

Brussel, 15 juni 2016

cc: COREPER
cc: leden Commissie Volksgezondheid

Geachte Minister, Geachte heer Borsus,

Op 24 juni 2016 stemt u in de beroepscommissie over het voorstel van de Europese Commissie om de goedkeuringsperiode van glyfosaat met 12-18 maanden te verlengen. De discussie ging tot nu toe voornamelijk over 'is glyfosaat kankerverwekkend of niet'. Intussen wordt duidelijk dat deze kwestie veel ruimer moet bekeken worden. Het gaat steeds meer¹ over hoe ons huidige landbouwmodel er uit ziet - grote afhankelijkheid en overconsumptie van destructieve chemische producten - en de nood aan een transitie naar een meer duurzaam voedselproductiesysteem.

Wij zijn er vast van overtuigd dat als we de toekomstige voedselproductie én een gezonde omgeving willen veilig stellen, we eerder zullen moeten samenwerken met de natuur en natuurlijke processen, dan er tegen in te gaan. Alleen zo kunnen we voorkomen dat boeren afhankelijk blijven van steeds meer en steeds duurdere producten, kunnen we meer focussen op een levende, gezonde en dus productieve bodem en kunnen we de diensten ondersteunen die ons ecosysteem al voorziet om planten en gewassen te beschermen, te verzorgen en te voeden.

Glyfosaat is een niet-selectief herbicide. Dat betekent dat het álle planten doodt, niet alleen het onkruid. Bovendien doodt het ook bacteriën, algen en schimmels. Het zorgt misschien voor toenemende opbrengsten en lagere werkingskosten, maar het gaat ten koste van onze volksgezondheid, de gezondheid van dieren, de bodem en de biodiversiteit. We kunnen niet langer onze ogen sluiten voor deze reële - edoch geëxternaliseerde - kosten die het industrieel landbouwmodel en stoffen als glyfosaat met zich meebrengen.

In bijlage hebben we zeven manieren opgesomd om voedsel te produceren, zonder glyfosaat of andere pesticiden te gebruiken.

We rekenen op u om werk te maken van een nieuw model van een duurzame, niet-giftige landbouw. We zitten op een kantelmoment, alstublieft, grijp deze kans en stem voor meer duurzame landbouw.

¹ Discussienota van het Nederlands voorzitterschap: *Food of the future - the future of food* <http://bit.ly/1WIWnxd>,
Wir brauchen die ökologische Wende, kein Glyphosat, Die Welt, 20.05.16,
<http://www.welt.de/debatte/kolumnen/Fuhrs-Woche/article155525738/Wir-brauchen-die-oekologische-Wende-kein-Glyphosat.html>

Net zoals toen Rachel Carson haar Silent Spring publiceerde in 1962, gaat dit niet over een conflict tussen wetenschappelijk en anti-wetenschappelijk beleid, maar over een conflict binnen de wetenschap zélf: tussen de chemische sector - en de bedrijfsbelangen die de infrastructuur controleren en begrijpelijkerwijs hun bedrijfsmodel verdedigen - en ecologie. Doorgeredeneerd gaat dit over de keuze tussen processen die leven stimuleren of processen die doden.

Als eerste stap dringen we er op aan om tegen deze technische verlenging van glyfosaat te stemmen en de Europese Commissie te verzoeken met een voorstel te komen dat glyfosaat niet langer toelaat.

Hoogachtend,

Bart Staes, Groen
Lid van het Europees Parlement

Philippe Lamberts, Ecolo
Lid van het Europees Parlement

Greens/EFA

Bart STAES
Philippe LAMBERTS
Michèle RIVASI
Benedek JAVOR
Davor SKRLEC
Ernest URTASUN
Yannick JADOT
Igor SOLTES
Margrete AUKEN
Molly SCOTT-CATO
Keith TAYLOR
Claude TURMES
Ulrike LUNACEK
Maria HEUBUCH
Martin HAÜSLING
José BOVE
Karima DELLI
Eva JOLY
Pascal DURAND
Rebecca HARMS
Reinhard BÜTIKOFER
Sven GIEGOLD
Bas EICKHOUT
Heidi HAUTALA

