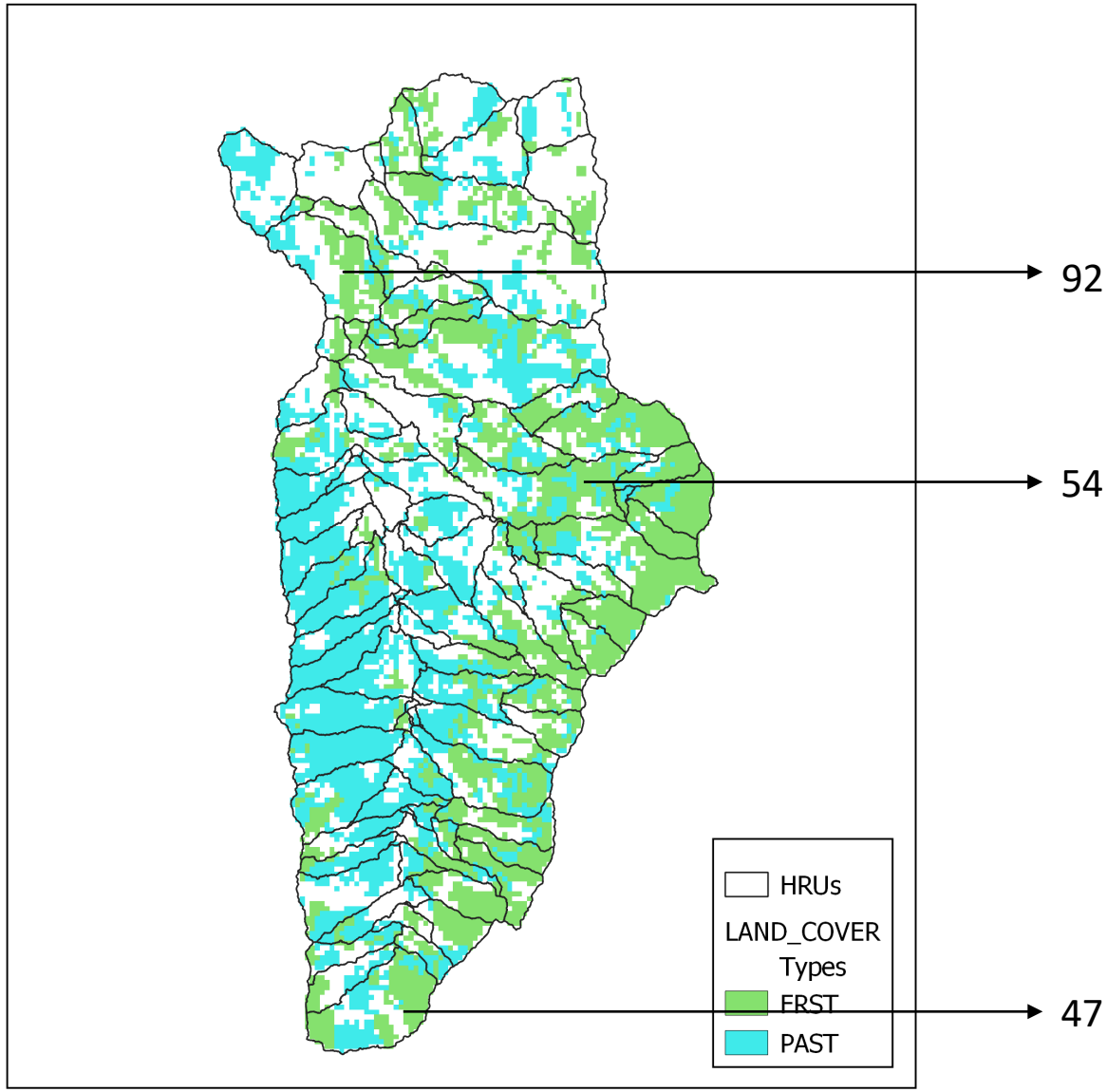


Class	%	**Ha**
RNGB	17.0%	2978.6
AGRL	1.0%	178.5
BARR	0.3%	54.8
FRST	18.0%	3145.6
MESQ	3.6%	634.4
OAK	0.1%	21.2
PAST	18.7%	3272.9
PINE	0.0%	0.9
PINP	0.2%	33.6
URHD	0.2%	34.5



