ENVIRONMENTAL-ECONOMIC ACCOUNTING

Land use of food products
2010 – 2017

2019
Contents

List of tables ......................................................  4
List of figures ......................................................  5
List of abbreviations ................................................  5
Introduction .......................................................  6

1 Land-use for food of plant and animal origin .................  7
   1.1 Agricultural land – domestic and abroad ....................  7
   1.2 Land-use of domestic consumption .........................  9

2 Land-use of products of animal origin ......................... 10
   2.1 Land-use of fodder crops ..................................  10
   2.2 Land-use of products of animal origin ....................  12
   2.3 Land-use of domestic production, imports and exports ....  13
   2.4 Land-use per capita .........................................  14

3 Land-use of plant products ....................................... 15
   3.1 Methodology ...............................................  15
   3.2 Imports ...................................................  16
   3.3 Exports ...................................................  22
   3.4 Import share of exports ..................................... 26
   3.5 Domestic use of plant-based food products ..................  27
   3.6 Analysis of selected products ..............................  29
List of tables

Table 1  Land-use – domestic and abroad – for food products of plant and animal origin .......................... 8
Table 2  Land-use for nutritional purposes, exports and domestic consumption ........................................ 10
Table 3  Feed consumption by livestock and related land-use in 2017 ........................................ 11
Table 4  Fodder and land-use by region of origin .......................................................... 12
Table 5  Land-use of products of animal origin for domestic production, imports, exports and domestic consumption 2017 .... 13
Table 6  Land-use in m² per capita for products of animal origin – domestic consumption ........................ 14
Table 7  Import volumes of crop products according chapters of trade statistics .................................. 16
Table 8  Land-use of imported crop products according to trade statistics ........................................ 17
Table 9  Import volume of crop products by supplying country .................................................. 19
Table 10  Land-use of imported crop products by growing countries ........................................... 20
Table 11  Land-use of crop products by product families 2017 ................................................ 21
Table 12  Exports of plant products by trade statistics chapters ................................................ 22
Table 13  Land-use of plant product exports by trade statistics chapters ........................................... 23
Table 14  Export volume of crop products by countries of destination ............................................... 24
Table 15  Land-use of exported crop products by product family 2017 ........................................... 25
Table 16  Area-coefficients of selected products ................................................................. 29
Table 17  Area coefficient of chocolate ............................................................ 29
Contents

List of figures

Figure 1  Domestic agricultural land by type of use in 2017  ................  7
Figure 2  Land used for domestically produced fodder and for imported feed 2017  ..............................................  11
Figure 3  Land-use of domestic production and imports of fodder and imports and exports of food products of animal origin  ............  14
Figure 4  Land-use of imported crop products by processing stages  ..........  17
Figure 5  Land-use of imports by land categories 2017  .........................  18
Figure 6  Land-use of imported products of plant origin by product families  21
Figure 7  Land-use of exports by processing stages  ..............................................  24
Figure 8  Land-use of exports of plant based food products 2017  ............  26
Figure 9  Import share of exports  ..................................................  27
Figure 10 Land-use of domestic consumption of food products  ......................  28
Figure 11 Land-use of imports intended for domestic use by food categories 2017  ..............................................  28

List of abbreviations

BLE  = Bundesanstalt für Landwirtschaft und Ernährung/Federal Agency of Food and Agriculture
BMEL  = Bundesministerium für Landwirtschaft und Ernährung/Federal Ministry of Food and Agriculture
FAO  = Food and Agriculture Organization of the United Nations
mn  = Million
ha  = Hectares
kg  = Kilogram
g  = Gramm
t  = tons
m²  = Square meter
Kcal  = Kilocalorie
%  = Percentage
X  = Entry blocked, because statement not plausible.

Discrepancies in totals are due to roundings.
Introduction

Worldwide agricultural land is increasingly becoming a scarce resource. The main reasons are:

- Population growth resulting in higher demand for food.
- Increased energy crop cultivation requiring more agricultural land.
- Changes in nutritional habits increasing the consumption of luxury foods such as coffee and chocolate, fast food with high land use.
- A growing dietary share of animal proteins and fats requires a higher land use than a plant-based diet.

Cultivating agricultural raw materials like oil seeds and fruits abroad often has high environmental impacts, such as slash-and-burn practices and high pesticide and industrial fertilizers use. Slash-and-burn-practices produce large volumes of harmful greenhouse gases. Additionally, they cause a high loss of species in the rain forest. Besides these environmental impacts the focus on export-oriented agriculture results in severe social problems such as the marginalization of small farmers.

Industrial farming in Germany is leading to increased land use in foreign countries. Rising exports of agricultural goods and food products cause a higher demand for imported agricultural raw materials, which are used to produce these exports. This particularly concerns exports of animal products, especially meat, milk and dairy products. Domestic fattening farms and dairy farms use increasingly imported protein to feed the livestock. Increased exports also require more domestic land. In addition more and more land is used to cultivate energy crop, leaving less land available for growing domestically consumed food products. This “gap” was partly compensated by increased land-use abroad.

A comprehensive description of the concepts used to calculate land use of food products is provided in the methodological paper “Land use of food products – methods and concepts 2018”. Additional results for land use of products of animal origin are published in the paper “Land use of products of animal origin 2010 – 2017”.

1 Both reports can be downloaded here
1 Land-use for food of plant and animal origin

1.1 Agricultural land – domestic and abroad

Increasing land-use of imports and exports of food of plant and animal origin

Agricultural land is used for growing food products and other agricultural raw materials like energy crops. Land for food products can be divided in “land used for products of animal origin” and “land used for products of plant origin”.

The basis for calculating land-use of imports and exports of food products is the foreign trade statistics, which collects data on the volume of imports and exports. In a computational model data on the land used for agricultural raw materials is determined. In this model imports and exports of fodder are allocated to the category “animal origin”.

In 2017, agricultural land in Germany totaled to 16.7 million ha (cf. Table 1), of which 14.0 million ha were used for nutritional purposes: 9.6 million ha for growing fodder and 4.5 million ha for plant based food products. In 2010 land used for nutritional purposes was 14.7 million ha. This corresponds to a decrease of 4.2 %. This decrease reflects land used for fodder crops (– 6.4 %) whereas land used for plant based food increased slightly by 0.9 %.

In 2017 57.2 % of total domestic agricultural land was used for growing fodder plants, 26.9 % for cultivating vegetable based food crops and 12.1 % for growing energy plants. (cf. Figure 1).

Figure 1 Domestic agricultural land by type of use in 2017
Among the 16.7 million ha (2017) of agricultural land, 11.8 million ha were arable land, 4.7 million ha were permanent cropland. The remainder is used for tree nurseries, orchards, Christmas tree nurseries and domestic gardens and vegetables plots.