GUE/NGL

Alexandra LOBAO
Sofia SAKORAFI
Tania GONZALEZ PENAS
Josu JUARISTI ABAUNZ
Maria Lidia SENRA RODRIGUEZ
Stefan ECK
Anja HAZEKAMP
Katerina KONECNA
Barbara SPINELLI
Xavier BENITO ZILUAGA
Anne-Marie MINEUR
Marisa MATIAS
Ernst CORNELIA
Fabio DE MASI
Younous OMARJEE
Estefania TORRES MARTINEZ
Marina ALBIOL
Merja KYLLÖNEN
Maria Dolores Lola SÁNCHEZ CALDENTY
Tina HARTMAN
Jiri MASTALKA
Martina MICHELS
Eleonora FORENZA
Gabriela ZIMMER
Rina Ronja KARI
Marie-Christine VERGIAT
Patrick LE HYARIC
Curzio MALTESE

EFDD

Eleonora EVI
Rosa D'AMATO
Marco VALLI
Marco AFFRONTE
Dario TAMBURANO
Piernicola PEDICINI
Fabio Massimo CASTALDO

S&D

Pavel POC
Marc TARABELLA
Karin KADENBACH
Brando BENIFEI
Gilles PARGNEAUX
Maria NOICHL

ALDE

Frédérique RIES

EPP

Sirpa PIETIKAINEN

Claude ROLIN

NI

Zoltan BALCZO

Annex

1. Non-chemical techniques as alternatives to herbicide use

Herbicides are intended to kill weeds. First of all, use of herbicides as a ripening and desiccation agent for the crop itself must be discontinued; it is inevitable that elevated levels of pesticide residues end up in final food products if the crops are sprayed while seed or fruit is developing on the stem.

Evidence suggests that weeds only affect the yields under certain conditions, and that a totally weed-free field is not needed², and indeed that many wild plants offer microhabitats for other beneficial species that protect the crops from pests³. To prevent too much competition from weeds, there are a number of techniques that are already being used in various production systems which have been shown to be at least equally cost effective as glyphosate application⁴, and do not have the negative consequences for biodiversity posed by long term pesticide use. The alternatives to pesticides like glyphosate have been likened to “many little hammers”⁵, instead of one big chemical hammer. Alternative control of weeds includes combinations of mechanical, physical and biological techniques - notably used in organic farming - such as:

- Appropriate crop rotations⁶ including
 - Clean fallow against perennial and rhizomal weeds,
 - Cover crops doubling as mulch or green manure,
 - Following weed-prone crops with those where weeds can easily be controlled before they set seed
 - rotating between crops that are planted in different seasons
- Stale bed techniques to germinate weed seeds before sowing crops combined with mechanical weeding⁷
- Mulching⁸ to suppress weed germination

² Andreasen, C. et al., 1996: *Decline of the flora in the Danish Arable field*. J. Appl. Ecol. 33, p. 619-626. Danish studies on wild plant species from 1970 to 1990 shows that weed growing in cultivated fields comprise approx. 200 wild plant species, but approx. 80% of them are so weak in the competition with the crops that they do not affect yield substantially in any well-run farms. Therefore it is the remaining 20% of weed species that are so competitive that they can affect the yield significantly.

³ Bianchi et al, 2006, *Sustainable pest regulation in agricultural landscapes: a review on landscape composition, biodiversity and natural pest control*, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1634792/> also <http://theconversation.com/as-biodiversity-declines-on-corn-farms-pest-problems-grow-45477> also <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1634792/>

⁴ Kehlenbeck et al, 2015: *Impact assessment of partial or complete abandonment of glyphosate application for farmers in Germany*, Julius-Kuhn-Archiv, 451, 2015. ISBN 978-3-95547-027-2. EN executive summary (p.17)

⁵ Liebman, M., and E. R. Gallandt. 1997. *Many little hammers: Ecological management of crop-weed interactions*. In *Agricultural Ecology*, L. E. Jackson, ed., pp. 291–343. San Diego, CA: Academic Press. Also Organic Agriculture Centre of Canada, 2013, *Ecologically based weed management*

http://www.oacc.info/NewspaperArticles/tcog_2012/tcog_many_little_hammers.asp

⁶ Liebman, M., and C. P. Staver. 2001. *Crop diversification for weed management*. In *Ecological Management of Agricultural Weeds*, M. Liebman, C. L. Mohler, and C. P. Staver, eds., pp. 322–74. New York: Cambridge University Press.