Class	Landscape Proportion	Column1
RNGB	17.0%	2978.6
AGRL	1.0%	178.5
BARR	0.3%	54.8
FRSE	18.0%	3145.6
MESQ	3.6%	634.4
OAK	0.1%	21.2
FRST	18.7%	3272.9
PINE	0.0%	0.9
PINP	0.2%	33.6
URHD	0.2%	34.5

WB – Et/Sr - Sed

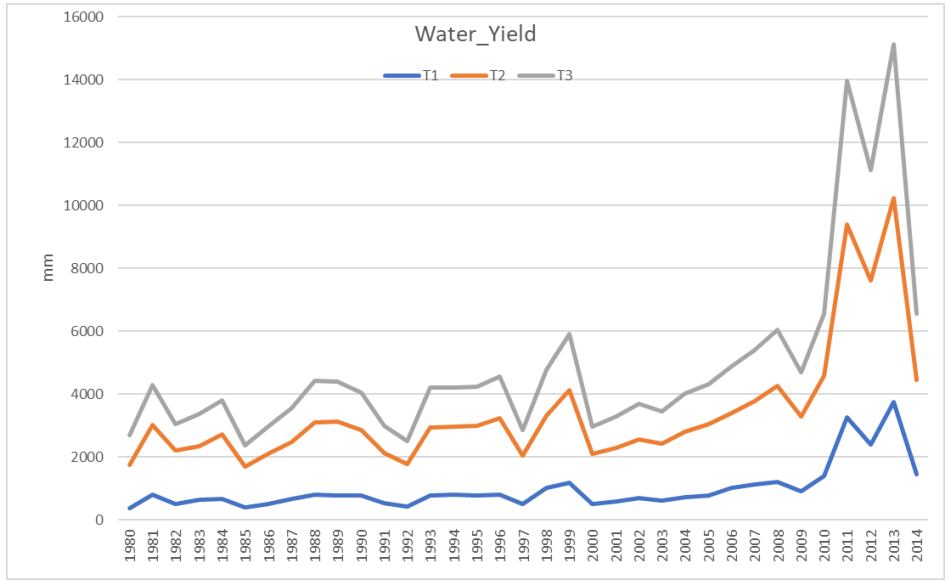


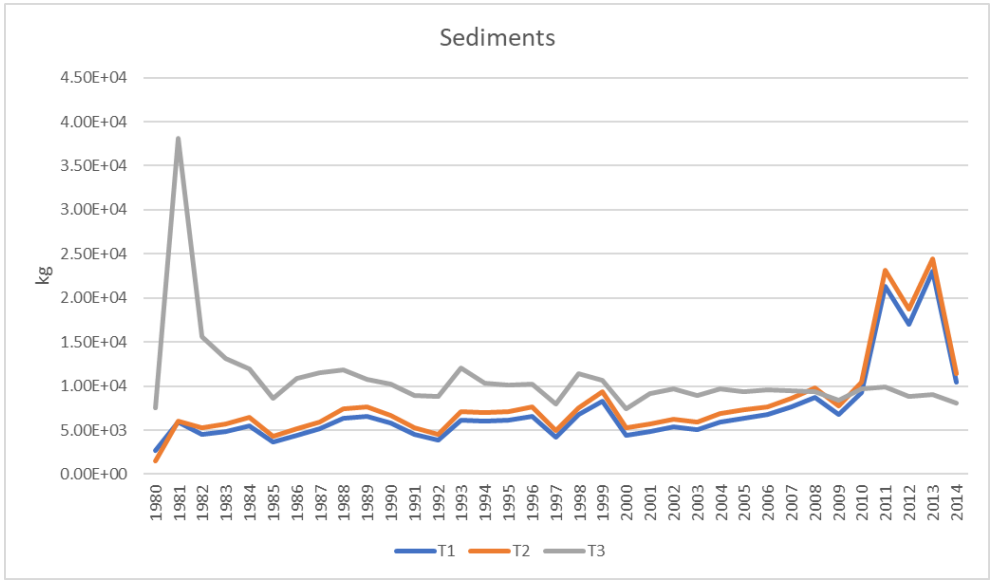
Comparison between series of water yields on each treatment for each HRU picked

