Supplementary Material 2 – Script for generating the dataset for the simulations

We used PostgreSQL11 with PostGIS extension.

-- Preparing the raw data
---- Importing the shapefiles into the SQL database from the DBManager of QGIS
------ Altitude: the 4 polygonised rasters of the BDALTI covering our study area : extra1.shp, extra2.shp, extra3.shp, extra4.shp
------ Sub-watersheds: sousbassinsversants.shp
------ Land use from 2009 to 2039 in our study area: total_scenario1_final_be2.shp
------ Wetlands from the SRCE in our study area: l_srce_zonehumide_s_r82_RGF_1993_esnet.shp
------ Protected and managed areas in our study area: onf_rb_2012_pub_esnet_acv.shp, n_enp_rnr_S_000_esnet_acv.shp, n_enp_rnn_s_r82_rgf_1993_esnet.shp, n_enp_pn_s_r82_rgf_1993_esnet.shp, n_enp_apb_s_r82_rgf_1993_esnet.shp, ens_locaux_zintervention.shp, ens_dptx_intervention.shp
------ Ecological corridors: n_srce_corridor_s_r82_RGF_1993_esnet.shp
---- Importing the correspondance table between the subwatershed codes and names (ssbv_codes) into the SQL database with Corresp_sws_names_codes.R

-- Creating the dataset for altitude (used later on for affecting scoring systems)
---- Creating a unique shapefile with areas under 1000m

```
drop table poly_inf1000;
create table poly_inf1000 as
with
extra1_fus as(select ST_union(geom) as geom from extra1 where dn<1000),
extra2_fus as(select ST_union(geom) as geom from extra2 where dn<1000),
extra3_fus as(select ST_union(geom) as geom from extra3 where dn<1000),
extra4_fus as(select ST_union(geom) as geom from extra4 where dn<1000),
tout as (select * from extra1_fus union all select * from extra2_fus union all select * from extra3_fus union all select * from extra4_fus)
select ST_SetSRID(ST_union(geom),2154) as geom from tout;
```

-- Codes used later on for the scoring systems
----301: Permanent grasslands
----302: Spring crops (SC) monocropping
----304: Winter crops (WC) monocropping
----306: Market gardening; horticulture
----307: Permanent crop (orchard, wine)
----308: 3 grasslands and 2 SC / 3 SC and 2 grasslands
----309: 3 grasslands and 2 WC / 3 WC and 2 grasslands
----310: 3 SC and 2 WC / 3 WC and 2 SC
----311: 3 or 4 grasslands + 1 or 2 other land use
----312: 3 or 4 SC with 1 grassland
----313: 3 or 4 SC without grassland
----314: 3 or 4 WC with 1 grassland
----315: 3 or 4 WC without grassland

----316: 2 grasslands, 1 SC, 1 other
----317: 2 grasslands, 1 WC, 1 other
----319: other crop rotation
----318: 2 WC, 2 SC, 1 other
----330: Arboriculture
----333: Poplar
----334: Hedgerow
----335: Other agricultural practice

-- Creating a table where each ID of the polygons of the study area is affected the name of the subwatershed where it is located. When the polygon is spread across several watersheds, it is affected to the subwatershed that is the most covered in terms of area. Used later on, on the code.

```
drop table link_id_sws;
create table link_id_sws as
with
t1 as(select * from total_scenario1_final_be2),
t2 as(select t1.*,ST_intersection(t1.geom,sousbassinsversants.geom) as new_geom,
ssbv_codes.nom as sws_name from t1 left join sousbassinsversants on
ST_Intersects(t1.geom, sousbassinsversants.geom) left join ssbv_codes on code=ssbv),
t3 as (select t2.id, sws_name, ST_area(new_geom)/ST_area(t2.geom) as ratio_bv from t2)
select distinct on (t3.id)
   t3.id,
   sws_name
from t3
order by t3.id, ratio_bv desc;
```

