


Sustainable and regional supply with organic grain legumes in Europe

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General importance of legumes in sustainable cropping

- Provision of ecosystem service
- Soil fertility
- Symbiosis with soil bacteria (N-fixiation)

  atmospheric nitrogen (N_2) → ammonium (NH_4^+)
- Improved soil-structure by deep top roots
- Breaking cycles of infection in heavy cereal crop rotations
- Improvement of biodiversity
- Mobilization of nutrients in the subsoil (esp. phosphorus)
- Provision of high-protein forages and food

→ Legumes have great significance especially for organic farming (food and feed production, energy cropping, nutrient cycle …)

Use of grain legumes

Attractive to organic farming, especially to cash-crop farms with little livestock or stockless farms

- Forage production (monogastric animals, ruminants)
  - Local alternative to replace soya imports

  ➡ EU imports annual 32 Mio. tons soya: beans (20 Mt) & meal (12 Mt)
  - Germany imports 3,3 Mio. tons soya beans & 4,5 Mio. tons soya meal
- Human nutrition (little importance in Germany : 2005 – 2010 with an annual consumption of ~48.000 tons)

  However, to cover the requirements of dry pulses for human consumption, DE relies on imports (90%)
- Material and energetic use

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Regional feed production

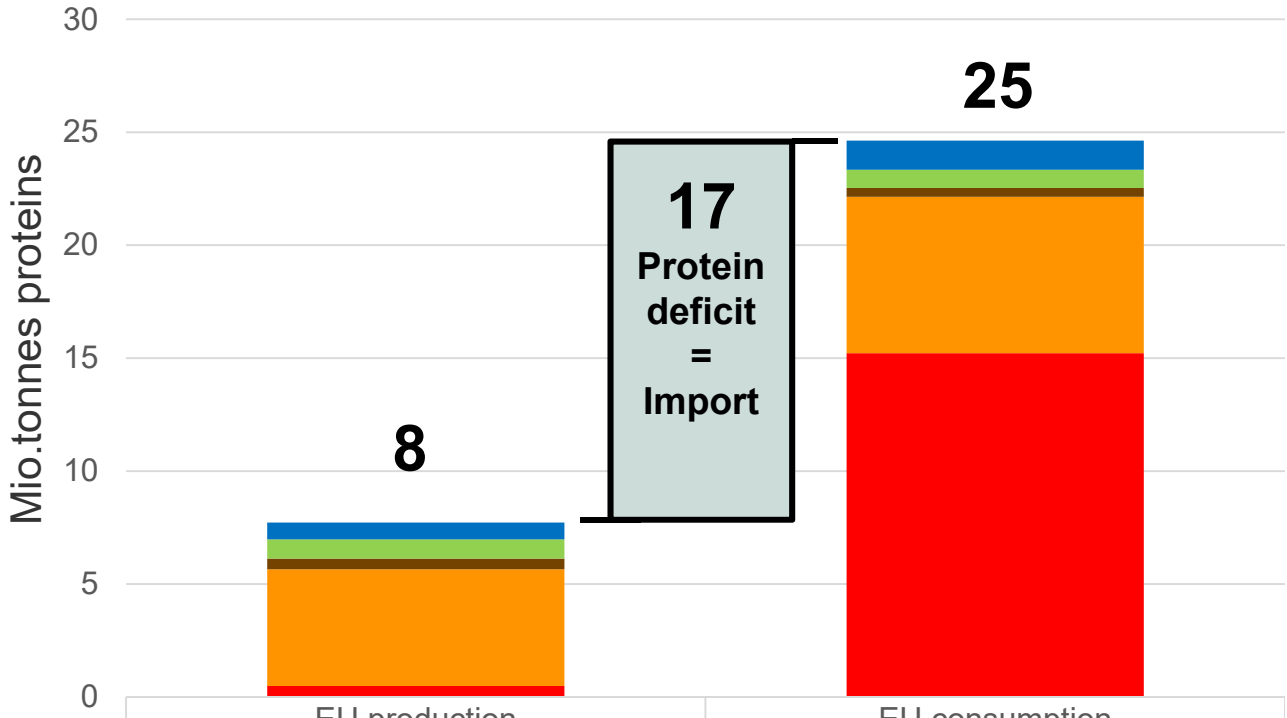
- Protein deficiency

  EU has a 70% deficit in protein rich grains
- Soya as feed for livestock: massive imports of nutrients alongside with environmental costs in export countries
- World market soya price with a trend to increase
- More than 80% of soya import are genetically modified
- Non-GMO soy supply at high costs
- 100% organic feeding of monogastrics until 2018
- High demand for protein crops in organic farming

➡ Cultivation of regional grain legumes is of high significance!

Protein deficiency - EU depends on soya imports

EU-27 balance of protein-rich forage 2011/2012



	EU production	EU consumption
Miscellaneous	0,74	1,29
Dried forage	0,85	0,81
Pulses	0,48	0,39
Rapeseed & sunflower seed/meals	5,16	6,92
Soybeans/meal	0,49	15,22
Total	**7,72**	**24,63**

Source: Feed & Food Statistical Yearbook 2013, Europäischer Verband der Mischfutterindustrie

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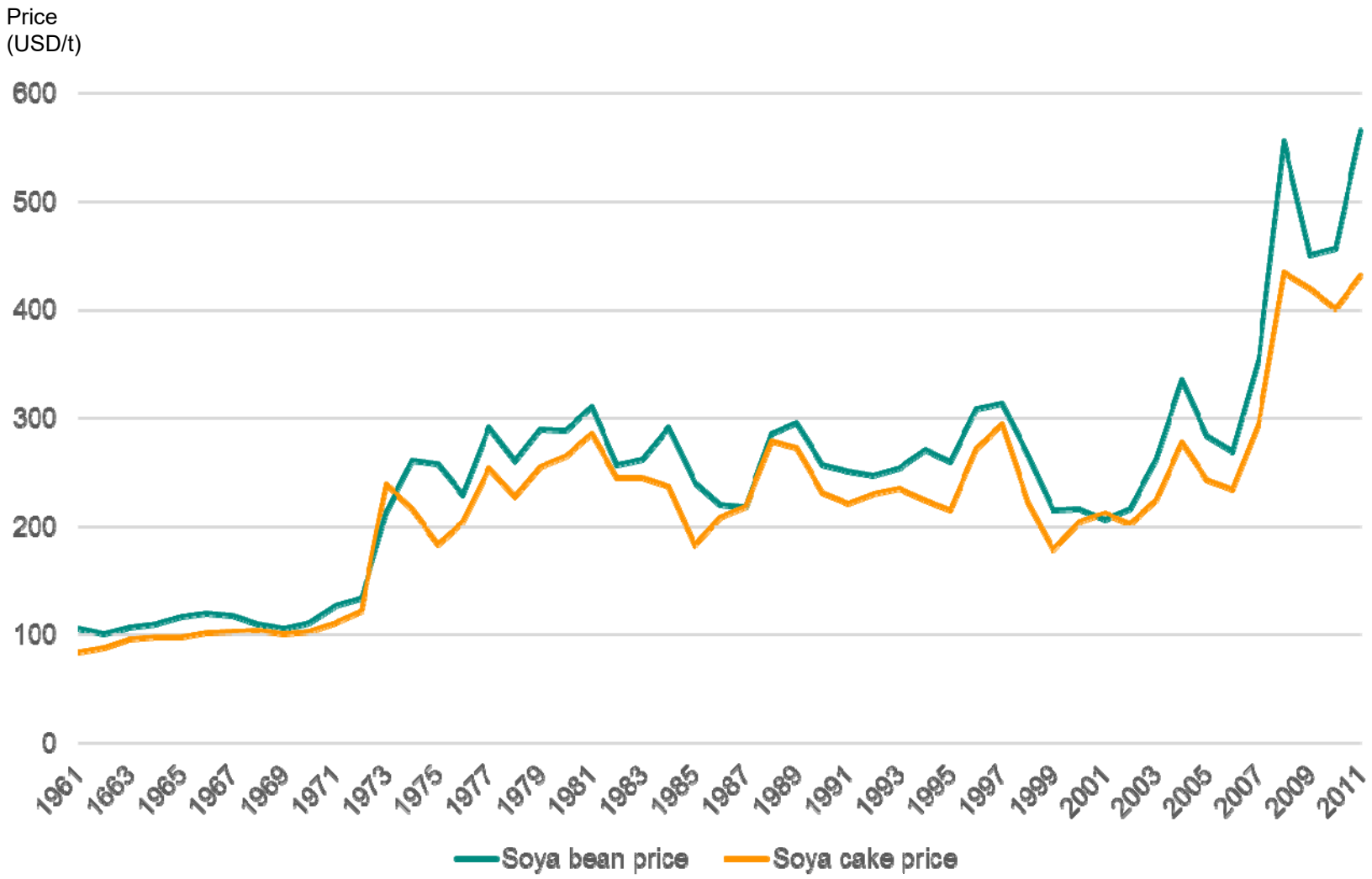
Soy bean and soy cake import prices (1961 - 2011)