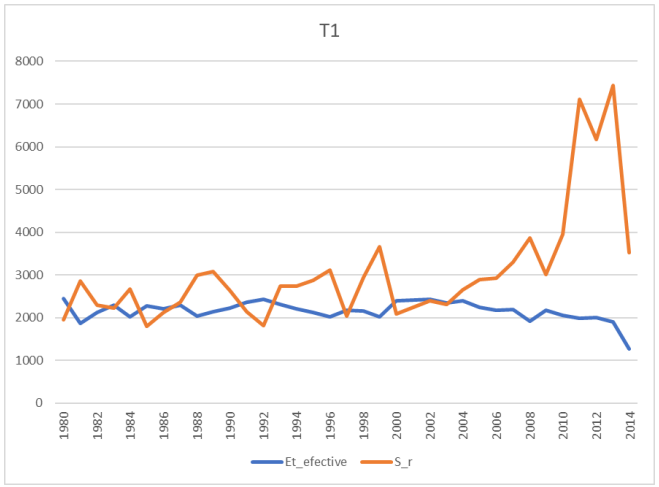
Relation between evapotranspiration and superficial run-off

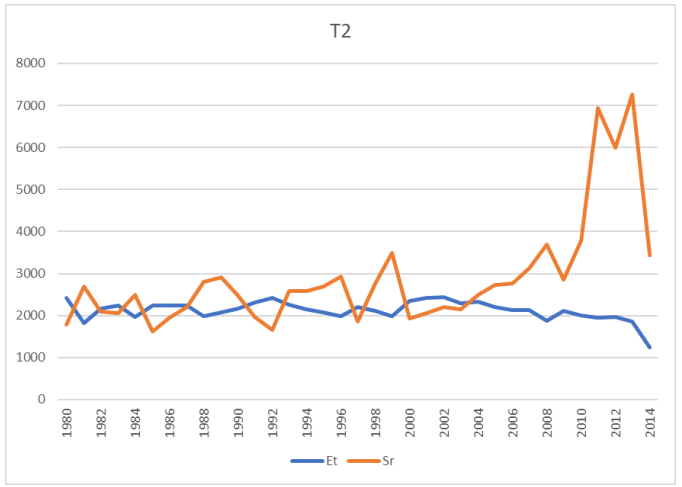
Quantity of sediments reduced by each treatment

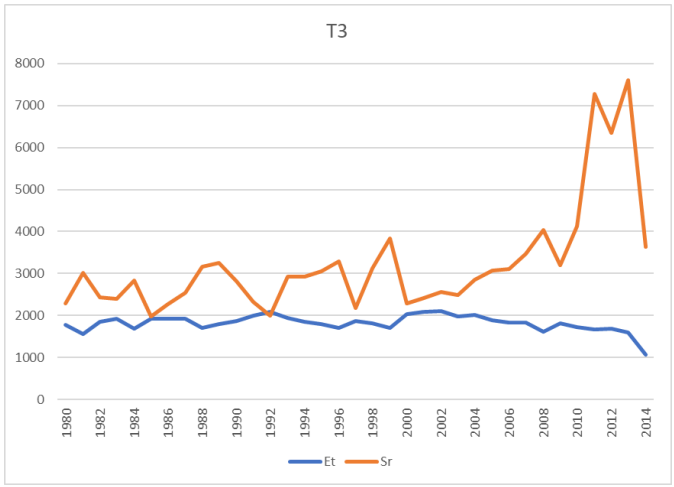
5. Results


Water_Yield
T1
T2
T3
mm
16000
14000
12000
10000
8000
6000
4000
2000
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