More practices to avoid weeds at <http://www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms/Text-Version/Physical-and-Biological-Processes-In-Crop-Production/The-Role-of-Crop-Rotation-in-Weed-Management>

⁷ Institut technique de l'agriculture biologique, webpage on mechanical weeding

<http://www.itab.asso.fr/programmes/desherbage.php>

⁸ *Gestion du Sol en Agriculture Biologique: Paillage et enherbement sur le rang en viticulture*. Goma-Fortin, Gontier, Gaviglio, Chovelon et Malet (2012). Nov.-Dec. 2012 - ALter AGri n°116, pg. 22-24 <http://www.itab.asso.fr/downloads/solab/aa116-dossier-solab-viti.pdf>

- Avoiding bare soil in plantings, for example using intercropping or nurse crops undersown to emerge before the main crop
- Shallow ploughing to maintain subterranean communities and soil structures, while avoiding bringing up weed seeds from the seed soil bank
- Use of rotary hoe between rows and within rows in bigger crops later in season
- Thermal treatment in using steam or grill/hotplate

2. Letting beneficial species do their work: IPM and cascade approach, chemicals as last resort

Organic farmers have proved that producing without pesticides without large yield gaps is possible. A first step to reach organic production can be Integrated Pest Management: IPM is a concept already established in and promoted through EU legislation (both Reg.1107/2009 and Dir.2009/128/EC). However, it is not enough to merely promote it - implementation of IPM practices is patchy, and to achieve its maximum benefits it should be made compulsory. Many ways of managing pests via IPM rely on biodiversity, e.g. through beneficial species of predators of pests in the soil and in the wider agro-ecosystem. But those species may either be directly affected by glyphosate application, or their food source or habitat is⁹. However, most pesticide

Gestion du Sol en Agriculture Biologique: Alternatives au travail du sol sur le rang et gestion du sol en arboriculture. Garcin, Bussi, Corroyer, Dupont, Ondet, Parveaud (2012). Nov.-Dec. 2012 - ALter AGri n°116, pg. 19-21 <http://www.itab.asso.fr/downloads/solab/aa116-dossier-solab-arbo.pdf>

⁹ The UK charity Buglife filtered out statically significant results of scientific investigations of glyphosate toxicity published in peer-reviewed journals, allowing for field-realistic exposures. Significantly negative effects were seen in the following taxonomic groups:

- Ground beetles: Fewer larger species in treated areas; Brust (1990)
- Collembolans: Highly sensitive to glyphosate; Hammad and Gurkan (2012)
- Spiders: Fewer in treated areas; Haughton et al. (1999a)
- Invertebrates, Araneae, Heteroptera, Auchenorrhyncha: Fewer in treated areas; Haughton et al. (1999b)
- Woodlouse (*Porcellio scaber*): Feeding activity significantly affected. Bushaiba et al. (2006)
- Predatory soil arthropods: observable effects late in season; House (1989)
- Honeybees (*Apis mellifera*): Impaired cognitive capacity; adversely affects navigation; Sol Balbuena et al. (2015). Reduced sucrose sensitivity and learning performance; Herbert et al. (2014)
- lynx spider (*Oxyopes salticus*): disrupted mating behaviour; Hanna (2015)
- Soil macroarthropods: No observable effect until late in season when fewer in treated areas; House et al. (1987)
- Soil-dwelling gastropods: Higher impact in treated areas at 3 and 4 years post-treatment; Prezio et al. (1999)
- Surface gastropods: decreased abundance in treated areas at 3 and 4 years post-treatment; Prezio et al. (1999)
- Earthworms: Reduction in activity and reproduction; Gaupp-Berghausen et al. (2015)
- Spider (*Lepthyphantes tenuis*): Less abundant in treated areas; Haughton, et al. (2001)
- Lacewing (*Chrysoperla externa*): long-term effects on development time between 3rd instar & pupal stage. Adult stage significantly shortened by exposure to Glyphosate over long periods, with effects on fertility and fecundity; Schneider et al. (2009)
- Spider (*Alpaida veniliae*): detrimental effects on web building, abnormalities in the ovaries, egg sacs and egg masses, and on fertility and fecundity. Also development time from egg-laying to third instar was significantly longer in glyphosate treatments; Benamu et al. (2010)