Source: Calculations based on data from 1961-2011 - FAOstat (2015)

Traditional grain legumes in comparison with soya: limitations by anti-nutritives

- Anti-nutritive substances reduce protein digestibility

ingredients	occurrence
tannins, saponins	all grain legumes
alkaloids	lupine
vicin und convicin	broad bean
lectins	broad bean, peas
trypsin inhibitor	soya

- Less favorable amino acid pattern (few methionine)

  Methionine: - essential amino acid

  - (besides cysteine) the only sulphur-containing amino acid

- Lower & unsteady protein content

(Griese et al. 2014)

100% organic diet: Methionine gap of traditional grain legumes

Cereals and Pulses	Energy MJ poultry	Prot g/kg	Lysin g/kg	Meth g/kg	M:P%
Wheat	12,5	108	3	1,7	1,6
Peas	11,6	202	15	2,1	**1**
Faba beans	10,9	272	16,3	2,1	**0,8**
Blue lupins	8,8	304	13,3	1,8	**0,6**
White lupins	8,7	304	15,4	2,8	**0,8**
Soya	14,7	368	21,4	5,1	1,4

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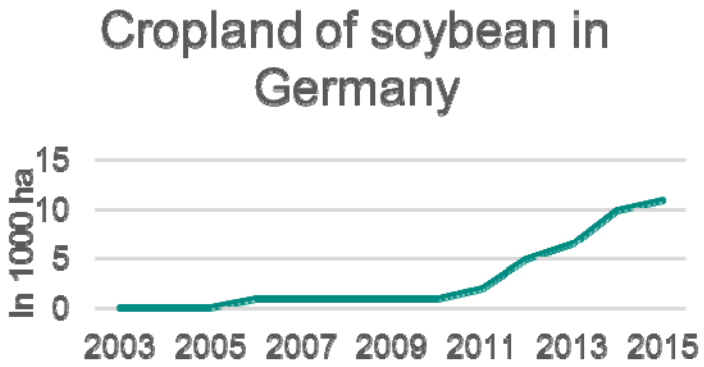
Source: Werner Vogt-Kaute, Naturland

Local cultivation of soybean

- High demand
- Reduce dependence of imports
- GMO- free, organic



Source: Graph based on data from BLE (2015)

Protein quality

- High crude protein content ~35%
- Good amino acid pattern
- Sufficient content of methionine

Ingredients of grain legumes (g/kg)

Forage	RP	Lysine	Methionine	Meth. + Cysteine	RF
Peas	202	15	2,1	4,9	57
Broad bean	272	16,3	2,1	4,6	72
Lupine	304	13,3	1,8	6	145
Soybean	368	21,4	5,1	11,4	51

Source: Vogt-Kaute in Naturland Nachrichten 02/2011

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Broad bean (*Vicia faba*)

› Variation

- Summer annual and winter annual types
- White-blossomed (low content of bitter substances)
- Coloured-blossomed (high content of bitter s.)

› Habitat

Cooler and wetter sites
Deep medium - high soils or light soils with low groundwater level
Soil with high water holding capacity, without waterlogging and soil compaction
pH >6,5

› Crop rotation

Cultivation breaks of 6 years (self incompatibility) and distance of 2 years to other legumes

(Ann-Kathrin Spiegel et al. 2014)

Peas (*Pisum sativum*)

›Variation

- Summer annual and winter annual types
- Leafless-, semi-leafless- & leafed types
- White-blossomed (low content of bitter substances)
- Coloured-blossomed (high content of bitter s.)

›Habitat

Cool-warmer sites
Deep light - midclayey soil with high water holding capacity, without waterlogging and soil compaction
pH 6,2 – 7

›Crop rotation

Cultivation breaks of 9 - 10 years (self incompatibility) and distance of 2 years to other legumes

(Ann-Kathrin Spiegel et al. 2014)

Lupin (*Lupinus)*

- Yellow lupine (*Lupinus luteus*)

(clayey) sand; pH 4,6 - 6

- Blue lupine (*Lupinus angustifolius)*

(sandy) clay, loess; pH 5,5 – 6,8

- White lupine (*Lupinus albus)*

Better soil types; pH 5 – 6,8

- <u>Crop rotation</u>

cultivation breaks of 6 years, sufficient distance to other legumes

- % of alkaloid content

Blue lupine	Yellow lupine	White lupine
Sweet: 0,001 – 0,1	Sweet: 0 – 0,1	Sweet: ca. 0,2
Bitter: 0,3 – 2,0	Bitter: 0,4 – 1,5	Bitter: 0,3 – 3,3

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Challenges in the cultivation of grain legumes

- Climate and habitat requirements
- Yield stability
- Self-intolerance & intolerance with other legumes
- Partly/termporarily low weed suppression due to slow growth in spring
- Partly problems with lodging (e.g. pure stands of leafed peas)
- Little variety assortment available – decline in breeding activities due to decreasing demand

Possibility of mixed cropping

- Repression of weeds by shadowing and allelopathy (e.g. oats)
- Cereals can be used as supporting crops for climbing legumes
- Easier harvest through supporting crops

Peas/ barley (80/40*)

