Toit muutuvas kliimas – väljakutsed ja võimalused

Ülo Niinemets,
Taimebioloogia ja maaviljeluse õppetool, Eesti Maaülikool

Keskkonnahariduse konverents 2026,
Kliimatargalt tulevikku, Valga, 27.10. 2026

Centre of Excellence AgroCropFuture

Estonian University of Life Sciences

Miks me peame rääkima toidujulgeolekust?

Plahvatuslik maakera elanikkonna juurdekasv:
Praegu 7.6 miljardit
8.6 miljardit aastaks 2030
9.8 miljardit aastaks 2050

United Nations | Department of Economic and Social Affairs

Home | About Us » | What We Do » | Key Topics » | Latest from DESA | Products » | UN DESA Voice | Highlights Report » | Calendar | Contact Us

World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100

The current world population of 7.6 billion is expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100, according to a new United Nations report being launched today. With roughly 83 million people being added to the world's population every year, the upward trend in population size is expected to continue, even assuming that fertility levels will continue to decline.

The *World Population Prospects: The 2017 Revision*, published by the UN Department of Economic and Social Affairs, provides a comprehensive review of global demographic trends and prospects for the future. The information is essential to guide policies aimed at achieving the new Sustainable Development Goals.

Globaalne toidujulgeolek: maakera elanikkonna kasv + kliimamuutused

EARTH·ORG

Climate Change Energy Pollution Policy & Economics Oceans Biodiversity Conservation Solutions Guides



Since June 2023, the world has been witn
regions. Whether it is in India, China, Eu
weather changes such as floods, heatwave
in the oceans. These natural disasters, the
agricultural sector, leading to hunger and
climate change on global food security.

OCHA Services

reliefweb

SEARCH UPDATES COUNTRIES DISASTERS

World + 2 more

Global food crisis: what

News and Press Release • Source: ECHO

The global food crisis is affecting million

In 2023, record levels of acute food insec
shocks. In 48 countries, 238 million peop
more than in 2022.

How is the EU reacting to this alarming tr
countries affected?

21.6 million more people face high level

According to the Mid-Year Update of the
least 238 million acutely food insecure p
figure.

How is the EU helping?

Official blog of the Met Office news team

Met Office

Official

Home News About

← With September 2023 breaking g
does the UK sit?

Food security under

Posted on 9 October, 2023 by Met O

The UN define food securit
and economic access to su
needs and food preference

Food security is under pres
supply chains need to be b

European Commission's Knowledge Centre for Global Food and Nutrition Secu

Newsletter

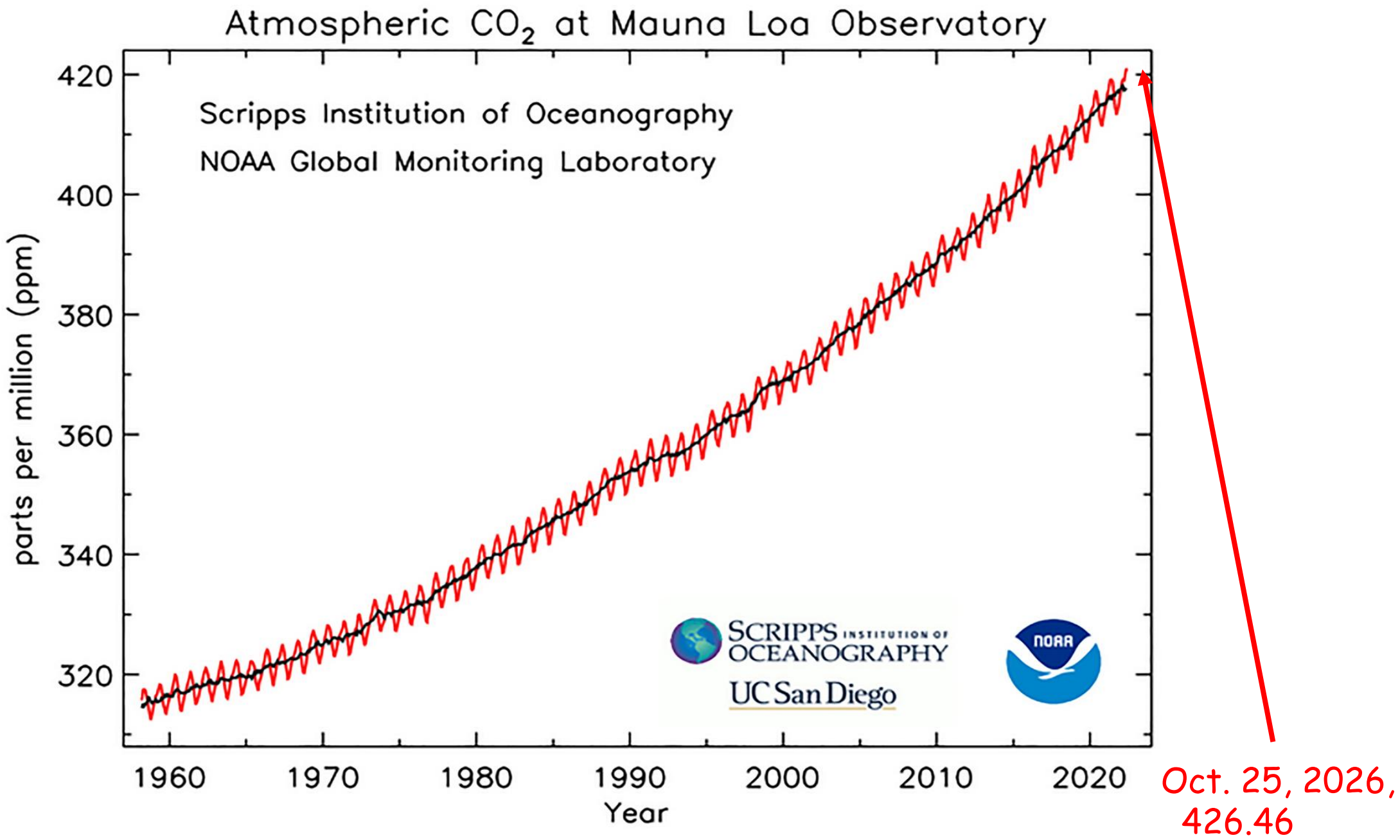


European

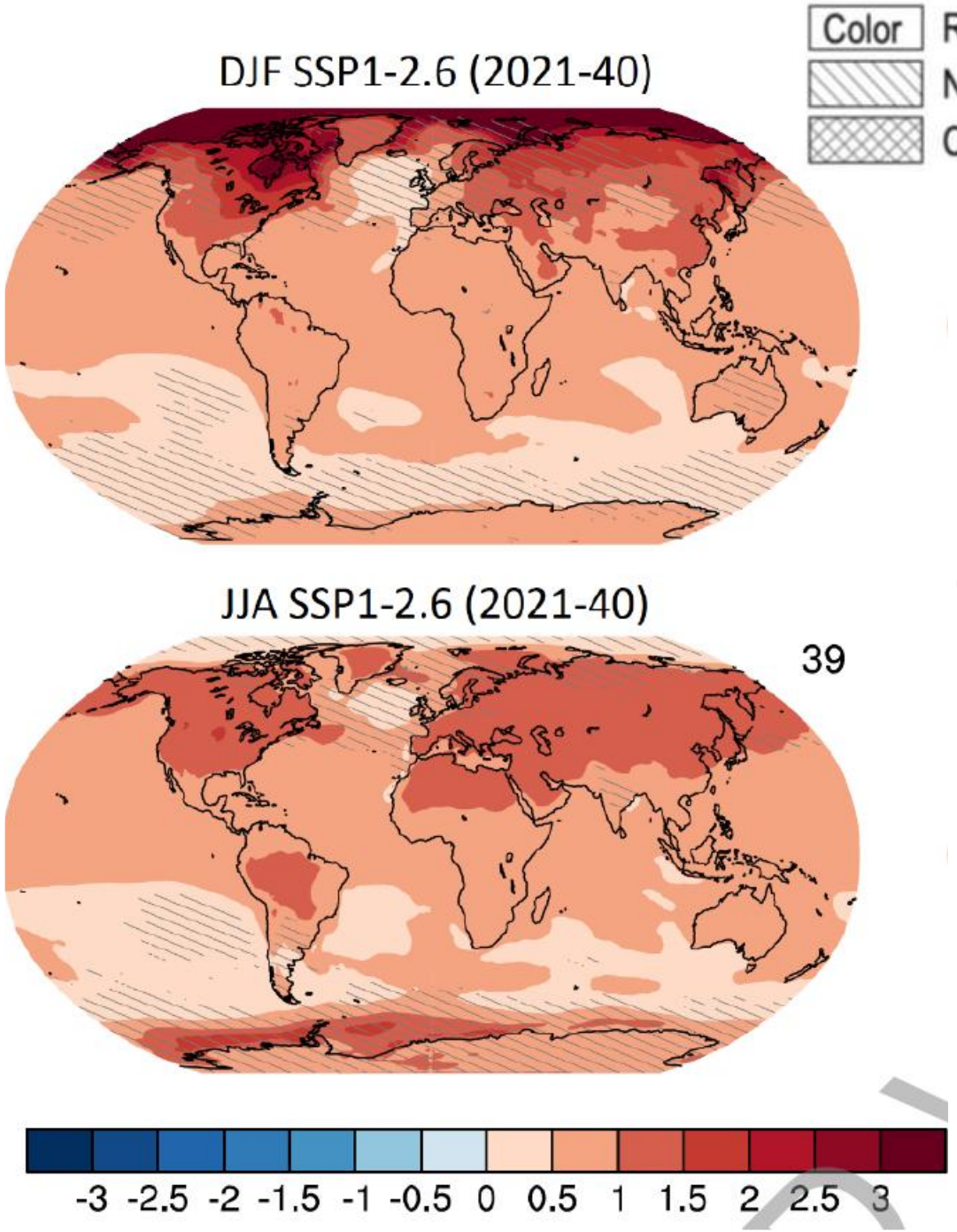
Food and Agriculture Organization
of the United Nations

Climate change and food security: risks and responses




Atmospheric CO_2 at Mauna Loa Observatory
Scripps Institution of Oceanography
NOAA Global Monitoring Laboratory
parts per million (ppm)
420
400
380
360
340
320
1960
1970
1980
1990
2000
2010
2020
Year
SCRIPPS INSTITUTION OF OCEANOGRAPHY
UC San Diego
NOAA
Oct. 25, 2026,
426.46

SSP1-2.6 – (SSP-shared socioeconomic pathway) scenario assuming that global net CO_2 emissions reach zero by 2050



IPCC, 6-s assessment report

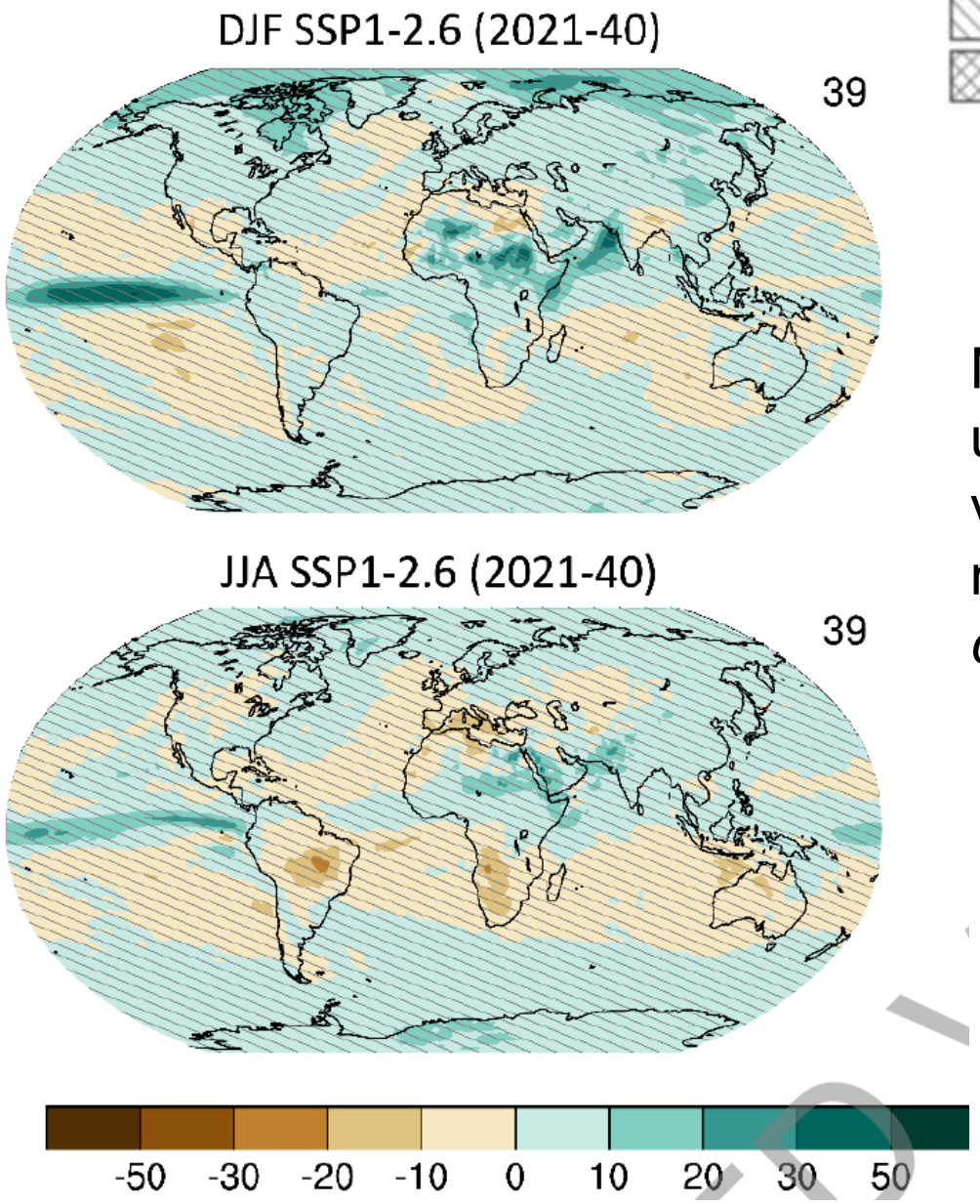
In the near term (2021–2040), a **1.5 °C increase** in the 20-year average of **global surface air temperature**, relative to the average over the period 1850–1900, is *very likely* to occur... (IPCC, 2021)

WMO confirms 2024 as warmest year on record at about 1.55°C above pre-industrial level

PRESS RELEASE

10 January 2025

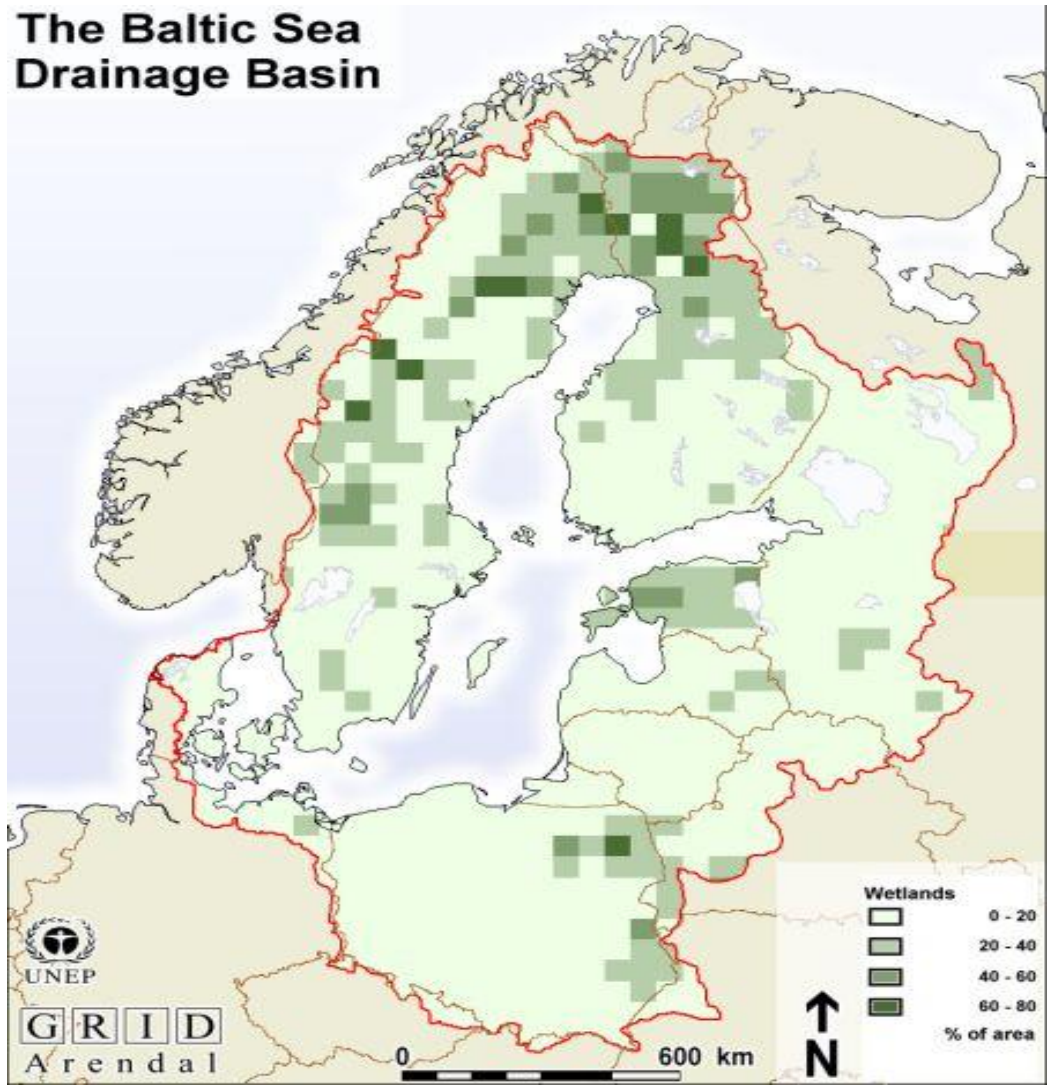
The World Meteorological Organization (WMO) has confirmed that 2024 is the warmest year on record, based on six international datasets. The past ten years have all been in the Top Ten, in an extraordinary streak of record-breaking temperatures.



Color Robust signal
No change or no robust signal
Conflicting signals

Near-term projected changes in precipitation are uncertain, mainly because of natural internal variability, model uncertainty, and uncertainty in natural and anthropogenic aerosol forcing (*medium confidence*).

Väga suur osa Eesti pindalast on kaetud märgaladega







Kobraste populatsioon 2025: 13,000

Kui kõik sobivad elupaigad oleks asustatud: 200,000



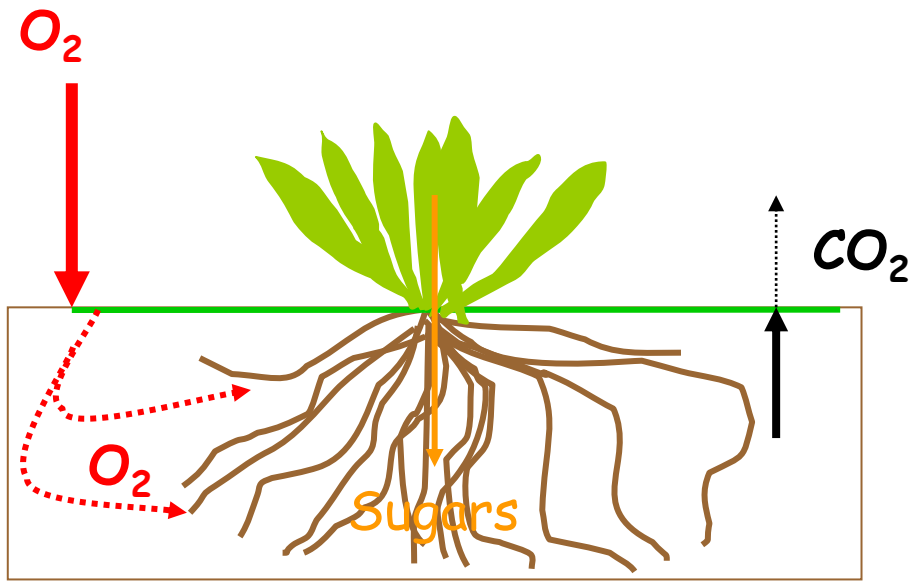








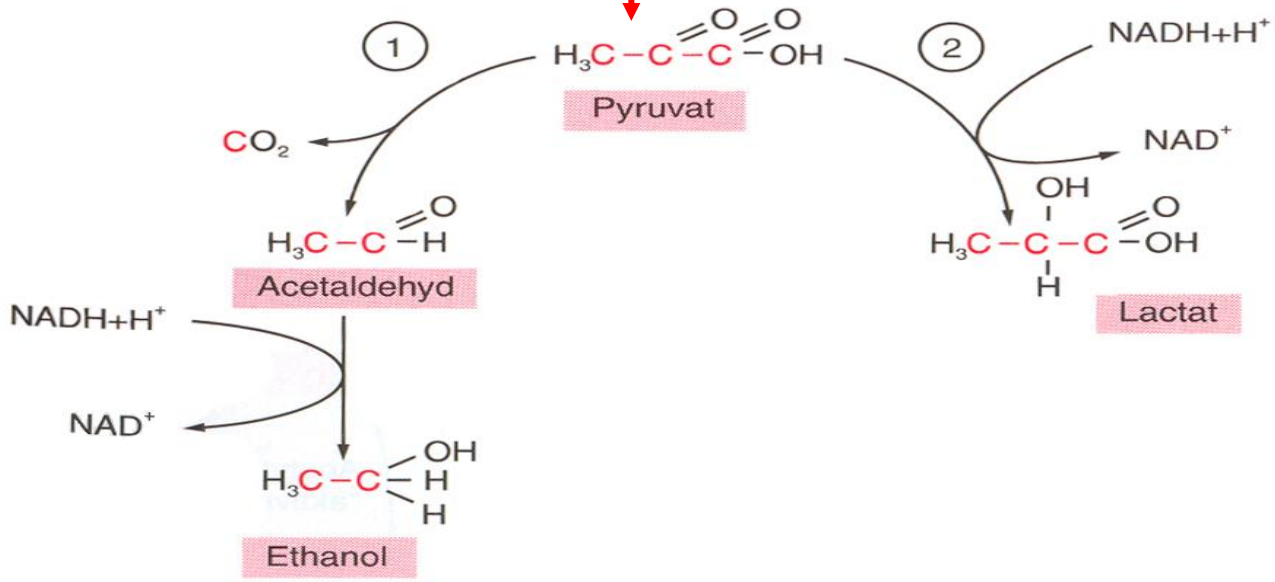
Madala O_2 mõju taimedele: energiapuudus



Tavapärane metabolism O_2-ga
Glükolüüs + Krebsi tsükkel

1 mol glükoosi --> 36 mol ATP

Anaeroobsed tingimused
Ainult glükolüüs!



