FACCE SURPLUS
SUSTAINABLE AND RESILIENT AGRICULTURE FOR FOOD AND NON-FOOD SYSTEMS

Intensify production, transform biomass to energy and novel goods and protect soils in Europe

INTENSE Newsletter #4

(May 2017)

INTENSE

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Foreword

Welcome to the fourth newsletter of the EU INTENSE project. This newsletter series provides you with updated information on our project progress, achievements and important forthcoming activities related to the reconversion of poor, degraded, abandoned and polluted sites including grassland, set aside land, brownfields, and otherwise marginal lands into sustainable agricultural production across Europe. The improvement of soil status refers to improved water holding capacity, improved microbial diversity and functionality, improved nutrient status, and resilience against pollutants. This encompass innovative systems-based tools for the development and implementation of integrated food and non-food production serving for intensified land management of these land areas. INTENSE sites are located throughout Europe from Spain in the south to Norway in the north, and cover a climatic gradient from cold/wet to warm/dry sites, and a soil quality regime from poor/rich in nutrients and organic matter as well as low/high in pollutants.

INTENSE ("Intensify production, transform biomass to energy and novel goods and protect soils in Europe") is a 36-month project (started on April 1, 2016; end in March 2019) funded by the ERA-NET JPI FACCE SURPLUS 2015 (Research Council of Norway, ANR-15-SUSF-0007-06). The main goals are to:

1. Determine and harmonize methodologies for identification and recuperation of degraded soils of specific degradation status,

2. Develop, and optimize novel cropping systems, using precision agriculture and modeling tools, which are capable of i) increasing productivity, ii) increasing soil life and functionality, and iii) making use of specific amendments, to suppress pathogens and fertilize soils.

3. Develop and implement suitable production systems applicable for land amelioration in complex degradation situations and finally

4. Develop and implement sustainable and financially attractive production alternatives for production on recovered farmland.

This 4th newsletter includes a brief report of the third meeting in Madrid and Buendia (Spain, April 3 – 5th 2017) and information on progress for each work-packages and experiments. More details can be found on our website http://www.nibio.no/en/prosjekter/intense which offers in-depth information about project results, publications related to the project, as well as INTENSE partners.

Enjoy reading,

Dr Arne Saebo (project coordinator), Dr Michel Mench, Dr Wieslaw Szulc

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INTENSE Meeting in Madrid (CIEMAT) and Buendia, Spain (April 2017).

■ After the kick-off meeting in Munich, Germany (April 27-28th, 2016), the WP1 meeting in Warsaw, Poland (June 14th 2016), INTENSE partners attended the 2nd INTENSE meeting organized by the CIEMAT partner (Dr R. Millán, Schmid et al), in Madrid (CIEMAT research Center, fig. 1, http://www.ciemat.es/portal.do) and Buendia (field trials, fig.2), April 3 – 5th 2017 (Fig. 1). They were welcomed by the Research Unit working on the soil conservation and remediation. (http://www.ciemat.es/cargarSubLineaInvestigacion.do?identificador=34&idArea=7&idLinea=22; http://www.ciemat.es/cargarGrupoInvestigacion.do?identificador=16&idArea=7&idLinea=22&idSublinea=34)

■ Attendees were: Dr. Arne Sæbø, Dr. Tomas Persson (Norwegian Institute of Bioeconomy Research); Prof. Peter Schröder (Helmholtz Zentrum München, Germany); Prof. Wiesław Szulc, Dr. Beata Rutkowska (Warsaw University of Life Sciences, Poland); Dr. Nele Witters (Hasselt University, Belgium); Prof. Elena Maestri, Dr. Roberto Reggiani, Dr. José Antonio López Gonzalez (University of Parma, Italy), Dr. Michel Mench, Dr. Nadege Oustriere, Ms Marie Dellise (INRA, University of Bordeaux, France); Mr. Christoph Poschenrieder (Martelhof am Tegernsee, Germany), Dr. Rocio Millán, Dr. Thomas Schmid, Dr. Maria José Sierra, Mr. Javier Rodríguez, and Mr. Carlos Menarguez (CIEMAT, Spain) (Fig.1 & 2).




Fig. 1. Visit of the CIEMAT Research Center in Madrid by the INTENSE partners (Laboratory for Soil preparation and analysis, fermenters for assessing anaerobic digestion of organic matters, greenhouse and lysimeter facility, etc.) © Michel Mench

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The agenda was dedicated to progress in WP milestones and deliverables of the project, including selection of plant species, soil amendments, tools for precise farming, sampling methods, valuation of ecosystem services, modelling of plant growth, etc., and preparation of forthcoming events.

Fig. 2. Visit of the INTENSE field trial established by the CIEMAT partner in Buendia, Spain, for assessing organic amendments in a degraded, dry soil. © Wieslaw Szulc

The CIEMAT partner: the Soil Conservation and Recuperation Research Unit

■ CIEMAT is a public research body assigned to the Ministry of Economy and Competitiveness, focusing on energy and environment and the technologies related to them. It has offices in several different regions of Spain, and its activity is structured around projects, which form a bridge between R&D&I and social interest goals. It collaborates with other R&D&I institutions, universities and business in the sector to transfer the knowledge and technology generated and supporting and encouraging innovation and changing the economic model. CIEMAT R&D&I activity is framed in national and international settings, and is complemented by activities such as education, technology transfer, rendering technical services, advising to the administrations and representation of Spain in a diversity of forums. Its mission is to contribute to sustainable development of the country and to the quality of life of its citizens through the generation and application of scientific and technological knowledge. Its team of around 1,300 people is technologically and geographically diversified.