-- THE OFFSETTING NEEDS

---- Creating a shapfile of the offsetting need (map 1)

```
drop table offsetting_need_shp;
create table offsetting_need_shp as
with
t1 as(select * from total_scenario1_final_be2 where n1_2039=2 and n1_2009!=2), --
Selecting the polygons that are urbanised between 2009 and 2039
t2 as (select t1.*,sws_name from t1 left join link_id_sws using(id) where sws_name is not
null), -- Affecting the name of the most represented subwatershed to each polygon
t3 as (select ST_union(l_srce_zonehumide_s_r82_RGF_1993_esnet.geom) as geom from
l_srce_zonehumide_s_r82_RGF_1993_esnet), -- Creating an unique polygon of the wetlands
of the study area (enhances performance in the next step)
t4 as (select t2.*,ST_intersection(t2.geom,t3.geom) as new_geom from t2 left join t3 on
ST_Intersects(t2.geom,t3.geom) where ST_Intersects(t2.geom,t3.geom)), -- Selecting (by
cropping) the wetland polygons that are urbanised between 2009 and 2039
t4_dump as (select
id,n1_2009,n2_2009,n1_2014,n2_2014,n1_2019,n2_2019,n1_2024,n2_2024,n1_2029,n2_2
029,n1_2034,n2_2034,n1_2039,n2_2039,ss_site,sws_name,(ST_Dump(t4.new_geom)).geo
m as geom from t4), -- ST_Dump to have one single row of data per polygon (avoid
multipolygons), ensuring that we calculate relevant area later on
```

```
t5 as (select t4_dump.*, ST_area(geom)/10000 as surf_ha from t4_dump), -- Calculating
their area
t6 as(select t5.*, -- For each polygon of 2 subwatersheds, calculating the area ratio of the
polygon that is below 1000 m
CASE
WHEN st_intersects(t5.geom, poly_inf1000.geom)=TRUE and ss_site in ('Gresivaudan','Sud
Gresivaudan')
THEN (st_area(st_intersection(t5.geom, poly_inf1000.geom))/st_area(t5.geom))
WHEN st_intersects(t5.geom, poly_inf1000.geom)=FALSE and ss_site in ('Gresivaudan','Sud
Gresivaudan')
THEN 0
ELSE NULL
END

as ratio_inf1000 from t5,poly_inf1000),
t7 as(select t6.*, -- Affecting the name of the ecological scoring system to each polygon
CASE
WHEN ss_site in ('Bievre Valloire','Voironnais','Agglomeration Grenobloise') THEN 'intensive'
-- Intensive for these 3 subwatersheds
WHEN ss_site in ('Gresivaudan','Sud Gresivaudan') AND ratio_inf1000=1 THEN 'intensive' --
Intensive for the polygons of these 2 subwatershed when they are below 1000m
WHEN ss_site in ('Gresivaudan','Sud Gresivaudan') AND ratio_inf1000 >0 and
ratio_inf1000<1 THEN 'mixed' -- Mixed for the polygons of these 2 subwateshed when they
include areas below and over 1000m
ELSE 'extensive' -- Extensive for all the other polygons
END
as ecovalue_scoringsystem from t6),
t8 as(select t7.*, -- Affecting the ecological score per ha of each polygon according to the
ecological scoring system, and within it, according to the land use (see the section "Codes
used for the scoring systems" above, and appendix 1 for details)
CASE
WHEN ecovalue_scoringsystem in ('intensive') AND n2_2009 in
(302,304,306,307,310,313,315,318,319,335) THEN 1
WHEN ecovalue_scoringsystem in ('intensive') AND n2_2009 in (330,314,312) THEN 2