1 mol glükoosi --> 2 mol ATP

Mulla drenaažiomadused

A: tugev/liigne

B: hea/keskmine

C: nõrk

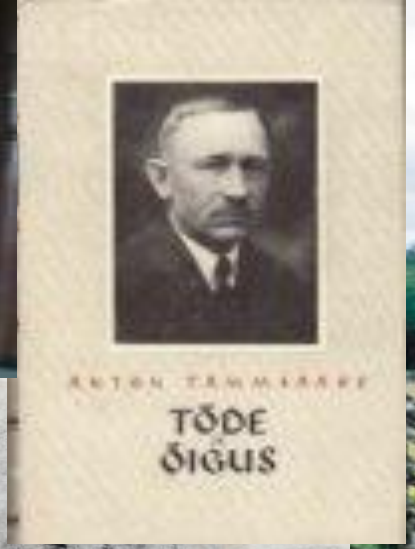
D: pole äravoolu



Tšeban & Vares, 1970, Eesti Loodus, 210-213

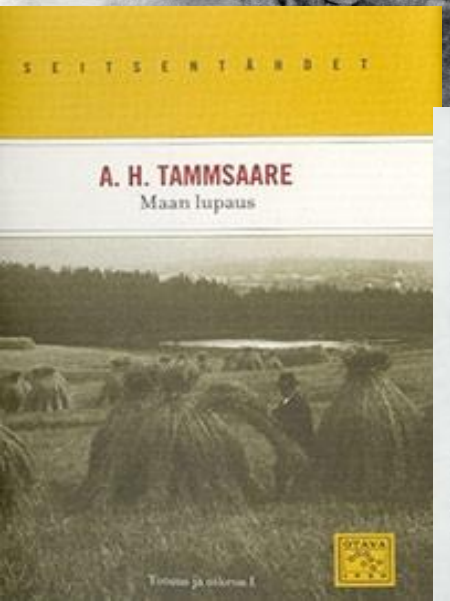


"Tõde ja õigus"

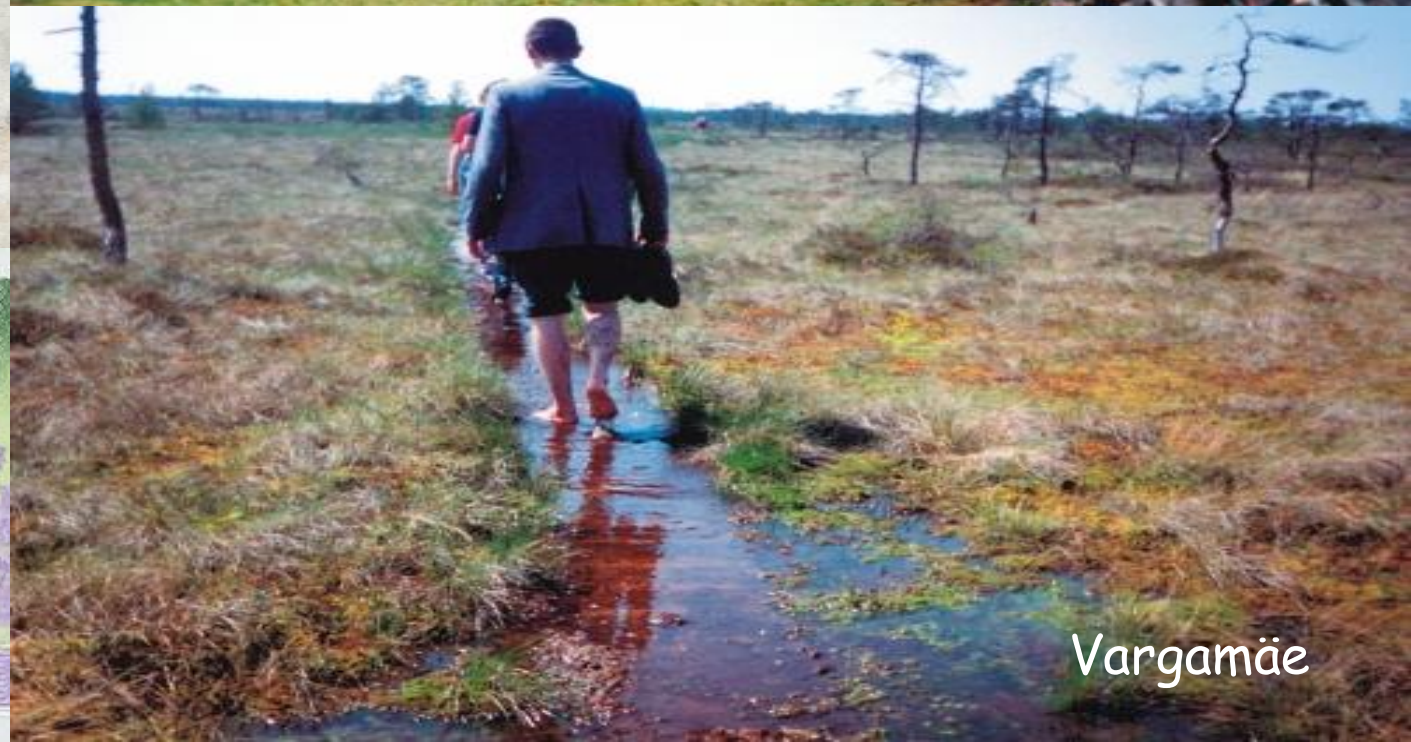












Vargamäe



© 2014 American Meteorological Society

Weather, Climate and Society, 2014, 6, 331–340

Water, Drought, Climate Change, and Conflict in Syria

PETER H. GLEICK

Pacific Institute, Oakland, California

Political Geography 60 (2017) 232–244

Contents lists available at ScienceDirect

Political Geography

journal homepage: www.elsevier.com/locate/polgeo

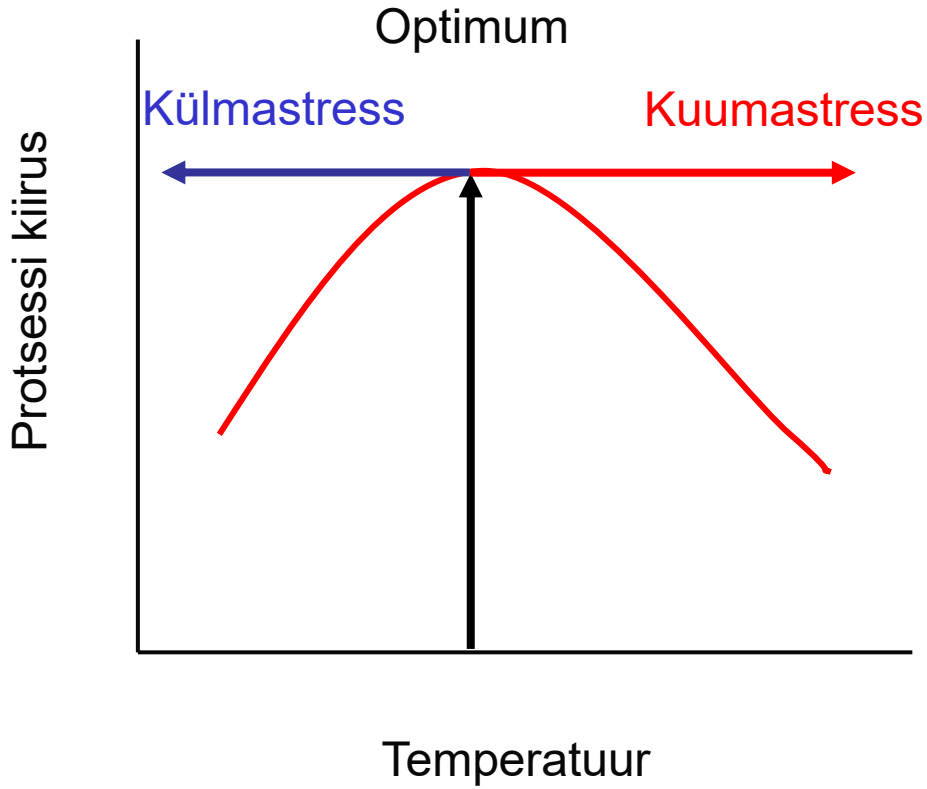


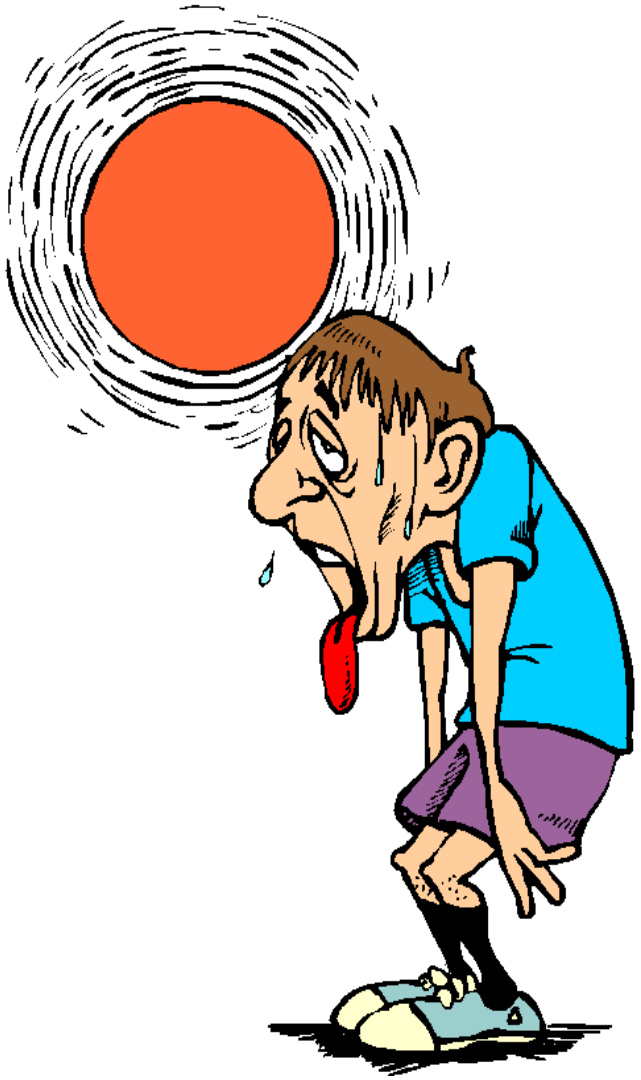
Climate change and the Syrian civil war revisited

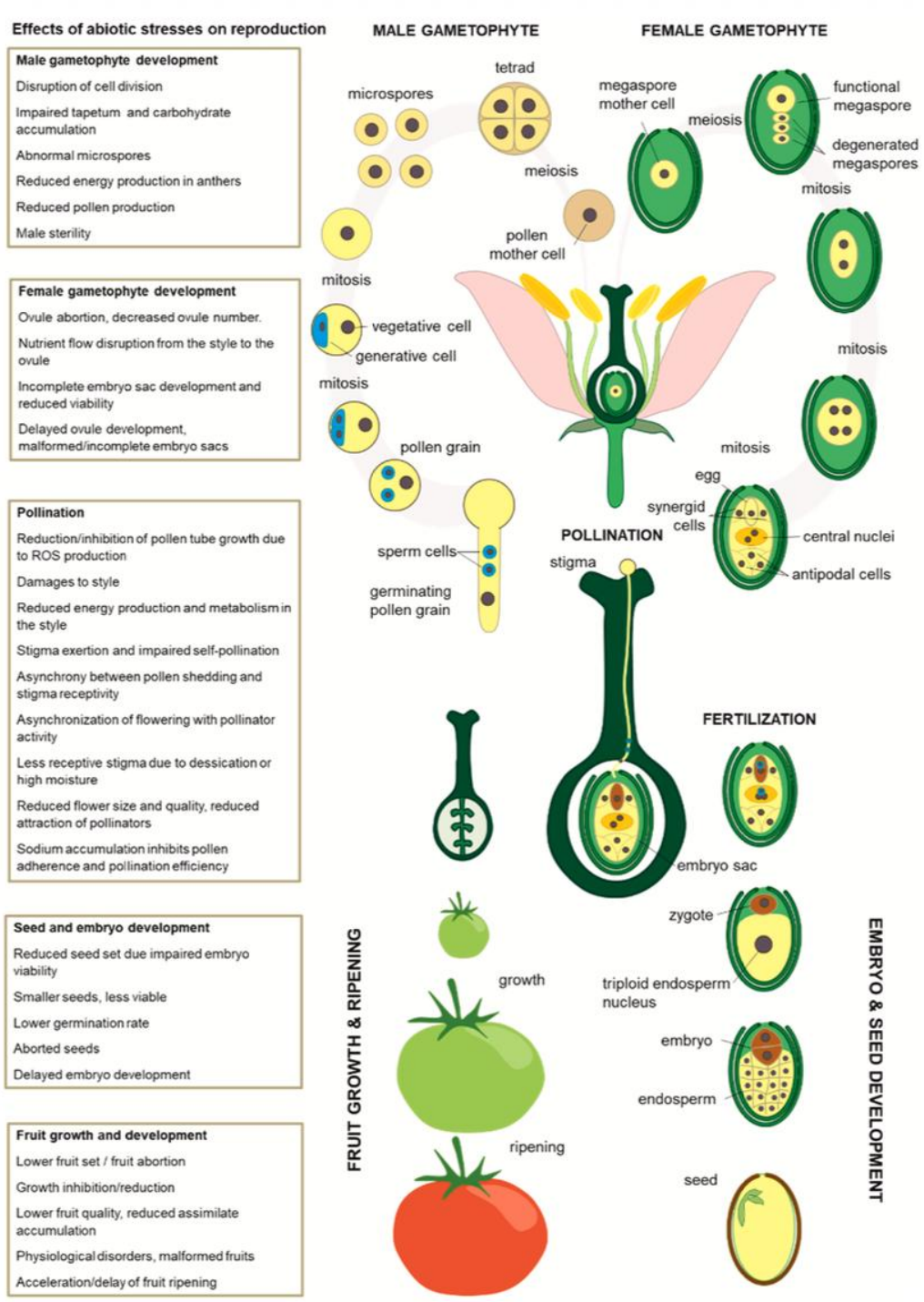
Jan Selby [a, *], Omar S. Dahi [b], Christiane Fröhlich [c, d], Mike Hulme [e]

Kuumastressi mõju kultuurtaimedele: fotosüntees, kasv, viljakus









Paljud viljakust määravad protsessid on väga kuumatundlikud



Tomati kuumakahjustus

https://www.gardeninginla.net/blog/tomato-growing-problems-solutions

Plant Stress 15 (2025) 100704

Contents lists available at ScienceDirect

Plant Stress

journal homepage: www.sciencedirect.com/journal/plant-stress

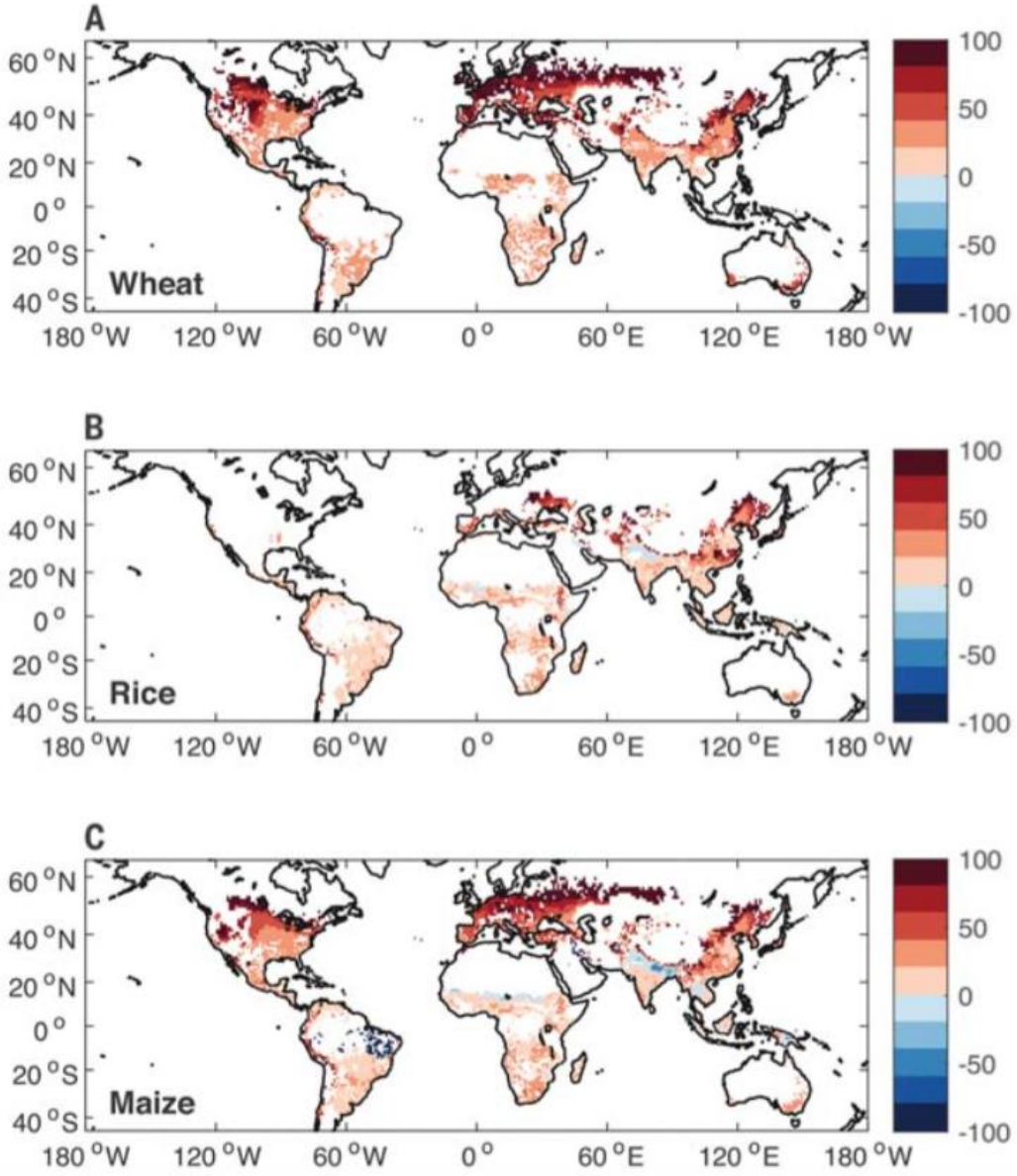
Review

Integrative approaches to enhance reproductive resilience of crops for climate-proof agriculture

RECROP COST+

RECROP: EU COST action
Reproductive enhancement of CROP resilience to extreme climate

+ Author list:[a]Collins Agho, [b]Adi Avni, [c]Ariola Bacu, [e]Salma Balazadeh, [f]Faheem Shehzad Baloch, [g]Christos Bazakos, [h]Nataša Čereković, [i]Palak Chaturvedi, [j]Harsh Chauhan, [k]Ive De Smet, [l]Thomas Dresselhaus, [m]Liliana J. Ferreira, [n]Jan Fíla, [o]Ana M. Fortes, [p]Vasileios Fotopoulos, [q]Silvana Francesca, [r]Pascual García-Perez, [l]Wen Gong, [q]Salvatore Graci, [s]Antonio Granell, [t]Andrea Gulyás, [t]Norbert Hidvégi, [n]David Honys, [u]Elžbieta Jankovska-Bortkevič, [v]Claudia Jonak, [u]Sigita Jurkonienė, [w]Eirini Kaiserli, [j]Meenakshi Kanwar, [x]Musa Kavas, [y]Natasa Koceska, [y]Saso Koceski, [z]Hannes Kollist, [aa]Olha Lakhneko, [ab]Michal Lieberman-Lazarovich, [ac]Nataša Lukić, [ad]Adrien Luyckx, [g]Ifigeneia Mellidou, [ae]Marta Mendes, [af]Begoña Miras-Moreno, [ag]Iman Mirmazloum, [ah]Velimir Mladenov, [ag]Maryam Mozafarian, [ai]Bernd Mueller-Roeber, [aj]Joëlle Mühlemann, [ak]Eduardo D. Munaiz, [al]Gniewko Niedbała, [am]Cristina Nieto, [a]Ülo Niinemets, [c]Stela Papa, [af]Maria Pedreño, [an]Magdalena Piekutowska, [ao]Stella Provelengiou, [ad]Muriel Quinet, [ap]Aleksandra Radanović, [ae]Francesca Resentini, [aq]Ivo Rieu, [q]Maria Manuela Rigano, [ar]Hélène S. Robert, [aq]Laura I. Rojas, [as]Dunja Šamec, [m]Ana Paula Santos, [at]Petra P. Schrumpfova, [au]Stefan Simm, [av]Valentina Spanic, [d]Yvonne Stahl, [ah]Rada Šućur, [aw]Konstantinos E. Vlachonasios, [d]Stavros Vraggalas, [ax]Wim H. Vriezen, [al]Tomasz Wojciechowski, [ay]Rosa M. Rivero, [d]*Sotirios Fragkostefanakis.[a]Estonian University of Life Sciences, Tartu,



CLIMATE CHANGE , *Science* **361**, 916–919 (2018) 31 August 2018

Increase in crop losses to insect pests in a warming climate

Curtis A. Deutsch[1,2*†], Joshua J. Tewksbury[3,4,5†], Michelle Tigchelaar[6], David S. Battisti[6], Scott C. Merrill[7], Raymond B. Huey[2], Rosamond L. Naylor[8]

Ennustatud saagikuse langus putukkahjurite tõttu keskmise temperatuuri 2 °C tõusu korral

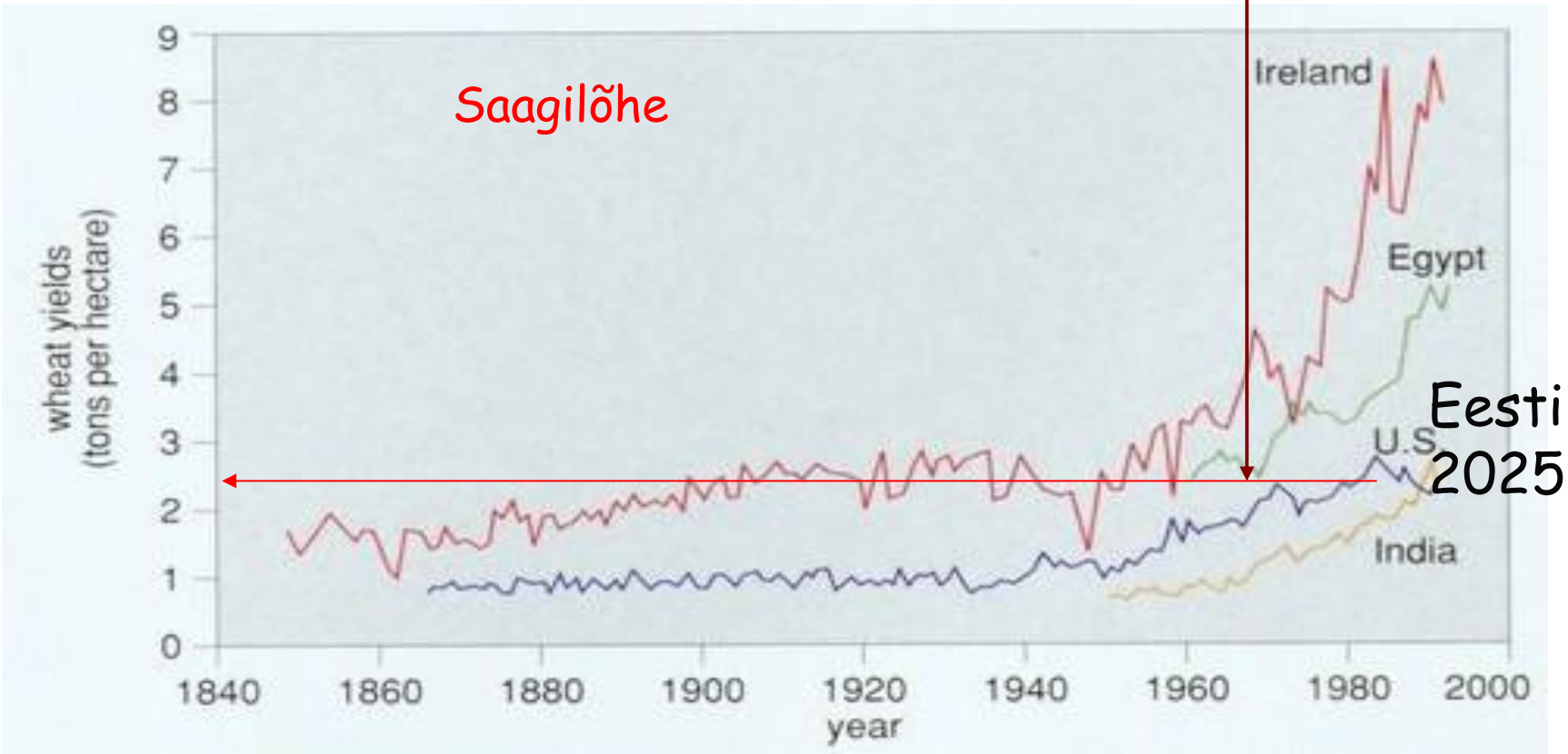




Põllukultuuride aretuses on põhiline tähelepanu läinud saagi suurendamisele optimaalsetes tingimustes (saagilõhe vähendamine).