■ The interdisciplinary research group of the Soil Conservation and Recuperation Research Unit, led by Dr. R. Millán, has three main areas of research: 1) Investigate the parameters and processes involved in the degradation and pollution of soil environment, as well as the appropriate technologies and activities for its remediation. 2) Agricultural studies as biofortification of crops, safe agronomical land uses in abandoned mine/industrial areas, sustainable agricultural systems, treatment of organic waste from farms or agricultural areas. 3) Study and assess both biodegradable waste treatment processes in order to optimize the ones that are being employed, and the use of by-products obtained from those processes (i.e. biogas, organic amendments). The group participates in various R&D projects evaluating and recuperating contaminated areas, performing the environmental restoration of degraded areas and participating in the conservation of protected ecosystems with a high ecological value. Studies are carried out at increasing work levels from laboratory and green house experiments to field work.

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INTENSE project: flows of data, methods, and procedures through 5 workpackages

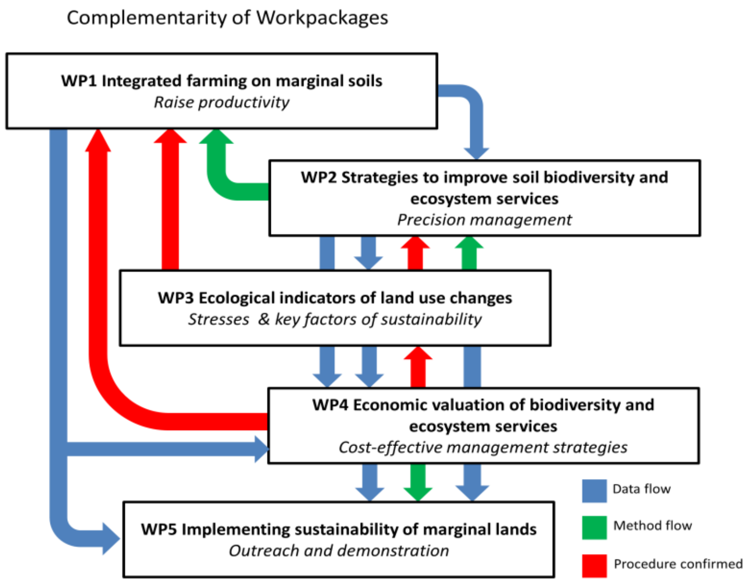

Fig. 3. Complementarity of workpackages in the INTENSE project

■ INTENSE consists of 5 operational WPs, i.e. WP 1 to 5, each based on a specific field study (fig. 3). It focuses on generating knowledge on the biology and ecology of selected abandoned or marginal sites, for developing both efficient and innovative preventive strategies and solutions to improve soils and enhance productivity, and, in particular, tools for site management and organic production. WP5 is performing training and outreach activities, and establishing contacts to stakeholders and advisors.

■ These 5 WPs are strongly interlinked so that reciprocal feedback, especially from field trials, is influencing and optimizing the work at each stage.

Degraded and contaminated land © Peter Schroeder

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Integrated farming on marginal soils to raise productivity (WP1)

Aims: *Typical problems of agriculturally intensive used areas and generally of other soils impacted by anthropogenic activities (e.g. soils contaminated by either local or diffuse contamination sources) are: erosion, soil compaction, contamination of soil & groundwater, impoverishment of flora and fauna, marginal lands set aside without concept, only few hedges and fallow stripes, decoupling of energy and matter fluxes, and decreasing quality of life.*

The purpose is to include marginal land for food and energy crops which have the following characteristics: (1) dry (low water-holding capacity) - agricultural; (2) low organic matter content - agricultural; (3) contaminated - former industrial and agricultural. Due to such characteristics, these lands are left aside or at suboptimal production. Researches focuses on (1) improving soil characteristics, and (2) the use of agricultural residues for producing soil amendments and amelioration of soil properties. An increase in soil organic matter should improve soil reaction, microbial activity and water-holding capacity.

■ A site network

A site network was created to support pot experiments and field trials for assessing various organic amendments (e.g. biochars, composts, manures, byproducts from biogas production, and organic granulated fertilizers) (fig. 4). The INTENSE network of field trials is covering various soil and climatic conditions, notably accounting for climate change, across Europe as well as various strategies regarding marginal soils, crops for the Bioeconomy, brownfields, set-aside and agricultural soils. Initial status and changes in soil properties are monitored along the project.

