Former Yugoslav Republic of Macedonia

Land cover 2012

Overview of land cover & change 2006-2012

The period 2006-2012 in the former Yugoslav Republic of Macedonia is characterized by an average speed of land cover exchange, compared to other European countries. The annual land cover change rate – 0.17% shows, that the intensity of landscape development in the country, is only a bit higher than in the previous period. However, most of this exchange is represented by internal forest conversions, with prevailing share of recent felling and transition. Also the increase of the overall land cover change rate is caused by acceleration of these flows.

Agriculture internal conversions are the second most significant drivers of change in the country, followed by sprawl of economic sites and infrastructures. However, their intensity is much lower, compared to forest internal exchanges.

The intensity of artificial land take is showing a decreasing tendency. However, the annual sprawl rate of the former Yugoslav Republic of Macedonia (0.47%) is still one of the highest among European countries. The sprawl in the country is driven mainly by extension of mines, quarries and dumpsites and construction.

Note: The results presented here are based on a change analysis of 44 land cover types mapped consistently on a 1:100,000 scale across Europe over more than decade between 2000-2006-2012 - see Corine land cover (CLC) programme for details.

Number of years between CLC2006-CLC2012 data for the former Yugoslav Republic of Macedonia: 6

<table>
<thead>
<tr>
<th>Land cover 2006</th>
<th>423</th>
<th>3075</th>
<th>6149</th>
<th>12658</th>
<th>2349</th>
<th>111</th>
<th>19</th>
<th>535</th>
<th>25319</th>
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<tbody>
<tr>
<td>Consumption of initial LC</td>
<td>6.4</td>
<td>27.5</td>
<td>10.1</td>
<td>212.2</td>
<td>5.7</td>
<td>0.2</td>
<td>0.5</td>
<td>0.6</td>
<td>263</td>
</tr>
<tr>
<td>Formation of new LC</td>
<td>12.7</td>
<td>19.7</td>
<td>12.2</td>
<td>207.9</td>
<td>4.0</td>
<td>4.0</td>
<td>0.7</td>
<td>2.0</td>
<td>263</td>
</tr>
<tr>
<td>Net Formation of LC</td>
<td>6.4</td>
<td>-7.8</td>
<td>2.1</td>
<td>-4.3</td>
<td>-1.7</td>
<td>3.8</td>
<td>0.2</td>
<td>1.4</td>
<td>0</td>
</tr>
<tr>
<td>Net formation as % of initial year</td>
<td>1.5</td>
<td>-0.3</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.1</td>
<td>3.4</td>
<td>0.9</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Total turnover of LC</td>
<td>19.1</td>
<td>47.1</td>
<td>22.3</td>
<td>420.0</td>
<td>9.7</td>
<td>4.2</td>
<td>1.3</td>
<td>2.5</td>
<td>526</td>
</tr>
<tr>
<td>Total turnover as % of initial year</td>
<td>4.5</td>
<td>1.5</td>
<td>0.4</td>
<td>3.3</td>
<td>0.4</td>
<td>3.7</td>
<td>6.5</td>
<td>0.5</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Land cover 2012

| Land cover 2012 | 430 | 3067 | 6151 | 12654 | 2347 | 115 | 20 | 537 | 25319 |

Summarized balance table 2006-2012
Land cover trends comparison 2000-2006 vs. 2006-2012