<table>
<thead>
<tr>
<th>Categories</th>
<th>2010</th>
<th>2014</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>in 1,000 ha</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land-use for agriculture</td>
<td>16,704</td>
<td>16,725</td>
<td>16,687</td>
<td>- 0.1</td>
</tr>
<tr>
<td>Thereof:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fodder</td>
<td>10,205</td>
<td>9,600</td>
<td>9,552</td>
<td>- 6.4</td>
</tr>
<tr>
<td>Plant based nutrition</td>
<td>4,458</td>
<td>4,573</td>
<td>4,497</td>
<td>0.9</td>
</tr>
<tr>
<td>Energy plants</td>
<td>1,445</td>
<td>2,085</td>
<td>2,014</td>
<td>39.4</td>
</tr>
<tr>
<td>Industrial use</td>
<td>343</td>
<td>279</td>
<td>307</td>
<td>- 10.6</td>
</tr>
<tr>
<td>Fallow land, land set-aside</td>
<td>252</td>
<td>189</td>
<td>318</td>
<td>25.8</td>
</tr>
<tr>
<td>Exports</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant origin</td>
<td>6,330</td>
<td>6,428</td>
<td>7,039</td>
<td>11.2</td>
</tr>
<tr>
<td>Animal origin</td>
<td>5,405</td>
<td>5,151</td>
<td>5,119</td>
<td>- 5.3</td>
</tr>
<tr>
<td>Total</td>
<td>11,735</td>
<td>11,579</td>
<td>12,158</td>
<td>3.6</td>
</tr>
<tr>
<td>Thereof imports</td>
<td>4,258</td>
<td>4,862</td>
<td>5,215</td>
<td>22.5</td>
</tr>
<tr>
<td>Plant origin</td>
<td>3,141</td>
<td>3,635</td>
<td>3,994</td>
<td>27.1</td>
</tr>
<tr>
<td>Animal origin</td>
<td>1,117</td>
<td>1,227</td>
<td>1,221</td>
<td>9.3</td>
</tr>
<tr>
<td>Imports</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17,671</td>
<td>18,049</td>
<td>19,024</td>
<td>7.7</td>
</tr>
<tr>
<td>Animal origin</td>
<td>4,519</td>
<td>4,181</td>
<td>4,870</td>
<td>7.8</td>
</tr>
<tr>
<td>Plant origin</td>
<td>13,152</td>
<td>13,868</td>
<td>14,154</td>
<td>7.6</td>
</tr>
<tr>
<td>Thereof for domestic use</td>
<td>10,011</td>
<td>10,233</td>
<td>10,161</td>
<td>1.5</td>
</tr>
<tr>
<td>Thereof:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fodder</td>
<td>2,800</td>
<td>3,137</td>
<td>3,084</td>
<td>10.1</td>
</tr>
<tr>
<td>Industrial use, energy use</td>
<td>1,603</td>
<td>2,001</td>
<td>2,156</td>
<td>34.5</td>
</tr>
<tr>
<td>Nutrition</td>
<td>8,750</td>
<td>8,730</td>
<td>8,915</td>
<td>1.9</td>
</tr>
<tr>
<td>Domestic consumption of food products</td>
<td>19,038</td>
<td>18,784</td>
<td>19,082</td>
<td>0.2</td>
</tr>
<tr>
<td>Plant origin</td>
<td>7,759</td>
<td>7,768</td>
<td>7,450</td>
<td>- 4.0</td>
</tr>
<tr>
<td>Animal origin</td>
<td>11,279</td>
<td>11,016</td>
<td>11,632</td>
<td>3.1</td>
</tr>
</tbody>
</table>

1 Federal Statistical Office, Subject matter Series 3, Land- and Forstwirtschaft, Fischerei; Series 3.1.2 Landwirtschaftliche Bodennutzung, various years.
2 Roughage and other preparations of fodder.
3 Excl. wood and other plant-based waste.
4 Incl. plants for industrial (e.g. starch, technical oil)nd pharmaceutical use, Christmas tree plantations etc..
5 Excl. re-exports.
6 Regarding cropland multiple counts of areas possible due to crop-rotation.
7 Excl. fodder.
8 Incl. fodder.
Land-use for food of plant and animal origin

Between 2010 and 2017 land used abroad for imports increased by 7.7 % from 17.7 million ha to 19.0 million ha; the increase for products of animal origin and for plant based products is almost similar with 7.8 % and 7.6 %. Land used for producing exported goods rose by 3.6%. However this increase applies particular to plant based products (11.2 %), while exports of products of animal origin have decreased by 5.3 %.

1.2 Land-use of domestic consumption
Less domestic land for food production, more land for energy crops

When calculating domestic consumption of food products, imports are added and exports are subtracted. Crops used for energy or industrial purposes are excluded. Fodder is reclassified to the category „animal origin“. This makes it easier to estimate the total area required for domestic production and consumption of products of animal origin.

In 2017, the total area required for domestic food consumption was 19.1 million ha (cf. Table 1). It therefore exceeds the domestic area used for nutritional purposes by 5.0 million ha. Germany records an import surplus – in other words a “land deficit”. This import surplus corresponds with the balance of imports and exports.

Between 2010 and 2017 land used for domestic consumption of food products has remained almost constant (+ 0.2 %). Thereof land used for food products of animal origin increased by 3.1 %, land used for plant based products fell by 4.0 %. The proportion of land used for products of plant origin was close to 39 % in 2017 and that for products of animal origin at 61 %. Since 2010 these shares have changed by 2 percentage points.

Domestic consumption of food products includes food products from domestic production and imports. Between 2010 and 2017 the import ratio of domestic consumption remained almost unchanged, in 2017 by 62.3 %. Consequently more than half of the land used for growing food products is located abroad. There are big differences between products of plant origin and animal origin. The import ratio of domestic consumption of products of animal origin increased only slightly from 49.3 % to 52.2 % in the period 2010 – 2017. The import ratio of domestic consumption for products of vegetable origin was substantially higher. In 2017 it was 78.1 %. Therefore in 2017 only a fifth of the land required for domestic consumption was used domestically. Between 2010 and 2017 land use for growing plants for energy use has increased by 39 % from 1.4 million ha to 2.0 million ha.
Land-use for food of plant and animal origin

Table 2 Land-use for nutritional purposes, exports and domestic consumption

<table>
<thead>
<tr>
<th>Categories</th>
<th>2010</th>
<th>2014</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land-use of agriculture (domestic territory) .......</td>
<td>16,704</td>
<td>16,725</td>
<td>16,687</td>
<td>– 0.1</td>
</tr>
<tr>
<td>Land used for nutrition ................................</td>
<td>14,663</td>
<td>14,172</td>
<td>14,049</td>
<td>– 4.2</td>
</tr>
<tr>
<td>Thereof:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use of exports</td>
<td>7,477</td>
<td>6,717</td>
<td>6,944</td>
<td>– 7.1</td>
</tr>
<tr>
<td>Land-use of domestic consumption ...................</td>
<td>7,187</td>
<td>7,455</td>
<td>7,105</td>
<td>– 1.1</td>
</tr>
</tbody>
</table>

Compared to 2010 domestic land-use of exports of food products has declined by 7.1 % in 2017, the land-use of domestic consumption declined by 1.1 % (cf. Table 2). In 2017 land-use of exports was only 0.2 million ha lower than land-use of domestic production. Thereby in 2017 49.4 % of total land-use can be allocated to the production of exports, 50.6 % to the production of food products for domestic consumption.