Freshwater ecosystems:

- Common blue damselfly (*Enallagma cyathigerum*): larval growth rates were lower in larvae exposed to glyphosate; Janssens and Stoks (2013)
- Painter's Mussel *Unio pictorum*: proteins of the oxidative pathway, detoxification, and energetic metabolism were affected either by glyphosate or microcystin-LR or by the mixture; Malecot et al. (2013)
- Freshwater crustaceans: Moderately toxic to *Phyllodiaptomus annae* and slightly toxic to *Caridina nilotica*. Deepananda et al (2011)
- water flea (*Daphnia magna*): Fecundity significantly lower in future generations of *Daphnia* exposed to glyphosate; Papchenkova et al. (2009)
- Aquatic invertebrates: Increased mortality in *Acilius semisulcatus* (water beetle) and Eurytemora (zooplankton); Frogs: Roundup completely eliminated two species of tadpoles and nearly exterminated a third species; Relyea (2005)
- Aquatic ecosystems: Glyphosate was positively associated with greater ecosystem impacts; Siemering, Hayworth (2008)

The UK's Soil Association filtered studies of the impact of glyphosate on earthworms and nematodes:

risk assessment is often very short term, meaning that few longer term studies exist looking at sub-lethal effects due to repeated exposure. A fundamental problem with the methodological approach taken for approval by EFSA means that significant findings are diluted by the many scientific studies that do not look for long enough or in the right places. Such collateral damage on biodiversity means that prophylactic use of glyphosate and other pesticides (when the weeds present would not affect yield or when no pest is even seen), and especially its use as a ripening or desiccation agent, is seriously flawed because these natural defence mechanisms based on biodiversity are prevented from being effective, prevented from even having a chance to work and to cut the need for pesticide use.

Systematic regular or prophylactic use also leads to an increase of resistance, so that when a substance is really needed, it might no longer work as well, as effectiveness will decrease over time.

What's more, killing all weeds/wild flowers means less food all year round for bees and other wild pollinators, which means less effective pollination in the time window when insect pollinated crops come into bloom, which may lead to decreasing yields¹⁰. Following the same logic of increasing food available for natural predators of pests, wildflowers are being sown with cereals in order to decrease pest outbreaks¹¹.

Therefore a cascade approach should be followed, first using physical, mechanical and biological alternatives to pesticides, with pesticides only as a last resort if precautionary measures such as increasing structural and biological diversity, spreading risk and avoiding monocultures do not work. This will also help solve the problem of resistance and reduce the need to constantly innovate chemicals in a costly evolutionary arms race.

3. Advice and extension services, and exchange of farming knowledge

An effective exchange of knowledge and advice is essential to help inform farmers on how to implement those alternatives techniques and achieve a transition in agriculture. Many weed control techniques used before the widespread and systematic use of

- Correia, F. V. & Moreira, J. C. (2010) Effects of glyphosate and 2,4-D on earthworms (*Eisenia foetida*) in laboratory tests, *Bulletin of Environmental Contamination and Toxicology*, 85, pp.264–268.

- García-Pérez, J.A., Alarcón, E., Hernández, Y., Christian Hernández, C. (2016) Impact of litter contaminated with glyphosate-based herbicide on the performance of *Pontosclex corethrurus*, soil phosphatase activities and soil pH, *Applied Soil Ecology*, available online 15 March 2016.

- Zhao, J., Neher, D.A., Shenglei, F., Li, Z., and Wang, K. (2013) Non-target effects of herbicides on soil nematode assemblages, *Pest Management Science*, 69: pp. 679–684.

- Liphadzi, K.B., Al-Khatib, K., Bensch, C.N., Stahlman, P.W., Dille, J.A., Todd, T., Rice, C.W., Horak, M.J., and Head, G. (2005) Soil Microbial and Nematode Communities as Affected by Glyphosate and Tillage Practices in a Glyphosate-Resistant Cropping System, *Weed Science*, Vol. 53, No. 4 (Jul. - Aug., 2005), pp. 536-545

- Verrell, P. and Van Buskirk, E. (2004) As the worm turns: *Eisenia foetida* avoids soil contaminated by a glyphosate-based herbicide, *Bulletin of Environmental Contamination and Toxicology*, 72, pp. 219–224.