2.4. Annual land cover change
[ha/year, % of total area]

2.5. Annual turnover of LC types
[ha/year]

2.6. Net annual change of LC types [ha/year]

Summary trend figures

<table>
<thead>
<tr>
<th></th>
<th>2000-2006</th>
<th>2006-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual land cover change [ha/year]</td>
<td>3501</td>
<td>4385</td>
</tr>
<tr>
<td>Annual land cover change as % of initial year</td>
<td>0.14%</td>
<td>0.17%</td>
</tr>
<tr>
<td>Land uptake by artificial development as mean annual change [ha/year]</td>
<td>263</td>
<td>198</td>
</tr>
<tr>
<td>Agricultural land uptake by urban and infrastructures development as mean annual change [ha/year]</td>
<td>266</td>
<td>139</td>
</tr>
<tr>
<td>Net uptake of forests and semi-natural land by agriculture as mean annual change [ha/year]</td>
<td>-52</td>
<td>-19</td>
</tr>
<tr>
<td>Net conversion from pasture to arable land and permanent crops as mean annual change [ha/year]</td>
<td>-10</td>
<td>-2</td>
</tr>
<tr>
<td>Forest &amp; other woodland net formation as mean annual change [ha/year]</td>
<td>4</td>
<td>-72</td>
</tr>
<tr>
<td>Dry semi-natural land cover net formation as mean annual change [ha/year]</td>
<td>-94</td>
<td>35</td>
</tr>
<tr>
<td>Wetlands &amp; water bodies net formation as mean annual change [ha/year]</td>
<td>149</td>
<td>26</td>
</tr>
</tbody>
</table>

2.7. Intensity of main change drivers (LC FLOWS) [ha/year]
Residential sprawl disappeared

The pace of artificial development in the former Yugoslav Republic of Macedonia is getting slower, compared to the period 2000-2006. Recently, the land take is driven mostly by extension of mines, quarries and dumpsites, followed by construction. The residential sprawl, which was the main driver of artificial development in the previous period, became rather neglectable in the period 2006-2012.

The sprawl is still concentrated mainly into the surroundings of the capital city Skopje, with two other major patches observable in the southern part of the country, representing extension of quarries. This extension of mines is compensated by the opposite conversion of developed areas mainly to agriculture, which occurs in the same mining resort.


Formation of rice fields through conversion from pasture

The volume of agricultural exchange in former Yugoslav Republic of Macedonia is rather low in the long term, with prevailing internal agriculture flows. Both directions of conversion between arable/crop land and pasture have approximately the same intensity in the period 2006-2012, which, in both cases, is slightly higher than in the previous period. However, the most significant internal agricultural flow in the last period is the conversion from arable land to permanent irrigation perimeters, which causes an increase of rice fields’ area by 17%. This formation has not been observed in the previous period. The other relatively frequent internal agriculture conversions occur between vineyards/orchards and non-irrigated arable land. Again, they have comparable intensity in both directions, which, however, means significant slowdown (by more than half) of conversion from vineyards/orchards to non-irrigated arable land. Externally, the agricultural land is consumed by the sprawl of economic sites/infrastructures and there also occurs few examples of withdrawal of farming with woodland creation. On the other hand, new agricultural land has been created through conversion from developed areas (mainly dumpsites).

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**4.12. Agricultural areas 2012 [% of total area]**

- Non-irrigated arable land: 211 (27%)
- Permanently irrigated land: 242 (25%)
- Rice fields: 212 (3%)
- Vineyards: 213 (3%)
- Fruit trees and berry plantations: 222 (3%)
- Olive groves: 223 (3%)
- Pastures: 231 (21%)
- Annual crops associated with permanent crops: 244 (1%)
- Complex cultivation patterns: 243 (0.2%)
- Agriculture land with significant areas of natural vegetation: 241 (0.2%)
- Agro-forestry areas: 242 (1%)


- Consumption of initial land cover
- Formation of new land cover

**4.14. Mean annual agricultural change by class [ha/year]**

- Non-irrigated arable land
- Permanently irrigated land
- Rice fields
- Vineyards
- Fruit trees and berry plantations
- Olive groves
- Pastures
- Annual/ permanent crops
- Complex cult. patterns
- Agriculture land with nat. veg.
- Agro-forestry areas

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4.12. Agricultural areas 2012 [% of total area]


4.14. Mean annual agricultural change by class [ha/year]
**Internal forest conversions even more intensive**

Forest creation and management is by far the most frequent conversion in the landscape of the former Yugoslav Republic of Macedonia, with significantly increased intensity, compared to the previous period. However, it is almost exclusively driven by internal forest conversions, with prevailing share of recent felling and transition. Beside these internal flows, there also occurs forest creation/afforestation, represented by conversion from agricultural land with natural vegetation, pastures and former construction sites into mainly transitional woodland/shrub or broad-leaved forest. Semi-natural creation (represented by conversion from transitional woodland and shrub into mainly semi-natural grassland) and forest fires were also observed during the period 2006-2012 in this country. On the other hand, water bodies’ creation, which was quite significant in the previous period, lost most of its intensity.
Annex: Land cover flows and trends