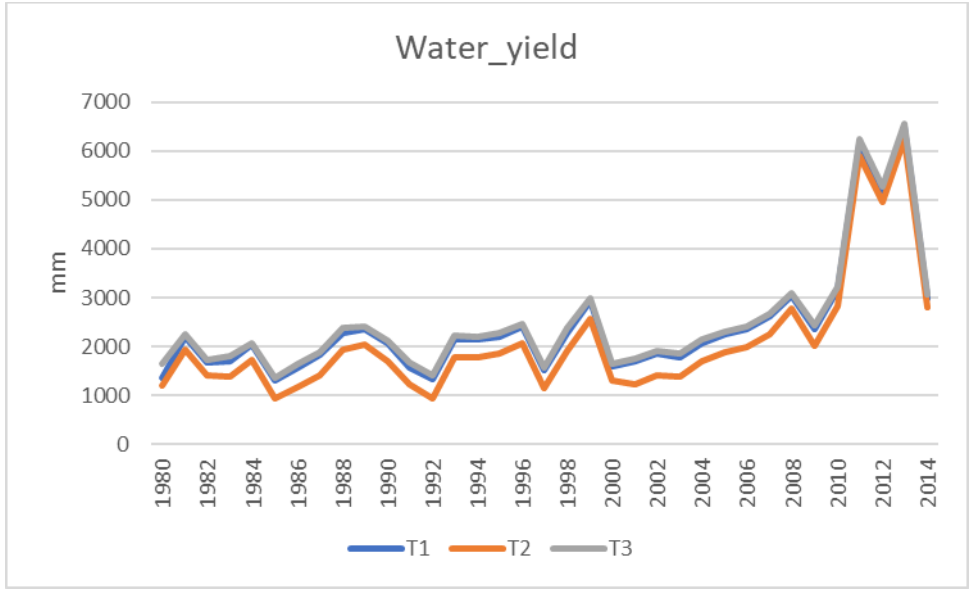

Sediments
kg
4.50E+04
4.00E+04
3.50E+04
3.00E+04
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
T1
T2
T3