Paraku muutuvas kliimas saagilõhe pigem suureneb, sest tingimused on harva "optimaalsed"





Eesti, suvinisu
2025: 3.25 t/ha

8.3 Technologies and policies for alleviating yield gaps

Yield gap closing has generally been a slow process. Recall that, over the past 20 years, average differences between annual global rates of increase in FY and in PY were estimated to be:

- –0.4% p.a. for wheat (Table 3.7)

PLOS ONE | PLOS ONE | DOI:10.1371/journal.pone.0129487 June 17, 2015

RESEARCH ARTICLE

Closing Yield Gaps: How Sustainable Can We Be?

Prajal Pradhan[1,2]*, Günther Fischer[2], Harrij van Velthuizen[2], Dominik E. Reusser[1], Juergen P. Kropp[1,3]

WHO

TIM LAMYMAN

WHAT

17.95 TONNE(S)/METRIC TON(S)

WHERE

UNITED KINGDOM (LOUTH)

WHEN

10 AUGUST 2022

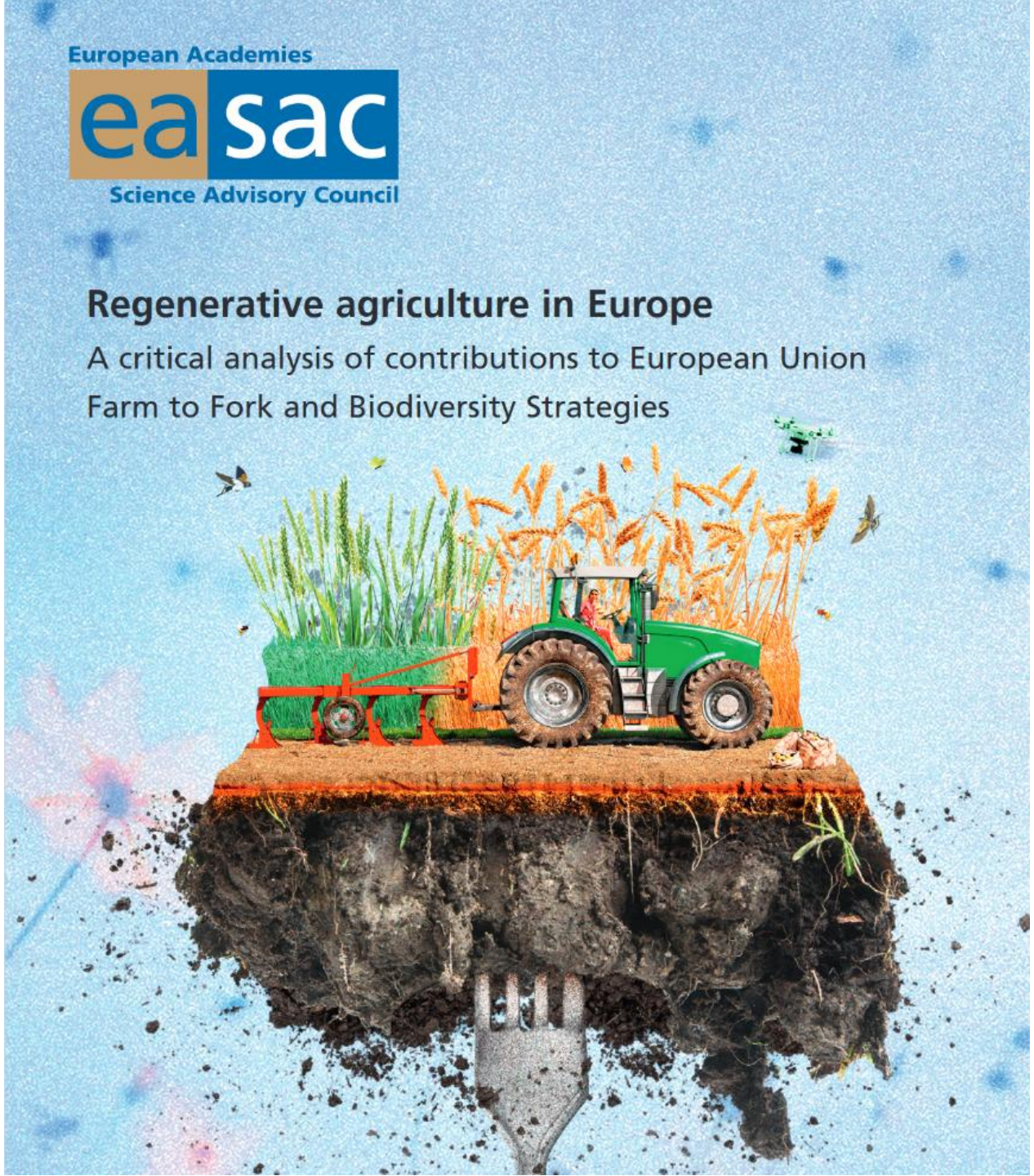
The highest wheat yield is 17.95 tonnes/ha (39572.97 lbs/ha) and was harvested from 8.2920 ha (20.49 acres) by Tim Lamyman (UK) in Louth, Lincolnshire, UK, on 10 August 2022.

Tim's belief in his technique of harvesting wheat inspired him to attempt this Guinness World Records title.

Rekordid

Kultuur	t/ha	Aasta	Rekordiomanik	Piirkond
Talinisu	12,8	2023	Erki Plamus	Raplamaa
Suvinisu	8,4	2015	Tõnis Riisk	Viljandimaa
Rukis	12,1	2019	Raido Allsaar	Järvamaa
Maherukis	4,9	2017	Jüri Ilves	Järvamaa
Triticale	10,8	2017	Eugen Koit	Saaremaa
Talioder	12	2015	Aivar Treiberg	Harjumaa
Suvioder	8,5	2019	Sven-Erik Lohu	Viljandimaa
Varane oder	7,4	2009	Erki Oidermaa	Põlvamaa
Kaer	8,6	2022	Ahti Nurm	Valgamaa
Põldhernes	6,6	2016	Mihkel Vainula	Pärnumaa
Põlduba	6,8	2022	Erki Plamus	Raplamaa
Taliraps	6,9	2015	Margus Lepp	Lääne-Virumaa
Suviraps	3,8	2017	Kalle Kits	Valgamaa
Talirüps	3,6	2015	Alar Mutli	Raplamaa
Maherüps	2,4	2020	Viljo Siimsalu	Raplamaa
Maheraps	3,0	2021	Tarmo Vest	Raplamaa
Köömen	1,8	2022	Andres Grents	Harjumaa
Mahe õlikanep	0,7	2025	Kalmer Kivirai	Saaremaa
Tulukus €/ha	2316	2022	Erki Plamus	Raplamaa

* 2026. aasta märtsikuu seisuga



Euroopa rohepööre: Talust taldrikule (farm to fork)

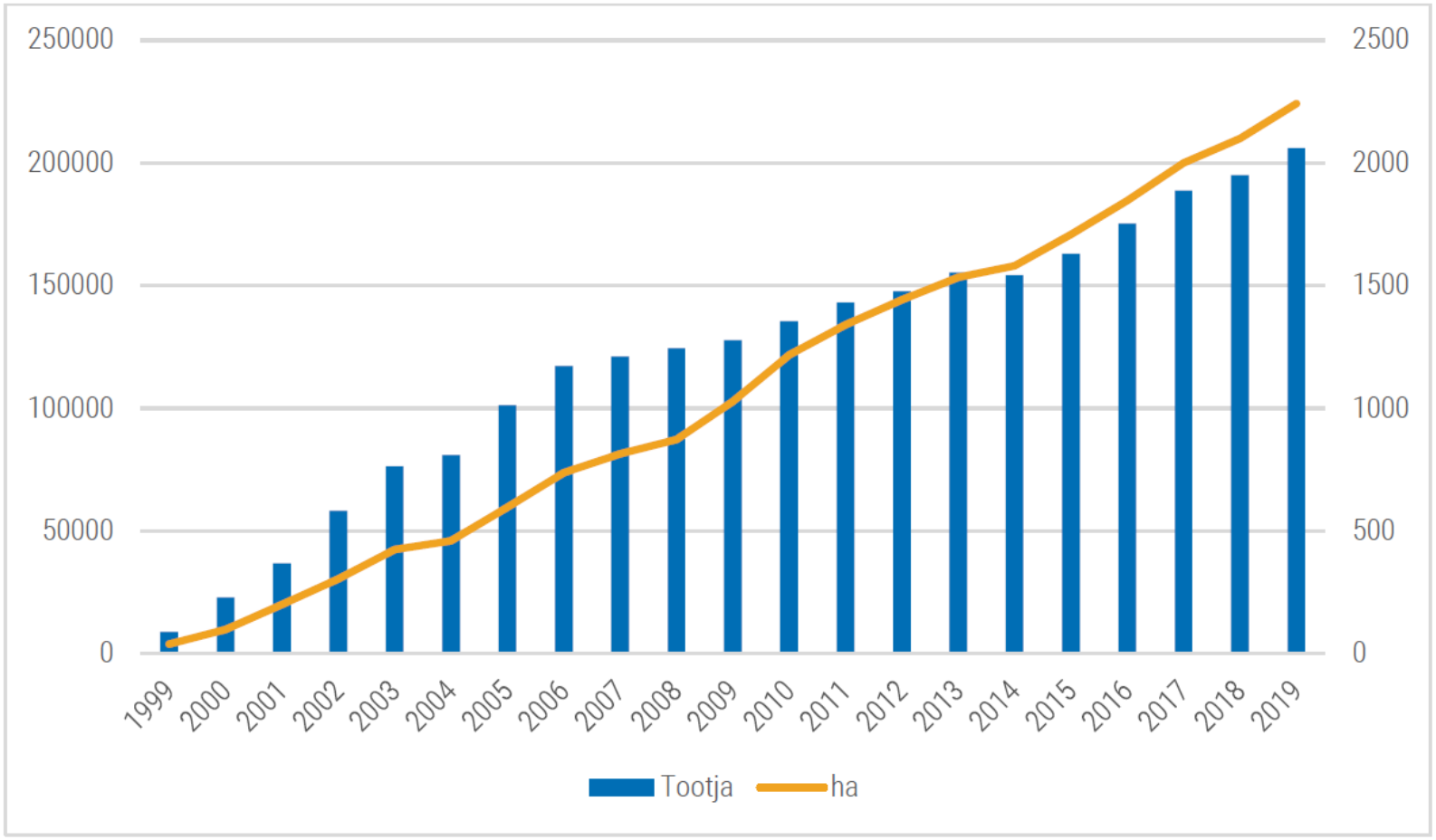
- kemikaalide kasutamine peab vähenema
- mahepõllumajanduse osakaal peab kasvama
- Selle vältimatu tulemus on taimekultuuride saagikuse vähenemine

EASAC policy report 44

April 2022

ISBN: 978-3-8047-4372-4

This report can be found at www.easac.eu



Joonis 2. Mahepõllumajandusmaa pindala (ha) ja mahetootmisega tegelevate ettevõtete arv 1999–2019

Allikas: Maheklubi[25]

Euroopa rohepööre (talust taldrikule strateegia)

- kemikaalide kasutus peab vähenema
- mahepõllumajanduse osakaal peab tõusma
- selle tulemusena saagikus langeb

MAAELUMINISTEERIUM

Taimekaitsevahendite kasutus ja mõjud Eestis 2020

Turustatud taimekaitsevahendid, 2011–2024

Allikas: statistikaamet



EESTI STATISTIKA

Avasta statistikat Esita andmeid Statistikaamet Rahvaloendus

Avaleht › Uudised › Taimekaitsevahendite turustamine suurenes mullu 10%

Taimekaitsevahendite turustamine suurenes mullu 10%

UUDIS Postitatud **12. juuni 2025, 8.00**

Statistikaameti andmetel turustati Eestis 2024. aastal toimeaine kogusesse ümberarvestatuna 782,5 tonni taimekaitsevahendeid, mis on kümnendiku võrra rohkem kui eelneval aastal. Suurem osa müüdud taimekaitsevahenditest olid umbrohutõrjevahendid.

Trends in
Plant Science

CellPress

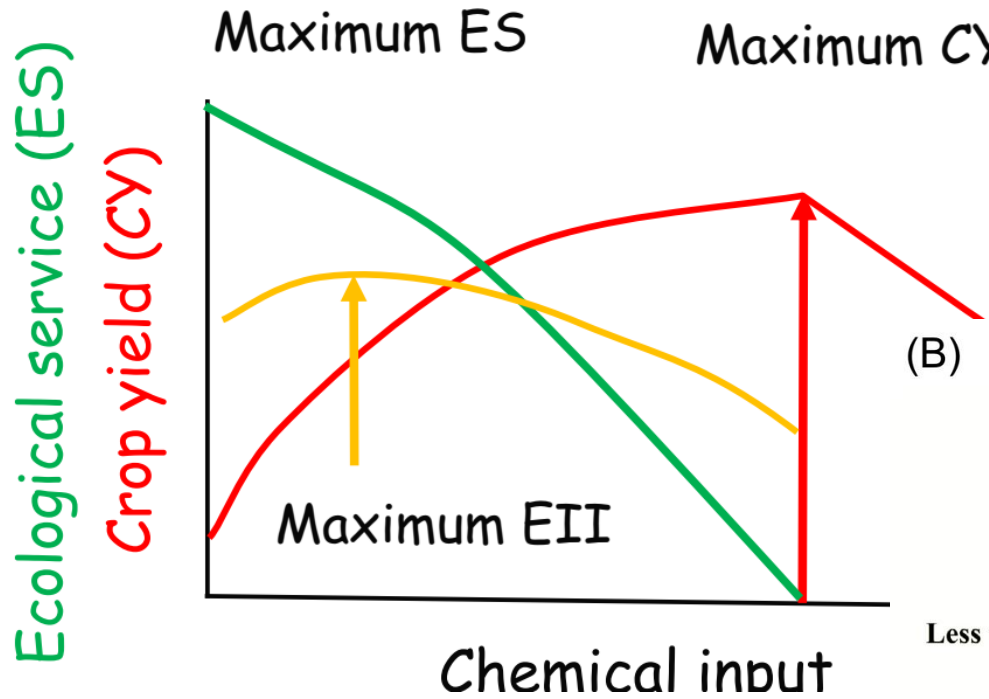
Opinion

Ecological intensification index: reducing global footprint of agriculture

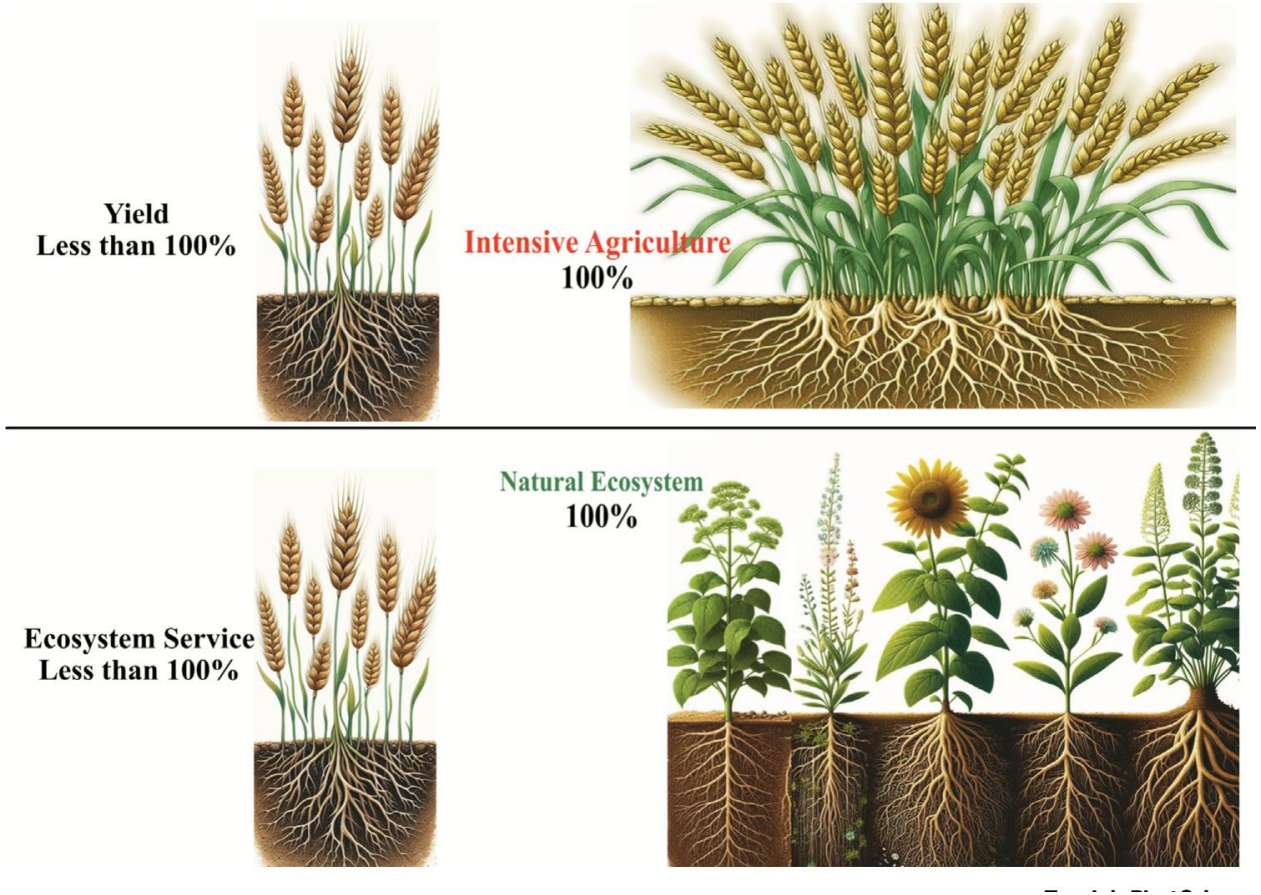
Ülo Niinemets [1] and Martin Zobel [2,*]

Trends in Plant Science, April 2025, Vol. 30, No. 4 https://doi.org/10.1016/j.tplants.2024.10.011

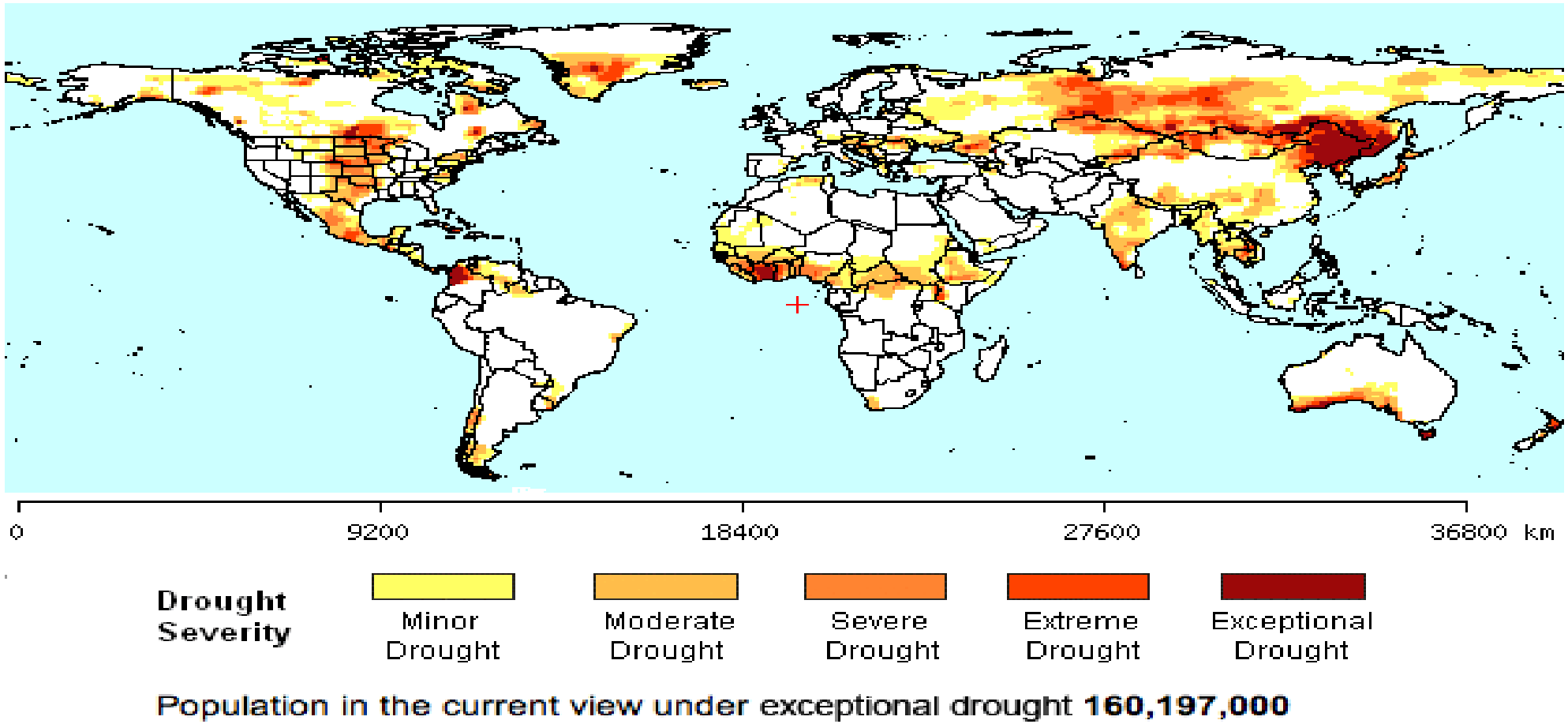
(A)


Maximum ES
Maximum CY
Ecological service (ES)
Crop yield (CY)
Maximum EII
Chemical input

(B)


Yield
Less than 100%
Intensive Agriculture
100%
Ecosystem Service
Less than 100%
Natural Ecosystem
100%

Olukorra teeb keerulisemaks veel see, et
põllumajanduseks sobilikku maad jääb järjest vähemaks



- klimaatiliselt ebasobivad tingimused
- muldade degradeerumine
- põllumajandustootmisest maade väljaminek

Me peame juba lähitulevikus täiesti teisiti majandama, aga kuidas??

