Supplementary material

Table S1. Weather stations

Table S1. Data and location of meteorological stations

State	Key	Name	East	North	Altitude
México	15124	Tepexpan	508214	2168623	2248
México	15125	Texcoco	512387	2156772	2250
México	15383	Lago Navor Carrillo	500875	2153079	2234
México	15210	Totolapan	528676	2159465	2750
México	15167	El Tejocote	510205	2149885	2256
México	15145	Lago Texcoco	507172	2150683	2260
México	15083	San Andrés	509384	2159690	2244
México	15008	Atenco	509150	2161012	2245
México	15101	Tlaixpan	519672	2158315	2405
México	15041	Gran Canal	497960	2162977	2236
México	15170	Chapingo	511923	2154466	2250
México	15268	Ixtapaluca	512372	2135932	2250
México	15017	Coatepec	516159	2143404	2405
México	15018	Manuel Ávila Camacho	524656	2136805	2900
Tlaxcala	29006	Cuaula	536704	2167256	2550

Figure S1. Location of the Catchments

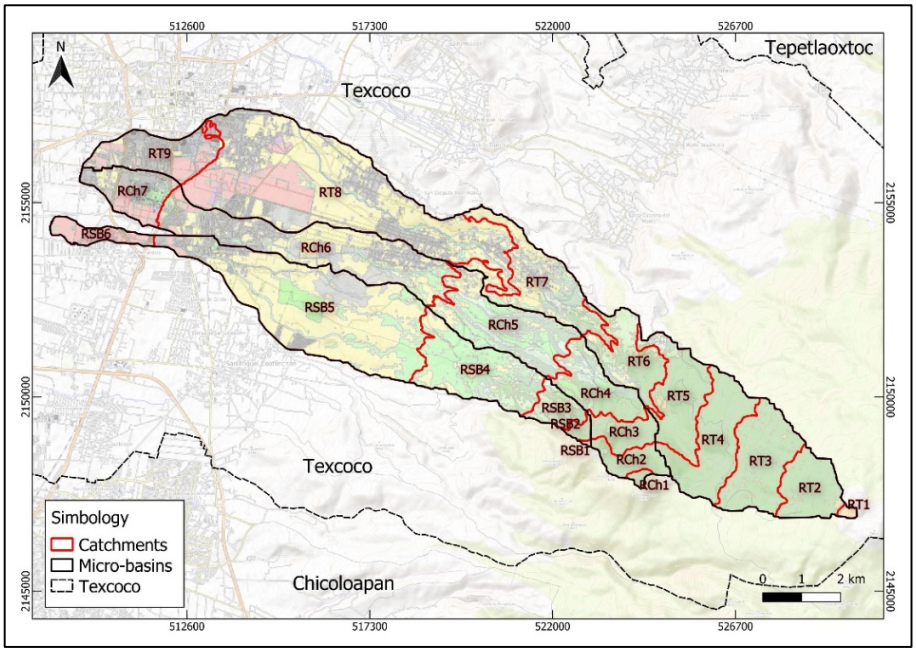


Figure S1. Delimitation and location of the Catchmets by micro-basin

Table S2. Initial values of the parameters of the soil moisture method, classified by class of land use and vegetation

Initial values of the hydrological balance parameters used in this research, classified by class of land use and vegetation. These values are within the range of minimums and maximums of previous works that have been carried out in America: 0.1<Kc<1, 1<IAF<8, 5<z2<30, 100<Dw<300,000, 3<Kd<6000, 0.1<f<0.9, 5<z1<30, 100<Sw<4320 y 30<Ks<2000 [25,1,68,73, among other].

Table S2. Initial values of the parameters of the soil moisture method, classified by class of soil use and vegetation

Parameter	Unit	Land use class										Initial value reference
		U	BT	R	VS	P	M	AT	AR	AP	CA	
Root zone												
Sw	mm	--	1000	280	320	250	--	50	40	25	--	[73]
Ks	mm/month	24	200	24	24	200	24	24	24	24	24	[25,68]
f	No drive	0.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	[45]
Z1	%	30	30	30	30	30	30	30	30	30	30	[45]
Kc	No drive	0.7	0.9	0.8	0.8	0.8	0.7	0.75	0.75	0.7	1	[25]
RRF	No drive	8.0	5.7	5.7	2.08	1.71	8.0	3.62	3.62	3.62	0.1	[25]
Deep zone												
Dw	mm	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	[45]
Kd	mm/month	60, 100, 320	60, 100, 320	60, 100, 320	60, 100, 320	60, 100, 320	60, 100, 320	60, 100, 320	60, 100, 320	60, 100, 320	60, 100, 320	[25]
Z2	%	30	30	30	30	30	30	30	30	30	30	[45]

Table S3. Reference values of the goodness of fit estimators, to classify the evaluation and performance of the model [52].

