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# NEW VALUE LANDSCAPES FOR PLANT PROTEIN PATHWAYS

## D3.1 Report on full IPS implementation 1

valpropath.eu

Co-funded by the European Union

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| **Author(s)/Organisation(s)** | Remigio Berruto, UNITO |
| **Contributor(s)** | Carl-Otto Ottosen, Milena Corredig, Sheila Alves, Mark Fenelon, Richard Lynch, Ewen Mullins |
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| **Abstract:** | This document aims to present each of the Innovative Production Systems (IPS) of VALPRO Path in their initial configuration at M12. It will outline the innovation paths currently being pursued by each IPS, along with those that are in proposal stage. This deliverable represents the first iteration of the implementation plan, which will evolve and expand as the project progresses. |

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| **Date** | **Version** | **Author/Contributor/ Reviewer** | **Summary of main changes** |
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|---|---|---|
| **PU** | Public, fully open, e.g. web | |

| VALPRO Path | | | |
|---|---|---|---|
| **Participant Number** | **Participant organisation name** | **Short name** | **Country** |
| 1 | TEAGASC - AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY | TEAGASC | Ireland |
| 2 | AARHUS UNIVERSITET | AU | Denmark |
| 3 | UNIVERSITA DEGLI STUDI DI TORINO | UNITO | Italy |
| 4 | NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA | NTUA | Greece |
| 5 | FOODSCALE HUB GREECE ASSOCIATION FOR ENTREPREUNERSHIP AND INNOVATION ASTIKI MI KERDOSKOPIKI ETAIREIA | FSH | Greece |
| 6 | LEIBNIZ-ZENTRUM FUER AGRARLANDSCHAFTSFORSCHUNG (ZALF) e.V. | ZALF | Germany |
| 7 | AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS | CSIC | Spain |
| 8 | CONFEDERAZIONE GENERALE DELL AGRICOLTURA ITALIANA | CONFAGRICOLTURA | Italy |
| 9 | AGRICOLUS S.R.L. | AGRICOLUS | Italy |
| 10 | WAGENINGEN UNIVERSITY | WU | Netherlands |
| 11 | BEOTANICS LIMITED | BEOTANICS | Ireland |
| 12 | PepsiCo | PEPSICO | Ireland |
| 13 | KPAD LTD | KPAD | United Kingdom |
| 14 | DIGNITY IDIOTIKI KEFALAIOUXIKI ETAIREIA | DNY | Greece |
| 15 | Moorepark Technology Ltd | MTL | Ireland |
| 16 | MOLINO PEILA SPA | MP | Italy |
| 17 | Global networks gUG | GN | DE |
| 18 | FARMB DIGITAL AGRICULTURE PRIVATE COMPANY | FARMB | Greece |
| 19 | PROLUPIN GMBH | PL | Germany |
| 20 | Fattoria Soidale del Circeo cooperativa sociale | FSDC | Italy |
| 21 | Antignano prodotto tipico di Tealdi Roberto | APT | Italy |
| 22 | Kerry Luxembourg S.á.r.l. | KERRY | Luxembourg |

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| List of Abbreviations and Acronyms | |
|---|---|
| **IPS** | Innovative Production System |
| | |

*Table 1: List of abbrevioations and acronyms*

# 1. Executive summary

The following document was drafted as a report on the implementation of the Innovative Production Systems, which the VALPRO Path project will utilise as testbeds for sustainable plant protein value chains. It outlines in detail the specific objectives and key performance indicators for each Innovative

Production System and then delves into further details on the technical and scientific activities, and proposed business cases that each will be explored.

In this respect, IPS 1 will explore technologies and supply chain innovations that can support on farm-processing, distribution and selling of protein crops, in order to generate more value at farm gate level for protein crop producers. Some of the key activities outlined involve demonstration of on farm milling and extraction to produce un-refined concentrates, with by-product valorisation also taken into account.

IPS 2 will investigate the varietal selection based ion regional suitability to ensure that growers are maximising their potential yields and thus revenue. Details are given on the proposed variety trials underway in each region for protein crops.