European Journal of Agronomy 138 (2022) 126516

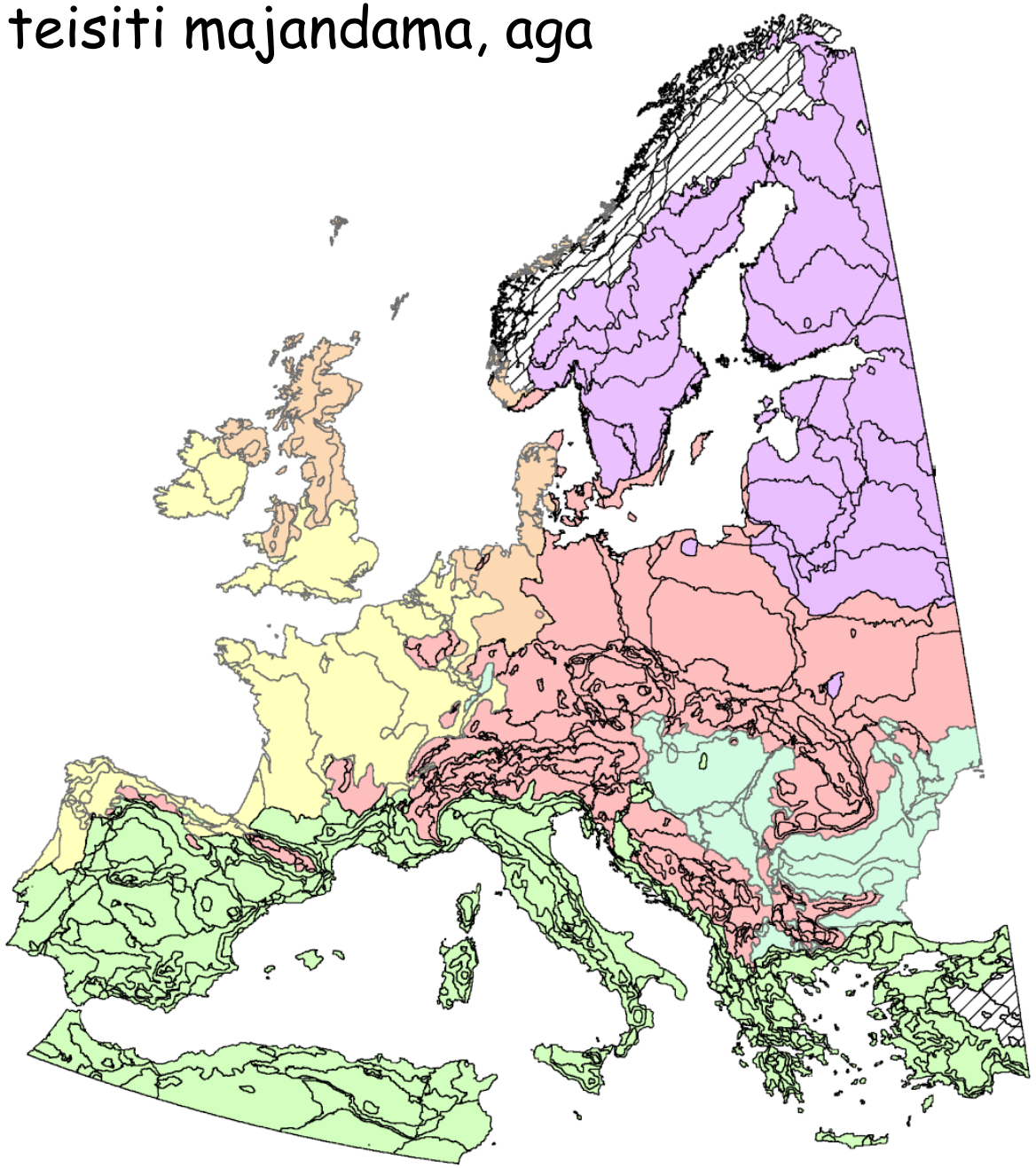
Contents lists available at ScienceDirect

European Journal of Agronomy

journal homepage: www.elsevier.com/locate/eja

Priority for climate adaptation measures in European crop production systems

Jin Zhao [a,b,*], Marco Bindi [c], Josef Eitzinger [d,e], Roberto Ferrise [c], Zinta Gaile [f], Anne
Annelie Holzkämper [i,j], Kurt-Christian Kersebaum [d,k,x], Jerzy Kozyra [l], Zita Kriaučiū
Evelin Loit [n], Pavol Nejedlik [o], Claas Nendel [d,k,p], Ülo Niinemets [n,q], Taru Palosuo [r],
Pirjo Peltonen-Sainio [r], Vera Potopová [s], Margarita Ruiz-Ramos [t], Pytrik Reidsma [u], I
Mirek Trnka [d,v], Martin K. van Ittersum [u], Jørgen E. Olesen [b,d,w]



Uued kultuurid tulevikukliimas: maguskartul (*Ipomoea batatas*) uue põllumajanduskultuurina Eestis

Eve Runno-Paurson, Slava Eremeev, Tiina Tosens, Ülo Niinemets





Saak sordilt Covington

ETTEKASVATATUD VARIANT (fotodel ühe pesa saak)

Väetusvariant **N - 0**



Väetusvariant **N - 100**



Kartul Eestis uudiskultuurina 19. saj
= TEINE LEIB 20. ja 21. saj.

Saagikus 50-60 t/ha

Nõuab suurt pestitsiidide ja väetiste sisendit

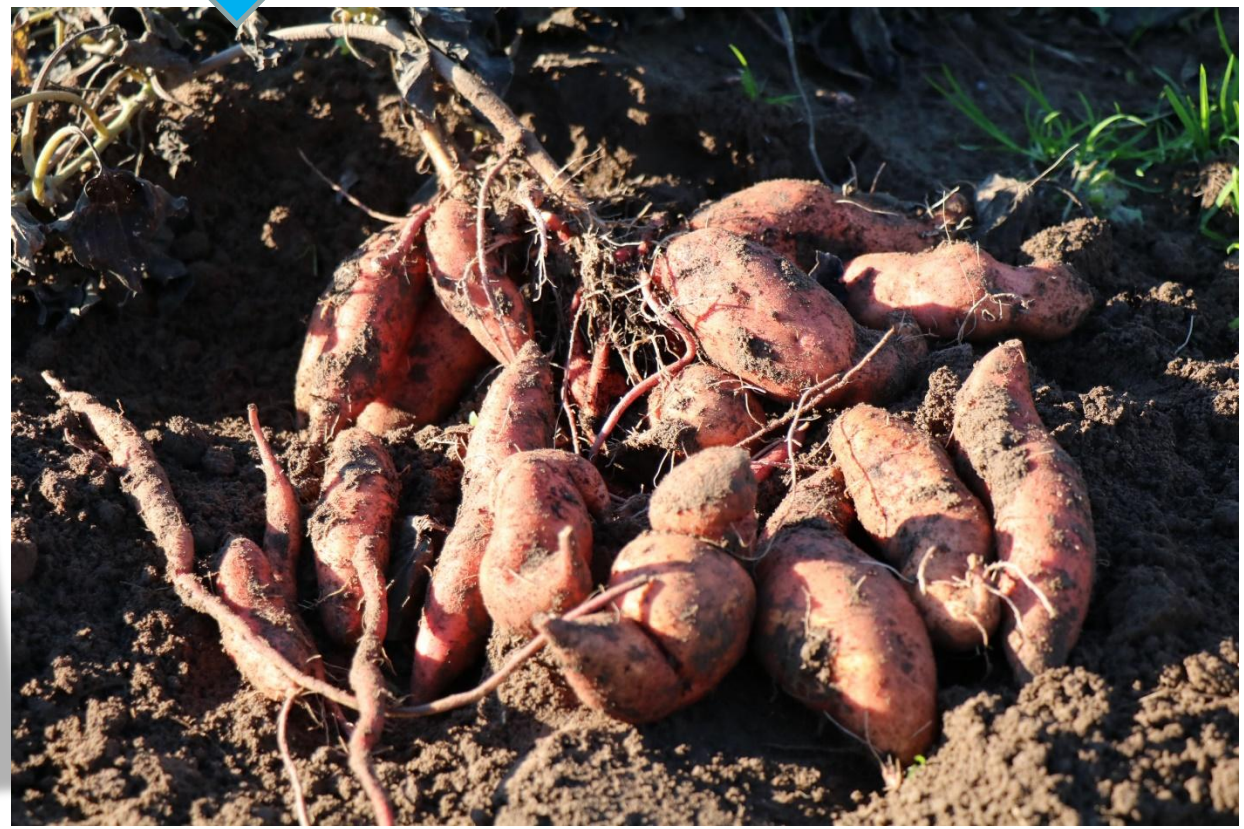


E. Runno-Paurson

Bataat uudiskultuur 21. sajandil
MIS EDASI?

Kasvas ja andis saaki ettekasvatatult Eesti põllutingimustes väga hästi!

E. Runno-Paurson







Fotosünteesiefektiivsuse parandamine

New Phytologist

Forum

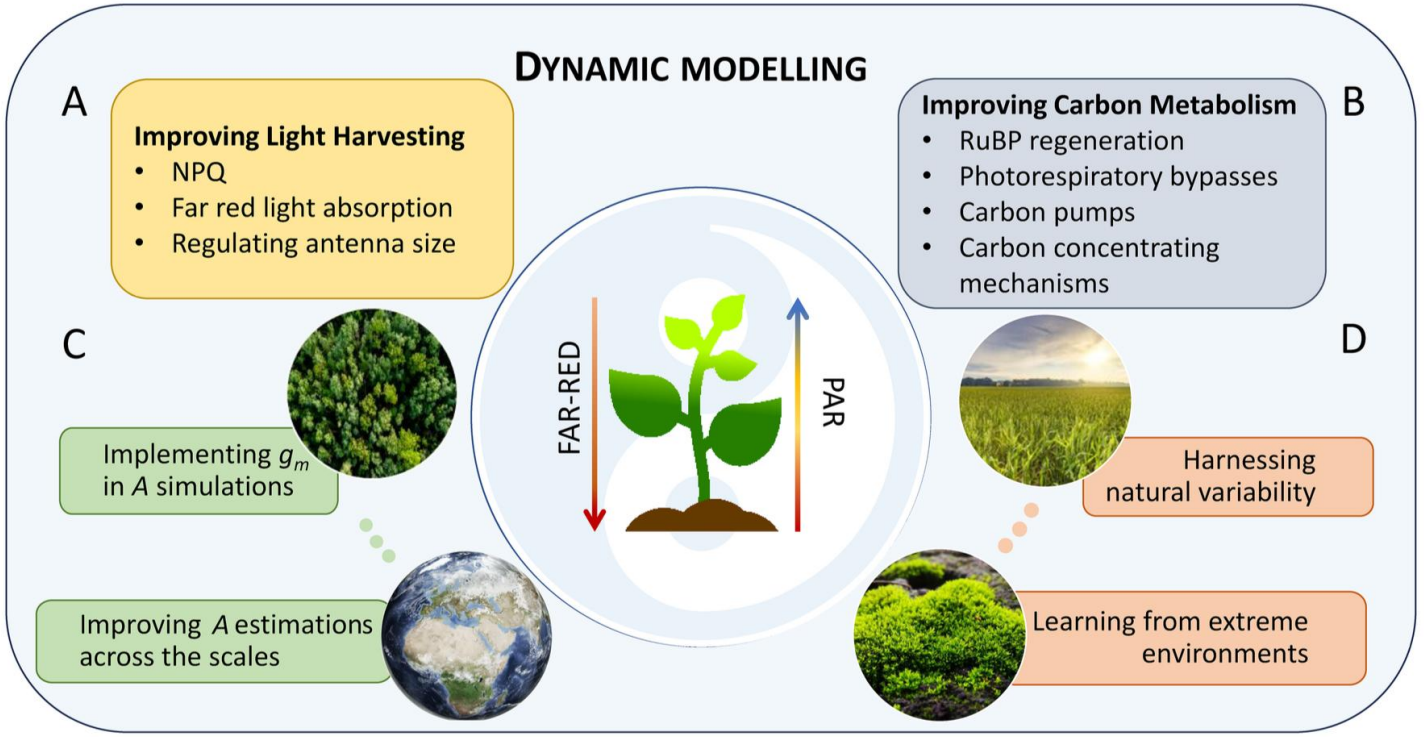
Meetings

Ülo Niinemets[1,2]*, Joseph A. Berry[3], Susanne von Caemmerer[4], Donald R. Ort[5], Martin A. J. Parry[6] and Hendrik Poorter[7]

Photosynthesis: ancient, essential, complex, diverse . . . and in need of improvement in a changing world

The 17th International Congress on Photosynthesis Research – Photosynthesis in a Changing World, Maastricht, the Netherlands, August, 2016

showing that soybean yield has been driven largely by a near doubling of harvest index. While the rate of carbon gain per unit leaf area has increased somewhat in modern soybean cultivars, it has been due to increased stomatal conductance and lower water-use efficiency, rather than via increases in photosynthetic capacity (Koester *et al.*, 2016). Yet, photosynthesis is the only yield determinant that is not close to its biological limits (Zhu *et al.*, 2008; Ort *et al.*, 2015), suggesting that increases in photosynthesis might indeed lead to increases in yield. In the following, we focus on meeting highlights pertaining to rate-limiting processes for which improvements could increase crop yield, and on new advancements in monitoring and predictive modeling of plant photosynthesis.



Received: 31 January 2025 | Revised: 7 March 2025 | Accepted: 14 March 2025
DOI: 10.1111/ppl.70198

MINIREVIEW

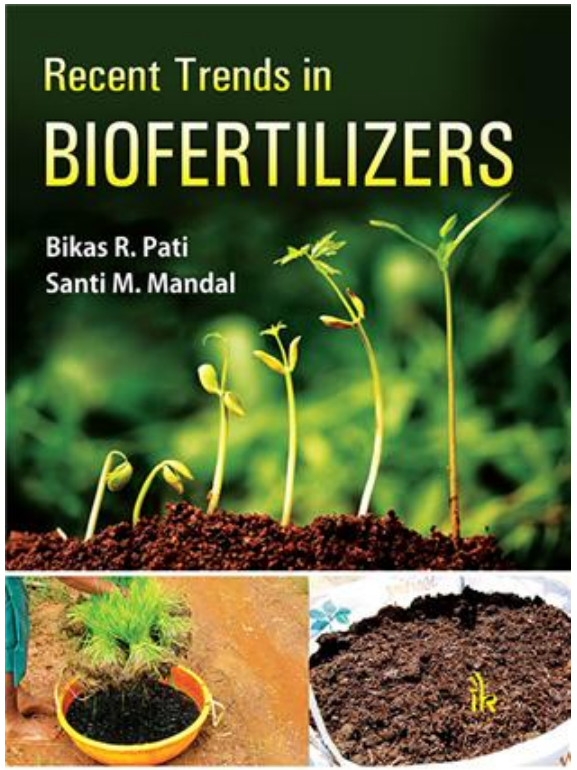
New avenues in photosynthesis: from light harvesting to global modeling

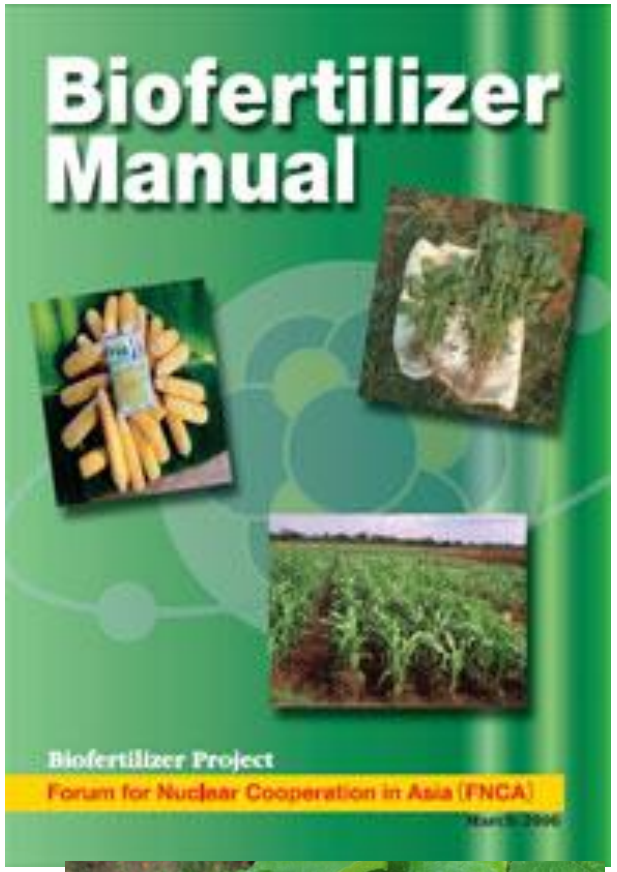
Tiina Tosens[1] | Alessandro Alboresi[2] | Herbert van Amerongen[3] | Roberto Bassi[4] | Florian A. Busch[5] | Giovanni Consoli[6] | Oliver Ebenhöh[7] | Jaume Flexas[8] | Jeremy Harbinson[3] | Peter Jahns[7] | Nina Kamennaya[9] | David M. Kramer[10] | Johannes Kromdijk[11] | Tracy Lawson[12,13] | Erik H. Murchie[14] | Ülo Niinemets[1] | Sara Natale[2] | Dennis J. Nürnberg[15] | Andrea Persello[16] | Paolo Pesaresi[16] | Christine Raines[13] | Urte Schlüter[7] | Tom P. J. M. Theeuwen[10,17] | Stefan Timm[18] | Dimitri Tolleter[19] | Andreas P. M. Weber[7]

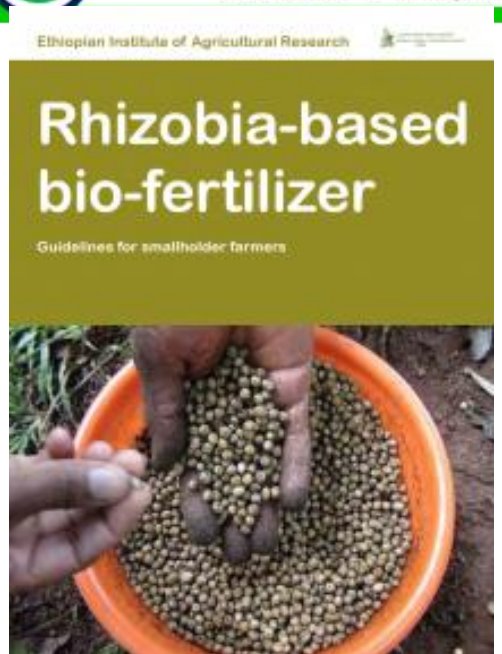
Physiologia Plantarum









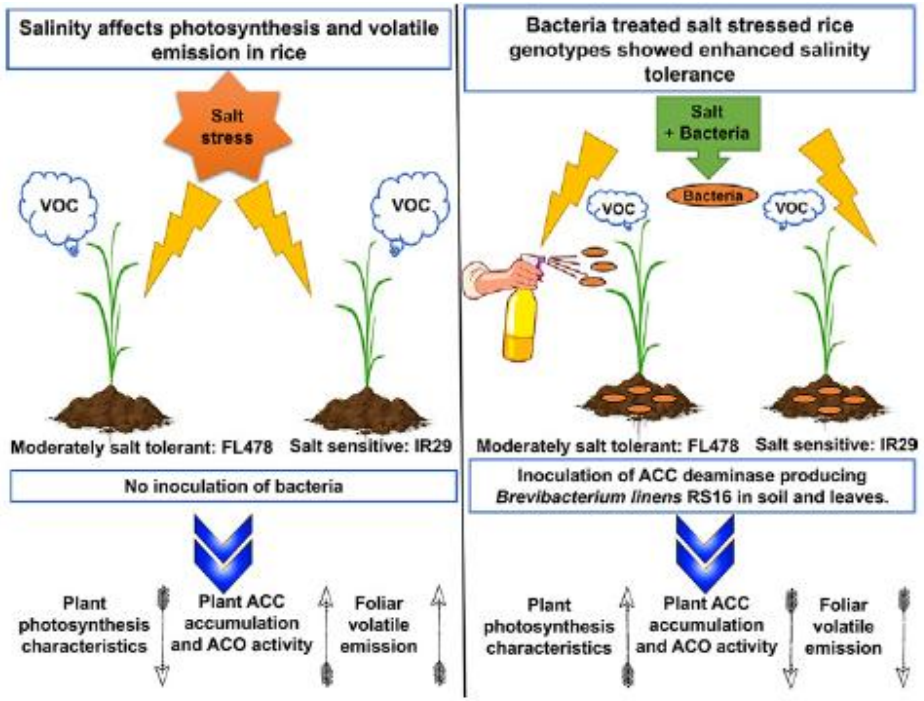


EFFECT GROW-

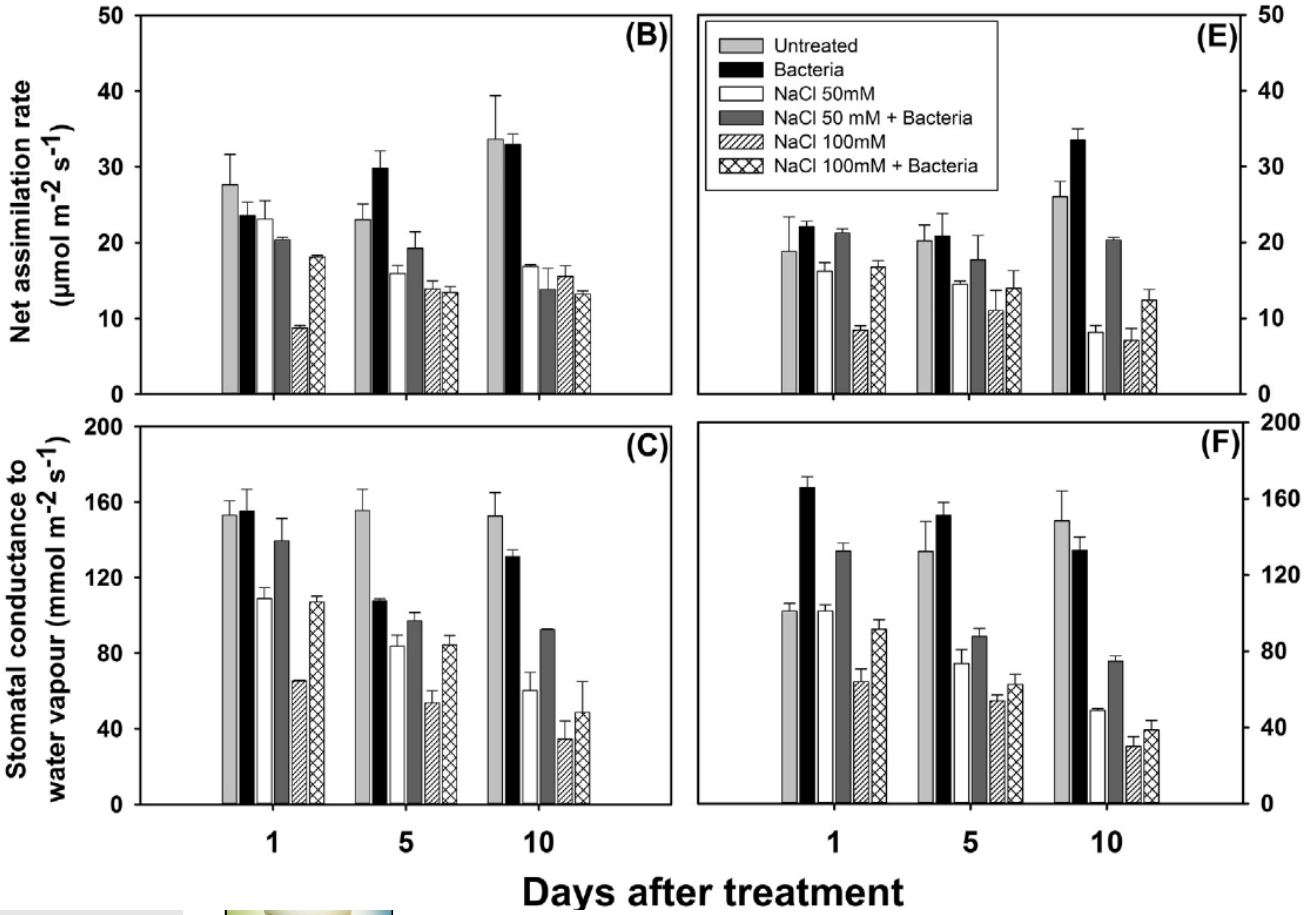
POTASSIUM MOBILIZING







Science of the Total Environment 645 (2018) 721–732



Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Inoculation of *Brevibacterium linens* RS16 in *Oryza sativa* genotypes enhanced salinity resistance: Impacts on photosynthetic traits and foliar volatile emissions