Table S3. Range of values for the interpretation of the goodness of fit estimators**.**

Classification	Range of values			
	NSE	R2	PBIAS	RSR
Very good	0.75<NSE≤1.00	0.7<R2<1	PBIAS<±10	0.00≤RSR≤0.50
Well	0.65<NSE≤0.75	0.6<R2<0.7	±10≤PBIAS<±15	0.50≤RSR≤0.60
Satisfactory	0.50<NSE≤0.65	0.5<R2<0.6	±15≤PBIAS<±20	0.60≤RSR≤0.70
Acceptable	0.4<NSE≤0.50	-	-	-
Unsatisfactory	NSE≤0.4	R2<0.5	PBIAS≥±25	RSR>0.70

Figure S2. Location of the areas affected by forest fires in the study area

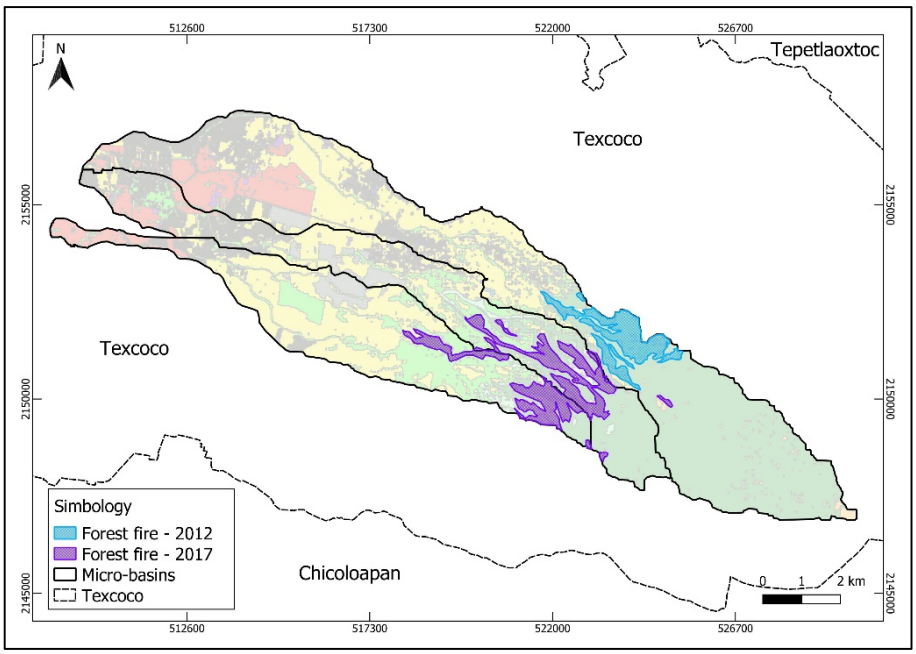


Figure S2. Location of the areas affected by forest fires in the study area [Adapted from Probosque 56].

Table S4. Dynamics of land use change by micro-basin in the period 1995-2008

The results of the matrix of the dynamics of changes in land use by micro-basin for the period 1995-2008 are presented in Table S4, it is observed that in the micro-basin of the San Bernardino River and Chapingo River, the class that suffered the greatest change were the reforestation areas, the total change in this area was 88.1 and 95.9 hectares respectively, specifically the change in these two micro-basins was due to secondary vegetation (55.6 and 39.6 ha.) and rain-fed agricultural areas (21.9 and 16.2 ha.), in the micro-basin of the Texcoco River, the greatest change was from temperate forest to grassland with 29.3 ha and from temperate forest to secondary vegetation with 17.6 ha, which indicates degradation due to forest fires.