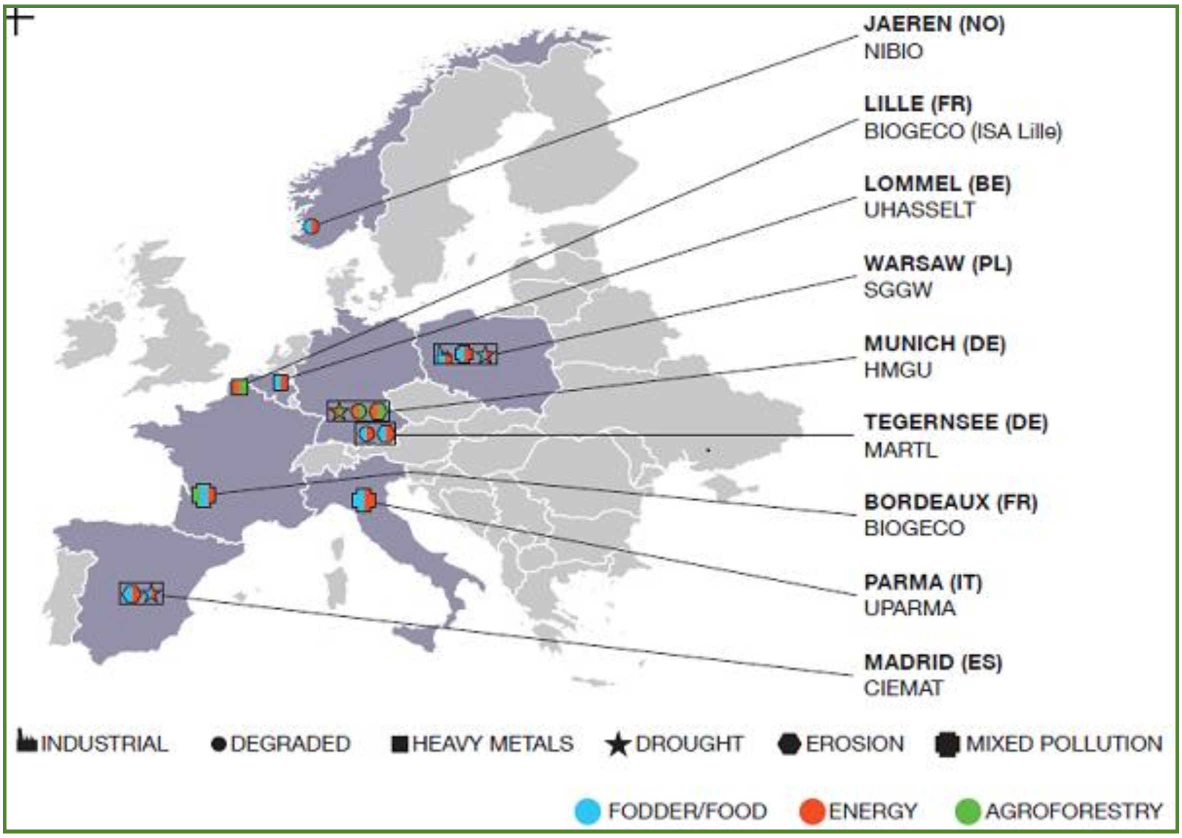

Fig. 4. Network of sites managed in the INTENSE project

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■ Production of fertilizing organic substances

The production of fertilizing organic substances involves the use of agricultural residues and rest products from energy crops and other agricultural organic waste substances produced in large quantities, e.g. spent mushroom substrate, pig and chicken manures, and digestate from biogas plants (Fig. 5 & 6). These substances are composted and/or granulated. The core properties of the organic fertilizers produced are assessed, and the optimum application rates of fertilizers to field experiments are determined, notably based on potential supply of mineral nitrogen.

Fig. 5. Production of (a) compost pellets by the SGGW partner © Wieslaw Szulc

Fig. 6. Production of anaerobic-digested pig manure by the NIBIO partner. © Tomas Persson

■ Soil sampling strategy and procedure

A soil sampling strategy and procedure was delivered, under the coordination of CIEMAT and SGGW partners regarding two aspects:

1 Characterization (based on Schoeneberger et al., 2012) and sampling of soil profiles according to the diagnostic horizons for selected clusters of each site. Site clusters are defined for risk assessment / soil quality / fertility and further design, select and assess phytomanagement options and optimizing practices.

2 Collection of soil samples from topsoil and in some cases from the subsoil, according to the Greenland and ISO procedures for initial risk assessment in untreated soils (according to information on spatial variation and zoning), uncontaminated soils (similar soil type, if available in the surrounding

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of each site) and phytomanaged soils (initial status for on-going field plots). Special attention is focused on soil sampling for microbial diversity. Sample management is summarized for the following determinations: Chemical and physical parameters, bulk density, CLPP, FDA, Next-generation sequencing (NGS) for microbial activity and diversity (DNA, RNA), microbial biomass and respiration, soil enzyme activities, soil quality via microfauna/microflora indicators, soil DNA analysis, and effects on water cycle: soil structure formation, water retention and filtration capacity

Contact: thomas.schmid@ciemat.es

■ Plant testing in outdoor/indoor pot experiments

Outdoor and indoor pot experiments are carried out by CIEMAT and SGGW for assessing various strategies based the incorporation of organic matters. For example, organic amendments (i.e. poultry manure, sewage sludge, composts, compost pellets, spent mushroom substrate) were evaluated in a degraded soil with low soil C and water holding capacity (Miedniewice, PL): as compared to unamended soil, all organic amendments improved the shoot biomass of maize; compost 1 incorporated in the topsoil led to a higher shoot maize production per plot than the granulated compost (pellet 1) (Fig. 7 & 8).

Fig. 7. Outdoor pot experiments carried out by the SGGW partner © Wieslaw Szulc

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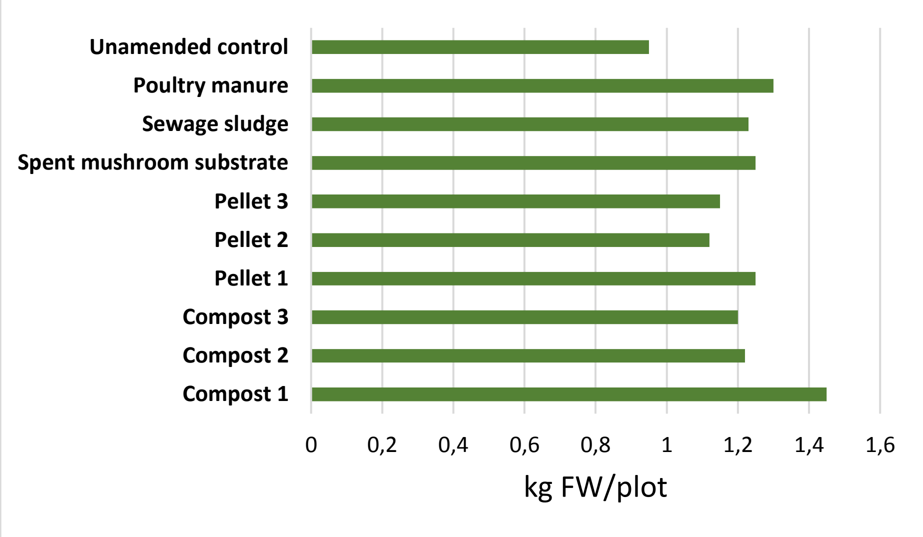

Fig. 8. Production of shoot biomass for maize in unamended and amended soils, with various organic amendments (SGGW, Miedniewice soil, PL) © Wieslaw Szulc

The CIEMAT partner is carrying out a pot experiment with barley to assess various addition rates of biochar (0.25 up to 5% soil w/w) and compost pellets in combination with typical mineral fertilizers according to the needs of studied soil.