WHEN ecovalue_scoringsystem in ('intensive') AND n2_2009 in (333,316,317) THEN 3
WHEN ecovalue_scoringsystem in ('intensive') AND n2_2009 in (308,309) THEN 4
WHEN ecovalue_scoringsystem in ('intensive') AND n2_2009=311 THEN 5
WHEN ecovalue_scoringsystem in ('intensive') AND n2_2009 in (301,334) THEN 7

WHEN ecovalue_scoringsystem in ('extensive') AND n2_2009 in
(302,304,306,307,310,313,315,318,319,335) THEN 1
WHEN ecovalue_scoringsystem in ('extensive') AND n2_2009 in (330,314,312)THEN 3
WHEN ecovalue_scoringsystem in ('extensive') AND n2_2009 in (333,316,317) THEN 4
WHEN ecovalue_scoringsystem in ('extensive') AND n2_2009 in(308,309) THEN 5
WHEN ecovalue_scoringsystem in ('extensive') AND n2_2009=311 THEN 6
WHEN ecovalue_scoringsystem in ('extensive') AND n2_2009 in (301,334) THEN 7
```

```
WHEN ecovalue_scoringsystem in ('mixed') AND n2_2009 in
(302,304,306,307,310,313,315,318,319,335) THEN 1
WHEN ecovalue_scoringsystem in ('mixed') AND n2_2009 in (330,314,312) THEN
(ratio_inf1000*2+(1-ratio_inf1000)*3)
WHEN ecovalue_scoringsystem in ('mixed') AND n2_2009 in (333,316,317) THEN
(ratio_inf1000*3+(1-ratio_inf1000)*4)
WHEN ecovalue_scoringsystem in ('mixed') AND n2_2009 in(308,309) THEN
(ratio_inf1000*4+(1-ratio_inf1000)*5)
WHEN ecovalue_scoringsystem in ('mixed') AND n2_2009=311 THEN (ratio_inf1000*5+(1-
ratio_inf1000)*6)
WHEN ecovalue_scoringsystem in ('mixed') AND n2_2009 in (301,334) THEN 7
END
as ecovalue from t7)
select *,ecovalue*surf_ha as ecovalue_polygon from t8; -- Calculating the absolute
ecological score of the polygon (multiplying the ecological score by the area of the polygon)

---- Table synthesising the offsetting need, in terms of area and absolute ecological score,
per subwatershed
drop table offsetting_need;
create table offsetting_need as
select sws_name,sum(ecovalue_polygon) as ecovalue,sum(surf_ha) as surf_ha from
offsetting_need_shp group by sws_name order by sws_name;

-- WETLANDS ELIGIBLE FOR BIODIVERSITY OFFSETTING
---- Creating the shapefile of the response capacity (map 2)
------ Selecting all the wetlands of the study area in 2039
drop table wetlands_in_2039;
create table wetlands_in_2039 as
with
t1 as(select * from total_scenario1_final_be2), -- Selecting all the polygons of the study area
t2 as (select t1.*, sws_name from t1 left join link_id_sws using(id) where sws_name is not
null), -- Affecting the name of the most represented subwatershed to each polygon
t3 as(select ST_union(l_srce_zonehumide_s_r82_RGF_1993_esnet.geom) as geom from
l_srce_zonehumide_s_r82_RGF_1993_esnet), -- Creating an unique polygon of the wetlands
of the study area (enhances performance in the next step)
t4 as(select
id,n1_2009,n2_2009,n1_2014,n2_2014,n1_2019,n2_2019,n1_2024,n2_2024,n1_2029,n2_2
029,n1_2034,n2_2034,n1_2039,n2_2039,ss_site,sws_name,ST_intersection(t2.geom,t3.geo
m) as geom from t2 left join t3 on ST_Intersects(t2.geom,t3.geom) where
ST_Intersects(t2.geom,t3.geom)), -- Selecting the wetland polygons
t5 as (select