Poulami Chatterjee [a], Arooran Kanagendran [b], Sandipan Samaddar [a], Leila Pazouki [b,c], Tong-Min Sa [a,*], Ülo Niinemets [b,d,**]





PRESSITEATED

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SA Joosep Tootsi Fond
Avalik teave

Taime kasvu soodustav bakter parandab toidutaimede soolsuse taluvust

18.09.2018

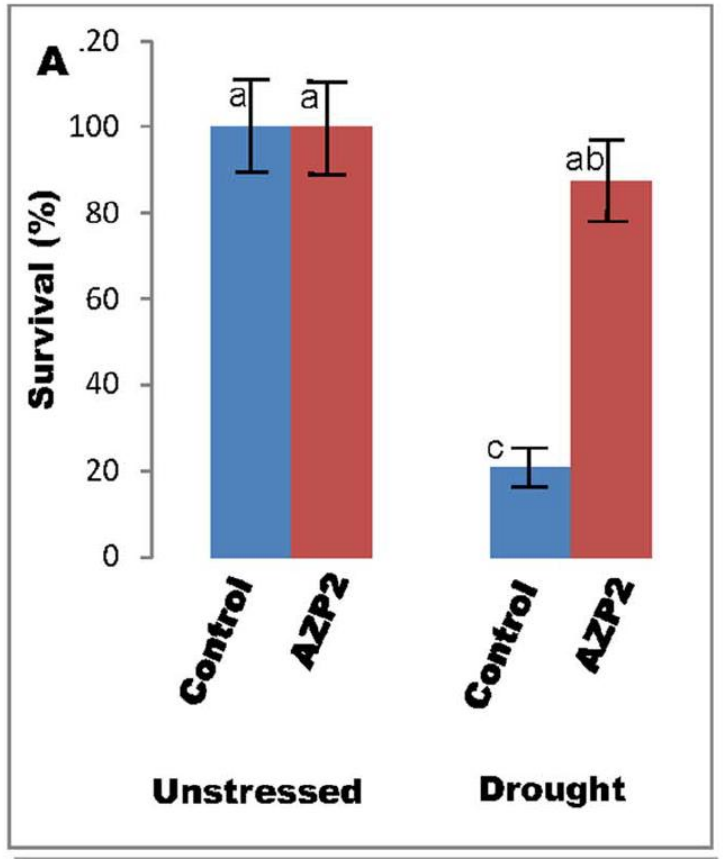


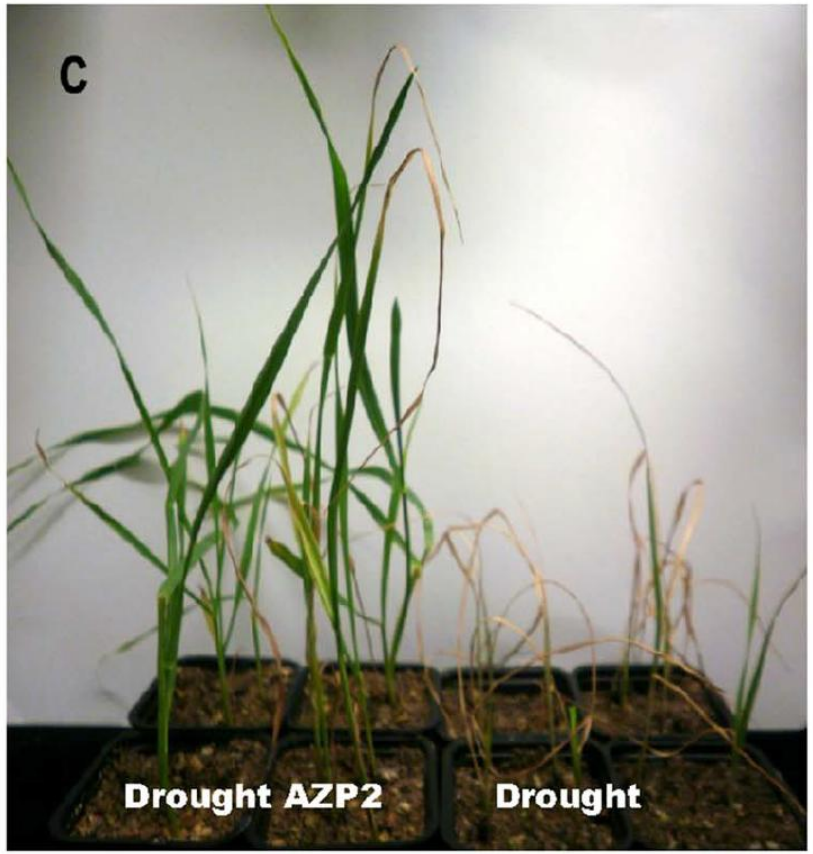
Foto: IRRI, Philippines

A – Terved riisitaimed B – Soolsusest mõjutatud taimed

Muldade sooldumine on üks peamisi abiootilise stressi tegureid, mis mõjutab põllumajandust kõikjal maailmas. Iga päev hävib selle tagajärjel ligi 2000 ha viljakat põllumaad. Aina suureneva muldade sooldumisega toimetulemiseks põllumajanduses ei ole just palju lahendusi, eriti neil juhtudel, kui tegemist on soolatundlike põhiteraviljadeg, nagu riis ja nisu, mille saagikus mitmetes maailma piirkondades sõltub olulisel määral just pinnase soolsusest.

Üheks võimalikuks lahenduseks on kasutada taime kasvu soodustavaid baktereid, millel on suur potentsiaal parandada saagitaimede produktiivsust sooldunud muldadel. Taime kasvu soodustavate bakterite kasutamine on olnud vaevaline, kuna senised meetodid ei ole võimaldanud kontrollida erinevate bakterite rolli taime soolsuse taluvuse paranemisel ilma taime hävitamata. Chungbuk National University (Lõuna Korea) ja Eesti Maaülikooli teadlaste koostöös uuriti, kas taimelehtede lenduvühendite emissiooni ja fotosünteesi funktsionaalseid tunnuseid mõõtes on võimalik taime hävitamata hinnata tema vastupanuvõimet soolsusele ning seda, kas soolsusega toimetulek paraneb, kui riisi isendid on nakatatud taime kasvu soodustava risosfääri bakteriga *Brevibacterium linens*





OPEN ACCESS Freely available online

PLOS ONE

Drought-Tolerance of Wheat Improved by Rhizosphere Bacteria from Harsh Environments: Enhanced Biomass Production and Reduced Emissions of Stress Volatiles

Salme Timmusk[1]*, Islam A. Abd El-Daim[1], Lucian Copolovici[2], Triin Tanilas[2], Astrid Kännaste[2], Lawrence Behers[1], Eviatar Nevo[3], Gulaim Seisenbaeva[4], Elna Stenström[1], Ülo Niinemets[2,5]

Toidupüramiid: millise osa toidust peaksid moodustama valgud, süsivesikud ja rasvad (ja mida veel on vaja, näit. vitamiinid, asendumatud rasvad ja aminohapped)



2025: toidupüramiid pea peale?



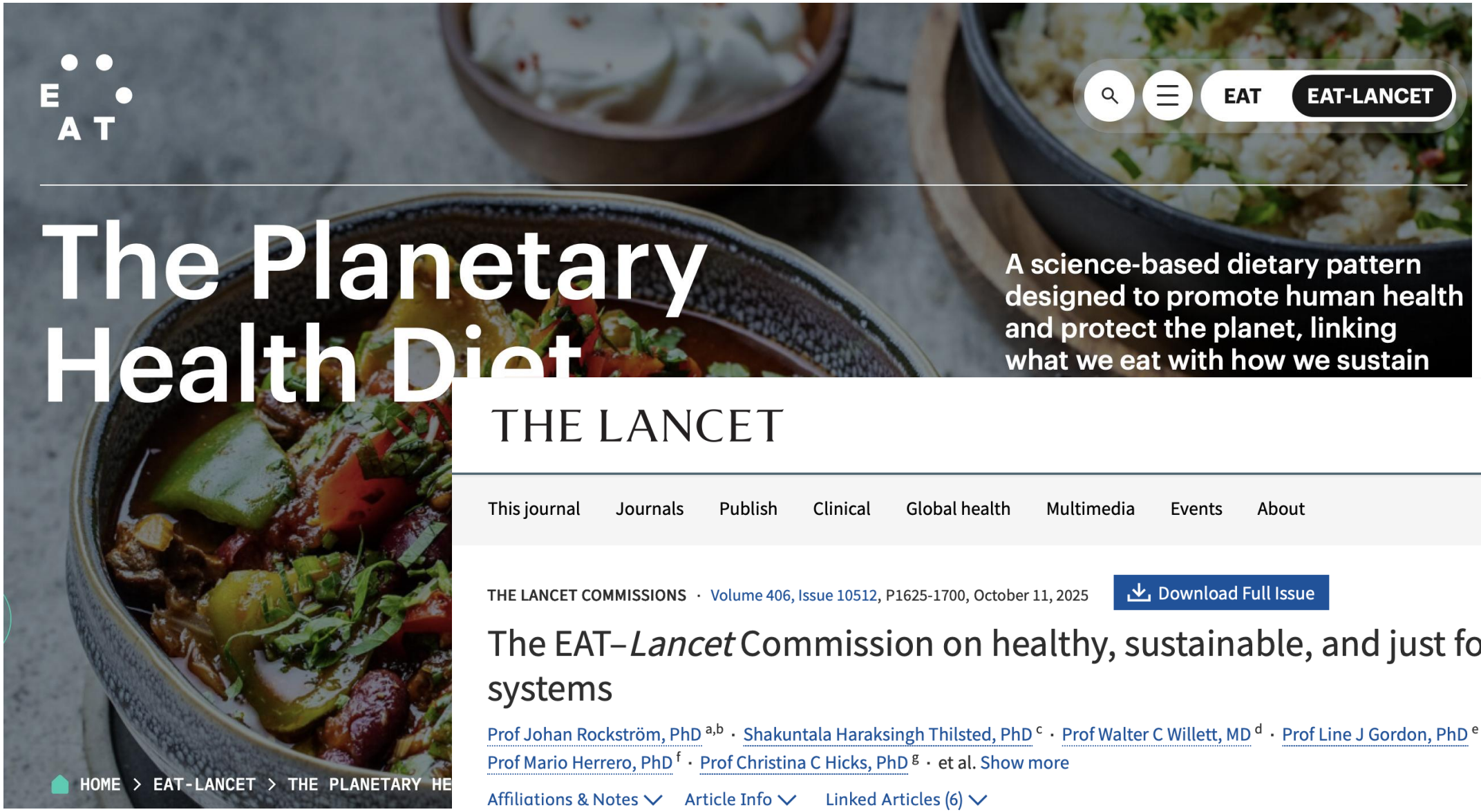
2025-2030 realfood.gov



Dietary Guidelines For Americans

USDA

EAT-Lancet – jätkusuutlik toidutootmine (ja tarbimine)



THE LANCET

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THE LANCET COMMISSIONS · Volume 406, Issue 10512, P1625-1700, October 11, 2025 Download Full Issue

The EAT–*Lancet* Commission on healthy, sustainable, and just food systems

Prof Johan Rockström, PhD [a,b] · Shakuntala Haraksingh Thilsted, PhD [c] · Prof Walter C Willett, MD [d] · Prof Line J Gordon, PhD [e] · Prof Mario Herrero, PhD [f] · Prof Christina C Hicks, PhD [g] · et al. Show more

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The Nine Planetary Boundaries, and the Global Food System's Role



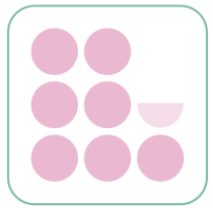
Climate change

Food systems drive nearly 30% of greenhouse gas emissions, but innovation in decarbonizing energy, halting land conversion, and shifting diets can turn agriculture from a source into a potential carbon sink.



Change in biosphere integrity

As the primary driver of functional biodiversity loss, food systems contribute to conservation through ecological farming practices that embed habitat and enhances space for biodiversity, to pollinate crops, capture pollutants, and regulate pests as active contributors to food production.



Stratospheric ozone depletion

With agriculture as the largest emitter of the ozone-depleting gas nitrous oxide (N_2O), innovation in precise nitrogen fertilizer use directly supports the restoration of our planet's protective ozone layer.



Increase in atmospheric aerosol loading

While not yet transgressed at a planetary scale, food systems are a major source of the air pollutants that drive this boundary, pointing to innovation in managing agricultural ammonia and eliminating biomass burning.



Ocean acidification

Driven largely by the 25% of CO_2 emissions from food systems, this boundary calls for innovation in the same solutions that address climate change: a net-zero food system that protects marine life.



Modification of biochemical flows

Food systems are responsible for the near-totality of nitrogen and phosphorous boundary transgression, creating an urgent space for innovation in circular nutrient systems, fertilizer management, and dietary changes to reduce pollution.



Freshwater change

With agriculture as the largest user of blue water for irrigation, innovation in water-saving technologies, soil management, and shifting to less water-intensive crops is essential to stay within the safe volume limit.



Land system change

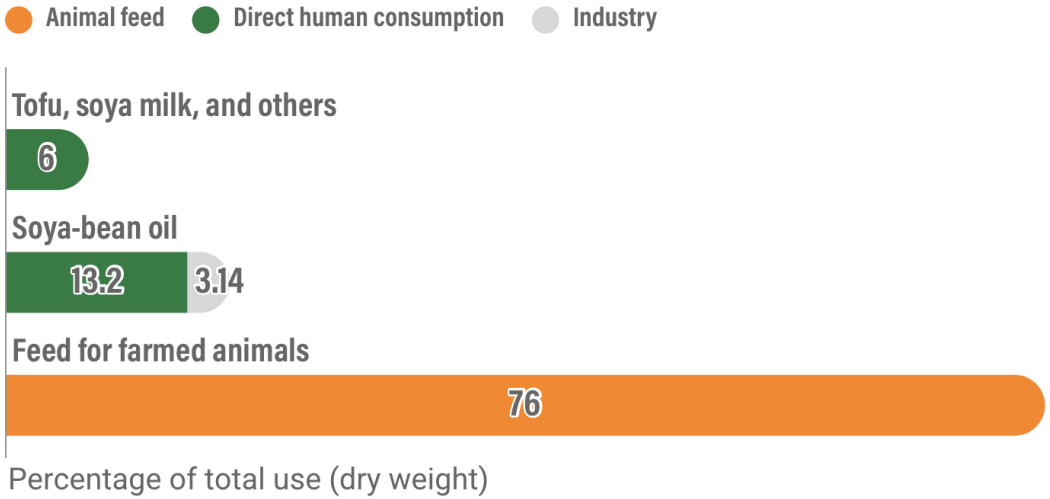
Agriculture has already converted 37% of the planet's ice-free land, but innovation lies in halting all conversion of remaining intact ecosystems and restoring those most at risk. Adding habitat in agricultural lands serves both conservation and food production.



Introduction of novel entities

The food system's widespread and extensive use of pesticides, plastics, and antimicrobials puts significant impact on this boundary. This, demands innovative solutions in biological pest control, non-toxic packaging, and halting the prophylactic use of pesticides and antibiotics in plant and animal production – reserving their use for treating infestations and disease.

Global use of soya beans [2]



Contrary to some common misconceptions, soya-based foods such as tofu and soya drinks make up a small fraction of global soya production

76% of soya is used for animal feed.



Soy

TABLE OF CONTENTS

The global soybean market
The land footprint of soybeans
The role of soybeans in deforestation

Soy consists of three main products: bean (or seed) product of soybean oil extraction. Crushing one to kg of meal (Peyronnet et al., 2014). The oil is used ir feed.

6%	of world soybean production is for human consumption
44%	of France's land footprint is due to soybean imports
54kg	per capita soybeans are imported into France each year

Sustainable soy

Amazon soy moratorium

The initiative to establish a zero deforestation soy industry is the Amazon soy moratorium signed in 2006 and implemented from 2008 (Kastens et al., 2017; Gibbs et al., 2015; Rudorff et al., 2011). The moratorium on soy is a commitment by major players in the soybean industry not to market soybeans produced in areas that come from deforestation in the Amazon biome. The engagement was institutionalized initially between these actors and environmental NGOs and then endorsed by the Brazilian government.

The certification standards

The main existing standards for soybeans are:

- RTRS Standard – Roundtable on Responsible Soybeans;
- ProTerra Standard;
- ISCC Standard - International Sustainability and Carbon Certification.

Their correspondence to the SNDI criteria (Objective 13) was studied by the dedicated working group of the AFD Forest Scientific and Technical Committee and resulted in a study report.

Find out more (reports in French):

Rapport CSTF - Déforestation associée à l'importation de soja (2020)
Fichier PDF - 2.3 Mb

Rapport CSTF - Importer du soja sans contribuer à la déforestation (Mai 2021)

TARTU ÜLIKOOL
RAKE

PROTEIINSÖÖTADES EESTI PÄRITOLU TOORAINE OSAKAALU SUURENDAMISE VÕIMAL

LÕPPARUANNE



Tartus 2026. aastal

Tabel 4. *Proteiinsöötade ja proteiinsööda toormete import Eestisse aastatel 2020–2024 (tonnides). Allikas: Statistikaamet (VKK10)*[9]

Proteiinsööt / söödamaterjal	2020	2021	2022	2023	2024	Alusjuurdekasv t= 2020*
Rapsi- ja rüpsiseemned	3 677	9 435	3 127	50 770	62 357	+16,9 x
Sojakook	44 218	45 353	48 832	43 686	58 274	+32%
Maisiterad	25 599	23 703	36 990	65 241	43 867	+71%
Päevalillekook	6 110	9 716	12 072	14 279	30 861	+5 x

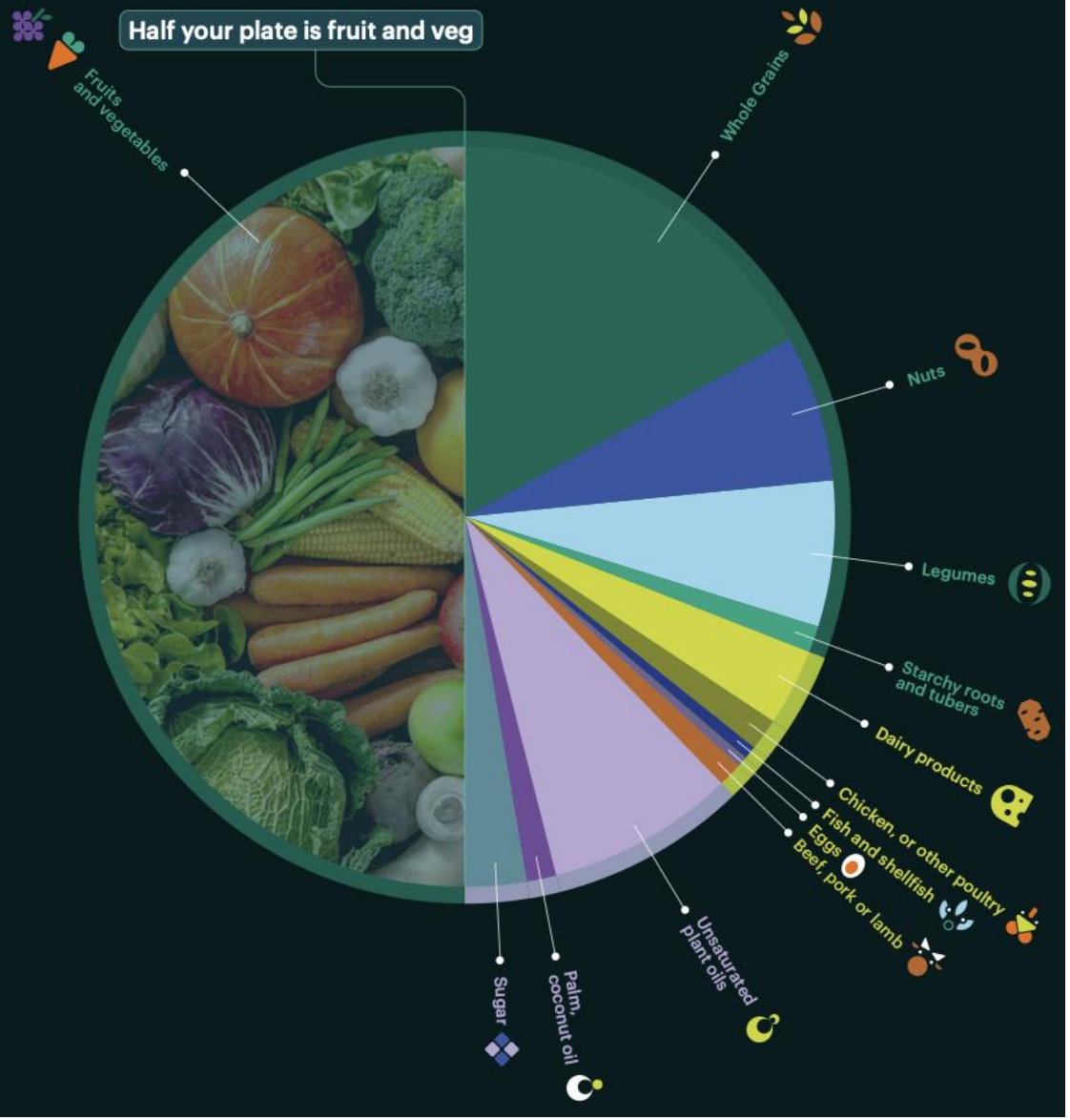
Eesti taimse toorproteiini netoimpordi osakaal ((import−eksport) / siseriiklik kasutus) oli 2024. aastal ligikaudu 29%, mis tähendab, et ligikaudu kolmandik siseriiklikust kasutusest kaeti netoimpordi arvelt. Hoolimata aktiivsest kaubavahetusest ja ekspordi osalisest tasakaalustavast mõjust sõltub Eesti proteiinsöötade varustatus endiselt märkimisväärselt välismaistest proteiiniallikatest.