2 Land-use of products of animal origin

2.1 Land-use of fodder crops

Fattening pigs and fowl consume proportionately less fodder, but require more land for fodder production

Producing food of animal origin (meat, dairy products, eggs) requires the cultivation of fodder crops. This feed is grown both in Germany and abroad. Accordingly, this results in a use of domestic and foreign land areas. To calculate the land used for domestic consumption of products of animal origin, the land used for producing exports is subtracted and the land for imports is added.

Table 3 shows the animal feed consumed in 2017 ascribed to the type of livestock and the corresponding land use for producing these quantities in Germany and abroad. Of the total feed consumed (132.5 million tons) almost 40 % is allocated to dairy cows and other female cattle, about 26 % to beef cattle, followed by about 12 % for pigs and another 12 % for calves.
Table 3  Feed consumption by livestock and related land-use in 2017

<table>
<thead>
<tr>
<th>Type of livestock</th>
<th>Fodder 1,000 tons</th>
<th>Land-use 1,000 ha</th>
<th>Fodder in % of total</th>
<th>Land-use in % of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef cattle</td>
<td>34,824</td>
<td>2,726</td>
<td>26.3</td>
<td>22.8</td>
</tr>
<tr>
<td>Cows and female cattle</td>
<td>52,320</td>
<td>4,308</td>
<td>39.5</td>
<td>36.0</td>
</tr>
<tr>
<td>Calves</td>
<td>15,902</td>
<td>1,041</td>
<td>12.0</td>
<td>8.7</td>
</tr>
<tr>
<td>Feeding pigs</td>
<td>15,801</td>
<td>2,015</td>
<td>11.9</td>
<td>16.8</td>
</tr>
<tr>
<td>Fowl</td>
<td>10,725</td>
<td>1,625</td>
<td>8.1</td>
<td>13.6</td>
</tr>
<tr>
<td>Sheeps/Goats</td>
<td>1,246</td>
<td>104</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Horses</td>
<td>1,707</td>
<td>161</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>132,525</td>
<td>11,980</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

The land used for producing feed shows a similar distribution to feed consumption. However, the share of land required to produce the feed for cattle is slightly smaller than their share of feed consumption. With pigs and fowl the opposite is the case. This is related to the fact that green fodder used for cattle is grown exclusively within the country, whereas feed for other animals (e.g. pigs or fowl) is increasingly imported. Imported feed has a higher requirement for land area than domestic feed because of the more extensive forms of farming found abroad.

**Green fodder from domestic land, concentrated feed from abroad**

Figure 2 shows the land used for fodder crops subdivided into domestic production and imports in the year 2017. Land-use for the domestic production of feed amounted to 9.5 million ha in 2017; land-use abroad for imported feed to Germany amounted to 2.5 million ha. Domestically 53.5 % of land was used for green fodder, 40.8 % for cereals and 4.7 % for concentrated feed. For imports, 81.2 % of land abroad was used for concentrated feed, followed by cereals at 16.9 %.

**Figure 2** Land used for domestically produced fodder and for imported feed 2017 in %

1 Incl. silage maize.
### Land-use of products of animal origin

#### Increased fodder imports and land-use abroad

Table 4 shows feed consumption of livestock according to feed origin as well as the land area used for its cultivation. In 2017 total fodder consumption was 132.5 million tons, thereof 119.5 million tons were produced domestically, 13.1 million tons abroad. Compared to 2010 the share of fodder produced abroad has increased slightly from 9.0 % to 9.9 %, the share of fodder of domestic origin decreased accordingly from 91.0 % to 90.1 %. Land-use abroad has a higher share than the respective feed consumption since more extensive forms of agriculture are used abroad and yields per hectare are lower. In 2017 79 % of land was used domestically and 21 % abroad. Compared to 2010 the share of land used abroad increased by 2.4 percentage points.

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic origin</th>
<th>Imports</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in 1,000 tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>118 546</td>
<td>11 721</td>
<td>130 267</td>
</tr>
<tr>
<td>2017</td>
<td>119 450</td>
<td>13 076</td>
<td>132 525</td>
</tr>
<tr>
<td></td>
<td>in % of total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>91,0</td>
<td>9,0</td>
<td>100</td>
</tr>
<tr>
<td>2017</td>
<td>90,1</td>
<td>9,9</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic origin</th>
<th>Imports</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in 1,000 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>10 002</td>
<td>2 284</td>
<td>12 286</td>
</tr>
<tr>
<td>2017</td>
<td>9 458</td>
<td>2 521</td>
<td>11 980</td>
</tr>
<tr>
<td></td>
<td>in % of total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>81,4</td>
<td>18,6</td>
<td>100</td>
</tr>
<tr>
<td>2017</td>
<td>79,0</td>
<td>21,0</td>
<td>100</td>
</tr>
</tbody>
</table>

#### 2.2 Land-use of products of animal origin

**Meat occupies less than one third of the land for domestic production, but more than half of the land for exports**

Table 5 shows the use of land by different types of products of animal origin for domestic production, imports, exports and domestic consumption. The land-use for meat accounts for 28 % of domestic production. For imports and exports, the percentages are much higher: at 55 % and 50 %. For sausage products, the share of domestic production is 29 %, with 6.0 % and 10.2 % for exports and imports respectively. For dairy products, the land-use of domestic production as well as for imports and exports vary between 35 % and 40 %.
Land-use of products of animal origin

Table 5  Land-use of products of animal origin for domestic production, imports, exports and domestic consumption 2017

<table>
<thead>
<tr>
<th>Categories</th>
<th>Meat</th>
<th>Sausage</th>
<th>Dairy products</th>
<th>Eggs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in 1,000 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic production</td>
<td>3,326</td>
<td>3,440</td>
<td>4,802</td>
<td>367</td>
<td>11,935</td>
</tr>
<tr>
<td>Imports</td>
<td>2,670</td>
<td>291</td>
<td>1,723</td>
<td>185</td>
<td>4,870</td>
</tr>
<tr>
<td>Exports</td>
<td>2,530</td>
<td>522</td>
<td>2,010</td>
<td>57</td>
<td>5,119</td>
</tr>
<tr>
<td>Domestic consumption</td>
<td>3,466</td>
<td>3,209</td>
<td>4,515</td>
<td>495</td>
<td>11,685</td>
</tr>
</tbody>
</table>

|                       | in % of total |         |                |      |        |
| Domestic production   | 27.9          | 28.8    | 40.2           | 3.1  | 100    |
| Imports               | 54.8          | 6.0     | 35.4           | 3.8  | 100    |
| Exports               | 49.4          | 10.2    | 39.3           | 1.1  | 100    |
| Domestic consumption  | 29.7          | 27.5    | 38.6           | 4.2  | 100    |

1 These results slightly differ from the results in table 1, since the calculations in this table cover several periods, whereas table 3 is based on a year-specific calculation.