Table S4. Dynamics of land use change by micro-basin in the period 1995-2008

Micro-basin	Reference class 1995	Current class 2008 (ha)										
		U	**BT**	**R**	**VS**	**P**	**M**	**AT**	**AR**	**AP**	**CA**	**Total**
San Bernardino River	BT	-	-	7.2	14.0	0.3	-	-	-	-	-	21.5
	R	1.5	5.4	-	55.6	0.1	1.4	21.9	2.3	-	-	88.1
	VS	-	10.1	0.8		0.4	-	-	0.4	-	-	11.6
	P	-	-	-	0.1	-	-	-	-	-	-	0.1
Chapingo River	BT	-	-	19.3	17.7	2.2	-	0.7	-	-	-	39.9
	R	22.3	10.7	-	39.6	-	4.1	16.2	2.2	0.3	0.6	95.9
	VS	-	14.9	0.5	-	0.2	-	-	0.8	-	-	16.3
	P	-	-	-	0.3	-	-	-	-	-	-	0.3
Texcoco River	BT	0.4	-	6.1	17.6	29.3	-	2.0	-	0.8	-	56.1
	R	11.2	2.1	-	5.0	-	-	11.3	4.5	0.1	0.3	34.3
	VS	-	9.8	3.1	-	0.4	-	-	1.5	-	-	14.8
	P	-	3.5	-	0.8	-	-	-	-	-	-	4.3

Table S5. Dynamics of land use change by micro-basin in the period 2008-2021

According to the results of the matrix on the dynamics of changes in land use by micro-basin for the period 2008-2021 (Table S5), it can be observed that the classes that have the greatest change in the three micro-basins were the areas from reforestation to agriculture of temporary with 113.9, 35.7 and 47.5 hectares respectively, and from temperate forest to secondary vegetation with 73.4, 73.4 and 134.2 ha. respectively.

Table S5. Dynamics of land use change by micro-basin in the period 2008-2021

Micro-basin	Reference class 2008	Current class 2021										
		U	**BT**	**R**	**VS**	**P**	**M**	**AT**	**AR**	**AP**	**CA**	**Total**
San Bernardino River	BT	-	-	41.9	73.4	0.1	-	0.3	-	-	-	115.6
	R	3.7	0.8	-	9.0	-	2.9	113.9	7.5	-	-	137.7
	VS	0.1	5.5	48.8	-	-	-	13.1	-	-	-	67.5
	P	-	0.4	0.1	0.4	-	-	-	-	-	-	0.8
Chapingo River	BT	-	-	59.7	73.4	2.3	-	0.3	-	-	-	135.5
	R	20.7	11.3	-	21.6		3.0	35.7	9.8	1.1	0.2	103.4
	VS	0.5	11.3	32.9	-	0.9	-	10.4	0.1	0.1	-	56.2
	P	-	2.9		0.1	-	-	-	-	-	-	3.0
Texcoco River	BT	-	-	30.0	134.2	15.9	-	3.5	-	-	-	183.6
	R	18.2	2.3	-	1.3	0.1	2.3	47.5	36.5	2.3	-	110.5
	VS	0.1	9.9	24.5	-	-	-	18.6	0.1	0.5	0.1	53.8
	P	-	65.6	-	-	-	-	0.2	-	-	-	65.8

Table S6. Evolution of land use changes

The percentage of evolution of the change (Ev) for the current scenario was generated based on the surface of the land use classes that existed in 2008, in turn the current scenario served as the basis to determine the percentage of evolution of the scenarios projected towards 2047. The evolution of land use changes according to the projection of scenarios is presented in Table 6, in which it can be observed that scenario 1 was constructed with a 15.9% decrease in forest cover, with an 18.3% increase in reforestation areas and a 220.2% increase in secondary vegetation. Scenario 2 was projected with an increase of 85.9% of the area covered by forest, this increase is constituted by the addition of 1145.6 ha. of reforestation that are already established (over 5 years), plus 390 ha. of new reforestations that began to be established in 2017 (including areas of productive reconversion: from agricultural to forestry) and considering that the ecosystem would have the capacity to regenerate naturally in at least 200 ha. that would be established mainly in the Oyamel forest and in the Pino-Encino forest, plus the area of forest existing today. Scenario 3 was simulated with a 50.1% reduction in temperate forest areas, this decrease represents the loss of 975.1 hectares of forest, with an 81.7% decrease in reforestation areas, due to the persistence of high severity forest fires. , but with an increase of 32.8% in urban areas and 64.2% in seasonal agriculture.

Table S6. Evolution of land use changes according to the projection of scenarios.