- Casabé, N Piola, L., Fuchs, J., Oneto, M.L., Pamparato, L., Basack, S., Gimenez, R., Massaro, R., Papa, J.C., and Kesten, E. (2007) Ecotoxicological assessment of the effects of glyphosate and chlorpyrifos in an Argentine soya field, *Journal of Soils and Sediment* 8, pp.1–8

¹⁰ Bee pollination improves crop quality, shelf life and commercial value, Klatt et al (2013)

<http://rspb.royalsocietypublishing.org/content/281/1775/20132440>

Insect pollination enhances seed yield, quality, and market value in oilseed rape; Bommarco et al (2012) found that insect pollination increases seed yield and the market value of oilseed rape (canola) by 20% cf. wind pollination alone.

<http://link.springer.com/article/10.1007%2Fs00442-012-2271-6>

Pesticides and Bees: Ecological-Economic Modelling of Bee Populations on Farmland; Ellis, Hanley, Kleczkowski, Goulson (2016) <http://www.st-andrews.ac.uk/media/dept-of-geography-and-sustainable-development/pdf-s/DP%202016-04%20Ellis%20et%20al.pdf>

¹¹ French government research agency INRA field trails <http://www.rtl.fr/actu/sciences-environnement/des-fleurs-au-milieu-des-champs-de-ble-pour-se-passer-des-pesticides-7783344684>

glyphosate and other pesticides would need to be re-learned, and new innovations not reliant on chemicals would have to be shared. But to allow for this knowledge exchange and multiplication, we must ensure there is no chemical bias in advice given, and that knowledge about alternatives and IPM is effectively transmitted. Thankfully these structures already exist¹², and all member states have the option to use the second pillar of the CAP to fund them.

In addition, a new form of interaction between researchers, farmers and other practitioners is now available: the EIP or European Innovation Partnership allows a participatory, community-based approach to exchange knowledge and innovation¹³.

4. Funding the transition via the Common Agricultural Policy (CAP)

Rather than farmers bearing the financial risk of the costs of the transition in learning and applying chemical-alternative techniques, we believe that public funds should do this, as the goal of sustainable, biodiverse agriculture is very much in the public interest. There is already a structure and programmes¹⁴ to cover the costs via the Rural Development pillar of the CAP. Measures and financial incentives to make the transition could also be further strengthened via Direct Payments in the First Pillar of the CAP. There is no need to wait until the next CAP reform; supporting the transition can already start now via Rural Development measures, including specially adapted agro-ecological measures that pay farmers to introduce new techniques and production systems, while also increasing public funding of advice services. What's more, just a few weeks ago, Commissioner Hogan announced¹⁵ a recently-introduced procedure to re-direct funds, which is a fast track way to adapt Rural Development programmes within just 8 weeks.

5. Coherence with EU biodiversity and climate change policy

Glyphosate and other pesticides impact soil microbial communities by killing beneficial bacteria and fungi¹⁶; indeed before its use as a herbicide, Monsanto first patented it as an anti-microbial agent¹⁷. By decreasing reliance on pesticides, and consequently by boosting biodiversity and natural processes in the soil and above ground in and around fields, it would not only help us meet our EU targets to halt the loss of biodiversity and ecosystem services¹⁸ in the EU and help stop global

¹² http://ec.europa.eu/agriculture/direct-support/cross-compliance/farm-advisory-system/index_en.htm As laid down in Articles 12-15 and Annex I of Regulation 1306/2013, <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1306&from=en>

¹³ <https://ec.europa.eu/eip/agriculture/en/content/EIPAGRIabout>, <http://ec.europa.eu/eip/agriculture/>

¹⁴ http://ec.europa.eu/agriculture/rural-development-2014-2020/index_en.htm

¹⁵ Exchange of views of the European Parliament Committee on agriculture and rural development with the Agriculture and Rural Development Commissioner Phil Hogan: Structured dialogue for 2016, 24th May 2016 <http://www.europarl.europa.eu/ep-live/en/committees/video?event=20160524-1500-COMMITTEE-AGRI>

¹⁶ Research shows that repeated applications of glyphosate can impact soil microbial communities: Cherni, A.E., Trabelsi, D, Chebil, S., Barhoumi, F., Rodriguez-Llorente, I.D., Zribi, K. (2015) Effect of Glyphosate on Enzymatic Activities, Rhizobiaceae and Total Bacterial Communities in an Agricultural Tunisian Soil, *Water Air Soil Pollution*, pp. 226:145 DOI 10.1007/s11270-014-2263-8.