*Land cover flows 2006-2012*

6.18. Consumption of land cover 2006-2012 [% of total change area]

6.19. Formation of land cover 2006-2012 [% of total change area]

6.20. Drivers of change (LC FLOWS) 2006-2012 [% of total change area]
**Former Yugoslav Republic of Macedonia**

**Artificial areas**

7.21. Consumption by artificial land take 2006-2012 [% of total]

- Semi-natural vegetation: 5%
- Arable land & permanent crops: 41%
- Forested land: 25%
- Pastures & mosaics: 29%

7.22. Formation by artificial land take 2006-2012 [% of total]

- Sport/leisure: 1%
- Disc. urban fabric: 2%
- Industrial/commer.: 15%
- Airports: 2%
- Dump sites: 22%
- Mineral extraction: 41%

7.23. Net formation of artificial area [ha/year, % of initial year]

- 2000-2006: 0.44%
- 2006-2012: 0.25%

7.24. Artificial development by change drivers (LC FLOWS) [ha/year]

- lcf11 Urban development/infilling (cons.)
- lcf11 Urban development/infilling (form.)
- lcf12 Recycling of developed urban land (cons.)
- lcf12 Recycling of developed urban land (form.)
- lcf13 Development of green urban areas (cons.)
- lcf13 Development of green urban areas (form.)
- lcf21 Urban dense residential sprawl
- lcf22 Urban diffuse residential sprawl
- lcf31 Sprawl of industrial & commercial sites
- lcf32 Sprawl of transport networks
- lcf33 Sprawl of harbours
- lcf34 Sprawl of airports
- lcf35 Sprawl of mines and quarrying areas
- lcf36 Sprawl of dumpsites
- lcf37 Construction
- lcf38 Sprawl of sport and leisure facilities (cons.)
- lcf38 Sprawl of sport and leisure facilities (form.)
- lcf54 Conversion from developed areas to agriculture
- lcf72 Forest creation, afforestation
- lcf81 Water bodies creation
- lcf911 Semi-natural creation
- lcf913 Extension of water courses
- lcf92 Forests and shrubs fires
- lcf93 Coastal erosion
- lcf99 Other changes and unknown (cons.)
- lcf99 Other changes and unknown (form.)
**Agriculture**

**8.25. LC consumed by agriculture 2006-2012 [% of total]**

- Natural grassland 22%
- Construct. 12%
- Dump sites 62%
- Transition, woodland/shrub 4%

**8.26. Formation of agricultural land from non-agriculture 2006-2012 [% of total]**

- Agriculture with natural veg. 5%
- Non-irrigated arable 1%
- Rice fields 1%
- Construct. 5%
- Complex cultivation patterns 29%
- Pastures 64%

**8.27. Consumption of agricultural land by non-agriculture 2006-2012 [% of total]**

- Agriculture with natural veg. 14%
- Complex cultivation patterns 9%
- Pastures 31%
- Vineyards 8%
- Fruit trees/berry plantations 3%

**8.28. Formation of non-agricultural land from agriculture 2006-2012 [% of total]**

- Non-irrigated arable 34%
- Transition, woodland/shrub 16%
- Agro-forestry areas 1%
- Fruit trees/berry plantations 3%
- Pastures 31%
- Complex cultivation patterns 9%

**8.29. Main annual conversions between agriculture and forests & semi-natural land 2006-2012 [ha/year]**

- Conversion from forest to agriculture
- Conversion from dry semi-natural & natural land to agriculture
- Conversion from wetlands to agriculture
- Withdrawal of farming with woodland creation
- Withdrawal of farming without significant woodland creation

**8.30. Mean annual conversion between arable land and pasture [ha/year]**

- Extension of pasture, set aside and fallow land
- Conversion from pasture to arable and permanent crops
9.31. Mean annual agriculture internal conversions [ha/year]