FIGURE 01

Planetary Health Diet

A Flexible Diet for Better Human Health

→ DIETARY TARGETS FOR A HEALTHY REFERENCE DIET, WITH POSSIBLE RANGES, FOR ADULT POPULATION-AVERAGE ENERGY INTAKE OF ROUGHLY 2,400 KCAL PER DAY.



HEALTH & NUTRITION CAMPAIGN

Our Cultures, Our Meals: Cooking for Planetary Health

Cooking for Planetary Health brings the 2025 EAT-*Lancet* Report to life through food and culture, showcasing the plant-rich traditions of the Mediterranean and Asia.



The **EAT-Lancet Planetary Health Diet** is a flexitarian eating pattern designed to support human health and environmental sustainability based on roughly 2,500 kcal per day. ScienceDirect.com +2

Daily Target Portions (Reference Ranges)

- **Whole Grains:** 232 g per day (e.g., brown rice, whole-wheat bread, oats)
- **Vegetables (including dark leafy greens and red/orange veggies):** ~300 g per day (~50% of the plate shared with fruits)
- **Fruits:** ~200 g per day
- **Legumes:** 50 g dry weight per day (e.g., lentils, chickpeas, dry beans)
- **Soy Foods:** 25 g per day (e.g., tofu, tempeh)
- **Nuts and Seeds:** 25 g per day (e.g., walnuts, almonds, peanuts)
- **Unsaturated Plant Oils:** 40 g per day (e.g., olive oil, canola oil)
- **Dairy:** 250 g per day (equivalent to a glass of milk or yogurt)
- **Poultry:** 29 g per day (optional/moderate)
- **Fish / Seafood:** 28 g per day (optional/moderate)
- **Eggs:** 13 g per day (about 1.5 eggs per week)
- **Red Meat (Beef, Lamb, Pork):** Limited to 14 g per day (or about one small portion a week)
- **Added Sugars & Starchy Vegetables:** Minimized Wikipedia +3

EAT-Lancet dieedi fookus on taimsel toidul, eelkõige vähese energiatihedusega toidul. Süüa on vaja rohkem.

Taimne toit sisaldab rohkem kiudaineid, mõjutab soolestiku toimimist

Gut 1986, **27**, 164–169

Bowel function measurements of individuals with different eating patterns

G J DAVIES, M CROWDER, B REID, AND J W T DICKERSON

Table 2 *Bowel function measurements in omnivores, vegetarians, and vegans*

Dietary group		*Mean transit (time)*	*Frequency of defecation/24 h*	*Wet weight of faeces (g/24 h)*	*Mean rheology of stools (0·1 mm)*	*Mean form of faeces (1–8)*
Omnivorous	Mean and SD	51·8±19·4	1·0±0·2	153±79	35±22	5·7±1·3
	Range	32·5–107·9	0·7–1·3	54–415	11–87	2·8–7·5
Vegetarian	Mean and SD	48·5±27·2	1·2±0·5	168±56	44±26	5·0±1·5
	Range	28·3–146·1	0·4–2·1	81–265	8–104	3·0–7·8
Vegan	Mean and SD	44·7±21·0	1·7±0·9‡	225±91†	52±18†	4·5±1·2‡
	Range	28·9–101·6	0·6–4·4	129–499	24–91	2·3–7·1

The mean daily intakes of dietary fibre for omnivores, vegetarians, and vegans were 23 g (10–57 g), 37 g (15–71 g), and 47 g (24–78 g) respectively.

Annals of Medicine

ISSN: 0785-3890 (Print) 1365-2060 (Online) Journal homepage: www.tandfonline.com/journals/iann20

Bowel health, defecation patterns and nutrient intake following adoption of a vegan di randomized-controlled trial

Julian Herter, Frieda Stübing, Volker Lüth, Julia Zimmerman Lederer, Luciana Hannibal, Roman Huber & Maximilian And

To cite this article: Julian Herter, Frieda Stübing, Volker Lüth, Julia Zimmer Lederer, Luciana Hannibal, Roman Huber & Maximilian Andreas Storz (20 defecation patterns and nutrient intake following adoption of a vegan die controlled trial, Annals of Medicine, 56:1, 2305693, DOI: 10.1080/0785389

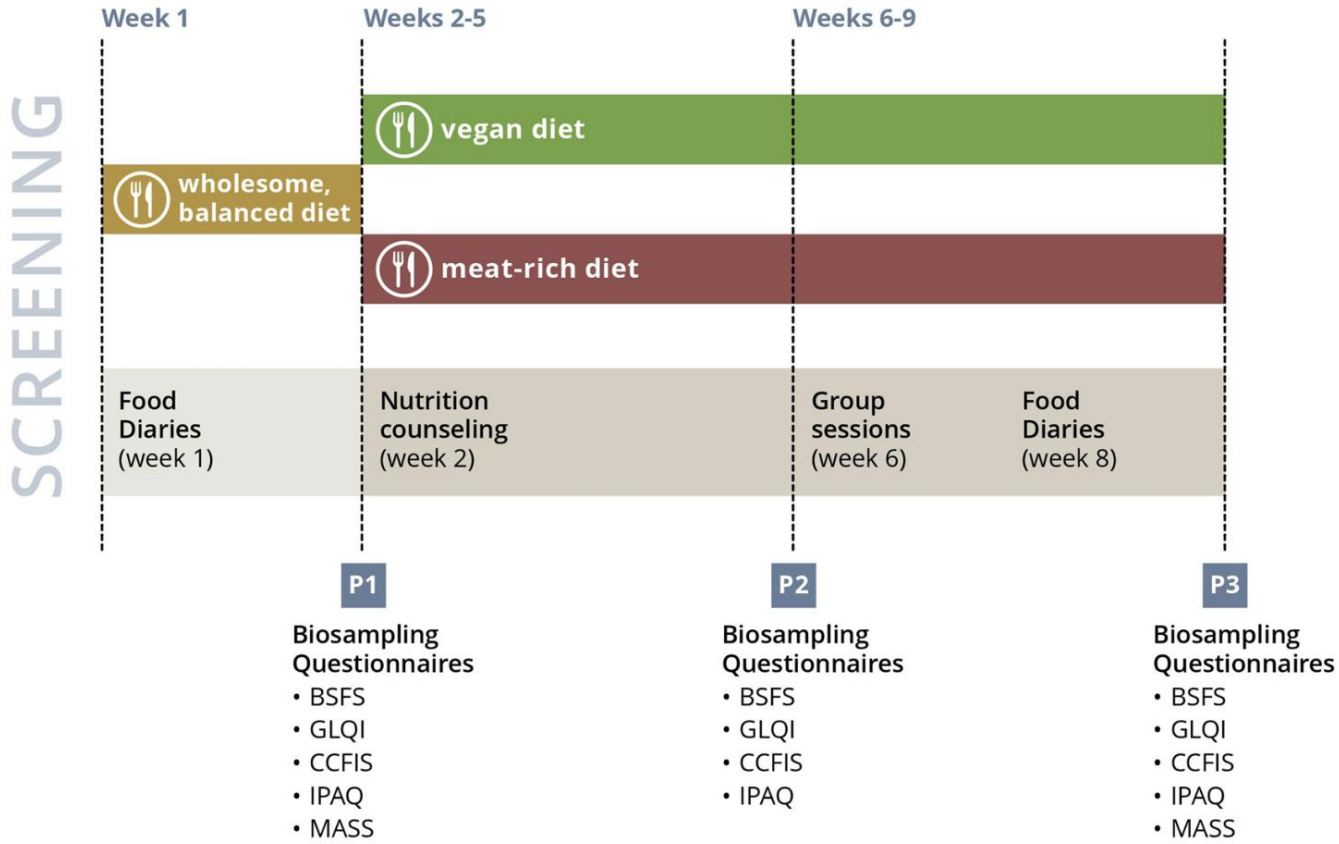
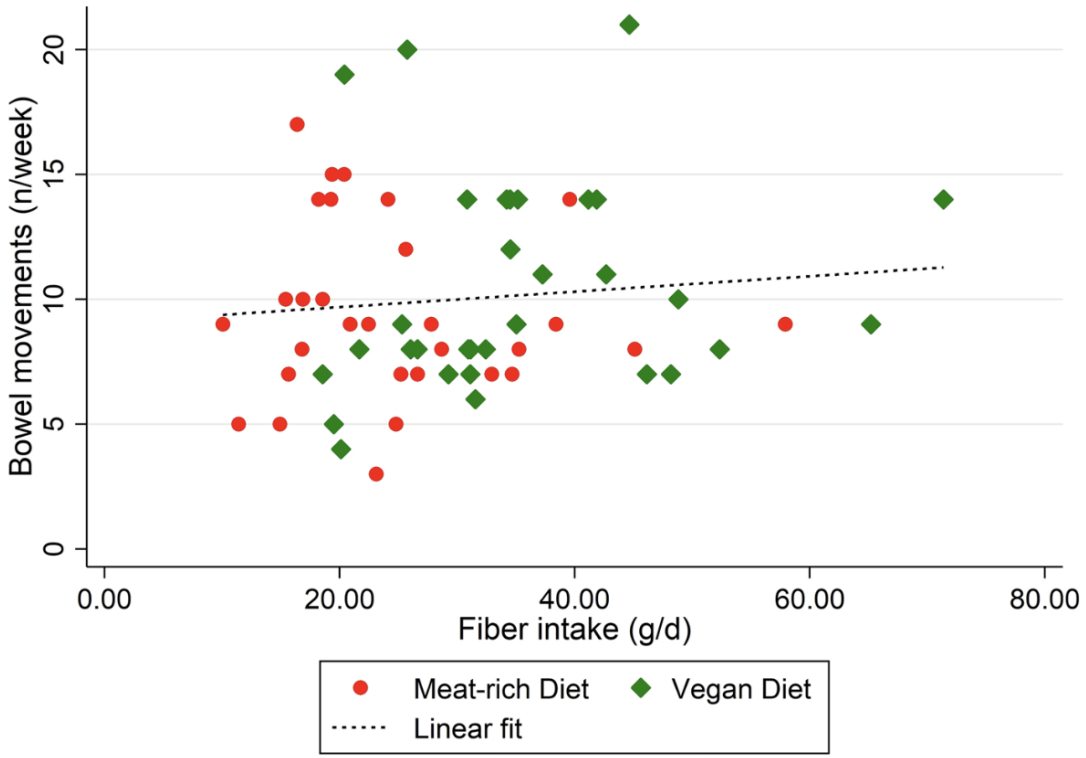


Table 5. Comparison of BM frequency, BSFS, and GIQLI across dietary groups.

	Baseline		Week 4		Week 8		*p*-value (Baseline – End)		
	Vegan Diet	MR Diet	Vegan Diet	MR Diet	Vegan Diet	MR Diet	Time	Diet	Time X Diet
BM frequency	8 (5)	9.44 ± 3.32	9 (7)	9.5 ± 3.84	9 (7)	9.53 ± 3.48	.078	.475	.142
BSFS (mean)	3.39 ± 0.9	3.67 ± 0.96	3.91 ± 1.04	3.97 ± 1.03	3.70 ± 1.07	3.59 ± 1.16	**.007**	.338	.378
GIQLI	132.18 ± 5.93	131.5 (8.5)	130.39 ± 6.21	130.5 (15)	134 (7)	133 (14.5)	**.001**	**.039**	.566



Dieedi otsene mõju nõrk

nature microbiology

Article

https://doi.org/10.1038/s41564-024-01870-z

Gut microbiome signatures of vegan, vegetarian and omnivore diets and associated health outcomes across 21,561 individuals

Received: 30 March 2024

Accepted: 25 October 2024

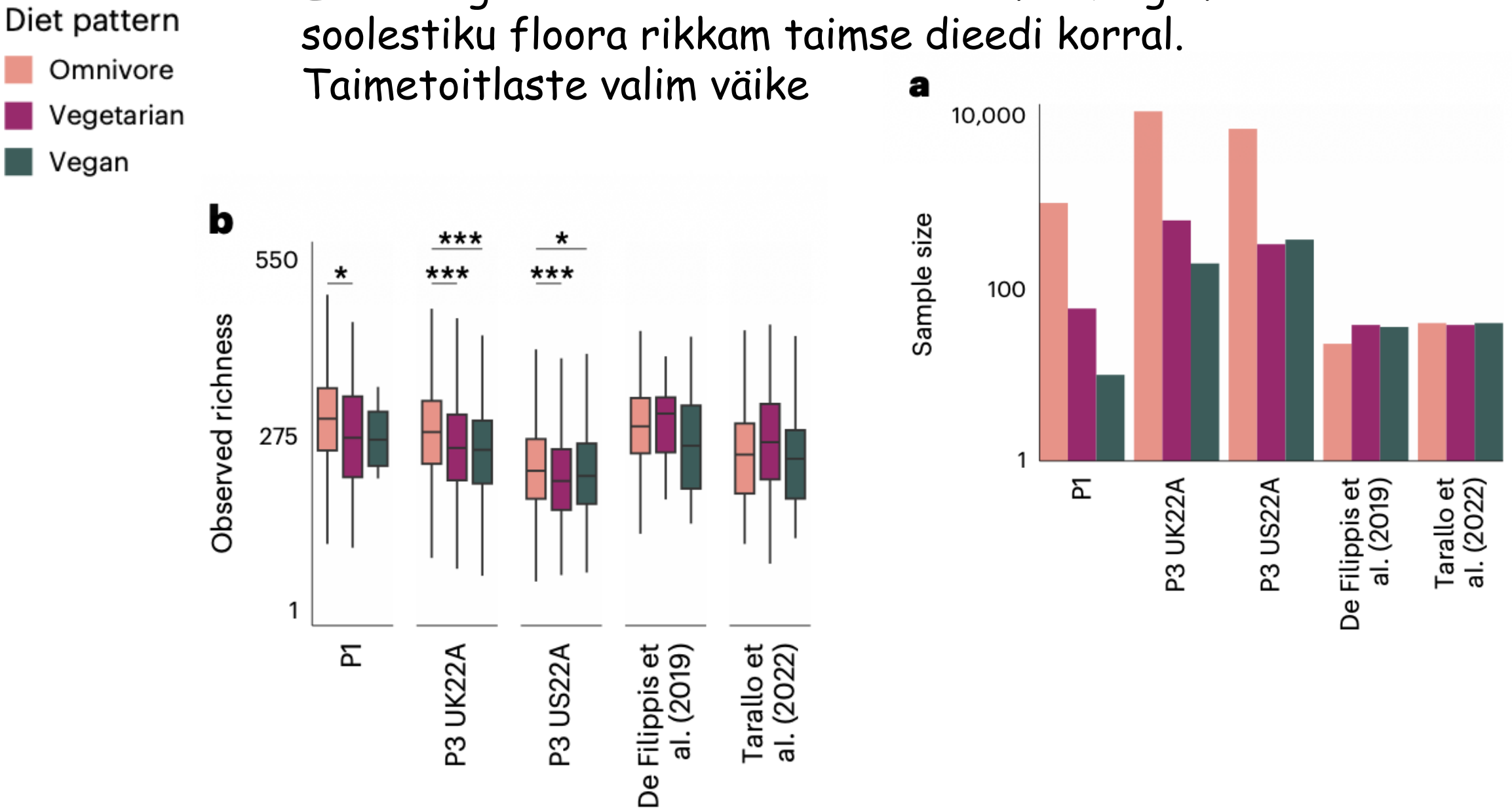
Published online: 6 January 2025

Check for updates

Gloria Fackelmann[1], Paolo Manghi[1], Niccolò Carlino[1], Vitor Heidrich[1], Gianmarco Piccinno[1], Liviana Ricci[1], Elisa Piperni[1], Alberto Arrè[2], Elco Bakker[2], Alice C. Creedon[2], Lucy Francis[2], Joan Capdevila Pujol[2], Richard Davies[2], Jonathan Wolf[2], Kate M. Bermingham[2], Sarah E. Berry[3,6], Tim D. Spector[2,4,6], Francesco Asnicar[1,6] & Nicola Segata[1,4,5,6]

patterns well (mean AUC = 0.85). Red meat was a strong driver of omnivore microbiomes, with corresponding signature microbes (for example, *Ruminococcus torques*, *Bilophila wadsworthia* and *Alistipes putredinis*) negatively correlated with host cardiometabolic health. Conversely, vegan signature microbes were correlated with favourable cardiometabolic markers and were enriched in omnivores consuming more plant-based foods.

Eri uuringutes saadud erinevaid tulemusi. Pigem ei ole soolestiku floora rikkam taimse dieedi korral. Taimetoitlaste valim väike



Ilmaparandaja



8. august

Kas globaalne toidurevolutsioon on ka tegelikult...

Kas globaalne toidurevolutsioon on ka tegelikult võimalik?

Maailm seisab kahe põletava küsimuse ees: kuidas toita aastaks 2050 ära 10–12 miljardit inimest ning kuidas teha seda meie planeeti ja tervist säästvalt? Lahendusena on teadlased pakkunud välja radikaalse muutuse meie toidulaual – nn planeedi tervise dieedi. See tähendaks oluliselt vähem punast liha ning rohkem puu- ja köögivilju, kaun- ja teravilju.
Eesti Maaülikooli professor Ülo Niinemets selgitab saates "Ilmaparandaja" teema keerukust. Saadet juhib Rein Pärn.

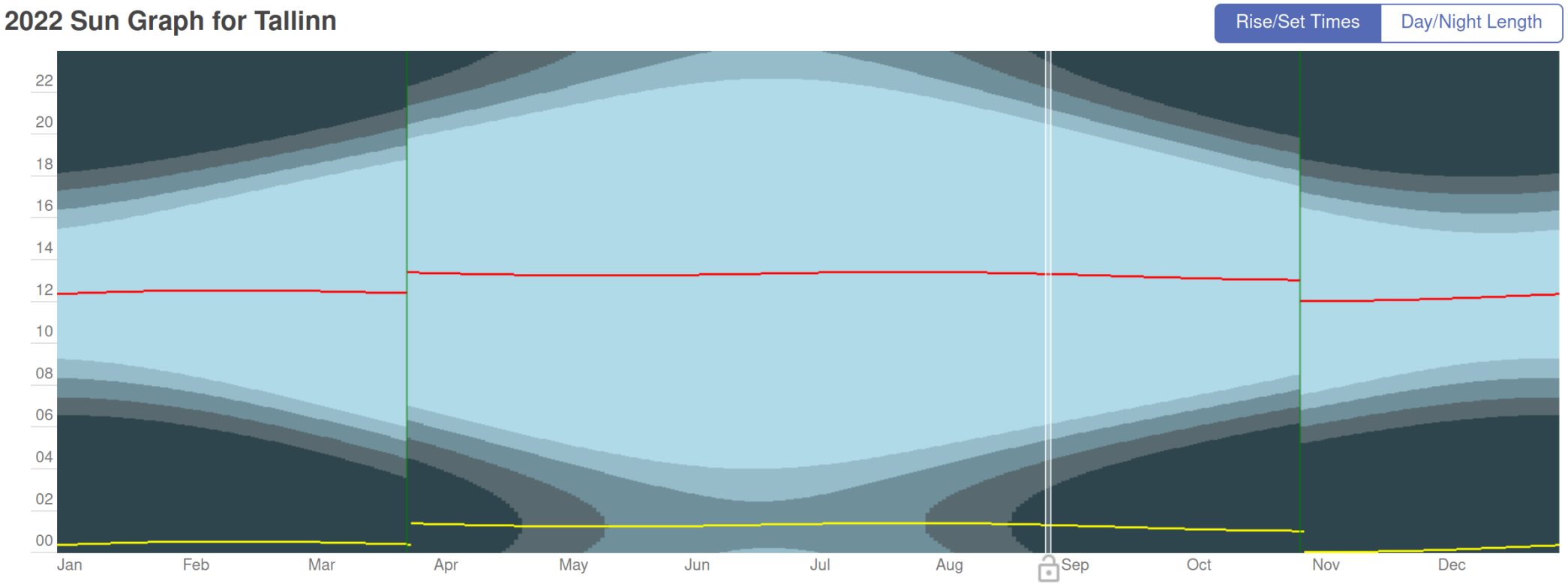
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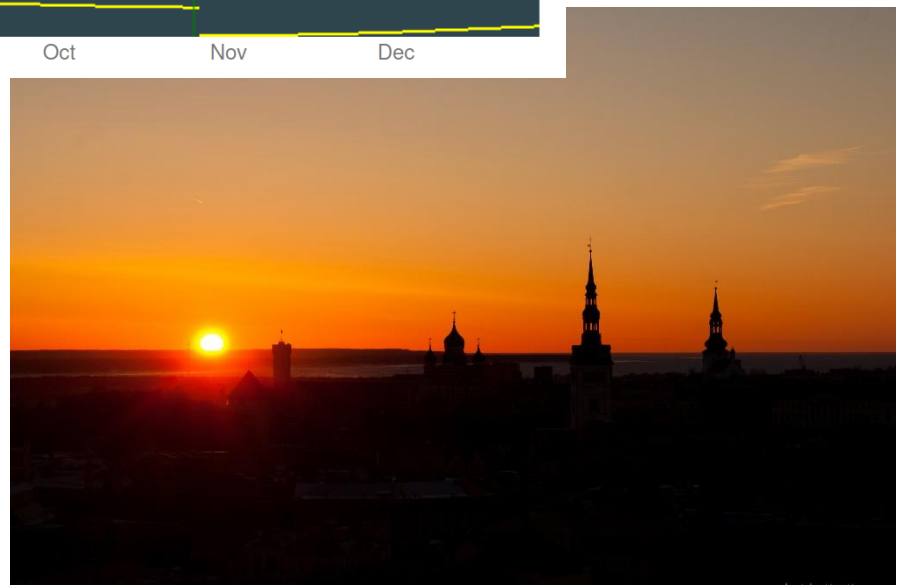
EAT-Lancet dieedi fookus on taimsel toidul, eelkõige vähese energiatihedusega suure kiudainete sisadlusega veerikkal toidul.
Süüa on vaja rohkem.
Paljudes paikades ei ole taimekasvatus võimalik.





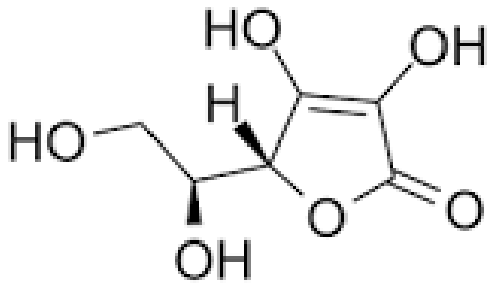
Isegi kui läheb soojaks, miks me kogu aeg väljas kultuurtaimi kasvatada ei saa?





Kui me talvel ise ei kasvata, siis on põhimõtteliselt kaks võimalust:
külmutada või sisse tuua
Mõlemal juhul tavaliselt langeb toidu kvaliteet





International Journal of Food Science and Technology 2008, **43**, 316–321

Original article

Influence of commercial freezing and storage on vitamin C content of some vegetables

Berat Nursal Tosun* & Sevinç Yücecan

...prefreezing operations caused a **19.1–51.5% decrease in the initial vitamin C levels**. The freezing process alone did not influence the vitamin levels except in the cases of green beans and spinach**. Total losses (%) were between 27.6 and 57.9** for the vegetables at the end of commercial frozen storage (6 months).