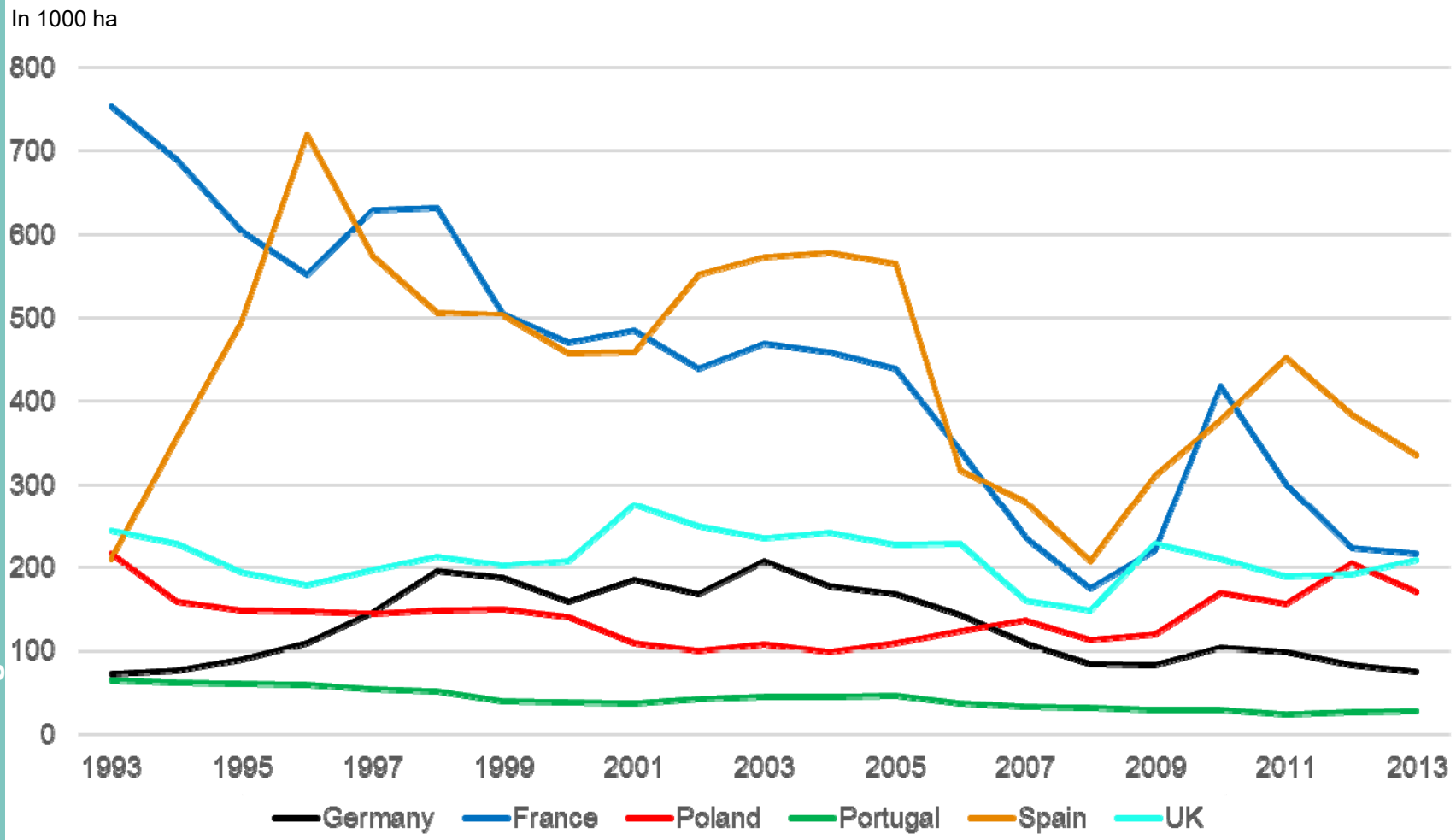
(Picture: © FiBL, Hansueli Dierauer)

Broad bean/ oats (80/40*)

(Picture: © FiBL, Cornelia Kupferschmid)

* Percentage of local sowing rate

Acreage of grain legumes by selected countries (EU)



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Source: Graph based on data from 1993 - 2013 - FAOstat (2015)

Differences between selected countries of the EU

	2012 Arable land (1000ha)	2012 Lupine	Lupine % of arable land	2012 Peas (dry)	Peas % of arable land	2012 Broad beans (dry)	Broad beans % of arable land
Germany	11.834,00	17.900	0,15	44.800	0,38	15.800	0,13
France	18.290,60	2.553	0,01	139.377	0,76	60.340	0,33
Italy	7.118,00	5.000	0,07	7.135	0,10	46.130	0,65
Spain	12.400,00	6.700	0,054	163.800	1,32	24.600	0,20

FAOstat (2014): arable land in 2012 and area harvested of lupine, peas and broad beans

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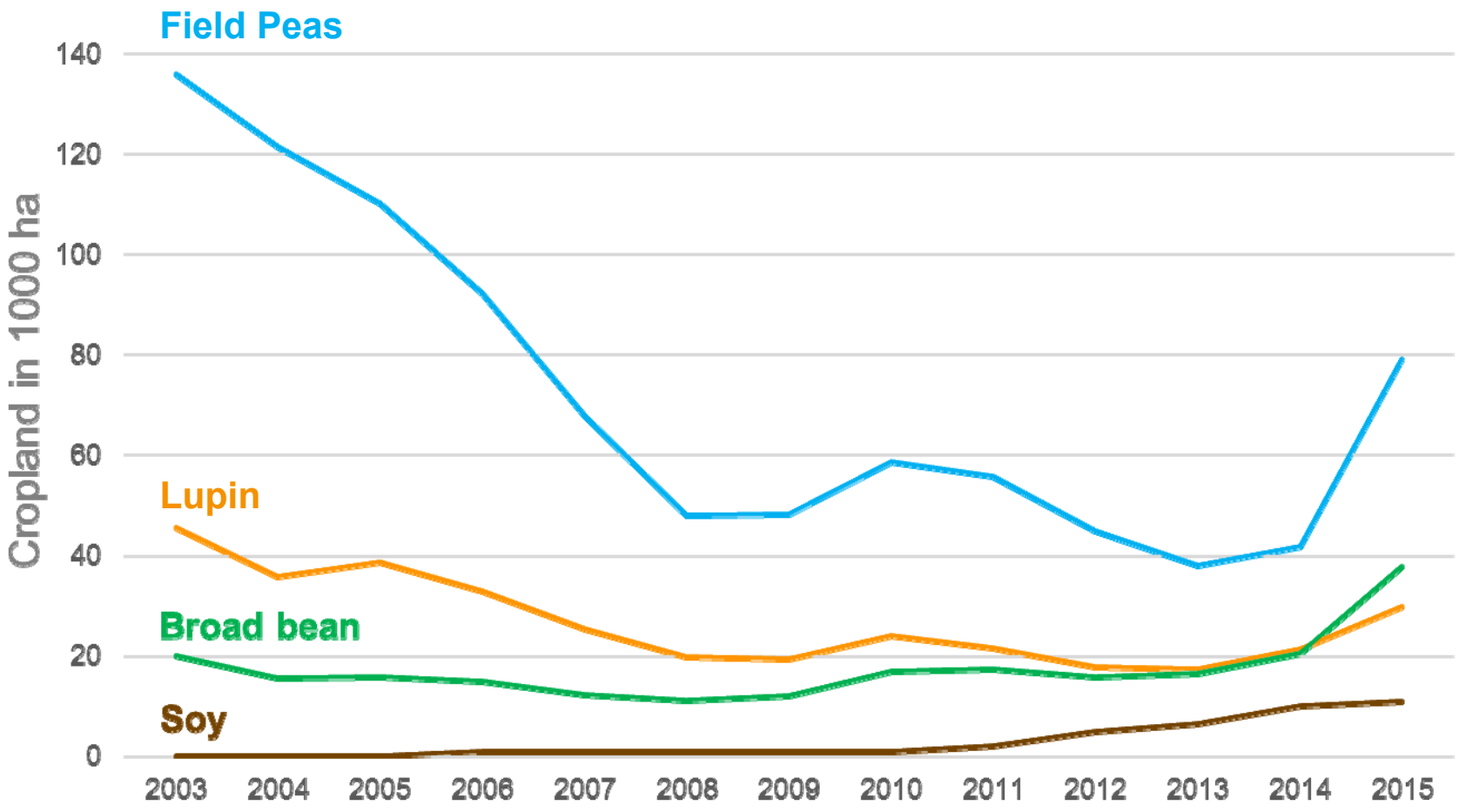
Cultivation of grain legumes in Germany (2003-2015)



Source: Graph based on dataa from 1960 - 2013 - FAOstat (2015), 2013 – 2015 - Statistisches Bundesamt (2015), Soy - BLE (2015)

Development of grain legume cultivation in Germany

Chart: Cultivation of broad bean, Peas an sweet lupines in Germany (in 1.000 ha)

Field crop	Avg. 2003-2008	2009	2010	2011	2012	2013	2014	2015 (p)
broad bean	14,9	12,0	16,3	17,3	15,8	16,5	20,5	37,7
Peas (without baby peas)	95,9	48,3	57,2	55,8	44,8	37,9	41,7	79,1
Sweet lupines[1)]	33,0	19,4	24,0	21,5	17,9	17,4	21,4	29,8
Other[2)]	4,5	3,3	3,2	2,9	3,6	2,9	8,8	14,0
In total	148,3	83,0	100,7	97,5	82,1	74,7	92,4	160,6

Source: Graph based on data from Statistisches Bundesamt (2015)