■ Field trials for assessing organic amendments and raising crop production

Several agricultural and former industrial sites with-soils contaminated by either local or diffuse anthropogenic sources are phytomanaged by growing energy and non-food crops (INRA, YNCREA, UPARMA, HMGU, and CIEMAT) intended for the production of biomass (e.g. willow, poplar, *Miscanthus*, *Arundo donax,* kenaf) and biogas (e.g. maize, sugar beet, rape, barley).

Additional outcomes are a procedure for soil sampling under the coordination of CIEMAT (Dr. T. Schmid) and scenarios for the valuation of ecosystem services (WP4, Dr N Witters)

The phytomanagement options assessed on degraded and contaminated soils included:

- Woody crops: poplar (*Populus nigra* L., *P. trichocarpa* x *deltoids* cv. Beaupré), willows (*Salix caprea* L and *Salix viminalis* L.) and false indigo bush (*Amorpha fruticosa* L.), *Pinus sylvestris* L.

- Perennial grassy crops: *Agrostis capillaris, A. delicatula, A. gigantea, Deschampsia caespitosa, Sporobolus indicus*, *Vulpia myuros, Phleum pratense, Festuca arundinacea*

- High yielding crops: sunflower, tobacco and oilseeds, barley, maize



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Sites	Soil stress	Remediation option	Phytomanagement in 2017
INRA, BIOGECO, FR	Cu, PAHs	Organic and mineral amendments, phytoextraction/rhizodegradation	Sunflower, tobacco, *Erucastrum incanum* (white clover as winter crop), broad bean
INRA, BIOGECO, FR	Cu, PAHs	Organic and mineral amendments, phytostabilisation/ rhizodegradation	*Miscanthus*, vetiver, poplar, willows, false indigo, barley, Timothy grass (*Phleum pratense*)
INRA Parc aux angéliques, FR	Metal(loid)s, PAHs	Organic amendments, phytostabilisation/ rhizodegradation	Alfalfa, poplar, grassy crops
MetalEurop, YNCREA, FR	Cd, Pb, Zn, other metal(loid)s	Organic and mineral amendments, phytostabilisation	Energy crops: Miscanthus, kenaf
Roggenstein, Technical University of Munich, DE			Energy crops
Martl-Hof, DE	Low fertility	Organic fertilizer: pig and sheep manure	Broad bean (*Vicia faba*) as intercrop, maize fodder beet, barley Miscanthus
SGGW Skierniewice, PL	Low soil C Low soil WHC	Organic amendments ± irrigation	Maize (2016), Timothy grass, Tall fescue
SGGW Miedniewice, PL	Low soil C Low soil WHC	Organic amendments ± irrigation	Maize
NIBIO, Særheim, NO	Low soil C Low soil WHC	Dry fraction from biogas-digested cattle manure, cattle manure dry fraction (not gasified), Biochar+ ± mineral fertilizer	Timothy grass (*P. pratense*), Tall fescue (*Festuca arundinacea)*
UParma			Maize

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□ Enhancing productivity on dry land and poor soils with low humus content by increasing the organic matter content (UPARMA, SGGW, CIEMAT, NIBIO)

■ New field trials established for assessing the organic amendments produced by the INTENSE partners: In coordination with stakeholders, CIEMAT was establishing 2 field trials at Casasana and Buendia, Spain, on alkaline soils with low organic matter content. Influence of organic amendments (i.e. compost, compost pellets, and biochar) is assessed and compared to mineral fertilization in relation to soil properties and the growth and yield of crops. Barley and sunflower are cultivated. The growth and development stages of plants are recorded. Soil and plant samples are collected at harvest time. Amelioration of soil erosion, water supply, and crop yield is expected.

(a)  (b) 

Field trials established in Spain by the CIEMAT partner on degraded soils with low soil C: field plots at (a) Casasana and (b) Buendia

(a)  (b) 

(c) 

Fig. 9. Germination and development of barley: Casasana field trial, (a) mineral fertilization and (b) biochar-amended soil; (c) Buendia field trial, soil amended by compost pellets © Mench

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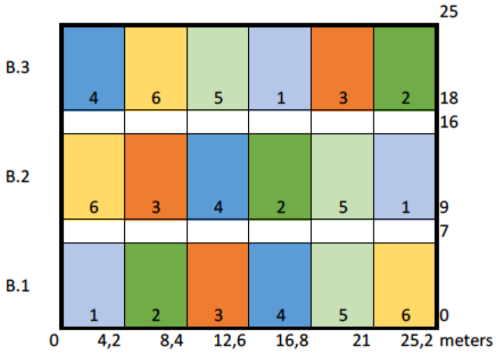
■ **Field trial established by UPARMA for assessing organic amendments vs. mineral fertilization**: UPARMA was establishing one field trial, Parma, Italy. Influence of organic amendments (i.e. compost, manure, and biochar), alone and in combination, is assessed and compared to nitrogen fertilization in relation to soil properties and the growth and yield of crops. Maize is cultivated in 2017. The density, growth, health and development stages of plants are monitored. At harvest time, maturation and harvest dates, yield, humidity of grain, SPAD in leaves, plant height, 1000 seed weight, grain specific weight (kg/ha), vigor, and biomass will be determined. Soil samples are collected at harvest time. Amelioration of soil erosion, water supply, and crop yield is expected.