WILEY Food Science & Nutrition Open Access

ORIGINAL RESEARCH

Impact of transportation, storage, and retail shelf conditions on lettuce quality and phytonutrients losses in the supply chain

Millicent G. Managa[1] | Peter P. Tinyani[1] | Grany M. Senyolo[1] | Puffy Soundy[1]
Yasmina Sultanbawa[2] | Dharini Sivakumar[1]



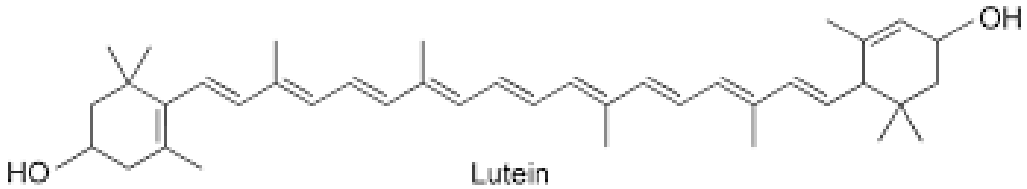
Supply chain point	Weight loss (%)	Yellowing (scale)	Rusty brown (scale)	Stem end discolora-tion (scale)	Wilting (scale)	Overall acceptance
Transport	0.10c ± 2.30	0.8c ± 1.20	1.9c ± 1.31	2.30c ± 1.31	0.65c ± 1.24	1.43a ± 1.34
Storage	25.55b ± 1.31	1.6b ± 1.10	3.3b ± 1.26	3.47b ± 1.08	1.54b ± 1.31	2.49b ± 0.76
Retail shelf (Day 3)	45.31a ± 2.40	2.0a ± 1.45	4.4a ± 1.53	4.49a ± 110	2.39a ± 1.56	3.02c ± 1.81

Treatment	Ascorbic acid (mg 100 g^{-1}FW)
Provinces	
GP	39.71^{ns} ± 0.45
NW	34.00 ± 0.52
Retailers shelf (Days)	
Day 1	54.40a ± 0.85
Day 2	47.85b ± 0.72
Day 3	28.30c ± 0.92
Day 4	16.87d ± 0.81

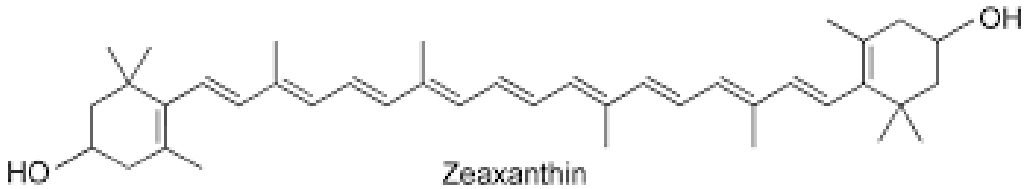
C vitamiin

Supply chain point	Carotenoids (mg 100 g/FW^{-1})
Transport	5.94a ± 0.53
Storage	4.58b ± 0.63
Retailers shelf (Day 3)	3.10c ± 0.75





Lutein



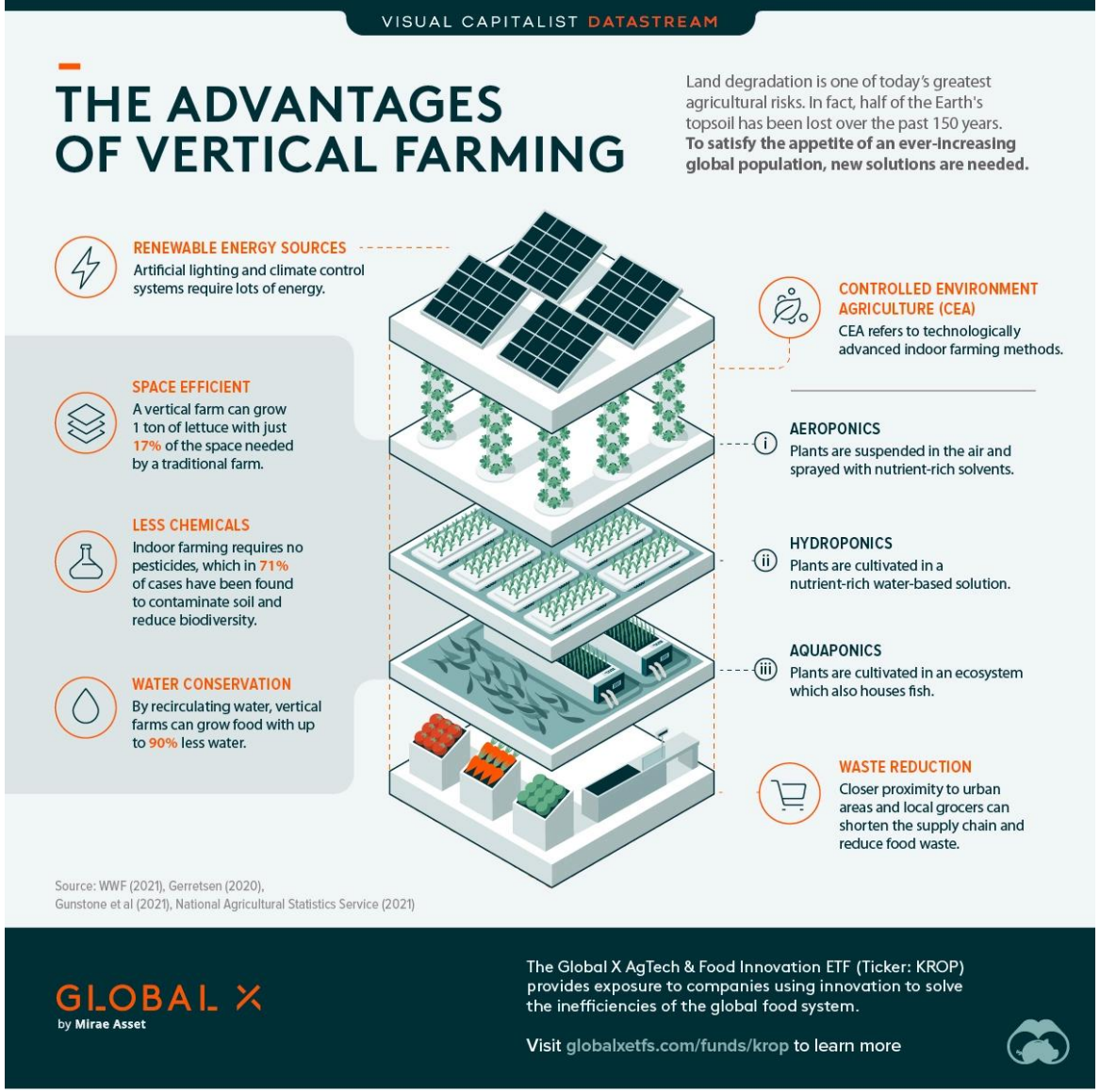
Zeaxanthin

Lahendus: kasvatada ise koha peal









Investing involves risk, including the possible loss of principal. The investable universe of companies in which KROP may invest may be limited. Narrowly focused investments will be more susceptible to factors affecting that sector and subject to more volatility. International investments may involve risk of capital loss from unfavorable fluctuation in currency values, from differences in generally accepted accounting principles or from social, economic or political instability in other nations. Emerging markets involve heightened risks related to the same factors as well as increased volatility and lower trading volume. KROP is non-diversified.

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Carefully consider the Fund's investment objectives, risks, and charges and expenses before investing. This and other information can be found in the Fund's summary or full prospectuses, which may be obtained at globalxetfs.com. Please read the prospectus carefully before investing.

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DATASTREAM

Is Vertical Farming the Future?

ARTICLE & EDITING
Marcus Lu

Published March 22, 2022 • Updated March 22, 2022 •



Vertical Farming Market to Rise at 24.8% CAGR Till 2026; Growing Demand for Efficient Crop Produce Will Contribute to Market Growth, Says Fortune Business Insights™

USA - English

Key Companies Covered in Vertical Farming Market Research Report are AeroFarms, Green Sense Farms Holdings, Inc., 4D Bios, Inc., Agrilution, AMHYDRO, EVERLIGHT ELECTRONICS CO., LTD., Koninklijke Philips N.V., Hort Americas, Illumitex Inc., Sky Greens, Plantagon International, PLENTY UNLIMITED INC, Thrive Agritech

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Fortune Business Insights →
Jan 20, 2020, 10:30 ET

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DATASTREAM

Is Vertical Farming the Future?



ARTICLE & EDITING
Marcus Lu

Published March 22, 2022 • Updated March 22, 2022 •

Metric 1 aaker ca. 0.4 ha	Traditional Outdoor Farm	Vertical Farm	Percentage Difference
Lettuce output per 1 acre	16 tons	126 tons	+787%
Kg CO_2 emitted per ton of lettuce	160 kg	540 kg	+337%
KL of water used per ton of lettuce	118 kL	6 kL	-95%

- suurem produktiivsus väiksemal pinnal
- lühem kasvuperiood
- väiksem veekasutus
- mineraalsed toitained - N, P – ei pääse keskkonda
- värske, bioaktiivsete ainete rikas toit tarbimise lähedal

- suurem CO_2-e jalajälg
- kallis (infra, energia)
- eelkõige vähekaloririkas toit

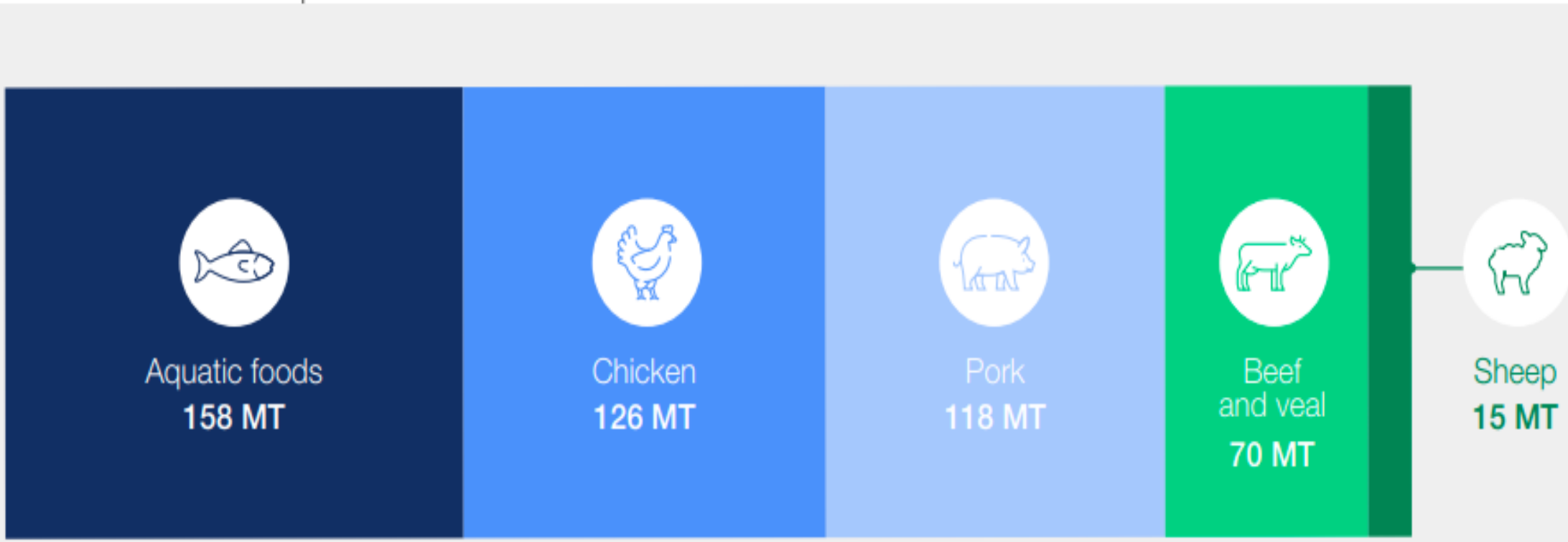




Päevase energiavajaduse katab ära ca. 25 kg kurke

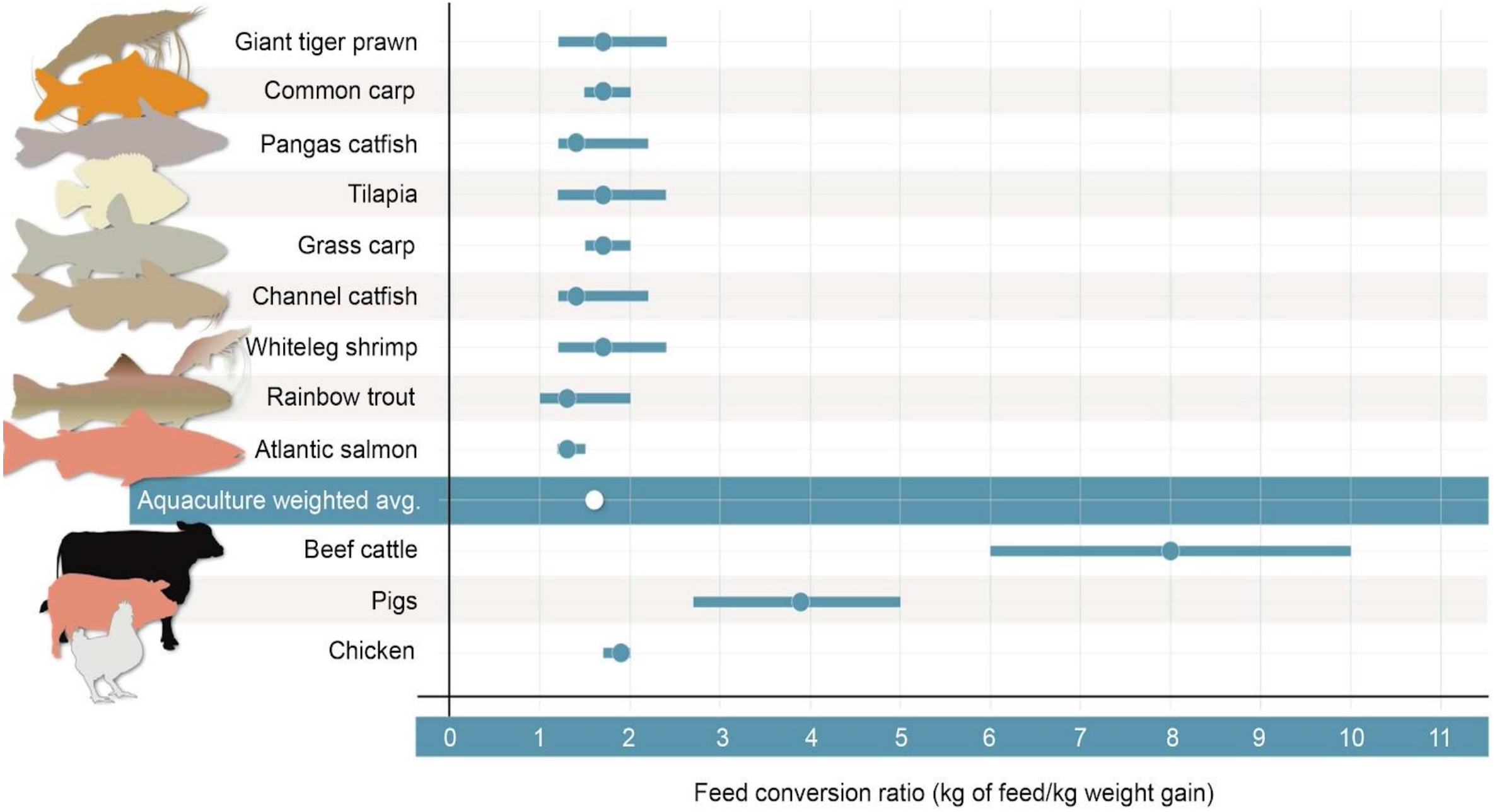
Sinine toit- kõik veest pärinev toit
Väga oluline globaalne proteiinide allikas
Enam kui pool „sinisest toidust“ tuleb vesiviljelusest

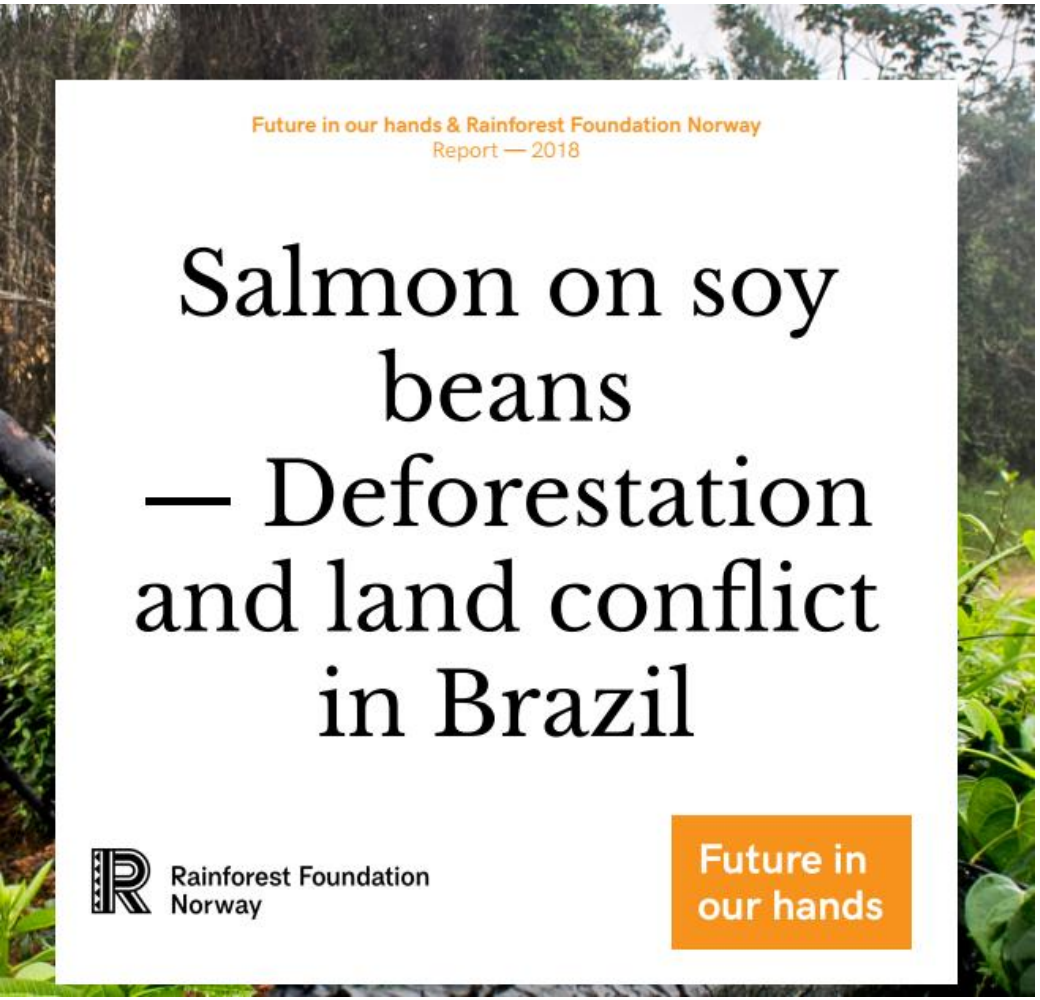
FIGURE 1 | Global production of protein in 2019



World Economic Forum 2024

Sinine toit- efektiivsem proteiiniallikas kui klassikaline loomakasvatus





The murky waters of soy fed salmon

New report reveals: The Norwegian salmon industry is linked to illegal deforestation, violent land conflict and plantations on indigenous lands through its Brazilian soy suppliers.



Deforestation in the area surrounding one of the farms that delivered soy to suppliers of the Norwegian salmon industry. Photo: Repórter Brazil

Sinise toidu kättesaadavus on samuti kliimamuutuste tõttu ohus

More than 90% of global aquatic food production faces substantial risk from environmental change, finds new research

Despite their importance to global diets, the vulnerability of aquatic foods to environmental change has been vastly understudied, with the US and major producers in Asia most at risk.

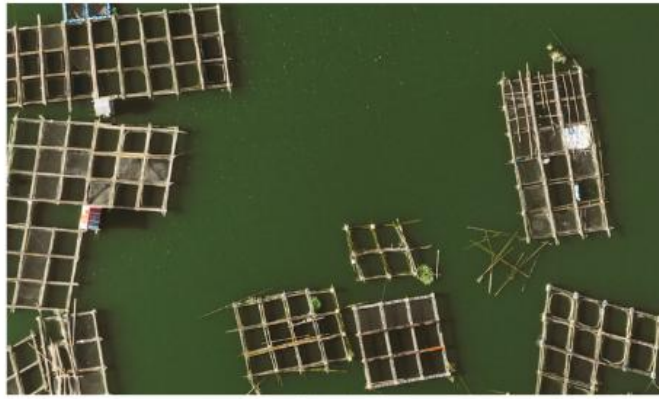


Image credit: Jannus Jegorsegi, Unsplash

June 26, 2023, LONDON – Many of the world's largest aquatic food producers are highly vulnerable to human-induced environmental change, with some of the highest-risk countries in Asia, Latin America, and Africa demonstrating the lowest capacity for adaptation, a landmark study has shown.

The study shows that more than 90% of global "blue" food production, in both capture fisheries and aquaculture, faces substantial risks from environmental change, with several leading countries in Asia and the United States set to face the greatest threats to production.