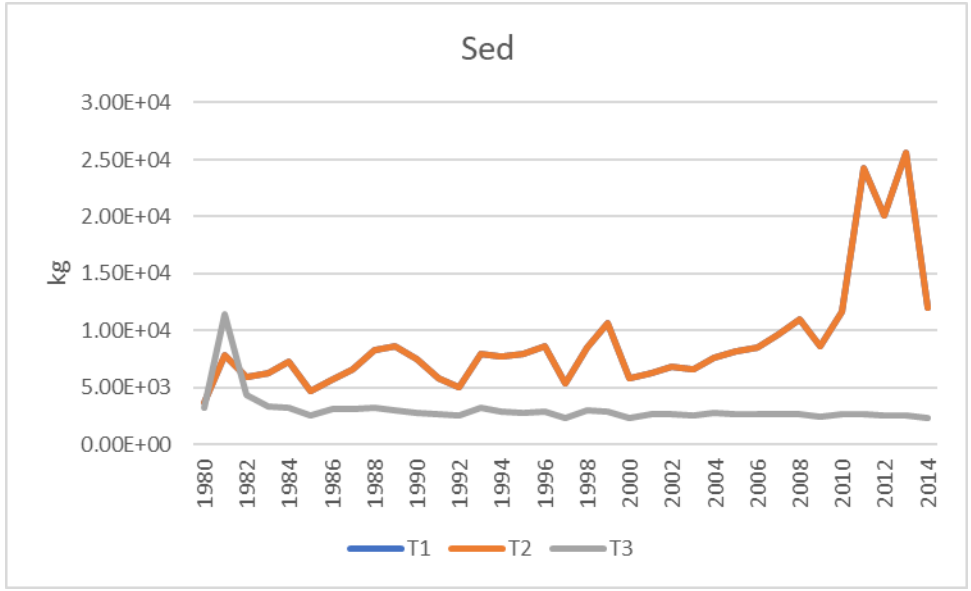

T1
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et_efective
S_r

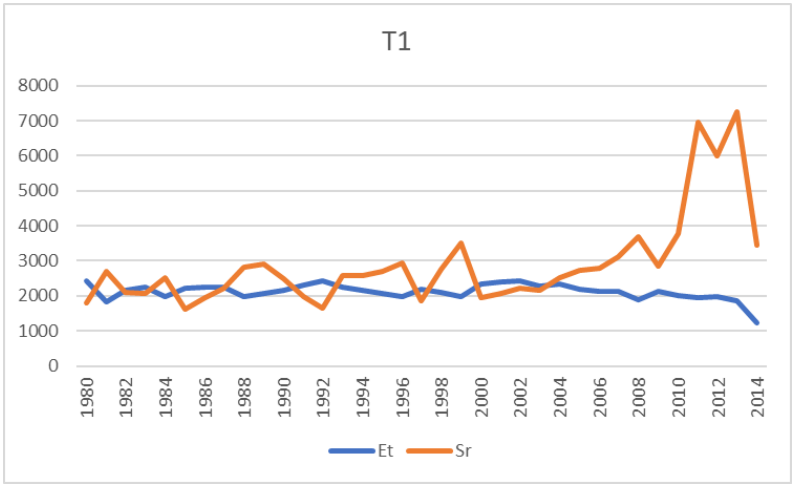

T2
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et
Sr

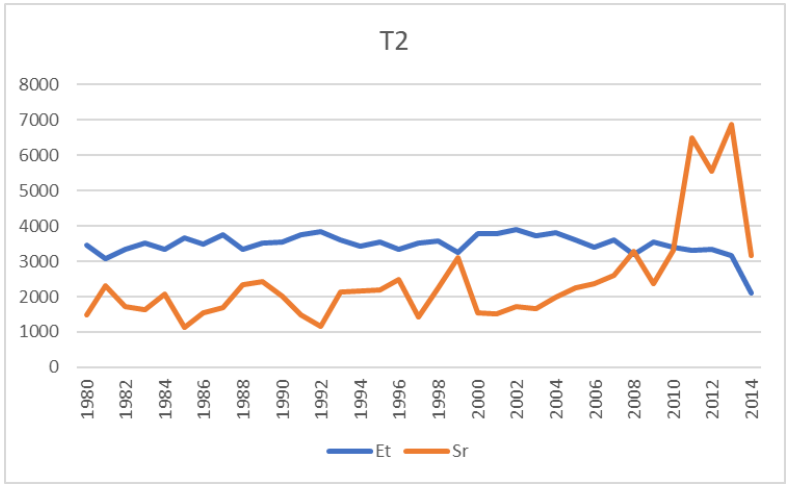

T3
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et
Sr

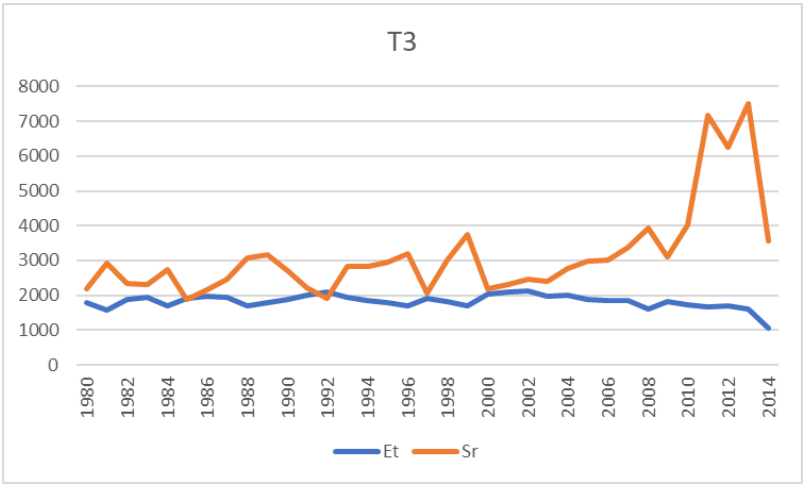
92

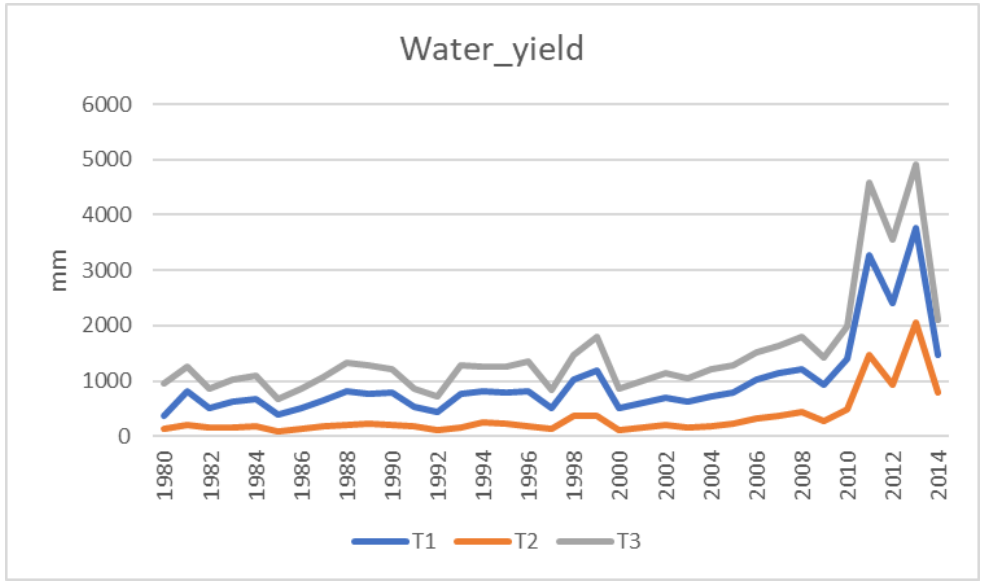

Water_yield
mm
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
T1 T2 T3

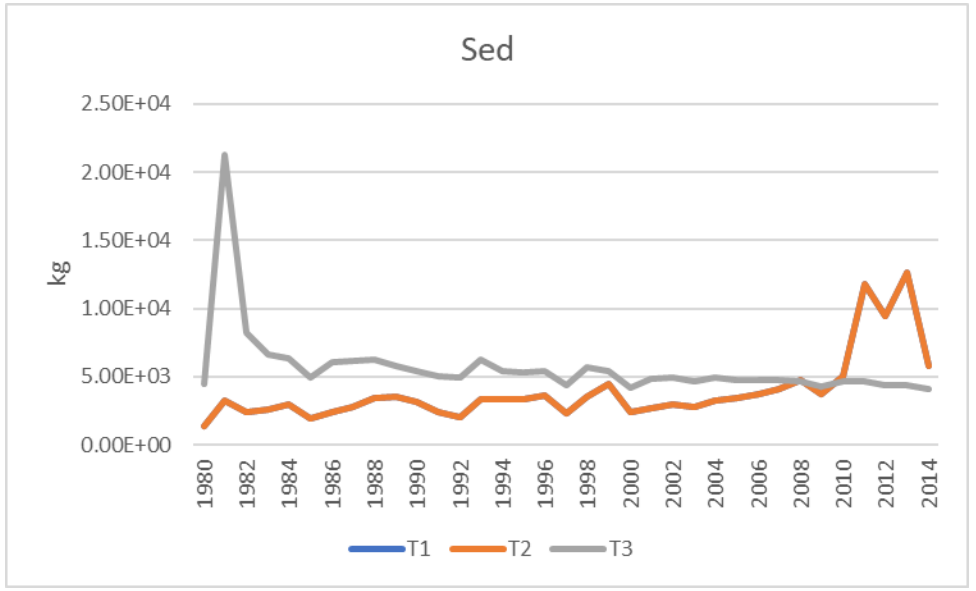

Sed
kg
3.00E+04
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
T1 T2 T3

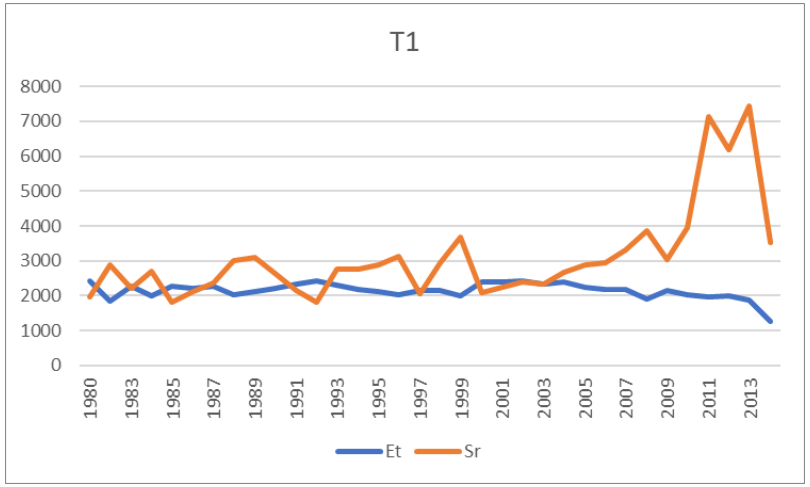

T1
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et Sr

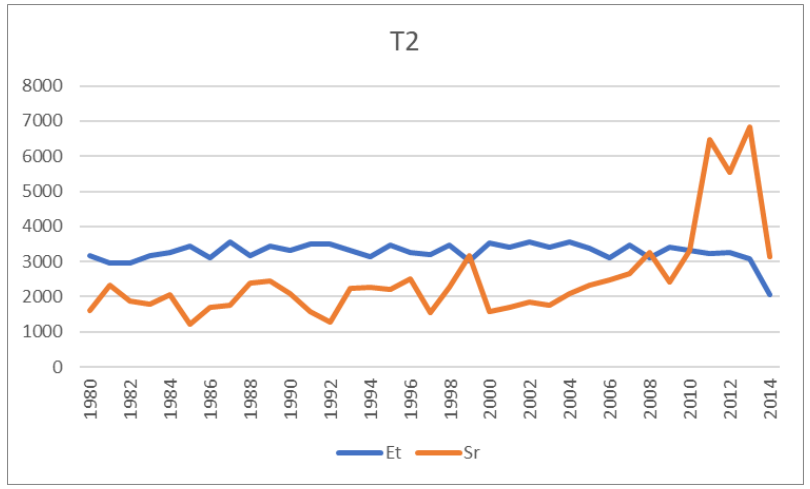