Treatments
1 Nitrogen fertilisation + biochar
2 Manure + biochar
3 Conpost + biochar
4 Nitrogen fertilisation
5 Manure
6 Compost

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► **Field trial established by Martlhof for increasing performance, sustainability and resilience of crop production**: Martlhof and HZM partner are carrying out one field trial, Gmund, Germany. In 2017 the influence of the various amendments (compost, compost pellets, and biochar) and crops (grassland, fodder beet, maize, and barley) on microbial diversity is assessed in relation to soil properties and the growth and yield of crops. The density, growth, health and development stages of plants are monitored. Amelioration of soil physico-chemical and biological properties, water supply, and crop yield is expected (see also Intense news monthly n°3).

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□ Increasing productivity of contaminated soils using organic amendments

■ Phytomanagement and soil remediation at a former wood preservation site; a new field trial established by INRA BIOGECO for assessing the organic amendments produced by the INTENSE partners: The former industrial site (wood preservation, 6 ha) is characterized by a coarse sandy Fluviosol, with a Cu-contaminated topsoil (620-1130 mg Cu/kg soil DW at this sub-site; Bes et al 2010). Prior to the experiment, the soil had patchy vegetation, with many bare areas. The main colonizing plant species were *Poa annua* L., *Portulaca oleracea* L., *Agrostis capillaris* L., *Rumex acetosella* L., *Senecio inaequidens* D.C., and seedlings of *Populus nigr*a L. and *Salix caprea* L.. Topsoil was loosened and organic amendments (i.e. compost, compost pellets, greenwaste compost, dry fraction from biogas-digested pig manure, and pig manure dry fraction (not gasified)) were incorporated into the topsoil in March 2017 at 2 addition rates (2.3 and 5% soil w/w), in order to sorb Cu and decrease its labile pool in the soil (Fig. 10). In early April, barley and Timothy grass were sowed in the plots. Germination and thereafter plant growth and phenological stages are recorded (Fig. 11). Preliminary results indicated beneficial effects of pig manure, compost and pellets (Fig.12).
Contact: Dr Michel Mench, michel.mench@inra.fr

BES et al 2010 Spatial variation of plant communities and shoot Cu concentrations of plant species at a timber treatment site. Plant Soil 330, 267-280. doi: 10.1007/s11104-009-0198-4

Fig. 10 (a) Initial degraded soil at the Biogeco site, (b) plot preparation, (c) application of organic amendments, and (d) pellets of compost produced by the SGGW partner (Spring 2017). ©Mench

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(a)

(b)

Fig 11. (a) overview of tested organic amendment before incorporation in the topsoil and (b) barley development in Spring 2017 © Mench

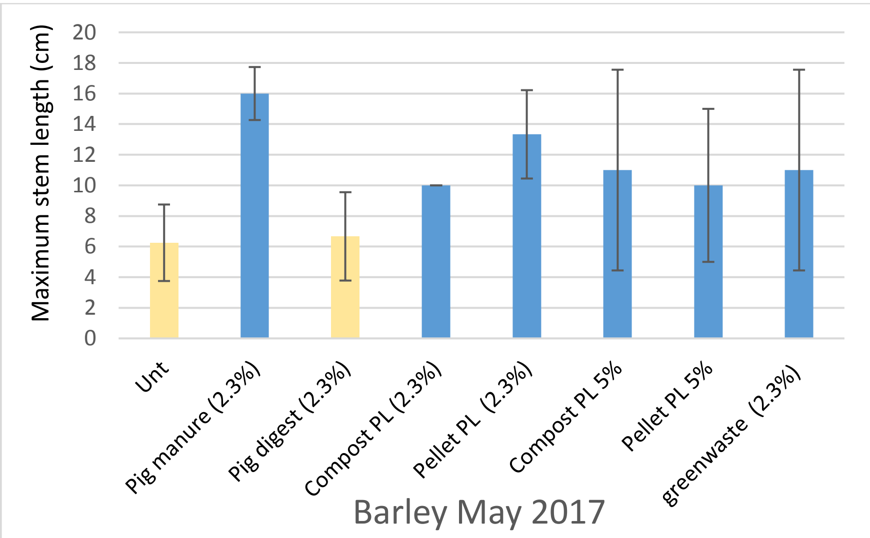

Fig. 12 Maximum stem height of barley at Month 1, Biogeco site

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■ **Phytomanagement and soil remediation at a former wood preservation site; long-term assessment of soil amendments and woody crops**: The P7 sub-site of this wood preservation site is characterized by a Cu/PAH contaminated topsoil (329-799 mg Cu/kg soil DW). Prior to the experiment, the soil had patchy vegetation, with many bare areas. Main colonizing plant species were *Agrostis capillaris* L. and *Rumex acetosella* L.. Topsoil was loosened and the trial consists in 4 soil treatments (in 2007), i.e. untreated (Unt), compost (OM), compost and dolomitic limestone (OMDL) and dolomitic limestone (DL). A mixed stand was established with mycorrhizal trees (*P. trichocarpa x deltoids* with *Hebeloma crustiliforme, Pinus sylvestris* associated with *Suillus luteus* and *Lactarius sanguineus*) and grasses (*Agrostis capillaris*, *A. gigantea*, *Dactylis glomerata*, and *Festuca pratensis*) in order to phytostabilise Cu and rhizodegradate PAHs. In March 2017 (Year 10), maximum stem height and trunk diameter were determined. Initial differences between the soil treatments faded as the root system developed now in the less contaminated sub-soil. Analysis of soil samples is in progress.