2.3 Land-use of domestic production, imports and exports

Declining domestic land use for feed, slightly increasing land use for imports of animal products

Figure 3 shows the changes in land-use of animal feed and products of animal origin with regard to imports and exports for the years 2010 – 2017.

Between 2010 and 2017 land-use of fodder has decreased on domestic territory by 6.4 %, whereas land-use abroad for imported fodder has grown by 10.4 %. Land use of imported products of animal origin (meat, sausage, dairy products, eggs) has also increased by 7.8 %, whereas land-use of exports decreased by 5.3 %.
Land-use of products of animal origin

2.4 Land-use per capita

Domestic food consumption: highest land-use for dairy products

Based on the land used for domestic consumption, it is possible to determine the land-use per capita (cf. Table 6). In 2017, it amounted to 1,417 square meters/capita and therefore has decreased by 3.5 % compared to 2010 (1,468 square meters/capita). For meat it decreased by 7.0 %.

Table 6 Land-use in m² per capita for products of animal origin – domestic consumption

<table>
<thead>
<tr>
<th>Products of animal origin</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m²/capita</td>
<td></td>
<td>in %</td>
</tr>
<tr>
<td>Meat</td>
<td>454</td>
<td>423</td>
<td>– 7.0</td>
</tr>
<tr>
<td>Sausage</td>
<td>384</td>
<td>388</td>
<td>1.1</td>
</tr>
<tr>
<td>Dairy products</td>
<td>568</td>
<td>546</td>
<td>– 3.8</td>
</tr>
<tr>
<td>Eggs</td>
<td>62</td>
<td>60</td>
<td>– 3.1</td>
</tr>
<tr>
<td>Total</td>
<td>1,468</td>
<td>1,417</td>
<td>– 3.5</td>
</tr>
</tbody>
</table>
3 Land-use of plant products

3.1 Methodology

For the calculation of land-use linked to domestic consumption of plant products not only domestic production and agricultural land used within the national territory need to be considered. Since Germany also imports plant products and food products from abroad, a certain part of agricultural land abroad has also to be assigned to domestic consumption. In contrast, there is domestic agricultural land which must not be attributed to domestic consumption because it is used to produce export goods. Hereinafter the methods used to calculate land-use of imports and exports of plant origin are presented.

The calculations are based on a coefficient approach. Import and export volumes of agricultural raw materials are linked to data on harvest yields of the crop-producing countries and the required cropland is determined. For processed products this simple approach could not be used. Instead the volume of raw materials included in the processed products needs to be specified. Furthermore, countries supplying imports are not necessarily the ones growing these raw materials. Therefore in many cases it is necessary to look closer at the supply chain of the traded goods.

The advantage of the coefficient approach is that by using a comprehensive commodity level a detailed calculation and presentation of results is feasible. Within the calculations only the land required for cultivating crops is taken into account. Land use during processing, transport routes etc. is not included.

Calculations are based on the detailed data from trade statistics on a commodity level as well as data for import and export volumes and data on re-exports. Country-specific land-coefficients and production volumes are taken from the database of United Nations Food and Agricultural Organization (FAO). For converting processed crops into their original raw materials several sources are used and completed by own estimates. The FAO’s “Technical Conversions Factors for Agricultural Commodities” are particularly important here. For tracking supply chains back the United Nations COMTRADE database is used.

2 In the following imports and exports are not differentiated by their designated use at first, viz. the commodities include food products as well as feedstuff and products for technical or industrial use.
3.2 Imports

Increasing crop imports

The volume of imported agricultural commodities and food products of plant origin increased by 12.2 % from 48.3 million tons (2010) to 54.1 million tons (2017) (cf. table 7). Oil seeds (+ 44 %), preparations of cereals (+ 30 %) and cocoa and cocoa preparations (+ 30 %) showed a particularly significant growth. In absolute numbers oil seeds (19 %) and cereals (18 %) were the most important import commodities in 2017.

Table 7 Import volumes of crop products according chapters of trade statistics

<table>
<thead>
<tr>
<th>WA</th>
<th>Products</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1,000 t</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>Vegetables</td>
<td>4,523</td>
<td>4,725</td>
<td>8.7</td>
</tr>
<tr>
<td>08</td>
<td>Fruits and nuts</td>
<td>5,812</td>
<td>6,600</td>
<td>11.9</td>
</tr>
<tr>
<td>09</td>
<td>Coffee, tea, spices etc</td>
<td>1,312</td>
<td>1,361</td>
<td>2.5</td>
</tr>
<tr>
<td>10</td>
<td>Cereals</td>
<td>8,546</td>
<td>9,596</td>
<td>17.7</td>
</tr>
<tr>
<td>11</td>
<td>Products of the milling industry</td>
<td>893</td>
<td>1,001</td>
<td>1.8</td>
</tr>
<tr>
<td>12</td>
<td>Oil seeds and oleaginous fruits</td>
<td>6,952</td>
<td>9,992</td>
<td>18.5</td>
</tr>
<tr>
<td>15</td>
<td>Animal and vegetable fats and oils</td>
<td>3,410</td>
<td>2,667</td>
<td>4.9</td>
</tr>
<tr>
<td>17</td>
<td>Sugar and sugar confectionary</td>
<td>1,753</td>
<td>1,794</td>
<td>3.3</td>
</tr>
<tr>
<td>18</td>
<td>Cocoa and cocoa preparations</td>
<td>909</td>
<td>1,179</td>
<td>2.2</td>
</tr>
<tr>
<td>19</td>
<td>Preparations of cereals</td>
<td>1,385</td>
<td>1,802</td>
<td>3.3</td>
</tr>
<tr>
<td>20</td>
<td>Preparations of vegetables, fruits etc</td>
<td>3,386</td>
<td>3,534</td>
<td>6.5</td>
</tr>
<tr>
<td>21</td>
<td>Misc. edible preparations</td>
<td>665</td>
<td>919</td>
<td>1.7</td>
</tr>
<tr>
<td>22</td>
<td>Beverages, spirits</td>
<td>3,665</td>
<td>3,501</td>
<td>6.5</td>
</tr>
<tr>
<td>23</td>
<td>Waste from food industry, prep.</td>
<td>5,057</td>
<td>5,604</td>
<td>10.4</td>
</tr>
<tr>
<td></td>
<td>of fodder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>48,256</td>
<td>54,135</td>
<td>100</td>
</tr>
</tbody>
</table>

1 According the classification of foreign trade statistics.

When producing import commodities agricultural land is occupied in the respective cultivating country ³. Total land-use of imports increased by 13 % between 2010 and 2017 – from 14.1 million ha to 15.4 million ha (c.f. table 8). The growth in land-use reflects more or less the growth in import volume. For that reason the growth of the import volume should not be assigned – at least not solely – to an increase of yields per hectare. In accordance with the increase in volume, land-use particularly increases for the items oilseeds and oleaginous fruits (+ 47 %), cocoa and cocoa preparations (+ 27 %) and preparations of cereals (+ 23 %). In 2017 land-use of these three items added up to 56 % of total land-use of imports.