T2
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et Sr

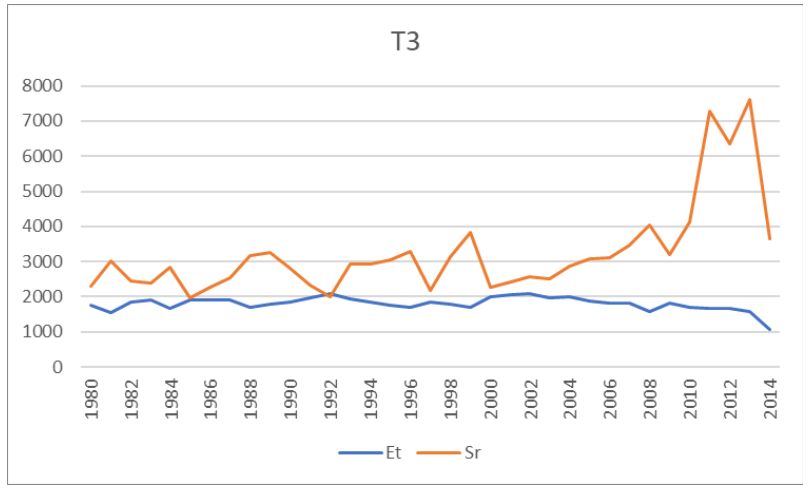

T3
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et Sr


Water_yield
mm
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
T1 T2 T3


Sed
kg
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
T1 T2 T3


T1
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
Et Sr


T2
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et Sr


T3
8000
7000
6000
5000
4000
3000
2000
1000
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
Et Sr

6. Conclusions and recommendations

Conclusions

- It is a preview of a bigger project
- The treatments show the effectiveness of the decision towards land cover management
- It is the baseline for economic decisions
- The results show where to do the investments and execute the actions of vegetation recover
- Dagua can generate the strategy to recover land cover using agroecological systems
- Also, the project it useful to implement early warning system

Recommendations

- The model must be calibrated
- Measurements of flow and sediments are needed to calibrate the model
- Research on values of water intake due to plants must be done, because of the tropical conditions. That must be pply for hydrological soil map, as well

What's next?

- To automatize the method to assess the specific areas where sediments are reduced.
- To prove another configurations of land cover recover…

For your attention, thank you so much!