Contact: Dr Michel Mench, michel.mench@inra.fr

MENCH M, BES C 2009 Assessment of the ecotoxicity of topsoils from a wood treatment site. Pedosphere 19, 143-155. BES et al 2010 Spatial variation of plant communities and shoot Cu concentrations of plant species at a timber treatment site. Plant Soil 330, 267-280. doi: 10.1007/s11104-009-0198-4

(a) (b)

Fig. 13. Development of the tree mixed stand at the Biogeco P7 sub-site (a) 2008 and (b) 2017)

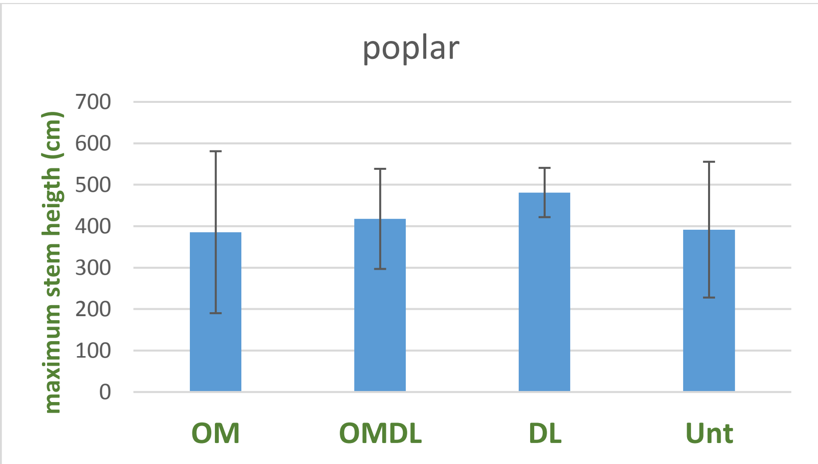

Fig. 14 Maximum stem height of poplars at the Biogeco P7 sub-site in year 9 (M Mench): Unt untreated, OMDL compost and dolomitic limestone, OM compost, and DL dolomitic limestone.

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Strategies to improve soil biodiversity and ecosystem services: precise management (WP2)

Aims: *This work relates critical factors like degradation, contamination and management intensity to changes in soil biodiversity and studies the impact of strategies designed in WP1 to improve system functionality by applying precision farming. It then links soil biodiversity to the delivery of selected ecosystem services: C sequestration, nutrient cycling and water retention. INTENSE is combining farming-by-soils tools as an integrated part into the final aim of producing biomass and byproducts on degraded soils in the most efficient way, aiming at a strategy to deliver different sources of biomass according to inter-and intra-seasonal variation in cropping conditions. This WP utilizes maps, tools and data already existing for the sites, and apply the most suitable management strategy; the approach will be harmonized, but tailored to the different situations. Taking advantage of data collected by other WPs, the WP is validating inputs, as well as providing output data to other WPs, notably WP3 and WP4. Essential requirements are strong cooperation with stakeholders and territorial institutions.*

UPARMA is currently collecting information on precision farming using a questionnaire and templates in the countries contributing to the project in order to construct a database, with the help of INTENSE partners and potential readers of this newsletter (feel free to contribute! See the following page).

UHA is working on protocols for microbial analysis. Simpler equipment and methods that can feasible also for small farms is a matter of debate. "Smart and soft" interpretation of the precision agriculture in our contexts are needed. The use of GPS, GIS, sensors, drones etc. are an important part of the tools we want to test and implement for a more Intense agriculture.

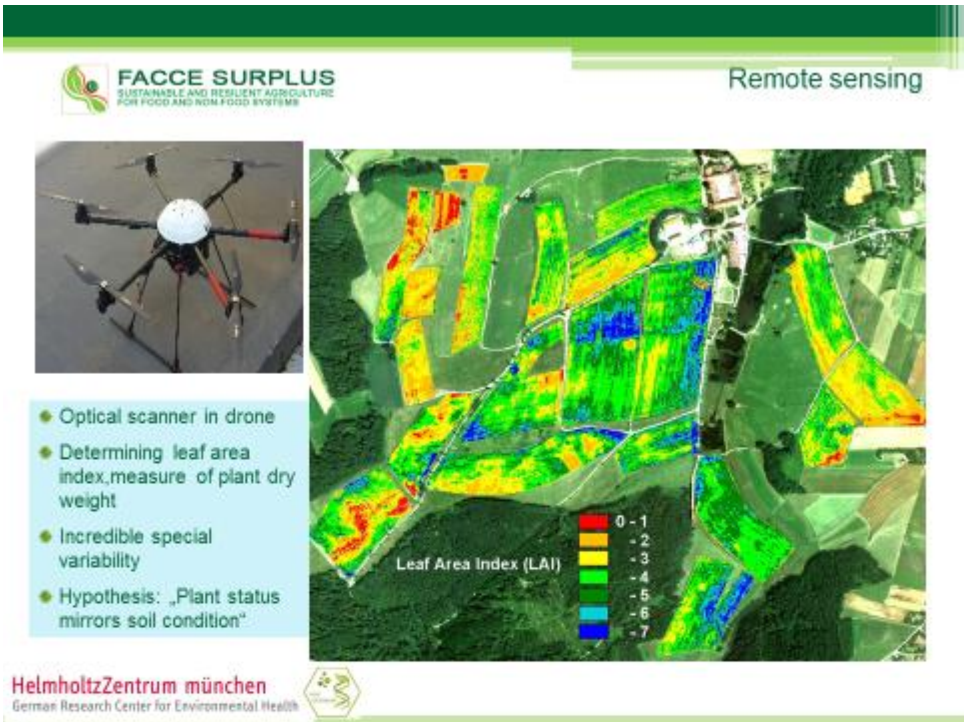

Fig. 15. Mapping of Leaf Area Index by optical scanner in drone. © Peter Schroeder