³ For arable land multiple accounting of land-use is possible due to multi-harvesting and crop rotation.
### Table 8  Land-use of imported crop products according to trade statistic chapters

<table>
<thead>
<tr>
<th>WA</th>
<th>Products</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1,000 ha</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>Vegetables</td>
<td>218</td>
<td>263</td>
<td>1.7</td>
</tr>
<tr>
<td>08</td>
<td>Fruits and nuts</td>
<td>793</td>
<td>879</td>
<td>5.7</td>
</tr>
<tr>
<td>09</td>
<td>Coffee, tea, spices etc.</td>
<td>1,401</td>
<td>1,302</td>
<td>8.4</td>
</tr>
<tr>
<td>10</td>
<td>Cereals</td>
<td>1,703</td>
<td>1,818</td>
<td>11.8</td>
</tr>
<tr>
<td>11</td>
<td>Products of the milling industry</td>
<td>207</td>
<td>237</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>Oil seeds and oleaginous fruits</td>
<td>2,782</td>
<td>4,090</td>
<td>26.5</td>
</tr>
<tr>
<td>13</td>
<td>Animal and vegetable fats and oils</td>
<td>2,093</td>
<td>1,506</td>
<td>9.8</td>
</tr>
<tr>
<td>17</td>
<td>Sugar and sugar confectionary</td>
<td>227</td>
<td>251</td>
<td>1.6</td>
</tr>
<tr>
<td>18</td>
<td>Cocoa and cocoa preparations</td>
<td>1,775</td>
<td>2,261</td>
<td>14.7</td>
</tr>
<tr>
<td>19</td>
<td>Preparations of cereals</td>
<td>322</td>
<td>396</td>
<td>2.6</td>
</tr>
<tr>
<td>21</td>
<td>Misc. edible preparations</td>
<td>98</td>
<td>150</td>
<td>1.0</td>
</tr>
<tr>
<td>22</td>
<td>Beverages, spirits</td>
<td>569</td>
<td>540</td>
<td>3.5</td>
</tr>
<tr>
<td>23</td>
<td>Waste from food industry, prep. of fodder</td>
<td>1,227</td>
<td>1,131</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>14,074</td>
<td>15,418</td>
<td>100</td>
</tr>
</tbody>
</table>

1 According the classification of foreign trade statistics.

### Germany imports relatively few manufactured food products of plant origin

About 55 % of land-use for imported plant-based goods accounts for agricultural raw materials (c.f. figure 4). Another 34 % account for first-stage processed goods. These products are directly produced from the crop. This includes semi-finished (semi-manufactured) products like cocoa paste or fruit concentrates. Finished (manufactured) products have a share of 11 %.

### Figure 4  Land-use of imported crop products by processing stages

in 1,000 ha

- Agricultural raw materials
- First processing stage
- Second processing stage

---

Land-use of plant products

Between 2010 and 2017 the growth of land-use of imports mostly resulted from increased raw material imports. The volume of finished products remained almost unchanged.

Particularly high land-use abroad for permanent crops

In 2017 about 60% of land-use abroad for imports was arable land, 40% were permanent crops (c.f. figure 5). This ratio remained stable during the whole period 2010 to 2017 despite an absolute growth in land-use.

Figure 5  Land-use of imports by land categories 2017

<table>
<thead>
<tr>
<th>Land Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arable land</td>
<td>60.3%</td>
</tr>
<tr>
<td>Permanent crops</td>
<td>39.7%</td>
</tr>
</tbody>
</table>

Important supplying countries

In 2017 the most important importing countries 4 for crops of plant origin in terms of volume were the Netherlands (13.1%), France (8.8%) and Poland (8.6%) (c.f. table 9). These three countries alone contributed to more than 30% of total imports. The Netherlands particularly imported vegetables, animal and vegetable fats and oils and food industry waste, for Poland it is especially cereals. From France mostly oilseeds and oleaginous fruits and cereals are imported to Germany. In the period 2010 to 2017 imports from the United States (+ 113 %), from Poland (+ 62 %) and the Czech Republic (+ 50 %) increased sharply.

4 The trade statistics’ import data is based on the principle of “country of origin”.

### Table 9 Import volume of crop products by supplying country

<table>
<thead>
<tr>
<th>Supplying country</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,000 t</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>7,237</td>
<td>7,098</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– 1.9</td>
</tr>
<tr>
<td>France</td>
<td>5,064</td>
<td>4,780</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– 5.6</td>
</tr>
<tr>
<td>Poland</td>
<td>2,891</td>
<td>4,674</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>61.7</td>
</tr>
<tr>
<td>Spain</td>
<td>2,932</td>
<td>3,696</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26.1</td>
</tr>
<tr>
<td>Italy</td>
<td>3,617</td>
<td>3,594</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– 0.7</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>2,346</td>
<td>3,517</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>49.9</td>
</tr>
<tr>
<td>Brazil</td>
<td>4,054</td>
<td>2,795</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– 31.1</td>
</tr>
<tr>
<td>Belgium</td>
<td>1,781</td>
<td>2,223</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24.8</td>
</tr>
<tr>
<td>United States</td>
<td>1,039</td>
<td>2,009</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>112.7</td>
</tr>
<tr>
<td>Hungary</td>
<td>1,300</td>
<td>1,967</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>51.3</td>
</tr>
<tr>
<td>Other countries</td>
<td>15,996</td>
<td>17,582</td>
<td>32.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>48,256</td>
<td>54,135</td>
<td>100</td>
</tr>
</tbody>
</table>

Although the data from trade statistics that was used for the calculations of import volumes is based on the “country of origin”-principle of, this does not automatically guarantee that the imported crop is also cultivated in that country. The trade statistics data includes agricultural raw materials like coffee beans from the Netherlands which are not cultivated in that country. Therefore in these cases, but only for the member states of the European Union and for Serbia and Switzerland, the origin of the raw material was determined by analyzing the supply chains. This is also necessary for manufactured products, for which the original growing country of the raw materials had also to be determined. In the calculation model for land use this is only done if the raw material is not cultivated at all in the supplying country. For certain products, particularly those made from oilseeds and cereals, intensive trade relations exist in Europe. Sometimes this could result in an inconsistent determination of the growing country. In these cases the growing country is registered in a special category “non-assignable countries”.