Druille, M., Cabello, M.N., Omacini, M., and Golluscio R.A (2013) Glyphosate reduces spore viability and root colonization of arbuscular mycorrhizal fungi, *Applied Soil Ecology*, 64, pp.99–103.

Zaller, J. G., Heigl, F., Ruess, L. & Grabmaier, A. (2014) Glyphosate herbicide affects belowground interactions between earthworms and symbiotic mycorrhizal fungi in a model ecosystem. *Scientific Reports*, 4, 5634. DOI: 5610.1038/srep05634.

¹⁷ United States Patent 3,160,632 (1964) Stauffer Chemicals: <http://1.usa.gov/1BULtJj>

¹⁸ *Ecosystem services and Biodiversity - Science for Environment Policy*, DG Environment, European Commission, in-depth report, May 2015, issue 11. Video - <https://www.youtube.com/watch?v=D6luBEJf3s> http://ec.europa.eu/environment/integration/research/newsalert/pdf/ecosystem_services_biodiversity_IR11_en.pdf

biodiversity loss by 2020, but also allow agriculture to play its part in combatting climate change¹⁹:

Bringing soils back to life with healthier, deeper topsoil and more humus will not only help to increase the capacity of this carbon reservoir, but will also allow our farm systems to be better adapted to the floods and droughts increasingly common with climate change:

With far longer taproots reaching far deeper down to the bedrock²⁰, and with humus and symbiotic fungal mycorrhizae supplying more nutrients and water, the crops will be less susceptible to drought;

With more nitrogen-fixing bacteria in the soil, and by kick-starting nutrient cycling through reinvigorated soil life, the crops will also be less reliant on highly polluting²¹ synthetic fertilisers and the expensive, energy-intensive and greenhouse gas-emitting Haber-Bosch process²² used to make them.

With more humus to hold on to water and better drainage thanks to increased soil biota, the fields and surrounding rural areas will be less likely to flood too.

What's more, increased abundance and diversity in agro-ecosystems will mean more beneficial predators of pest species to regulate pest populations, preventing them from booming in the first place and damaging crops.

6. Increased ecosystem functioning means greater input autonomy for farmers

A reduced reliance on chemical inputs and preventing pest and weeds from becoming a problem means greater autonomy for farmers. Prices for inputs have been rising over last decades²³ and contributing to rising production costs²⁴. At the same time, the prices at which farmers sell their food are becoming less and less remunerative, and in some sectors production costs outweigh income. Plant crops can grow more robustly, are resilient to insects and pathogens and can more easily out-compete weedy ephemeral species if:

Firstly, there is more direct fixation of atmospheric nitrogen into the soil by bacteria surrounding the crop roots²⁵;

Secondly, fungal mycorrhizae can supply more nutrients and water to crops;

¹⁹ http://ec.europa.eu/clima/policies/strategies/2020/index_en.htm

²⁰ e.g. LIFE+ 2015 EU-funded project inoculating dead soils with soil microbes and integrated agroforestry, <http://operationco2.com/>, <http://operacionco2.com/upload/file/1presentacion-pius-finalcompressed.pdf>, http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4262

²¹ Nitrogen use efficiency is typically less than 50%: Oenema, O.; Witzke, H.P.; Klimont, Z.; Lesschen, J.P.; Velthof, G.L. (2009). "Integrated assessment of promising measures to decrease nitrogen losses in agriculture in EU-27". *Agriculture, Ecosystems and Environment* **133**: 280–288. doi:10.1016/j.agee.2009.04.025

²² Haber-Bosch process uses up to 2% of the world's energy supply https://en.wikipedia.org/wiki/Haber_process

²³ European Parliament Policy Department B research - Agricultural inputs sector in the EU [http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563385/IPOL_STU\(2015\)563385_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563385/IPOL_STU(2015)563385_EN.pdf)