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Thanks in advances for your help: Feel free to contribute to the questionnaire and return your answer to elena.maestri@unipr.it

1. Please check if your "Ministry for Agriculture" has an official position on precision agriculture
a. Provide us with the address of the web site(s) of reference
b. Indicate if an English version exists
c. Provide any official document on precision agriculture, even if they are in your National language

2. As far as possible, try to recover some information about the status of precision agriculture in your own region (or in the area where the INTENSE activities are taking place): useful information (not exhaustive list) could concern:
a. Area affected by precision agriculture in general
b. Main fields of intervention: e.g. fertilisation, irrigation, mapping, livestock management, etc.
c. Main techniques or technologies applied: e.g. drones, tractors, etc.
d. Research initiatives involving farmers or experimental farms

3. List any stakeholder, company, farmer in your region and/or country who might possibly be involved in INTENSE activities: If available, provide name of company/Institution, name of contact person, email, website

4. Any other possible document or information you consider of interest

Ecological indicators of land use changes: stresses & key factors of sustainability (WP3)

Aims: *Environmental indicators provide information on pressures on the environmental conditions of the selected agroecosystems and societal responses as proxies for measuring conditions that are so complex that currently there are limited possibilities for direct measurement. This WP is collecting information about the status of the selected field sites, soil improvement, biomass production, and the impact that the measures exert on resilience and productivity in these ecosystems to stakeholders, the public and to policy makers. Information on soil fertility, soil life, plant performance and yield, as well as on stress factors and on product quality and the ecological sustainability of the measures taken in INTENSE are provided to the other WPs. This will help prioritizing regions and systems for the adaptations and mitigation strategies to be applied. Agrochemical use are minimized, and irrigation avoided as far as possible. Sectoral policies concerning e.g. land use, nature and biodiversity conservation, water and irrigation, greenhouse gas emissions and soil quality (e.g. soil carbon sequestration) will also benefit from this approach.*

Current ongoing tasks are: the monitoring of vegetation at sites of concern (based on Ellenberg procedure); harmonization of sampling and assays and determination of plant stress due to drought, metal(loid) excess or organic pollution in lead species during growth.

Economic valuation of biodiversity and ecosystem services: cost effective management (WP4)

Aims: *Farmers confronted with budget constraints are in need of supporting evidence of biodiversity benefits outweighing the opportunity costs incurred in order to strengthen the argument for biodiversity conservation at the farm level. WP4 contributes to this evidence in two ways: it aims (1) to reveal the economic value of soil biodiversity for agricultural production based on the functional role of microbial communities in delivering ecosystem services (determined in WP2), and (2) to perform a cost-effectiveness analysis of the management strategies accounting for the current shortcomings of the land (WP1) and impact on the delivery of ecosystem services (WP2), by assessing costs of these strategies and their benefits (e.g. increased biodiversity, ecosystem service delivery, etc.).*

Identification of data to describe ecosystem properties and evaluate ecosystem services, such as functional diversity, microbial diversity, soil quality, etc. is ongoing. A frame for collecting information is prepared by UHA (Dr. N. Witters et al), including climate conditions during the experiment, soil quality, biomass production, irrigation, herbicides/pesticides if they have been used. First data will come in autumn.

Partner	System in focus	Responsibility/Role	Specific contribution	Strategies developed
NIBIO Coordinator	Grassland pasture and bio-rest as fertilizer, northern climate	WP6. Management, nutrient cycling, grass yields, dissemination, crop model	Diversity, biomass, soil biology	Biomass, nutrient use from organic sources, climate adaptation
HMGU	Set aside land, Agroforestry, small plots	WP 3. Indicators, plant stress, maps, models (EXPERT-N, PLATHO)	Proteomics, N,P,C, yield model, water relations, indicators	Biomass, pellets, agroforest, precision farming
SGGW	Arable land, poor soils, set aside land	WP1. Agronomy, biofuels, energy budgets, GHG, teaching	Farming, yield . model, GHG emissions, nutrient availability,	Biomass, fibers, new varieties
UMR-BIOGECO	Brownfields, restoration sites, tailings	WP5. Industrial sites, pollutant uptake, phytoremediation	Soil restoration, organic pollutants, remediation	Biofuel, gentle remediation, mixed plantation
UHASSELT	Abandoned / arable land, plots	WP4. Heavy metals, socio-economy model	Models, Plant-microbe interaction, genomics	Agroforest, microbial inoculates
CIEMAT	Dryland, Innovative Greenhouses	Water reuse, biomass, socio-economy	Water use efficiency, soil biology, CO_2 cycling	Biomass, water reuse
MARTL	Small farm, erosion, pasture (SME)	Small scale productivity, dissemination, contact to local stakeholders	Marketable crops and fruits, biogas biomass, economy budgets	Biogas, alternative products, vegetables, alternative heating
UPAMA	Greenhouse, arable land, restoration sites	WP2. Heavy metal analysis, biofuel, biochar, teaching	Genomics, proteomics, life cycle analysis, fate of heavy metals	Biochar, LCA, ecotoxicology, teaching

Systems in focus and scenario/strategy developed within the framework of the INTENSE project

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Implementing sustainability of marginal lands: outreach and demonstration (WP5)