The importance of the neighboring countries Poland and France is also evident when looking at the land-use of imports. Overall, land-use is less concentrated than import volumes. Thus, when looking at volumes, the top 10 countries account for 68 % of import volumes, but only 50 % of land use. Particularly the share of Brazil (7.0 %) and the Ivory Coast (6.9 %) is quite high when looking at land-use. For Brazil this is due to a high share of oilseed-based products, which are relatively land-intensive. Germany imports substantial amounts of cocoa bean-based products from the Ivory Coast. This crop also needs very large cultivation areas due to small yield coefficient.
## Land-use of plant products

### Table 10 Land-use of imported crop products by growing countries

<table>
<thead>
<tr>
<th>Growing country</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,000 ha</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>1,637</td>
<td>1,082</td>
<td>7.0</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>619</td>
<td>1,057</td>
<td>6.9</td>
</tr>
<tr>
<td>France</td>
<td>932</td>
<td>1,044</td>
<td>6.8</td>
</tr>
<tr>
<td>Poland</td>
<td>789</td>
<td>864</td>
<td>5.6</td>
</tr>
<tr>
<td>United States</td>
<td>413</td>
<td>765</td>
<td>5.0</td>
</tr>
<tr>
<td>Australia</td>
<td>171</td>
<td>763</td>
<td>5.0</td>
</tr>
<tr>
<td>Hungary</td>
<td>440</td>
<td>621</td>
<td>4.0</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>464</td>
<td>575</td>
<td>3.7</td>
</tr>
<tr>
<td>Italy</td>
<td>549</td>
<td>541</td>
<td>3.5</td>
</tr>
<tr>
<td>Romania</td>
<td>267</td>
<td>472</td>
<td>3.1</td>
</tr>
<tr>
<td>Other countries</td>
<td>7,793</td>
<td>7,634</td>
<td>49.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14,074</td>
<td>15,418</td>
<td>100</td>
</tr>
</tbody>
</table>

### Product families

In the following chapter so-called “product families” are analyzed instead of using the tariff-based trade statistics classification. To generate product families, individual items from trade statistics are allocated to groups of specific raw materials. By this method, land use of raw materials of plant origin can be determined.

The imports show a significant concentration on a few product families. In 2017 the five most important groups caused 62 % of total land-use. The most important groups are products based on rape (18 %), cocoa (15 %) and soya (13 %). Whereas the combined share of products made from cocoa and coffee only account for 4.5 % of import volumes, land-use of these two product families amounts to 22.7 %. Conversely, less land is required for other vegetables and fruits and crops. These are cultivated intensively on a relatively small area.
Land-use of plant products

Table 11  Land-use of crop products by product families 2017

<table>
<thead>
<tr>
<th>Product family</th>
<th>Volume 1,000 t</th>
<th>Land use 1,000 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Rape</td>
<td>6,880</td>
<td>2,752</td>
</tr>
<tr>
<td>Cacao</td>
<td>1,179</td>
<td>2,261</td>
</tr>
<tr>
<td>Soya</td>
<td>6,351</td>
<td>1,964</td>
</tr>
<tr>
<td>Wheat</td>
<td>7,557</td>
<td>1,361</td>
</tr>
<tr>
<td>Coffee</td>
<td>1,242</td>
<td>1,238</td>
</tr>
<tr>
<td>Nuts</td>
<td>820</td>
<td>732</td>
</tr>
<tr>
<td>Other oil seeds</td>
<td>486</td>
<td>654</td>
</tr>
<tr>
<td>Maize</td>
<td>3,693</td>
<td>633</td>
</tr>
<tr>
<td>Sunflower seeds</td>
<td>1,179</td>
<td>605</td>
</tr>
<tr>
<td>Oil palm</td>
<td>2,049</td>
<td>491</td>
</tr>
<tr>
<td>Other corn</td>
<td>1,340</td>
<td>394</td>
</tr>
<tr>
<td>Wine</td>
<td>2,145</td>
<td>355</td>
</tr>
<tr>
<td>Barley</td>
<td>2,505</td>
<td>351</td>
</tr>
<tr>
<td>Exotic fruits</td>
<td>4,124</td>
<td>265</td>
</tr>
<tr>
<td>Fruit</td>
<td>3,041</td>
<td>260</td>
</tr>
<tr>
<td>Other</td>
<td>9,564</td>
<td>1,102</td>
</tr>
<tr>
<td>Total</td>
<td>54,135</td>
<td>15,418</td>
</tr>
</tbody>
</table>

Since 2010 particularly rape and cocoa gained significance (cf. figure 6). In contrast imports of soya products slightly declined. This is due to increased use of rape as animal feed.

Figure 6  Land-use of imported products of plant origin by product families in 1,000 ha
3.3 Exports

Significant growth of plant product exports

The volume of exported agricultural raw materials and of food products of plant origin increased by 8% from 36.0 million tons (2010) to 39.0 million tons (2017) (cf. table 12). The two most important export commodities were cereals (29%) and waste from food industry (14%).

Table 12  Exports of plant products by trade statistics chapters

<table>
<thead>
<tr>
<th>Products</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,000 t</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>07    Vegetables</td>
<td>2,323</td>
<td>2,560</td>
<td>6.6</td>
</tr>
<tr>
<td>08    Fruits and nuts</td>
<td>940</td>
<td>862</td>
<td>2.2</td>
</tr>
<tr>
<td>09    Coffee, tea, spices etc.</td>
<td>583</td>
<td>642</td>
<td>1.6</td>
</tr>
<tr>
<td>10    Cereals</td>
<td>12,159</td>
<td>11,224</td>
<td>28.8</td>
</tr>
<tr>
<td>11    Products of the milling industry</td>
<td>2,136</td>
<td>2,750</td>
<td>7.1</td>
</tr>
<tr>
<td>12    Oil seeds and oleaginous fruits</td>
<td>619</td>
<td>693</td>
<td>1.8</td>
</tr>
<tr>
<td>15    Animal and vegetable fats and oils</td>
<td>1,730</td>
<td>2,391</td>
<td>6.1</td>
</tr>
<tr>
<td>17    Sugar and sugar confectionary</td>
<td>2,049</td>
<td>2,424</td>
<td>6.2</td>
</tr>
<tr>
<td>18    Cocoa and cocoa preparations</td>
<td>876</td>
<td>1,166</td>
<td>3.0</td>
</tr>
<tr>
<td>19    Preparations of cereals</td>
<td>2,020</td>
<td>2,529</td>
<td>6.5</td>
</tr>
<tr>
<td>20    Preparations of vegetables, fruits etc.</td>
<td>1,829</td>
<td>1,992</td>
<td>5.1</td>
</tr>
<tr>
<td>21    Misc. edible preparations</td>
<td>1,129</td>
<td>1,355</td>
<td>3.5</td>
</tr>
<tr>
<td>22    Beverages, spirits</td>
<td>2,513</td>
<td>2,785</td>
<td>7.2</td>
</tr>
<tr>
<td>23    Waste from food industry, prep. of fodder</td>
<td>5,145</td>
<td>5,570</td>
<td>14.3</td>
</tr>
<tr>
<td>Total</td>
<td>36,050</td>
<td>38,943</td>
<td>100</td>
</tr>
</tbody>
</table>