1) Until 2009: lupins - 2) Whithout soja bean - (p) provisional

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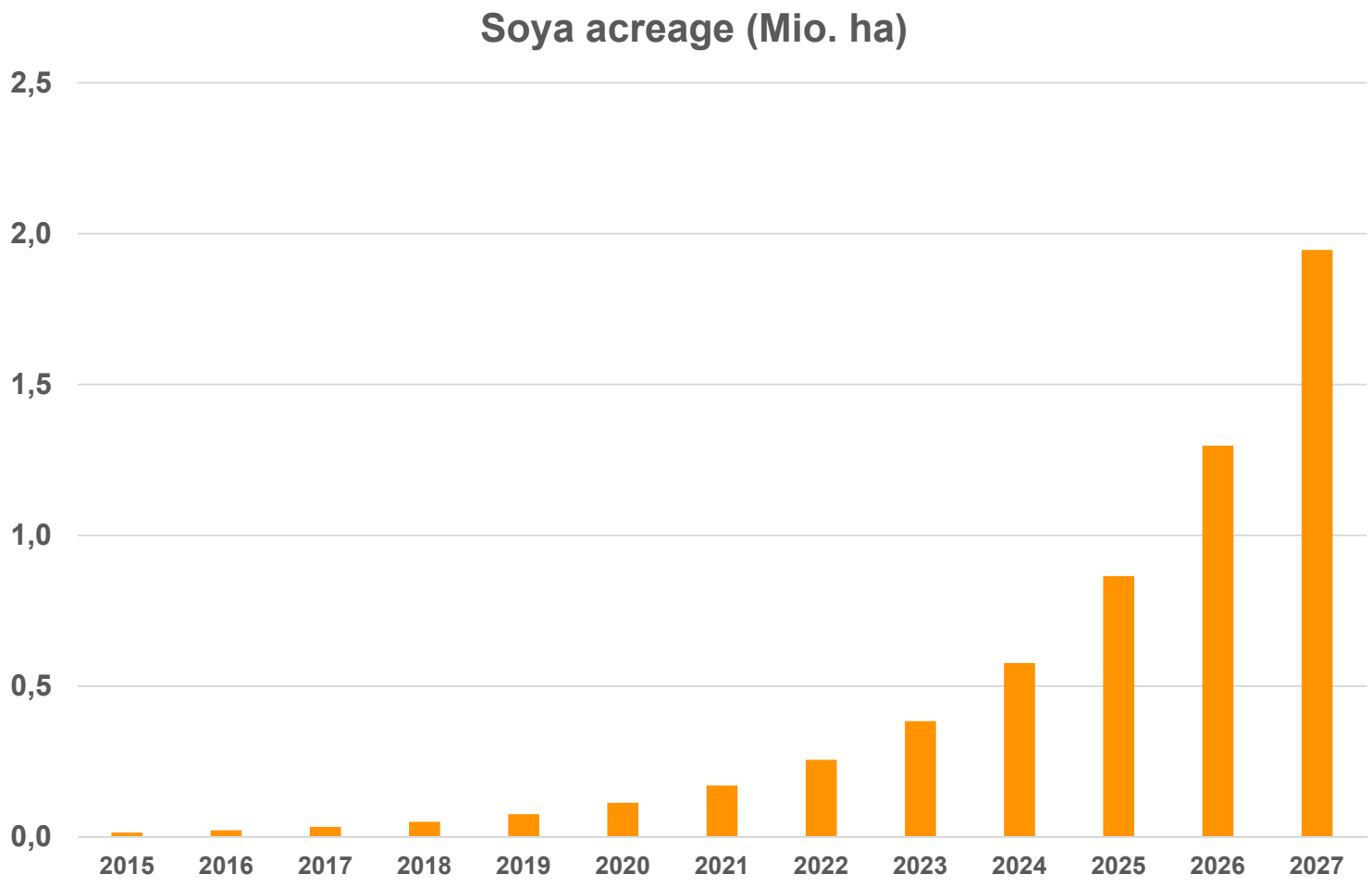
The greening direct payment

- Maintaining permanent grassland
- Crop diversification
- „Ecological focus area“ (EFA)
  - at least 5% of arable area
  - Farmer with more than 15 ha
  - Different weighting factors

Measure	Weighting factor	1ha EFA equivalent to
Legumes	0,7	1,43 ha
Catch crops	0,3	3,33 ha
Fallow land	1	1 ha

DE: 50% yearly increase in soya cropping (replacement of ca. 5,5 Mio. t imported soya)



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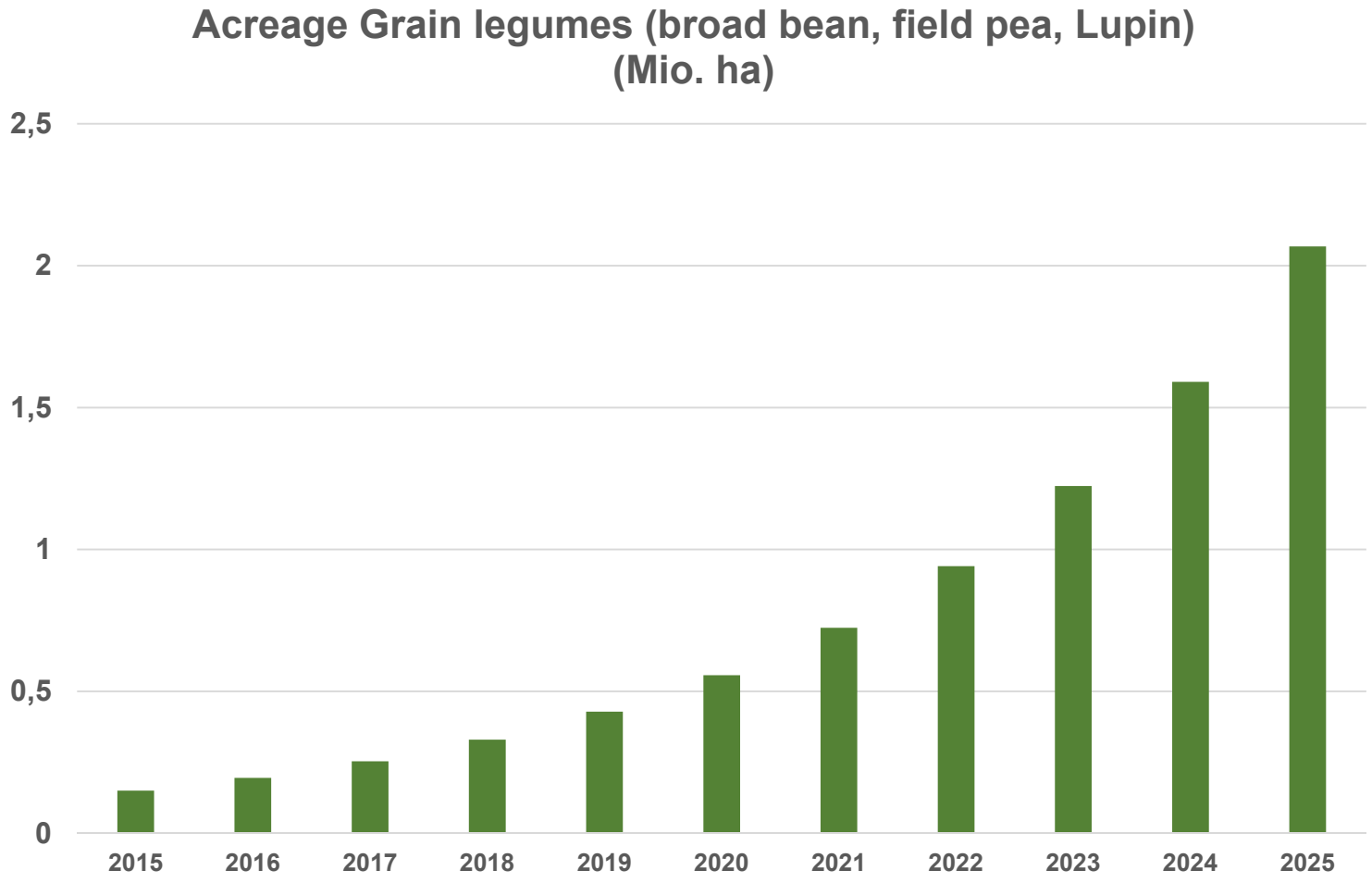
DE: 30% yearly increase in field pea, broad bean and lupin cropping (replacement of ca. 5,5 Mio. t imported soya)