Also, according to Eurostat, total input costs for EU farmers climbed on average by almost 40% between 2000 and 2010, while farm gate prices increased on average by less than 25%; whereas the increase in input costs within that decade reached 60% for energy and lubricants, almost 80% for synthetic fertilisers and soil improvers, over 30% for animal feed, around 36% for machinery and other equipment, almost 30% for seeds and planting stock and nearly 13% for plant protection products. Source: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database
Cited: <http://www.europarl.europa.eu/sides/getDoc.do?type=REPORT&reference=A7-2011-0421&language=EN>

²⁴ Fertiliser is 30% of farmers' production costs of growing winter wheat according to BASF representative, <http://www.eeb.org/index.cfm?LinkServID=23A21C82-5056-B741-DB87FA269B57F45A>

²⁵ Inoculating crops at seed drilling stage results in one third reduction in fertiliser. For example one company innovating in this field coats plant seeds with a beneficial bacteria *Gluconacetobacter diazotrophicus* which fixes atmospheric Nitrogen and makes it available to the plant via a symbiotic relationship – thus reducing dependency on nitrogen fertilisers. www.azotictchnologies.com

Thirdly, improved nutrient cycling by life within the soil and mobilisation of the complete range of 42 nutrients²⁶ provides crops with the micro-nutrients and minerals needed for healthy growth. In addition, healthy soils with balanced communities of beneficial species will defend crops from pathogens and pests²⁷, meaning farmers suffer fewer and smaller crop yield losses, spend less on agrochemical inputs, and build up resilience.

7. A paradigm shift supported by science: Agroecology

The real alternative involves not only a change of product, but a paradigm shift, choosing abundance, diversity and long-term fertility over uniformity and sterility - an approach already successfully applied through organic farming practices. Such a shift has just been recommended in the latest report of the International Panel of Experts on International Food Systems (IPES), under the coordination of former UN rapporteur on the Right to Food, Olivier de Schutter²⁸.

The agriculture of the future must work with nature, not against it. Yet non-chemical solutions may be low-tech at the point of application by the farmer, and may be equally or more effective and certainly more cost- and resource-efficient in the wider and long term, but some new nature-based solutions may also be science-intensive and therefore also need upstream investment: for example, methods using parasitic wasps or pheromones to prevent pest damage to crops, or finding the nitrogen fixing bacteria to cut fertiliser dependency and pollution, need lots of research behind them. When farmers adopt methods based on agroecology, there are multiple benefits for the environment, farmers and for crops, not least resilience to climate change²⁹, the biggest challenge farming faces. Not only research³⁰ but also communities of practice sharing ideas and knowledge between farmers shows this. What's more, these environment-friendly methods are economically sustainable³¹ and are sufficiently productive³² to provide enough food for all.

²⁶ Dr Elaine Ingham, former Rodale Institute Chief Scientist, president Soil Foodweb (lectures 2012-14): 2012 <http://ecoag.org.au/news-on-soils/>,

2015 Oxford Real Farming Conference <https://www.youtube.com/watch?v=x2H60ritjag>,

2015 ORFC keynote presentation <https://drive.google.com/file/d/0B6tV3TorfmstbXIIU5yMXB2MWM/view>,

²⁷ Using glyphosate as a weed control in agricultural systems has led to the increased severity or re-emergence of crop diseases; Johal, G.S., and Huber, D.M. (2009) Glyphosate effects on diseases of plants, *European Journal of Agronomy*, 31, pp. 144–152.

Use of glyphosate increases the potential for the development of pathogen levels that affect crop health, altering the communities of rhizosphere microbes involved in nutrient transformation, and shifting the balance between micro-organisms that are beneficial and detrimental to plant health; Kremer, R.J., Means, N.E. (2009) Glyphosate and glyphosate resistant crop interactions with rhizosphere micro-organisms, *European Journal of Agronomy* 31, pp. 153–161

²⁸ http://www.ipes-food.org/images/Reports/UniformityToDiversity_FullReport.pdf

²⁹ Increasing Crop Diversity Mitigates Weather Variations and Improves Yield Stability, Gaudin et al 2015, results of a 31-year crop rotation and tillage trial

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0113261>

³⁰ <http://civileats.com/2016/03/10/the-battle-over-the-glyphosate-herbicide-heats-up-as-nearly-100-scientists-weigh-in/>

³¹ <http://practicalfarmers.org/farmer-knowledge/research-reports/thompson-agriculture-alternatives/>

³² <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0047149>