Aim: *the purpose is to deliver remediation methods and management strategies for a number of marginal land situations, including various limiting factors and pollution scenarios, and a climate gradient across Europe. Besides providing practical experience from and tailor made solutions for special problem sites, it is essential to deliver a toolbox with a hierarchical set of methods to stabilize soils, improve soil life, maximize productivity, at high level of C sequestration, water retention, and nutrient cycling. This WP is integrating data from WPs 1-4 during the whole project and implement their results into an integrated management setup that mirrors best practices on a higher level of abstraction. The plant-microorganism partnerships with best performance will be listed, as well as soil amendments proven to yield highest stability and beneficial effects on soil ecological functions, and biomass will be converted to the products yielding best revenues to the farmer. The process of integration will be accompanied by close stakeholder contact. ESR, ER and end-users are involved in this WP by contacts before and during implementation at sites, workshops and round-tables, and a summer school with practical implementation examples is in preparation.*

Based on field experiments, we are ranking the field trials in scenarios (targets to reach), list the available tools (conceptual models, option appraisal, remediation/improvement strategy, list of tools to take decision and parameters to measure and then collate all of these information in toolboxes.

■ Stakeholder's workshops

A series of workshops with stakeholders (from public administration and research institutes to private companies) in the field of soil restoration and phytomanagement is organized within the frame of INTENSE project in collaboration with other European and national projects.

1st-stakeholder workshop in Buendia, Spain, April 4th, 2017

The first stakeholder meeting was organized at the city hall of Buendia (April 4th, morning). Attendees were the local authorities, farmers and citizens, and the project partners. Dr. R. Millan was explaining the main goals of the project and the purposes of the field experiments. Participants were asking questions to the project partners. As one aim was to disseminate outcomes to stakeholders locally adapted plant species are used in the field trials.

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Fig. 16. 1st-stakeholder workshop at the city hall of Buendia, Spain.

Joint stakeholder workshop in Bordeaux, France – April 27th, 2017

The 2nd-edition (April 27th, 2017) was hosted by INRA (UMR BIOGECO) in Bordeaux, France. It was organized by the INTENSE project in collaboration with the EU PhytoSUDOE project and the Labex COTE of the University of Bordeaux.

Attendees of the skateholder's workshop in Bordeaux, France and Pr. P. Schröder presenting the INTENSE project to the stakeholders in Bordeaux.

Forthcoming events

More and updated details about events organized by the INTENSE consortium can be found under the `Meetings and Events´ section of the webpage (http://www.nibio.no/en/prosjekter/intense)

3rd INTENSE meeting and workshop

The 3rd meeting edition (likely in October 2017) will be hosted by the University of Parma, Italy (Dr Elena Maestri). Specific dates and venue are still to be defined. As soon as this information is available it will be posted in the website.

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Time	Place	Topics
October 2017	Parma, Italy	Results from the season, Midterm report, plans for 2018
Late June 2018	Stavanger, Norway	Publications, Stakeholder, meeting, dissemination
September 2018	Warsaw, Poland	Publication, stakeholder meeting, dissemination
February 2019	Bordeaux, France	Final meeting

1st-INTENSE summer course

The 1st edition of the INTENSE summer course will be organized by CIEMAT in collaboration with the University of Basque Country (UPV/EHU; EU Phytosudoe project). It is scheduled in Spring 2018 (one or two speakers of the Phyosudoe projects will be invited for the contaminated land). In addition we will ask to the CEA of Vitoria-Gasteiz, Spain, and CSIC (Santiago de Compostella, Spain) if we can have an One day extension with input of the INTENSE project to the 3rd- PhytoSUDOE summer school which is scheduled on July 2018 (http://www.phytosudoe.eu/en/events/)

Specific program, dates and venue are still to be defined. As soon as this information is available it will be posted in the website. Application form will be available at the UPV/EHU summer courses´ webpage (https://www.uik.eus/en/nuevas-tendencias-en-restauracion-de-suelos-degradados-cultivos-energeticos-y-fitogestion-en-un-modelo-de-economia-circular).

Contributions to forthcoming International Conferences

INTENSE project will be present at several forthcoming international conferences

► International Conference on the Biogeochemistry of Trace Elements ICOBTE, ETH Zurich, Switzerland, July 16-20, 2017 (http://icobte2017.ch/)

► the 14th International Phytotechnologies Conference, Montréal, Canada, September 25 to 29, 2017 (http://www.ipc2017.org/en)

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CIEMAT will present a poster in CONSOWA (June, 2017),
http://www.consowalleida2017.com/
1st WORLD CONFERENCE ON SOIL AND WATER CONSERVATION UNDER GLOBAL CHANGE
(CONSOWA) - Sustainable Life on Earth through Soil and Water Conservation

Dr. R Millan will present a lecture in 2017 at the Summer Course on "New trends in restoration of degraded soils: energy crops and phytomanagement in a Circular Economy model" scheduled for the 13th and 14th of July in Vitoria-Gasteiz
http://www.phytosudoe.eu/wp-content/uploads/2017/03/Summer-Course-2017_v1.pdf

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The INTENSE project is funded by the ERA-NET FACCE SURPLUS

FACCE SURPLUS is an ERA-NET Cofund (http://faccesurplus.org/about-facce-surplus/), formed in collaboration between the European Commission and a partnership of 15 countries in the frame of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI), Europe Union's Horizon 2020 Research and Innovative programme under grant agreement No 652615.

FACCE SURPLUS (Sustainable and Resilient agriculture for food and non-food systems) is committed to improve collaboration across the European Research Area in the range of diverse, but integrated, food and non-food biomass production and transformation systems, including biorefining.