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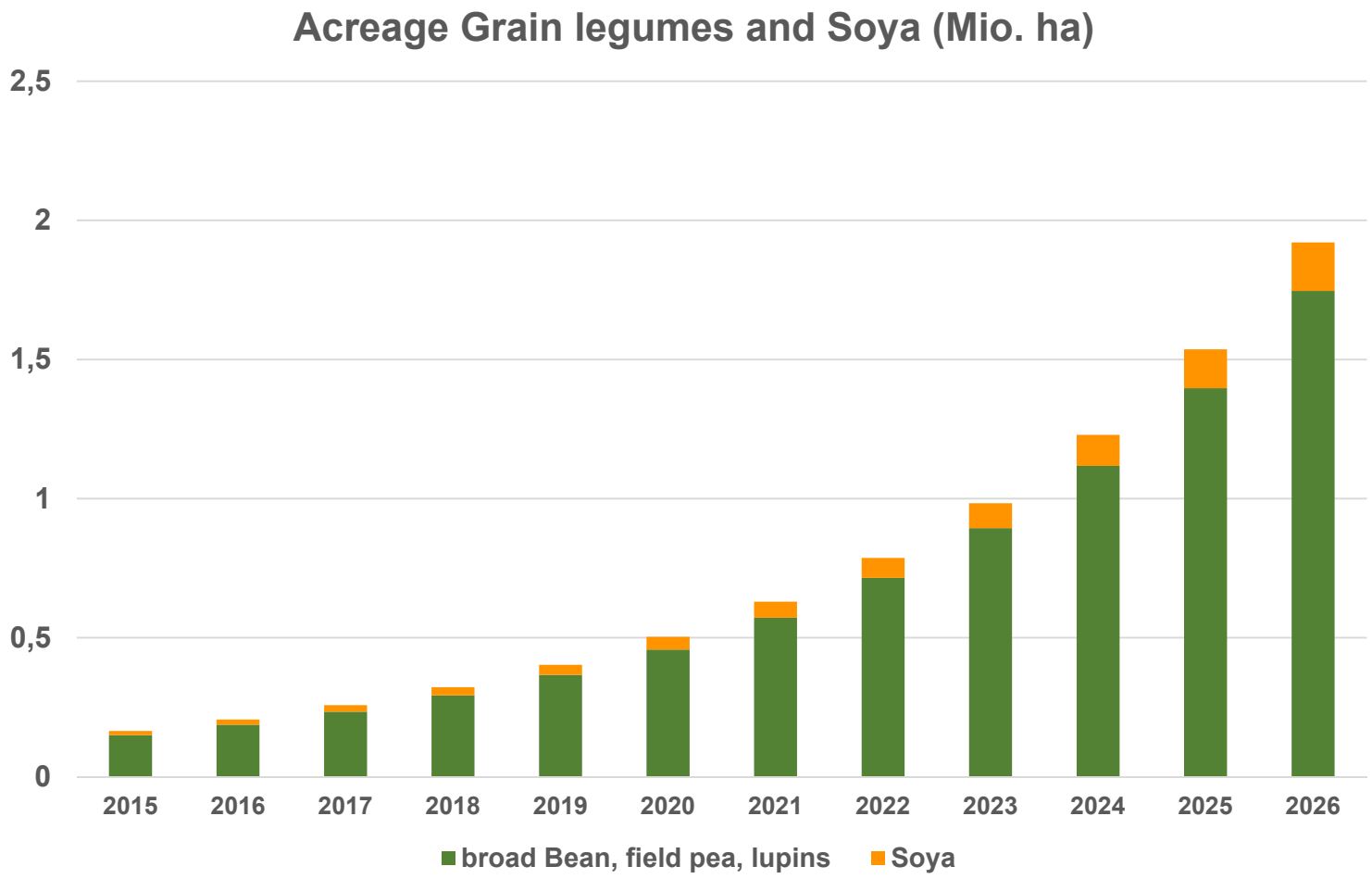
DE: 25% yearly increase in soya and 25% in field pea, broad bean and lupin cropping (replacement of ca. 5,5 Mio. t imported soya)



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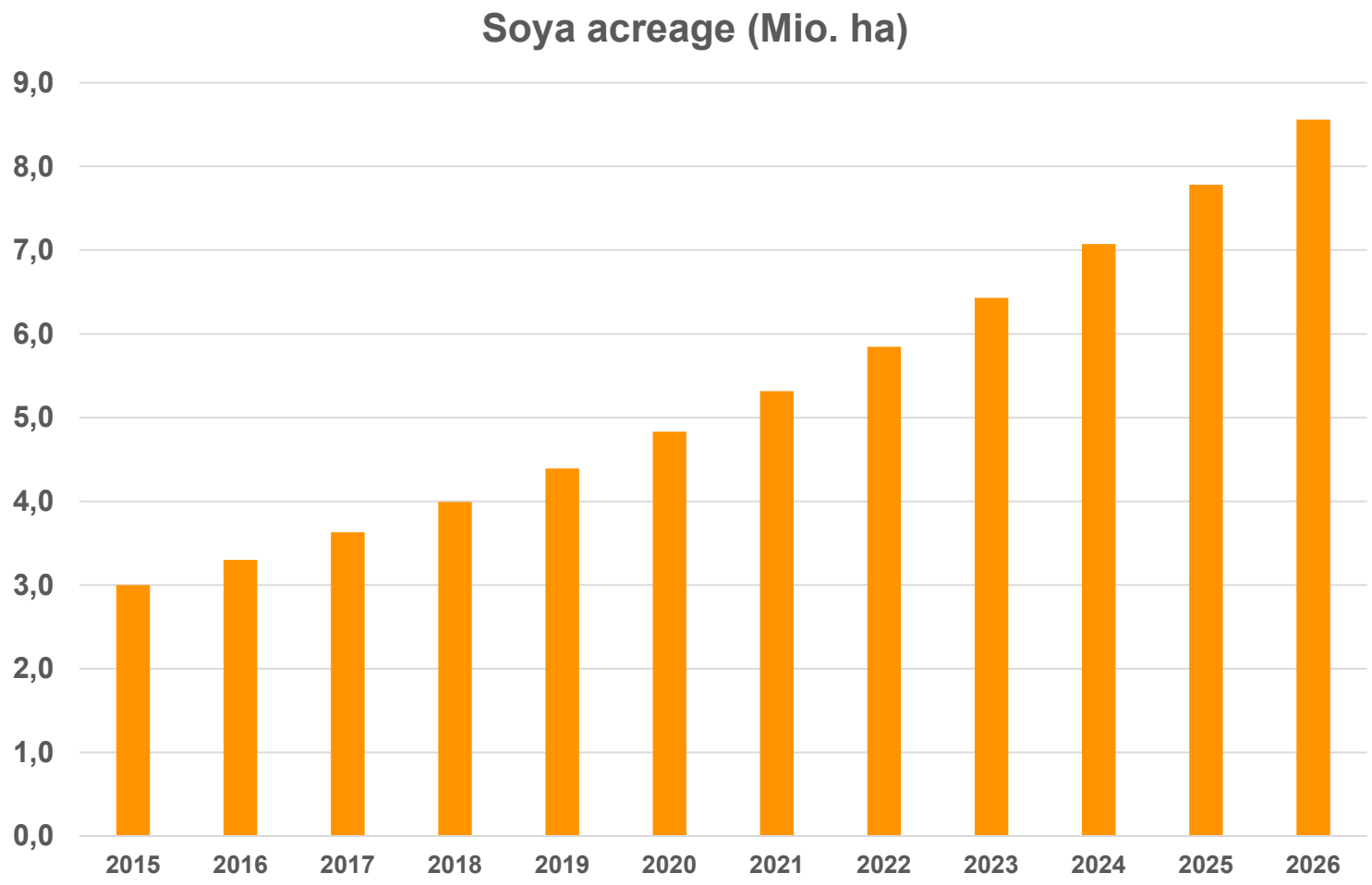
EU: 30% yearly increase in soya cropping (replacement of ca. 25 Mio. t imported soya)