n1_2009,n2_2009,n1_2014,n2_2014,n1_2019,n2_2019,n1_2024,n2_2024,n1_2029,n2_202
9,n1_2034,n2_2034,n1_2039,n2_2039,ss_site,sws_name, (ST_Dump(geom)).geom as geom
from t4) -- ST_Dump to have one single row of data per polygon (avoid multipolygons),
ensuring that we calculate relevant area later on
select * from t5;
```

```
------ Creating a table of the jurisdictional wetlands of the study area : APB, PN, RNN, RNR, RB, ENS departementaux and ENS locaux
drop table jurisdictional_wetlands_in_2039;
create table jurisdictional_wetlands_in_2039 as
with
t1 as(select ST_union(onf_rb_2012_pub_esnet_acv.geom) as geom from onf_rb_2012_pub_esnet_acv), -- Creating a simple shapefile of the RB
t2 as(select ST_union(n_enp_rnr_S_000_esnet_acv.geom) as geom from n_enp_rnr_S_000_esnet_acv), -- Creating a simple shapefile of the RNR
t3 as(select ST_union(n_enp_rnn_s_r82_rgf_1993_esnet.geom) as geom from n_enp_rnn_s_r82_rgf_1993_esnet), -- Creating a simple shapefile of the RNN
t4 as(select ST_union(n_enp_pn_s_r82_rgf_1993_esnet.geom) as geom from n_enp_pn_s_r82_rgf_1993_esnet), -- Creating a simple shapefile of the PN
t5 as(select ST_union(n_enp_apb_s_r82_rgf_1993_esnet.geom) as geom from n_enp_apb_s_r82_rgf_1993_esnet), -- Creating a simple shapefile of the APB
t6 as(select ST_union(ST_buffer(ens_locaux_zintervention.geom,0.001)) as geom from ens_locaux_zintervention), -- Creating a simple shapefile of the ENS locaux
t7 as(select ST_union(ens_dptx_intervention.geom) as geom from ens_dptx_intervention), -- Creating a simple shapefile of the ENS Departementaux
tout as (select * from t1 union all select * from t2 union all select * from t3 union all select * from t4 union all select * from t5 union all select * from t6 union all select * from t7)-- merging all the shapefiles into a single one
select ST_union(geom) as geom from tout;

------ Creating a table of the eligible wetlands in 2039 = removing the jurisdictional wetlands from the wetland polygons of the study area
drop table eligible_wetlands_in_2039;
create table eligible_wetlands_in_2039 as
with
t1 as(select wetlands_in_2039.*, ST_Difference(wetlands_in_2039.geom, jurisdictional_wetlands_in_2039.geom) as geom_diff from wetlands_in_2039,jurisdictional_wetlands_in_2039), -- Removing (by cropping) the jurisdictional wetlands from the wetland polygons of the study area
t2 as ( select *, (ST_Dump(geom_diff)).geom as new_geom from t1), -- ST_Dump to have one single row of data per polygon (avoid multipolygons), ensuring that we calculate relevant area later on
t3 as(select n1_2009,n2_2009,n1_2014,n2_2014,n1_2019,n2_2019,n1_2024,n2_2024,n1_2029,n2_2029,n1_2034,n2_2034,n1_2039,n2_2039,ss_site,sws_name, new_geom as geom from t2), -- Keeping only relevant fields
t4 as(select *, ST_area(geom)/10000 as surf_ha from t3 where n1_2039=3), -- Calculating each polygon area and selecting only rural land use (code 3)
t5 as(select * from t4 where surf_ha>=0.5) -- Removing the polygons below 0.5ha
select * from t5;
```