- lcf411 Uniform extension of set aside fallow land and pasture
- lcf412 Diffuse extension of set aside fallow land and pasture
- lcf421 Conversion from arable land to permanent irrigation perimeters
- lcf422 Other internal conversions of arable land
- lcf431 Conversion from olives groves to vineyards and orchards
- lcf432 Conversion from vineyards and orchards to olive groves
- lcf433 Other conversions between vineyards and orchards
- lcf441 Conversion from permanent crops to permanent irrigation perimeters
- lcf442 Conversion from vineyards and orchards to non-irrigated arable land
- lcf443 Conversion from olive groves to non-irrigated arable land
- lcf444 Diffuse conversion from permanent crops to arable land
- lcf451 Conversion from arable land to vineyards and orchards
- lcf452 Conversion from arable land to olive groves
- lcf453 Diffuse conversion from arable land to permanent crops
- lcf461 Conversion from pasture to permanent irrigation perimeters
- lcf462 Intensive conversion from pasture to non-irrigated arable land and permanent crops
- lcf463 Diffuse conversion from pasture to arable and permanent crops
- lcf47 Extension of agroforestry

9.32. Mean annual conversions between agriculture and other LC types [ha/year]

- lcf13 Development of green urban areas
- lcf2 Urban residential sprawl
- lcf3 Sprawl of economic sites and infrastructures
- lcf511 Intensive conversion from forest to agriculture
- lcf512 Diffuse conversion from forest to agriculture
- lcf521 Intensive conversion from semi-natural land to agriculture
- lcf522 Diffuse conversion from semi-natural land to agriculture
- lcf523 Conversions from agriculture-nature mosaics to continuous agriculture (cont. agri. cons.)
- lcf523 Conversions from agriculture-nature mosaics to continuous agriculture (cont. agri. form.)
- lcf53 Conversion from wetlands to agriculture
- lcf54 Conversion from developed areas to agriculture
- lcf61 Withdrawal of farming with woodland creation
- lcf62 Withdrawal of farming without significant woodland creation
- lcf81 Water bodies creation
- lcf913 Extension of water courses
- lcf92 Forests and shrubs fires
- lcf93 Coastal erosion
- lcf99 Other changes and unknown (agri. cons.)
- lcf99 Other changes and unknown (agri. form.)
Former Yugoslav Republic of Macedonia

Forest & nature

10.33. LC consumed by forest & nature 2006-2012 [% of total]

- Agriculture with natural veg. 23%
- Pastures 32%
- Complex cultivation patterns 5%
- Agro-forestry areas 3%
- Disc. urban fabric 1%
- Construct. 36%

10.34. Formation of forest & nature land from non-forest/nature 2006-2012 [% of total]

- Broad-leaved forest 16%
- Inland marshes 3%
- Water bodies 11%
- Transition, woodland/shrub 70%

10.35. Consumption of forest & nature land by non-forest/nature 2006-2012 [% of total]

- Broad-leaved forest 19%
- Coniferous forest 1%
- Mixed forest 1%
- Natural grassland 34%
- Moors and heathland 2%
- Transition, woodland/shrub 42%

10.36. Formation of non-forest/nature land from forest & nature 2006-2012 [% of total]

- Agriculture with natural veg. 2%
- Disc. urban fabric 2%
- Mineral extraction 22%
- Dump sites 18%
- Construct. 30%
- Non-irrigated arable 1%
- Rice fields 1%
- Complex cultivation patterns 24%

10.37. Forested land 2012 [% of total area]

- Broad-leaved forest 57%
- Mixed forest 4%
- Conifer. forest 4%
- Transit. woodland/shrub 35%

10.38. Main trends in woodland & forests consumption/formation 2006-2012 [ha/year]

- Consumption of forest land by urban sprawl
- Conversion from forest to agriculture
- Recent fellings and transitions
- Withdrawal of farming with woodland creation
- Forest creation, afforestation
- Conversion from transitional woodland to forests
- Forest creation over wetlands
**11.39. Dry semi-natural areas 2012 [% of total area]**

- Natural grassland: 78%
- Moors and heathland: 6%
- Sclerophyllous vegetation: 12%
- Beaches, dunes, and sand plains: 0.2%
- Bare rock: 0.1%
- Sparse vegetation: 4%
- Burnt areas: 0.1%

**11.40. Main trends in dry semi-natural land consumption/formation 2006-2012 [ha/year]**

- Consumption of dry semi-natural land cover by urban sprawl
- Conversion of semi-natural land cover to agriculture
- Forest creation, afforestation over dry semi-natural land
- Withdrawal of farming without woodland creation
- Decrease of permanent snow and glaciers