The authors behind the new paper produced the first-ever global analysis of environmental stressors impacting the production quantity and safety of blue foods around the world, ranking countries according to their exposure from key stressors for the first time. A total of 17 stressors were surveyed, including harmful algal blooms, sea level rise, changing temperatures, pesticide exposure, and more.

nature sustainability

Article

https://doi.org/10.1038/s41893-023-01156-y

Vulnerability of blue foods to human-induced environmental change

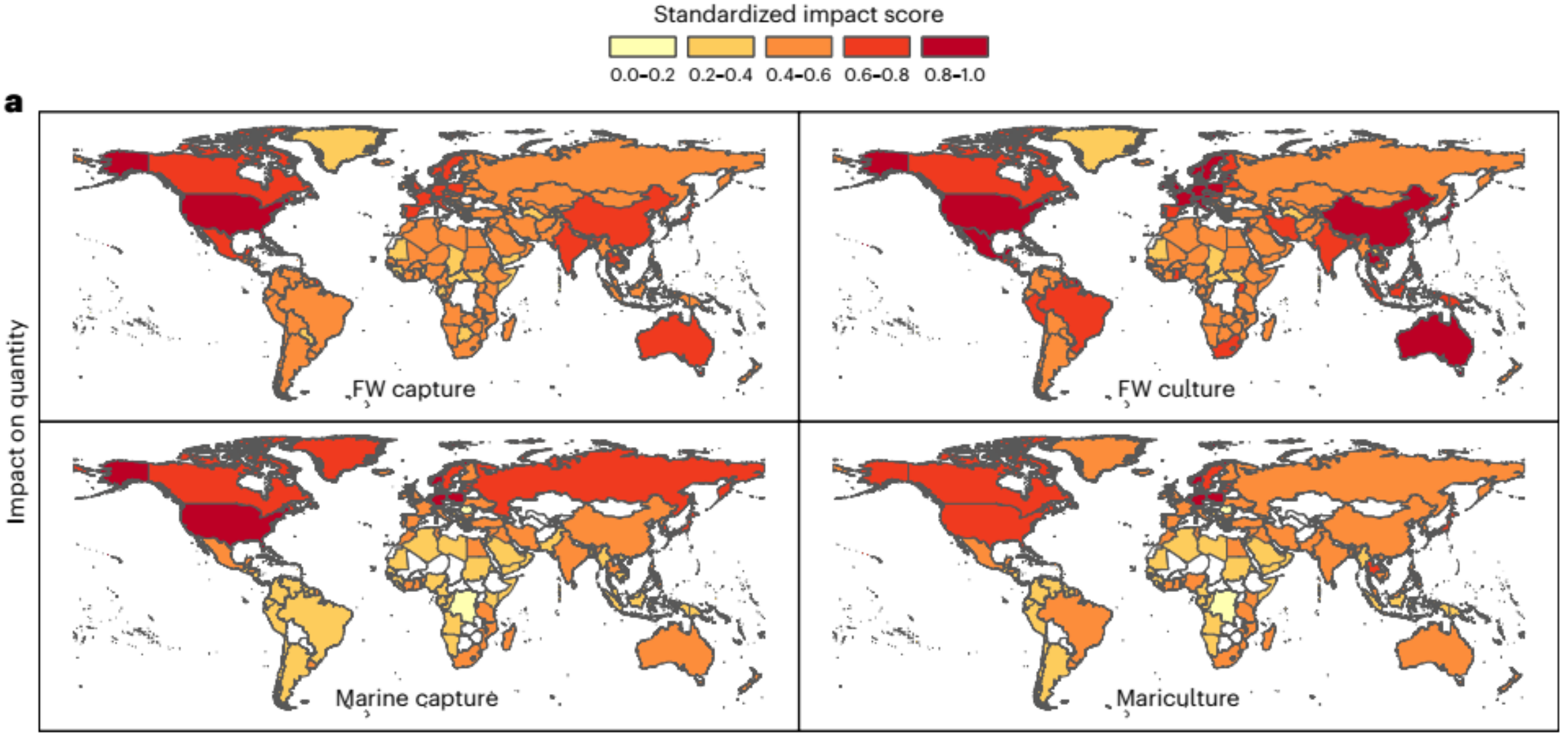
Received: 25 January 2022

Accepted: 24 May 2023

Published online: 26 June 2023

Check for updates

Ling Cao[1,17] ✉, Benjamin S. Halpern[2,3,17], Max Troell[4,5,17], Rebecca Short[4,17], Cong Zeng[6,17], Ziyu Jiang[6,17], Yue Liu[6,17], Chengxuan Zou[6], Chunyu Liu[6], Shurong Liu[6], Xiangwei Liu[6], William W. L. Cheung[7], Richard S. Cottrell[8], Fabrice DeClerck[4,9], Stefan Gelcich[10], Jessica A. Gephart[11], Dakoury Godo-Solo[11], Jessie Ihilani Kaull[12], Fiorenza Micheli[13], Rosamond L. Naylor[14], Hanna J. Payne[15], Elizabeth R. Selig[15], U. Rashid Sumaila[16] & Michelle Tigchelaar[15]



- Globaalsete kliimamuutuste mõju produktiivsusele

Mis me veel saame teha: toiduraiskamise vähendamine

5 facts about food waste and hunger

The shocking cost of poor storage in the farms of developing countries — and careless shopping in rich ones

25 June 2024, World Food Programme



Here are some basic facts (source: **UNEP Food Waste Index Report 2024)**:

1. **One-fifth of food** produced for human consumption is lost or wasted globally. This amounts to **one billion meals a day.**

2. The total cost of food loss and waste for the global economy is estimated at roughly **US$1 trillion**.

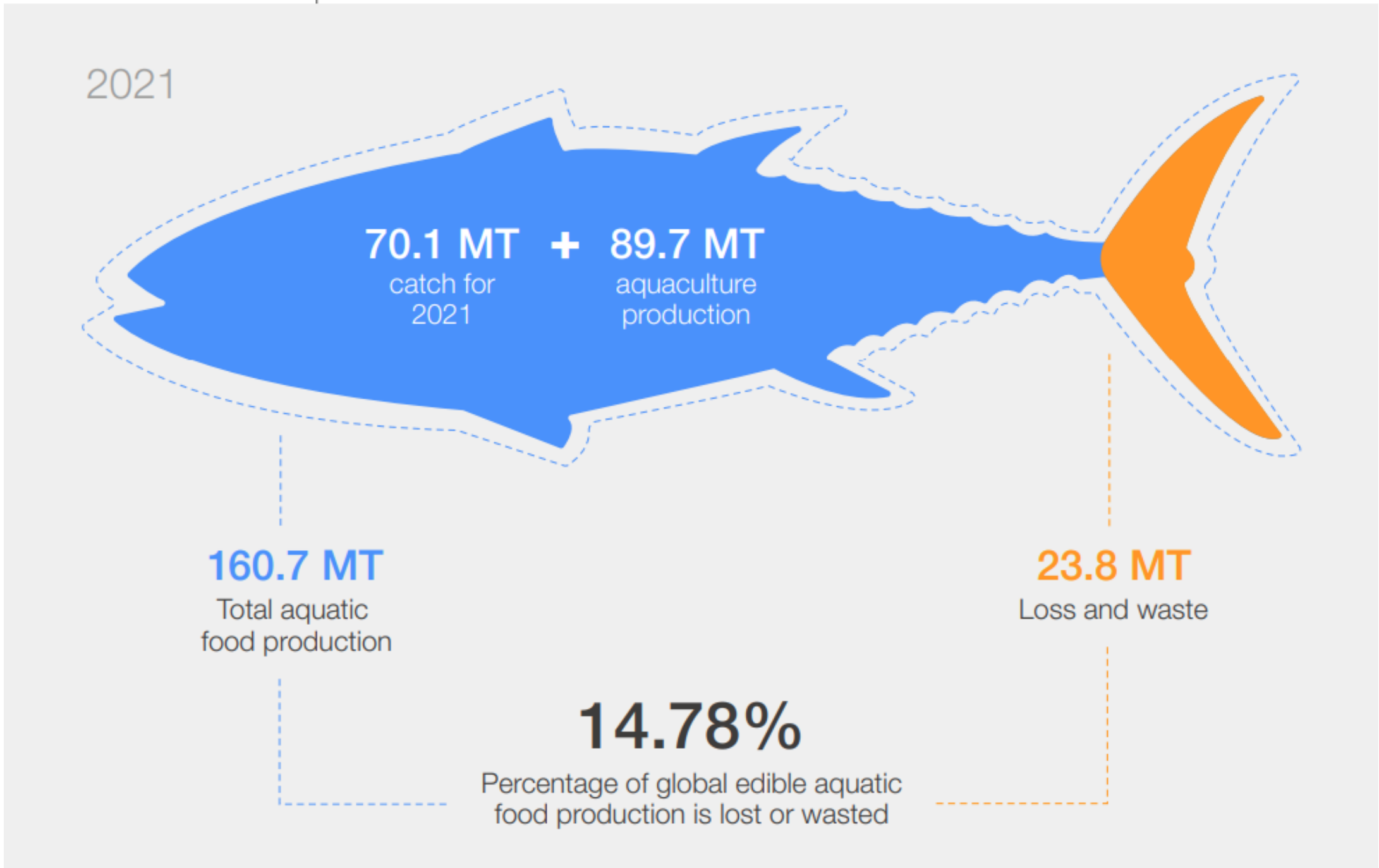
3. Food loss and waste generates **up to 10 per cent of global greenhouse gas emissions** – almost five times the total emissions compared to the aviation sector.

4. **Sixty percent** of food waste happens **at household level**.

5. Food waste is **higher in hotter countrie**s, both at the household level and in the post-harvest phase, with high temperatures affecting storage, processing and transportation of food.

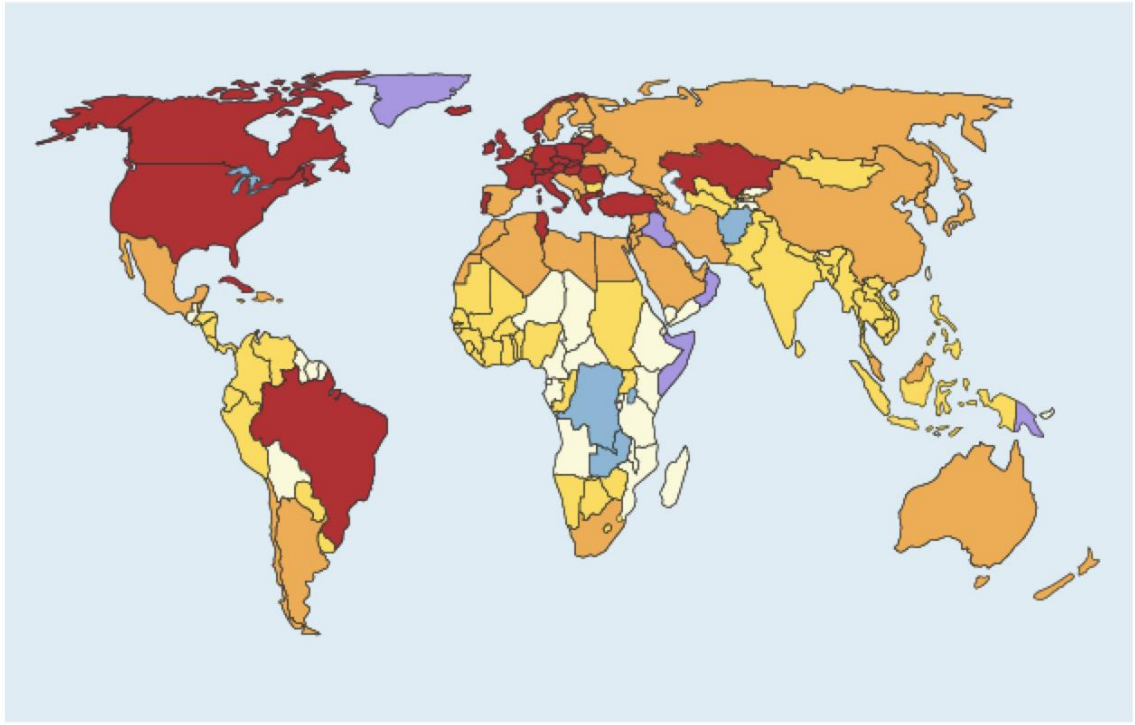
Cutting global food waste in half by 2030 is one of the UN's top priorities. In fact, it's one of the organization's 17 **Sustainable Development Goals**.

FIGURE 5 | **Percentage of global edible aquatic foods production that is lost or wasted**



Mida me veel saame teha: ületarbimise vähendamine

Global calorie consumption

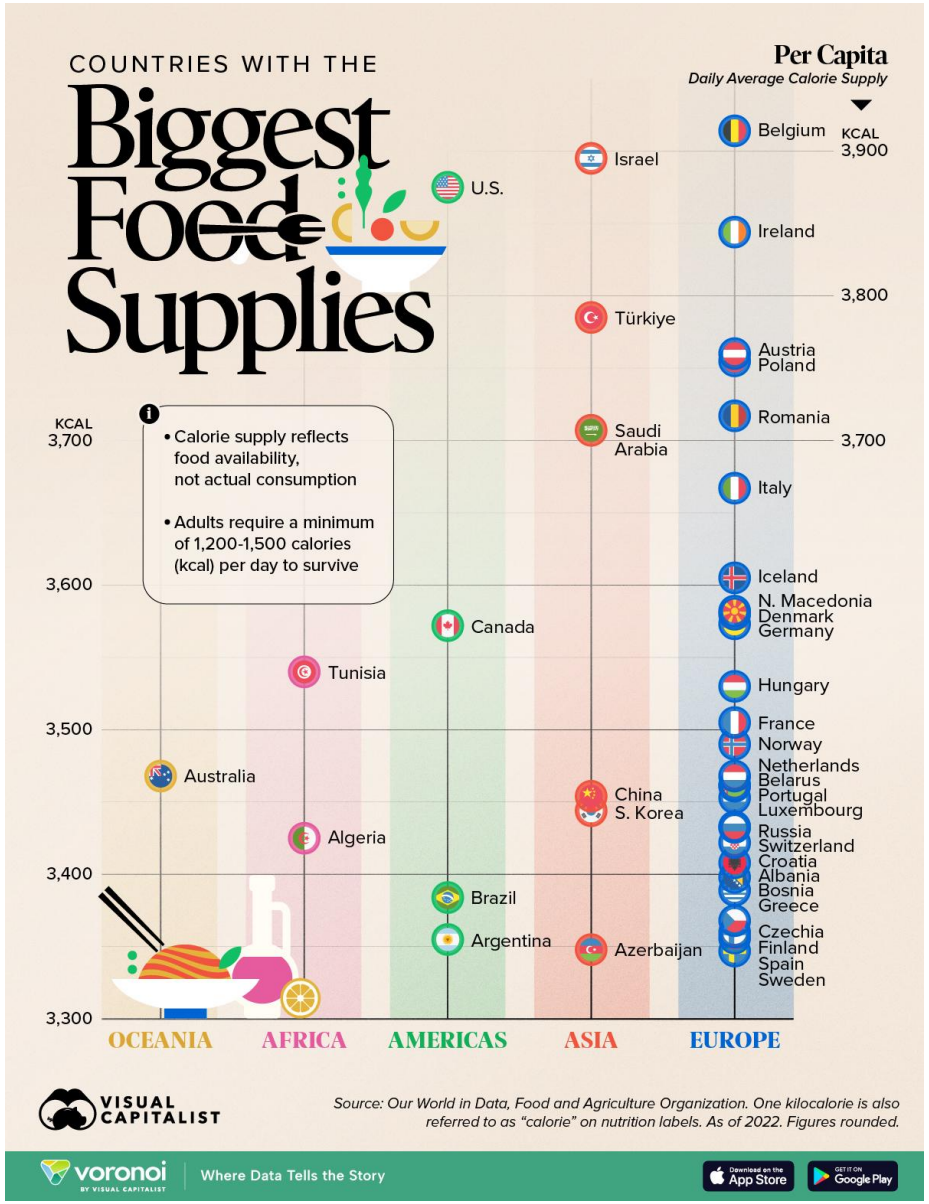


GCSE Cambridge OCR

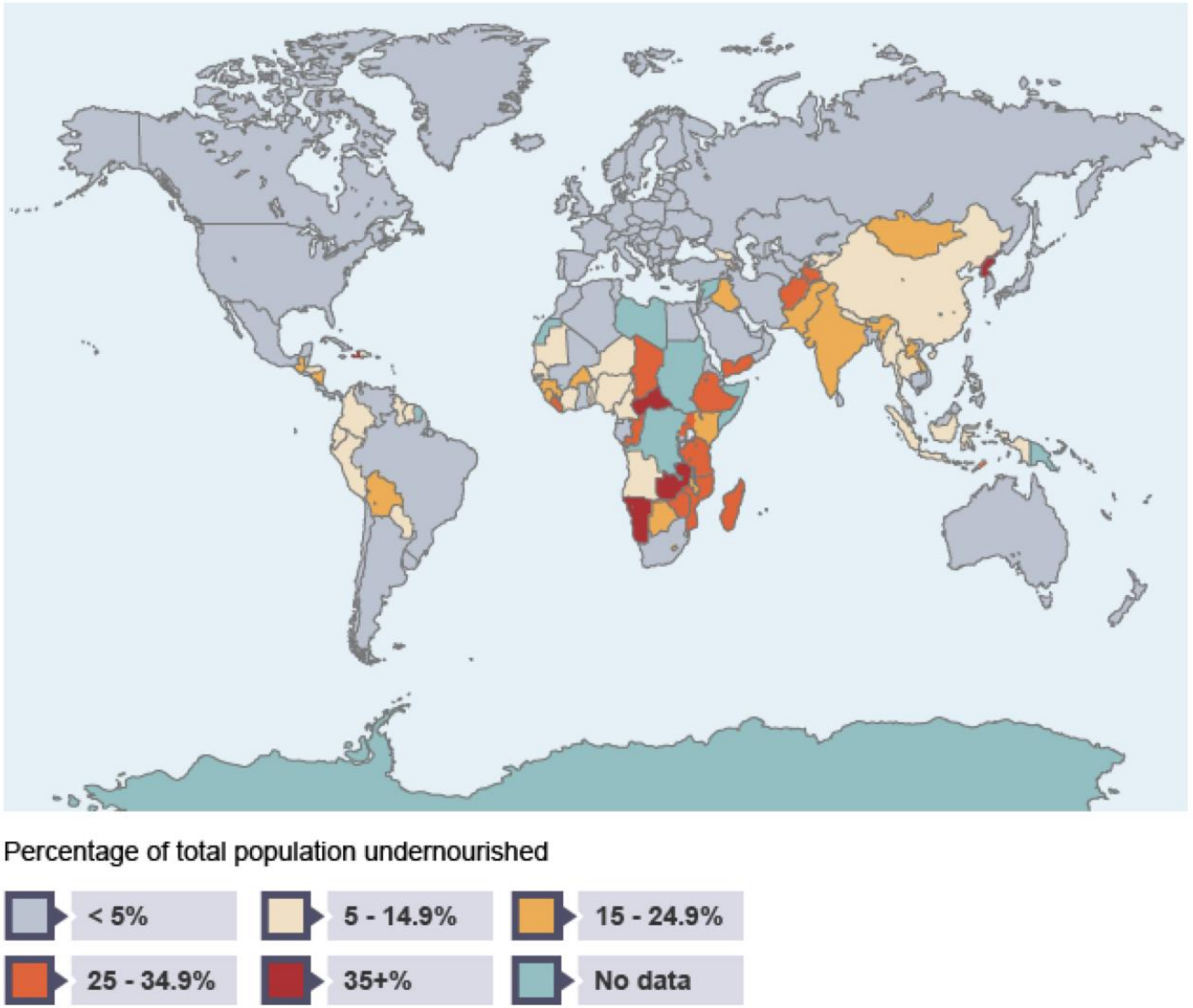
Food security - a global concern - Cambridge OCR

Global patterns of food consumption

Global food supply and consumption are unequal. There is a need to produce more food and there are several strategies that can be put in place to achieve this. Food security is a global concern.



The Global Hunger Index is used to target food security needs.



Teaduse tippkeskus AgroCropFutute

Taimekasvatus ja taimebioloogia
(Prof. Ülo Niinemets)

Eesti Maaülikool
Estonian University of Life Sciences





Põllumajanduskoosluste aineringed (Prof. Ülo Mander)

TARTU ÜLIKOOL

Taim-muld vastasmõjud
(Prof. Marina Semtchenko)

TARTU ÜLIKOOL





Mikroobide liigirikkus ja agroökoloogia
(Prof. Leho Tedersoo)

TARTU ÜLIKOOL

Taim-mikroob interaktsioonid
(Prof. Mari Moora

TARTU ÜLIKOOL



Põllukultuurid ja nende aretus (Dr. Ilmar Tamm)

METK Maaelu Teadmuskeskus



Põllumajanduskoosluste teenused (Prof. Meelis Pärtel)

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Taim-muld liigirikkus ja AI lahendused (Prof. Urmas Kõljalg)

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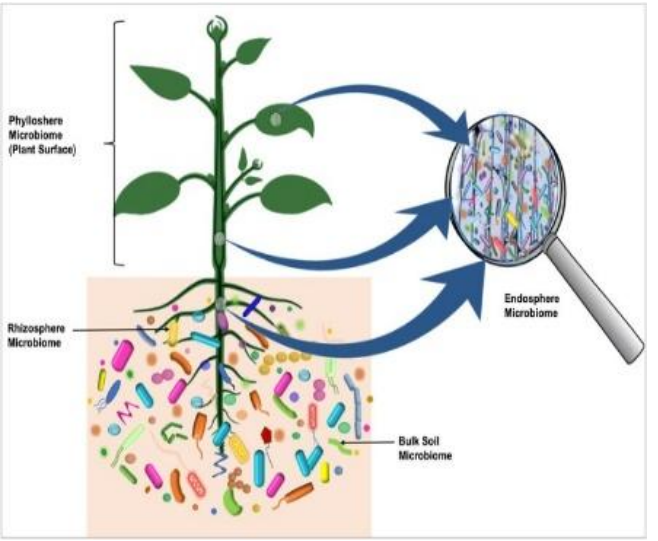
2016-2026 indikaatorid

- **10 1% tsiteeritavusega teadlast (20% Eesti top 1% teadlastest)**
- **5 ERC granti**
- **20 artiklit ajakirjades Nature and Science**
- 890 kõrgetasemelist publikatsiooni
- 200 populaarteaduslikku artiklit
- 250 meedia esinemist (TV, raadio)
- enam kui 150000 tsiteeringut
- 70 kaitstud doktoritööd

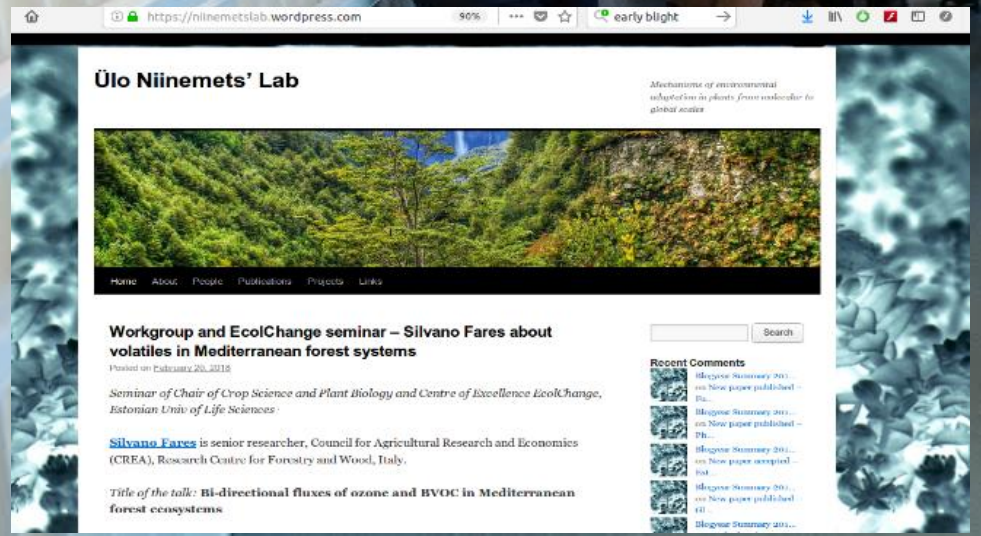
Tippkeskuse AgroCropFuture raames loodav intellektuaalne omand

1) vähemalt 300 taimekasvu parandava bakteritüve molekulaarne ja 20-ne tüve funktsionaalne kirjeldamine
2) vähemalt 200 taimekasvu parandava seenetüve molekulaarne ja 20-ne tüve funktsionaalne kirjeldamine
3) kaks bioväetist
4) Eesti tüüpilistele stressikombinatsioonidele kohanenud 10 uut põllukultuuri sorti (neist viis teraviljasorti)
5) Eestile kohandatud juhised 10 uue kultuuri kasvatamiseks
6) juhised vähemalt 10-ne põllukultuuri ökosüsteemiteenuste maksimiseerimiseks (mulla C talletamine, mullaviljakus ja liigirikkus)





K.M.G. Dastogeera, F.H. Tumpaa, A. Sultanaa, A. Aktera A. Chakraborty, doi:10.1016/j.cpb.2020.100161,



niinemetslab.wordpress.com