1 According the foreign trade statistics classification.

The growth in export volumes is also reflected in land use figures of exported products (cf. table 13). Land-use increased from 7.3 million ha (2010) to 8.3 million ha (2017), viz. by 15%. The largest share is used for cereals (19%). When it comes to land-use items like cocoa and cocoa preparations (19%) and animal and vegetables fats and oil (18%) gain importance in comparison to their export volume.
## Table 13  Land-use of plant product exports by trade statistics chapters

<table>
<thead>
<tr>
<th>WA</th>
<th>Products</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>07</td>
<td>Vegetables</td>
<td>85</td>
<td>98</td>
<td>1.2</td>
</tr>
<tr>
<td>08</td>
<td>Fruits and nuts</td>
<td>132</td>
<td>159</td>
<td>1.9</td>
</tr>
<tr>
<td>09</td>
<td>Coffee, tea, spices etc.</td>
<td>668</td>
<td>664</td>
<td>8.0</td>
</tr>
<tr>
<td>10</td>
<td>Cereal</td>
<td>1,785</td>
<td>1,568</td>
<td>18.9</td>
</tr>
<tr>
<td>11</td>
<td>Products of the milling industry</td>
<td>390</td>
<td>511</td>
<td>6.2</td>
</tr>
<tr>
<td>12</td>
<td>Oil seeds and oleaginous fruits</td>
<td>202</td>
<td>224</td>
<td>2.7</td>
</tr>
<tr>
<td>15</td>
<td>Animal and vegetable fats and oils</td>
<td>931</td>
<td>1,516</td>
<td>18.3</td>
</tr>
<tr>
<td>17</td>
<td>Sugar and sugar confectionary</td>
<td>190</td>
<td>212</td>
<td>2.6</td>
</tr>
<tr>
<td>18</td>
<td>Cocoa and cocoa preparations</td>
<td>1,126</td>
<td>1,545</td>
<td>18.6</td>
</tr>
<tr>
<td>19</td>
<td>Preparations of cereals</td>
<td>340</td>
<td>404</td>
<td>4.9</td>
</tr>
<tr>
<td>20</td>
<td>Preparations of vegetables, fruits etc.</td>
<td>204</td>
<td>202</td>
<td>2.4</td>
</tr>
<tr>
<td>21</td>
<td>Misc. edible preparations</td>
<td>147</td>
<td>166</td>
<td>2.0</td>
</tr>
<tr>
<td>22</td>
<td>Beverages, spirits</td>
<td>238</td>
<td>237</td>
<td>2.9</td>
</tr>
<tr>
<td>23</td>
<td>Waste from food industry, prep. of fodder</td>
<td>813</td>
<td>800</td>
<td>9.6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>7,252</td>
<td>8,303</td>
<td>100</td>
</tr>
</tbody>
</table>

1 According the foreign trade statistics classification.

### Germany exports more processed products than raw materials

Whereas raw materials dominate imports (55 %)(Figure 4), with 26 % their share is far less significant when it comes to exports (Figure 7). Therefore Germany primary imports plant-based raw materials whereas exports mainly comprise processed products.
Countries of destination

Data on the countries of export destination shows the great importance of the European Single Market (cf. table 14). The most important countries of destination are the neighboring countries the Netherlands (24.6 %), Belgium (7.2 %) and France (6.7 %). Among the top 10 countries of destination only Saudi-Arabia (6.7 %) is a non-European country. To this country mainly cereals are exported. Cereals and waste from the food industry have the largest share of exports to the Netherlands.

Table 14  
Export volume of crop products by countries of destination

<table>
<thead>
<tr>
<th>Country of destination</th>
<th>2010</th>
<th>2017</th>
<th>2017 to 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,000 t</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Netherlands .............</td>
<td>9,394</td>
<td>9,580</td>
<td>24.6</td>
</tr>
<tr>
<td>Belgium ..................</td>
<td>2,300</td>
<td>2,817</td>
<td>7.2</td>
</tr>
<tr>
<td>France ...................</td>
<td>2,654</td>
<td>2,622</td>
<td>6.7</td>
</tr>
<tr>
<td>Saudi-Arabia ..............</td>
<td>1,021</td>
<td>2,605</td>
<td>6.7</td>
</tr>
<tr>
<td>Poland .................</td>
<td>1,377</td>
<td>2,163</td>
<td>5.6</td>
</tr>
<tr>
<td>Italy ................</td>
<td>2,230</td>
<td>2,086</td>
<td>5.4</td>
</tr>
<tr>
<td>Denmark ..................</td>
<td>1,584</td>
<td>1,723</td>
<td>4.4</td>
</tr>
<tr>
<td>United Kingdom ..........</td>
<td>1,636</td>
<td>1,550</td>
<td>4.0</td>
</tr>
<tr>
<td>Austria .................</td>
<td>1,611</td>
<td>1,437</td>
<td>3.7</td>
</tr>
<tr>
<td>Czech Republic ..........</td>
<td>1,003</td>
<td>937</td>
<td>2.4</td>
</tr>
<tr>
<td>Other countries ..........</td>
<td>11,240</td>
<td>11,422</td>
<td>29.3</td>
</tr>
<tr>
<td>Total ..................</td>
<td>36,050</td>
<td>38,943</td>
<td>100</td>
</tr>
</tbody>
</table>

Land-use of plant products

Product families

Wheat-based products are of great significance for the German export industry (cf. table 15). In 2015 these products made up for 21% of total land-use of exports. Looking at the export volumes the share is even higher. It accounted for 32%. It is especially noticeable that there are many important raw materials like cocoa (18.6%), soya (8.8%) and coffee (7.9%) which are not cultivated at all in Germany or only in small volumes.