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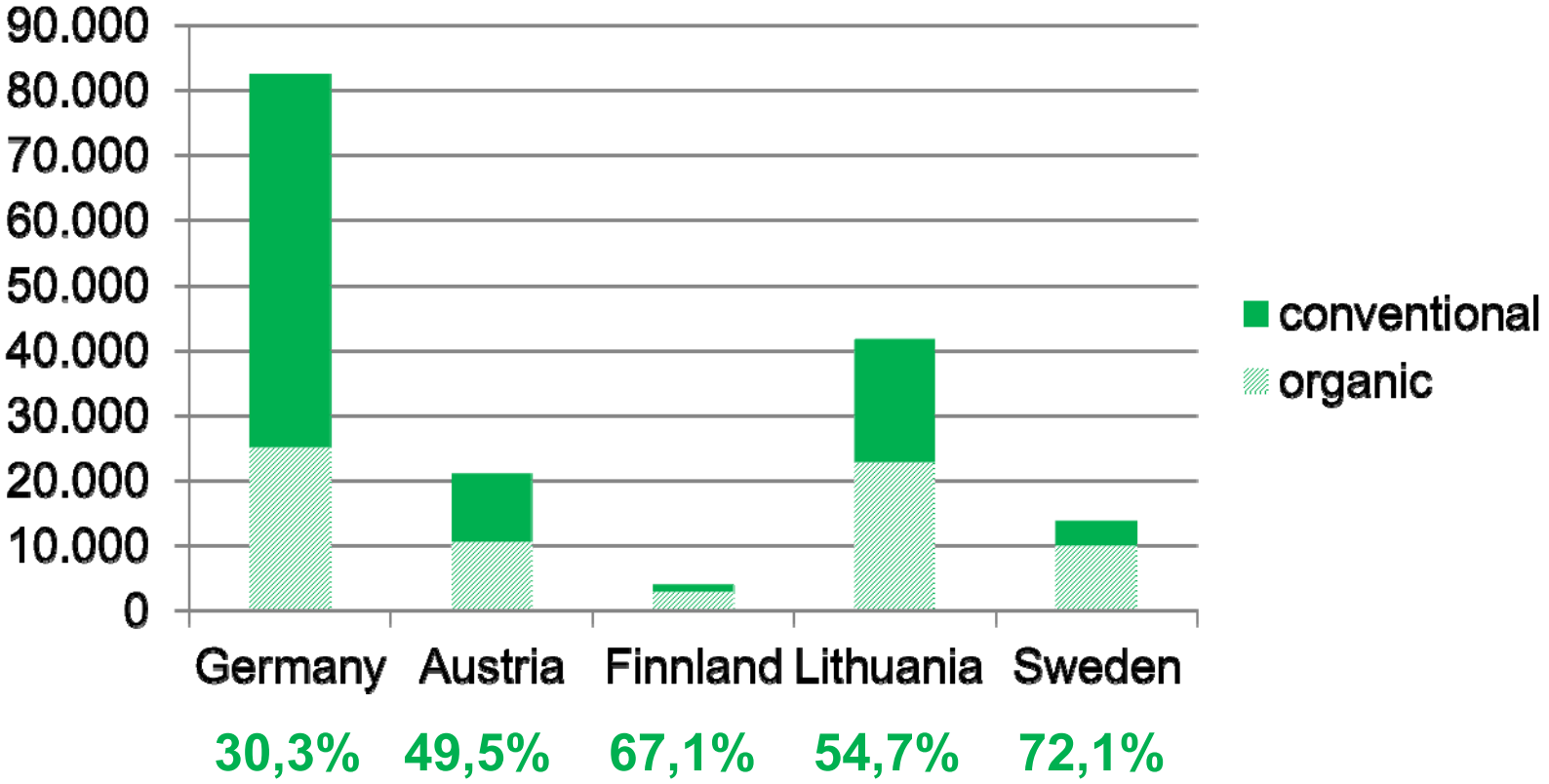
Particular importance for organic farming

- Attempt to work in as closed as possible farming cycle
- Nitrogen fixation
- Protein supply for animal feeding
- Prohibition of soya extraction meal & GMO
- Potential local market for human nutrition is available (vegetable source of protein)

Acreage of pulses and its organic share (2013)



