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The Rt. Hon. Elizabeth Truss MP
Secretary of State
Department for Environment, Food and Rural Affairs
Nobel House
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21st June 2016

Re: Extension of the approval period for glyphosate

The Rt. Hon. Elizabeth Truss MP,

On 24th June 2016, you will have to decide on the Commission proposal to extend the approval period of glyphosate for 12-18 months in the Appeal Committee. While the public discussion about the renewal of the approval of glyphosate has largely focussed on its probable carcinogenicity, it has become increasingly clear that the issue goes far beyond the question of whether glyphosate causes cancer or not. Recent discussions at national and international level[1] have raised concerns about our current agricultural model - depending upon and overusing chemicals designed to kill - and the need for a transition to sustainable food production, including sustainable protection and nutrition of crops.

The undersigned strongly believe that the future of food and a healthy environment lies in working with nature and natural processes rather than against them, with an emphasis on reducing farmer dependency on increasingly costly inputs, and focusing on a living, healthy soil and boosting the provision of ecosystem functions to protect, nurture and provide nutrition for crop plants.

Glyphosate is a non-selective herbicide. Instead of specifically dealing with unwanted weeds, it kills all plants indiscriminately. Moreover, it also kills bacteria, algae and fungi. It stands for increasing yields and lowering operational costs at all costs - at the expense of human health, animal health, biodiversity and soil health. We can no longer ignore the massive externalisation of the real costs of industrial agriculture that relies on substances like glyphosate.

In the annex, we have shortlisted seven ways to produce food without resorting to glyphosate and other pesticides.

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[1] Dutch Presidency of the EU, discussion paper: *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

We call on you to work towards a new model of sustainable, non-toxic agriculture. We are at a crossroads now - please seize the chance and vote for sustainable farming.

Just as at the time when Rachel Carson published Silent Spring, this is not a conflict between science and "anti-science" politics, but a conflict within science itself: between chemistry - and the corporate interests that control the infrastructure and understandably defend their business model - and ecology. Ultimately the choice is between processes boosting life and those boosting death.

As a first step, we urge you to oppose any technical extension of the approval of glyphosate, and instead request the Commission to present a proposal to no longer approve glyphosate.

Yours sincerely,

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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 needed[2], and indeed that many wild plants offer microhabitats for other beneficial species that protect the crops from pests[3]. 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 application[4], 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 rotations[6] 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 weeding[7]
- Mulching[8] to suppress weed germination

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[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] Institute 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
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

- 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 is[9]. However, most pesticide

[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:
- 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.

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 yields[10].

Following the same logic of increasing food available for natural predators of pests, wildflowers are being sown with cereals in order to decrease pest outbreaks[11].

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 glyphosate and other pesticides would need to be re-learnt, and new innovations not reliant on chemicals would have to be shared. But to allow for this knowledge

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- García-Pérez, J.A., Alarcón, E., Hernández, Y., Christian Hernández, C. (2016) Impact of litter contaminated with glyphosate-based herbicide on the performance of *Pontoscolex 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 fetida* 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

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 exist[12], 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 innovation[13].

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 programmes[14] 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 announced[15] 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 fungi[16]; indeed before its use as a herbicide, Monsanto first patented it as an anti-microbial agent[17]. 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 services[18] in the EU and help stop global biodiversity loss by 2020, but also allow agriculture to play its part in combatting climate change[19]:

Bringing soils back to life with healthier, deeper topsoil and more humus will not only

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[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=D6luBEJfi3s
http://ec.europa.eu/environment/integration/research/newsalert/pdf/ecosystem_services_biodiversity_IR11_en.pdf

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

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 bedrock[20], 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 polluting[21] synthetic fertilisers and the expensive, energy-intensive and greenhouse gas-emitting Haber-Bosch process[22] 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 decades[23] and contributing to rising production costs[24]. 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 roots[25];
Secondly, fungal mycorrhizae can supply more nutrients and water to crops;
Thirdly, improved nutrient cycling by life within the soil and mobilisation of the complete range of 42 nutrients[26] provides crops with the micro-nutrients and minerals

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[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
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.azotictechnologies.com

[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/0B6tV3TorfmstbXllUU5yMXB2MWM/view,

needed for healthy growth. In addition, healthy soils with balanced communities of beneficial species will defend crops from pathogens and pests[27], 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 Schutter[28].

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 change[29], the biggest challenge farming faces. Not only research[30] but also communities of practice sharing ideas and knowledge between farmers shows this. What's more, these environment-friendly methods are economically sustainable[31] and are sufficiently productive[32] to provide enough food for all.

[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