Table 15  Land-use of exported crop products by product family 2017

<table>
<thead>
<tr>
<th>Product family</th>
<th>Volume 1,000 t</th>
<th>Volume %</th>
<th>Land use 1,000 ha</th>
<th>Land use %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>12,282</td>
<td>31.5</td>
<td>1,751</td>
<td>21.1</td>
</tr>
<tr>
<td>Cacao</td>
<td>1,166</td>
<td>3.0</td>
<td>1,545</td>
<td>18.6</td>
</tr>
<tr>
<td>Rape</td>
<td>2,908</td>
<td>7.5</td>
<td>1,114</td>
<td>13.4</td>
</tr>
<tr>
<td>Soya</td>
<td>2,910</td>
<td>7.5</td>
<td>727</td>
<td>8.8</td>
</tr>
<tr>
<td>Coffee</td>
<td>633</td>
<td>1.7</td>
<td>657</td>
<td>7.9</td>
</tr>
<tr>
<td>Barley</td>
<td>5,333</td>
<td>13.7</td>
<td>587</td>
<td>7.1</td>
</tr>
<tr>
<td>Other oil seeds</td>
<td>169</td>
<td>0.4</td>
<td>258</td>
<td>3.1</td>
</tr>
<tr>
<td>Oil palm</td>
<td>733</td>
<td>1.9</td>
<td>245</td>
<td>2.9</td>
</tr>
<tr>
<td>Sugar beet/-cane</td>
<td>2,616</td>
<td>6.7</td>
<td>205</td>
<td>2.5</td>
</tr>
<tr>
<td>Nuts</td>
<td>200</td>
<td>0.5</td>
<td>189</td>
<td>2.3</td>
</tr>
<tr>
<td>Other corn</td>
<td>746</td>
<td>1.9</td>
<td>188</td>
<td>2.3</td>
</tr>
<tr>
<td>Sunflower seeds</td>
<td>270</td>
<td>0.7</td>
<td>175</td>
<td>2.1</td>
</tr>
<tr>
<td>Maize</td>
<td>1,011</td>
<td>2.6</td>
<td>134</td>
<td>1.6</td>
</tr>
<tr>
<td>Potatoes</td>
<td>3,805</td>
<td>9.8</td>
<td>102</td>
<td>1.2</td>
</tr>
<tr>
<td>Fruit</td>
<td>1,067</td>
<td>2.7</td>
<td>79</td>
<td>0.9</td>
</tr>
<tr>
<td>Other</td>
<td>3,065</td>
<td>7.9</td>
<td>351</td>
<td>4.2</td>
</tr>
<tr>
<td>Total</td>
<td>38,943</td>
<td>100</td>
<td>8,303</td>
<td>100</td>
</tr>
</tbody>
</table>
3.4 Import share of exports

To produce exports a lot of imported agricultural raw materials are needed

In 2017, 48% of land used for exports was provided domestically (cf. Figure 8). The predominant share (37%) is attributable to processed products, whose raw materials are cultivated abroad and imported to Germany.

Figure 8  Land-use of exports of plant based food products 2017 in %

Between 2010 and 2017 land use of the import share of exports has decreased by 4.5%. Whereas in 2010 3.2 million ha land were allocated abroad for products intended for the production of German exports, land-use decreased 3.1 million ha in 2017. Both land-use linked to imports and to exports have to be examined independently from domestic use.

The increased import share of exports is mainly caused by the product families oil seeds and cocoa and cocoa products (cf. figure 9). This indicates, that particularly those raw materials, which are not cultivated in Germany at all or only in small amounts have gained significance for plant-based exports.
3.5 Domestic use of plant-based food products

High share of land-use for domestic consumption of luxury goods

To determine land-use of domestic consumption imports have to be added to land-use on national territory, while exports need to be subtracted. Furthermore designated use of cultivated crop or processed products must be determined. Land-use of goods which are intended for feed, for energetic purposes or for industrial use has to be subtracted.  

5 The designated use is not identified for all exported goods. For instance, exported wheat could be used abroad as feed or for nutrition purposes. To determine land-use of domestic consumption, first the volume of domestic consumption has to be determined independently from the designated use. Then the part of domestic consumption which is not related to nutrition purposes has to be subtracted.
The results show a relatively constant course of land-use of domestic consumption of plant products (cf. figure 10). The rise of land-use of imports is not due to an increased domestic consumption, but predominantly the result of rising raw material demands for German exports. At the same time an increased part of the domestic agricultural land is used for energetic purposes.
Looking at the share of domestic consumption there is a remarkable high share of luxury products (cf. figure 11). In 2017 luxury food products made up for 34 % of total land-use. The reason is high land-use of cocoa products and coffee.

3.6 Analysis of selected products

Significant differences in land-use of certain products

In the following, land-use of four selected products is illustrated.

Table 16  Area-coefficients of selected products

<table>
<thead>
<tr>
<th>Product</th>
<th>Unit</th>
<th>Agricultural commodity</th>
<th>Area in m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roasted coffee</td>
<td>100 g</td>
<td>Coffee bean</td>
<td>0.82</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>100 g</td>
<td>Wheat</td>
<td>0.15</td>
</tr>
<tr>
<td>Chocolate</td>
<td>100 g</td>
<td>Cacao bean, Sugar beet</td>
<td>1.62, 0.03</td>
</tr>
<tr>
<td>Beer</td>
<td>1 Liter</td>
<td>Barley</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Coffee has a significantly low land requirement of 0.82 m² per 100 g. However, coffee is compared to other agricultural products still cultivated land-intensively. For 100 g of wheat flour, which is also cultivated land-intensively, an area of only 0.15 m² is needed. To produce one liter of beer one needs about 210 g barley and 4 g hop. This requires a cultivation area of 0.33 m². A chocolate bar of 100 g dark chocolate needs a cultivation area of 1.65 m². The major part of land-use takes place abroad, because the cocoa bean has a higher land requirement per unit of weight than sugar beet (which is also cultivated domestically).

Table 17  Area coefficient of chocolate

<table>
<thead>
<tr>
<th>Ingredients of chocolate</th>
<th>Share in %</th>
<th>Agricultural commodity</th>
<th>Raw material equivalent</th>
<th>Area in m² per 100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa mass/cocoa butter</td>
<td>60.0</td>
<td>Cacao bean</td>
<td>74.94</td>
<td>1.62</td>
</tr>
<tr>
<td>Sugar</td>
<td>35.0</td>
<td>Sugar bean</td>
<td>217.04</td>
<td>0.03</td>
</tr>
<tr>
<td>Non-vegetarian (e.g. milk)</td>
<td>5.0</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

A 100 g chocolate bar of dark chocolate consists of 60 g cocoa mass and cocoa butter, 35 g sugar and 5 g of non-vegetarian ingredients like milk. This corresponds to about 75 g of cocoa beans and 217 g of sugar beets needed for the production of the chocolate. Although a relatively high amount of sugar is needed, the cultivation area needed to produce the sugar (0.03 m²) is relatively small. In contrast, the cultivation of 75 g of cocoa bean requires an area of 1.62 m².