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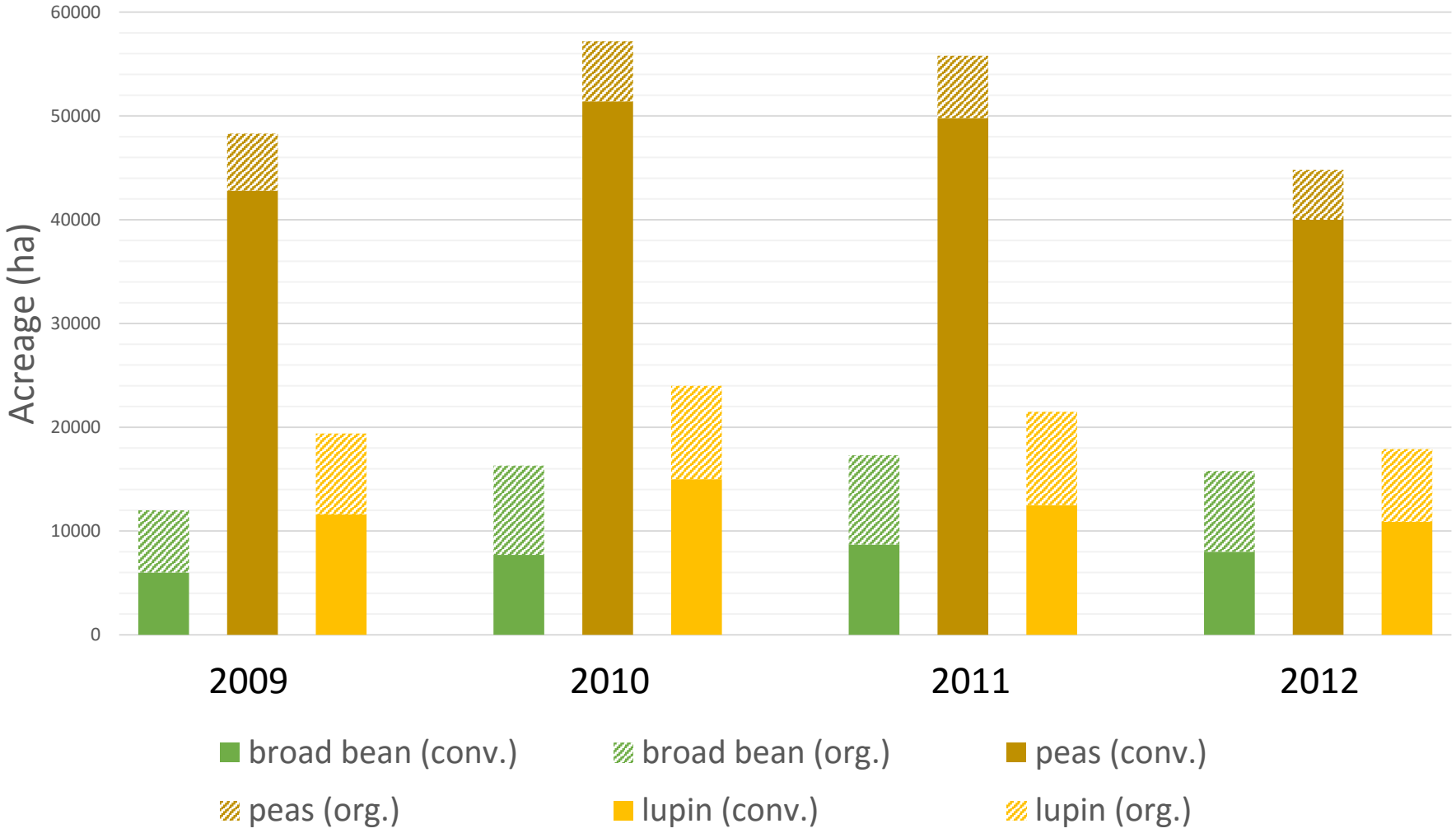
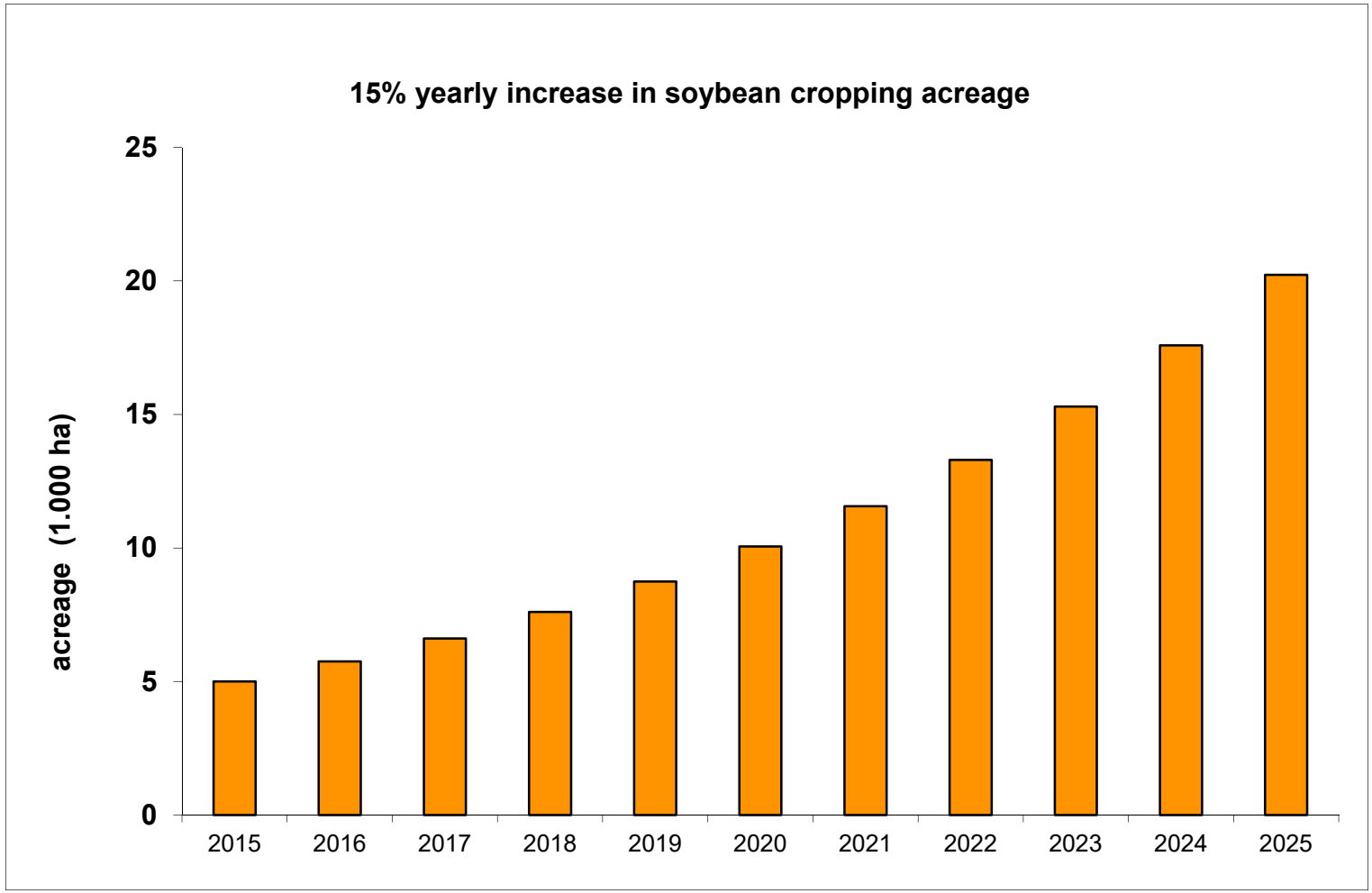
Source: FiBL & IFOAM (2015)

Acreage of broad bean, peas and lupin in Germany (conventional/ organic)



Source: Graph based on data from Statistisches Bundesamt (2015) & Griese (2014)

Organic farming (DE): 15% yearly increase in soya cropping



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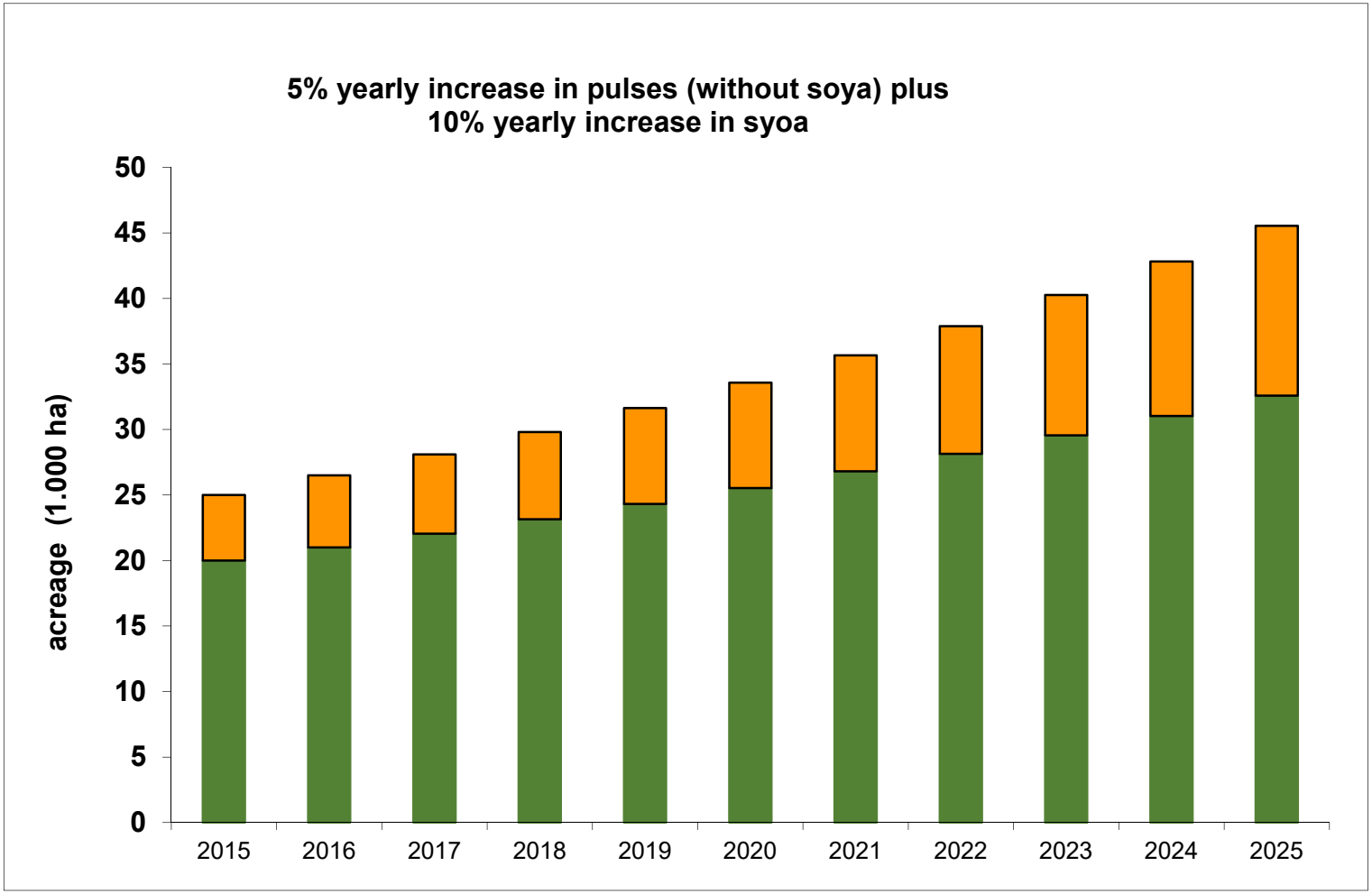
Organic farming (DE): 5% yearly increase in pulses and 10% yearly in soya cropping