------ Affecting the ecological restoration potential of each polygon according to the ecological restoration potential scoring system, and within it, according to the land use (see the section "Codes used for the scoring systems" above, and appendix 1 for details)

```
drop table response_capacity_shp;
create table response_capacity_shp as
with
t1 as(select eligible_wetlands_in_2039.*, -- For each polygon of 2 subwatersheds, calculating the area ratio of the polygon that is below 1000 m
CASE
WHEN st_intersects(eligible_wetlands_in_2039.geom, poly_inf1000.geom)=TRUE and ss_site in ('Gresivaudan','Sud Gresivaudan')
THEN (st_area(st_intersection(eligible_wetlands_in_2039.geom, poly_inf1000.geom))/st_area(eligible_wetlands_in_2039.geom))
WHEN st_intersects(eligible_wetlands_in_2039.geom, poly_inf1000.geom)=FALSE and ss_site in ('Gresivaudan','Sud Gresivaudan')
THEN 0
ELSE NULL
END

as ratio_inf1000 from eligible_wetlands_in_2039,poly_inf1000),
t2 as(select t1.*, -- Affecting the name of the ecological restoration potentiel scoring system to each polygon
CASE
WHEN ss_site in ('Bievre Valloire','Voironnais','Agglomeration Grenobloise') THEN 'intensive' -- Intensive for these 3 subwatersheds
WHEN ss_site in ('Gresivaudan','Sud Gresivaudan') AND ratio_inf1000=1 THEN 'intensive' -- Intensive for the polygons of these 2 subwatershed when they are below 1000m
WHEN ss_site in ('Gresivaudan','Sud Gresivaudan') AND ratio_inf1000 >0 and ratio_inf1000<1 THEN 'mixed' -- Mixed for the polygons of these 2 subwateshed when they include areas below and over 1000m
ELSE 'extensive' -- Extensive for all the other polygons
END
as ecorestopot_scoringsystem from t1),
t3 as(select t2.*, -- Affecting the ecological restoration potential per ha of each polygon according to the ecological restoration potential scoring system, and within it, according to the land use (see the section "Codes used for the scoring systems" above, and appendix 1 for details)
CASE
WHEN ecorestopot_scoringsystem in ('intensive') AND n2_2039 in (302,304,306,307,310,313,315,318,319,335) THEN 6
WHEN ecorestopot_scoringsystem in ('intensive') AND n2_2039 in (330,314,312) THEN 5
WHEN ecorestopot_scoringsystem in ('intensive') AND n2_2039 in (333,316,317) THEN 4
WHEN ecorestopot_scoringsystem in ('intensive') AND n2_2039 in (308,309) THEN 3
WHEN ecorestopot_scoringsystem in ('intensive') AND n2_2039=311 THEN 2
WHEN ecorestopot_scoringsystem in ('intensive') AND n2_2039 in (301,334) THEN 0
```

```
WHEN ecorestopot_scoringsystem in ('extensive') AND n2_2039 in
(302,304,306,307,310,313,315,318,319,335) THEN 6
WHEN ecorestopot_scoringsystem in ('extensive') AND n2_2039 in (330,314,312)THEN 4
WHEN ecorestopot_scoringsystem in ('extensive') AND n2_2039 in (333,316,317) THEN 3
WHEN ecorestopot_scoringsystem in ('extensive') AND n2_2039 in(308,309) THEN 2
WHEN ecorestopot_scoringsystem in ('extensive') AND n2_2039=311 THEN 1
WHEN ecorestopot_scoringsystem in ('extensive') AND n2_2039 in (301,334) THEN 0

WHEN ecorestopot_scoringsystem in ('mixed') AND n2_2039 in
(302,304,306,307,310,313,315,318,319,335) THEN 6
WHEN ecorestopot_scoringsystem in ('mixed') AND n2_2039 in (330,314,312) THEN
(ratio_inf1000*5+(1-ratio_inf1000)*4)
WHEN ecorestopot_scoringsystem in ('mixed') AND n2_2039 in (333,316,317) THEN
(ratio_inf1000*4+(1-ratio_inf1000)*3)
WHEN ecorestopot_scoringsystem in ('mixed') AND n2_2039 in(308,309) THEN
(ratio_inf1000*3+(1-ratio_inf1000)*2)
WHEN ecorestopot_scoringsystem in ('mixed') AND n2_2039=311 THEN
(ratio_inf1000*2+(1-ratio_inf1000)*1)
WHEN ecorestopot_scoringsystem in ('mixed') AND n2_2039 in (301,334) THEN 0
END
as ecorestopot from t2),
t4 as (select row_number() over() as unique_id,*,ecorestopot*surf_ha as
ecorestopot_polygon from t3), -- Calculating the absolute ecological restoration potential of
the polygon (multiplying the ecological restoration potential by the area of the polygon)
t5 as (select st_union(geom) as geom from n_srce_corridor_s_r82_rgf_1993_esnet), -- One
single clean shape for corridors//
t6 as (select t4.*,ST_intersects(t4.geom,t5.geom) as in_eco_corridor from t4,t5)
select * from t6

---- Table synthesising the response capacity, in terms of area and absolute ecological
restoration potential, per subwatershed
drop table response_capacity;
create table response_capacity as
select sws_name,sum(ecorestopot_polygon) as ecorestopot,sum(surf_ha) as surf_ha from
response_capacity_shp group by sws_name order by sws_name;
```