**11.41. Wetlands & water 2012 [% of total area]**

- Inland marshes: 3%
- Water courses: 2%
- Water bodies: 95%

**11.42. Main trends in wetlands & water consumption/formation 2006-2012 [ha/year]**

- Consumption of wetlands by urban sprawl
- Conversion of wetlands to agriculture
- Forest creation and afforestation over wetlands
- Withdrawal of farming without woodland creation
- Net water bodies creation
- Net wetlands creation

**11.43. Mean annual conversions of forest & other woodland [ha/year]**

- lcf13 Development of green urban areas
- lcf2 Urban residential sprawl
- lcf3 Sprawl of economic sites and infrastructures
- lcf511 Intensive conversion from forest to agriculture
- lcf512 Diffuse conversion from forest to agriculture
- lcf61 Withdrawal of farming with woodland creation
- lcf71 Conversion from transitional woodland to forest (cons.)
- lcf71 Conversion from transitional woodland to forest (form.)
- lcf72 Forest creation, afforestation
- lcf73 Forests internal conversions (cons.)
- lcf73 Forests internal conversions (form.)
- lcf74 Recent felling and transition (cons.)
- lcf74 Recent felling and transition (form.)
- lcf8 Water bodies creation and management
- lcf9 Changes of land cover due to natural and multiple causes (cons.)
- lcf9 Changes of land cover due to natural and multiple causes (form.)
12.44. Mean annual conversions of dry semi-natural LC [ha/year]

- lcf13 Development of green urban areas
- lcf2 Urban residential sprawl
- lcf3 Sprawl of economic sites and infrastructures
- lcf521 Intensive conversion from semi-natural land to agriculture
- lcf522 Diffuse conversion from semi-natural land to agriculture
- lcf523 Conversions from agriculture-nature mosaics to continuous.
- lcf62 Withdrawal of farming without significant woodland creation
- lcf72 Forest creation, afforestation
- lcf74 Recent felling and transition
- lcf8 Water bodies creation and management
- lcf82 Water bodies management
- lcf911 Semi-natural creation (form.)
- lcf912 Semi-natural rotation (cons.)
- lcf912 Semi-natural rotation (form.)
- lcf913 Extension of water courses (cons.)
- lcf92 Forests and shrubs fires (cons.)
- lcf92 Forests and shrubs fires (form.)
- lcf93 Coastal erosion (cons.)
- lcf94 Decrease in permanent snow and glaciers cover (cons.)
- lcf94 Decrease in permanent snow and glaciers cover (form.)
- lcf99 Other changes and unknown (cons.)
- lcf99 Other changes and unknown (form.)

12.45. Mean annual conversions of wetlands and water LC [ha/year]

- lcf13 Development of green urban areas
- lcf2 Urban residential sprawl
- lcf3 Sprawl of economic sites and infrastructures
- lcf53 Conversion from wetlands to agriculture
- lcf62 Withdrawal of farming without significant woodland creation
- lcf72 Forest creation, afforestation
- lcf8 Water bodies creation and management (cons.)
- lcf81 Water bodies creation
- lcf9 Changes of land cover due to natural and multiple causes (other than LCF91)
- lcf9 Changes of land cover due to natural and multiple causes (other than LCF912)
- lcf911 Semi-natural creation (form.)
- lcf912 Semi-natural rotation (cons.)
- lcf912 Semi-natural rotation (form.)
- lcf913 Extension of water courses (form.)
Drivers of change 2006-2012

**Dominant Land Cover Flow:**
- **lcf1** Urban land management
- **lcf2** Urban residential sprawl
- **lcf3** Sprawl of economic sites and infrastructures
- **lcf4** Agriculture internal conversions
- **lcf5** Conversion from forested & natural land to agriculture
- **lcf6** Withdrawal of farming
- **lcf7** Forests creation and management (except lcff4)
- **lcf8** Water bodies creation and management
- **lcf9** Changes of land cover due to natural and multiple causes

**Green landscape**
- 70% of pasture, forest and natural land in a 5km neighbourhood