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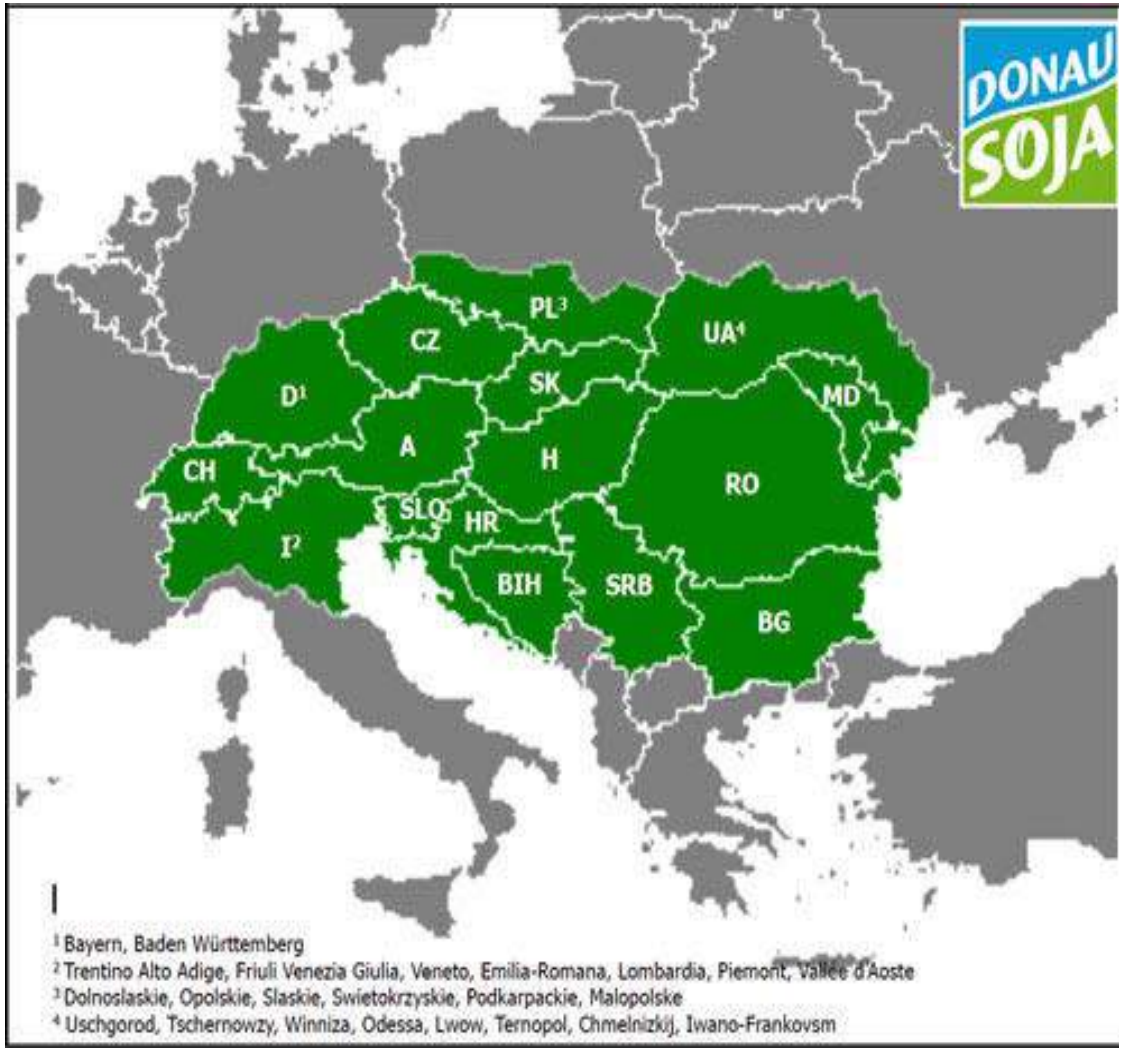
Danube Soya

- International non-profit association, based in Vienna
- Promote sustainable GM-free soy bean cultivation in Europe along the Danube river
- Marke-ted with the label:



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Statement by Danube soya CEO M. Krön

Großes Potential aus der Donau Region „Bereits über 3 Millionen Hektar Soja werden 2015 in der Donauregion (inkl. Ukraine) angebaut – das entspricht bereits mehr als 7,7 Millionen Tonnen. In zehn Jahren könnte Europa diese Menge ohne weiteres mehr als verdoppeln. Zusammen mit anderen europäischen Eiweißquellen, dem reduzierten Konsum von tierischem Eiweiß und mehr Importen an zertifiziertem Soja wie ProTerra, könnte Europa bis 2025 den Umstieg in eine nachhaltige Eiweißversorgung schaffen“, sagt Matthias Krön, Vorstandsvorsitzender des 2012 gegründeten Vereins Donau Soja.

„A doubling of this amount in 10 years time would be possible. Together with other european protein sources, a reduced consumption of animal protein and more imports of certified soya Europe could managed to switch to a sustainable protein supply“

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Press release: Verein Donau Soja, Berlin, 7./8. Mai 2015

Danube Soya

Donau-Soja-Ernte: 2,2 Mio. Tonnen

Freitag, 16.10.2015 - 13:10 Uhr

Trotz wesentlich niedrigerer Hektarerträge geht der Verein Donau-Soja von einer gleichbleibenden Soja Produktion 2015 in Europa aus. Die geringeren Mengen konnten durch die vergrößerten Anbauflächen ausgeglichen werden. In der Donauregion (ohne Ukraine) wurden die Sojaflächen zwischen 2012 und 2015 auf rund 950.000 Hektar beinahe verdoppelt. Dies entspricht bei einer normalen Ernte einer Menge von fast 3 Millionen Tonnen, bei einer schwachen Ernte wie heuer sind es zirka 2,2 Mio. t., erklärt Donau-Soja.

Soya acreage doubled between 2012 and 2015 in Danube region; 2,2 Mio. t harvest in 2015

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Requirements to expand the cultivation of traditional grain legumes

- Breeding of new varieties
  - Resistance to pest and diseases
  - adapted to cropping area (optimizing plant adaption to abiotic stress)
  - Reduce anti-nutritional factors
  - Improve digestibility
- Knowledge about practicable (mixed) cropping system & variety choice
- Profitable cultivation and marketing

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Date	Event	Location	Country
10/11/2015	Official launch of the International Year of Pulses	FAO HQ	Italy
19/11/2015	Scientific Symposium on Pulse Health & Nutrition	New York Academy of Sciences	New York
17/02/2016	The Pulses Conclave	Jaipur	India
05/04/2016	Regional Conference Central American Cooperative Program for Crops and Animal improvements		Costa Rica
01/05/2016	World Pulses Convention	Izmir	Turkey

FAO (2015)

Conclusions

- Switch to a more sustainable plant protein supply in Europe in 10 to 15 years seems possible
- It is not so much a question whether it works, it‘s more a question whether we really want this switch and whether we are prepared to pay the price and make the effort
- EU and national policies must support this switch (e.g. GAP reform)
- The protein gap in organic farming is much smaller but in terms of methionine more challenging; regarding esp. for monogastric animals a supplement of components with high methionine content is necessary
- Merits of a switch to more protein crops in Europe: domestic value added, ecosystem services (BNF, Biodiversity, soil nutrient improvement…), avoidance of environmental costs, economic opportunities for new EU Member States and candidates….

Sources

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