Land use class	**Evolution (%)**		
Scenarios	**Current _2021**	**Positive _2047**	**Negative _2047**
Temperate forest	-15.9	85.9	-50.1
Reforestation	18.3	-35.1	-81.7
Secondary vegetation	220.2	-94.8	-12.8
Pastureland	-29.4	-97.3	313.4
Mine	43.6	1.2	30.5
Rainfed agriculture	-9.3	-38.7	64.2
Irrigation agriculture	-18.7	-48.2	-19.3
Protected agriculture	304.1	150.4	97.9
Urban	20.0	16.7	32.8
Water bodies	6.5	12.2	5.9

Figure S3. Validation of the water balance model

Texcoco River. Figure S3a shows the data of the monthly average flow observed and simulated, for the micro-basin of the Texcoco River within the validation period (2011-2014), the goodness of the validation fit indicates that the calibration of the model to predict the Hydrological response is good according to the estimators R2 = 0.67 and RSR = 0.52 and very good according to the results of the estimator NSE = 0.87. However, the value of PBIAS = 46.8 is classified as unsatisfactory because the model is underestimating 46.8% of the flow, this may be due to the fact that there has been a considerable increase in flow in recent years, due to the increase in water discharges residual that flow into the channel [31], going from 5.6 m^3/s (calibration period) to 13.1 m^3/s taking into account only the four years of the validation period.

Chapingo River. Figure S3b shows the observed and simulated monthly mean flow data for the Chapingo river micro-basin in the validation period (2001-2014), the goodness of fit indicates that the calibration of the model to predict the hydrological response of the micro-basin is satisfactory according to the value of the estimator R2 = 0.53 and very good according to SES = 0.77 and RSR = 0.48. However, as in the Texcoco river, the flow of the Chapingo river has increased, going from 6.5 m^3/s to 9.5 m^3/s mainly due to the discharge of residual water in the channel, this is reflected in the value of PBIAS = 47.3 that it means that the model is underestimating the flow rate by 47.3%, a value that is classified as unsatisfactory.

San Bernardino River. Figure S3c shows the observed and simulated monthly mean flow data for the San Bernardino river micro-basin within the validation period (2001-2003), the goodness of the simulation fit indicates that the calibration is unsatisfactory according to the PBIAS estimator = 40.9, but it is satisfactory according to the RSR = 0.70, good for R2 = 0.61 and very good according to the results of the NSE = 0.79 estimator.

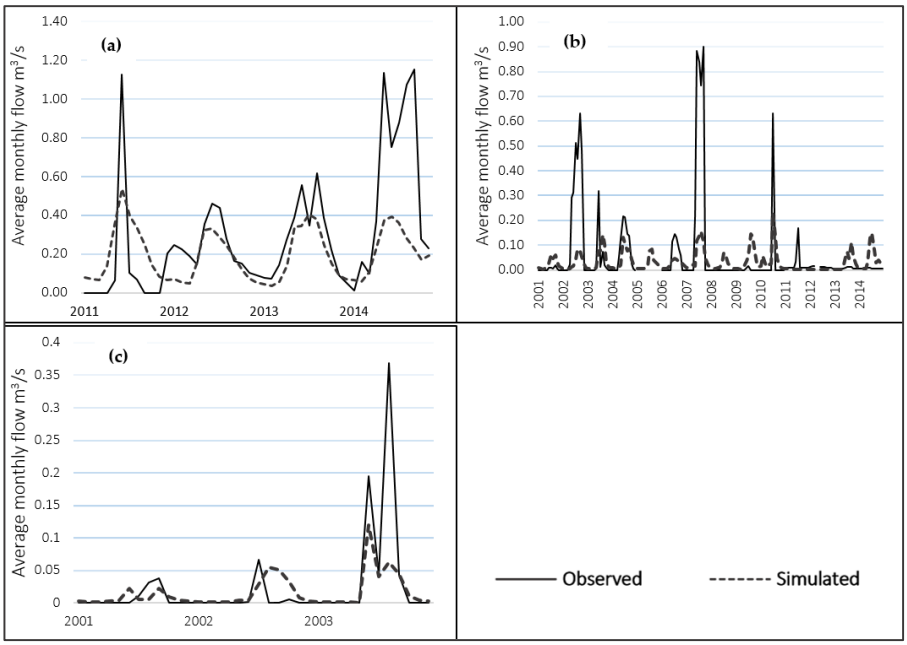


Figure S3. Average monthly flow simulated and observed in the validation periods: (a) Texcoco river, (b) Chapingo river and (c) San Bernardino river

Sensitivity analysis. According to Moriasi et al. [52] the assessment of model fit is less stringent in validation than in calibration, because model parameters are optimized during calibration and not during validation. According to the sensitivity analysis, although the validation presented values lower than those of the calibration period, it can be considered that the model maintained a satisfactory, good and very good general performance based on the classification of the ranges of the estimators in the three micro-basins. The difference between the ranges of the estimators of the calibration and validation period may be because the conditions in the validation period were significantly different, due to the increase in wastewater in the channels [31]. Even with this variation in the validation period, the performance of the model remained consistent with the R2 indices of 0.94, SES of 0.93, and RSR of 0.25 reported by Abera Abdi and Ayenew [70].