IPS 3 gives details of the work undertaken to investigate the synergies of intercropping certain protein crops to aid yield stability. It highlights the research trials currently being implemented in Ireland and Denmark with Faba beans and Peas, which can prevent lodging in the latter at harvest time.

IPS 4 details the development of a nutrient-tracking tool. Through the investigation of state of the art spectroscopy and advanced digital technologies, it outlines the work plan and activities to date to develop a tool capable of capturing nutrient flows and mass balances across the entire supply chain.

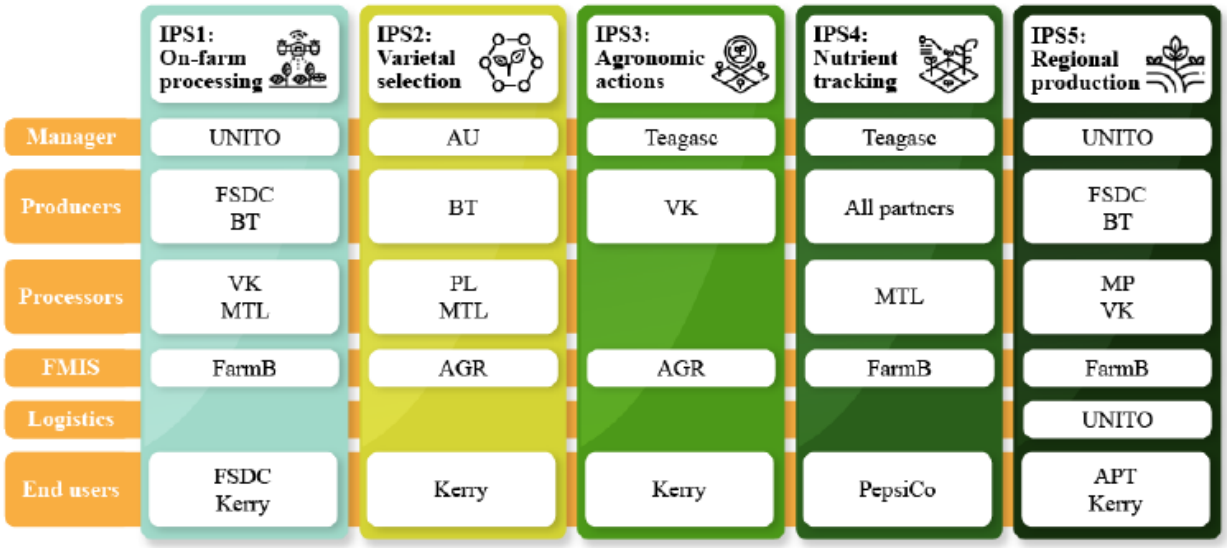
IPS 5 highlights the projects activities around the creation and demonstration of regional synergies that can improve the economic and environmental sustainability of plant protein value-chains. It focuses on activities involving the utilisation of crop sources from different regions around Europe for the production of ingredients and foodstuffs in different regions. This IPS will be expanded to investigate the use of novel bagging systems to transport plant protein fractions between regions.

Finally, this report outlines details of the reporting and monitoring structures for all Innovative Production Systems to ensure their success throughout the project.

# 2. Innovative production systems

As part of the project strategy, VALPRO Path will **promote concrete interventions through the Innovative Production Systems (IPSs) across the supply chain to improve the profitability, circularity, availability, affordability and acceptability of food/feed proteins developed from European land.**

Five living lab type environments (IPS 1-5) will be created based on: existing conventional/organic farms supported by breeders, farm networks and exisiting producer /processor supply chains. A number of key actors will work together to generate and collate system-knowledge and apply existing research and infrastructure (WP2) to demonstrate, with an iterative approach, the most sustainable transition paths using high value exemplar varieties (identified for protein quality and climate robustness in WP2), supply chain adaptations and innovations. The schematic below illustrates the main area of activity for each IPS and details the types of actors involved.




Results obtained from each iteration of an IPS will directly feed into WP1, for network optimisation (T1.2), WP4 for LCA (T4.1, 4.2, 4.3) and cost benefit analysis (T4.4) and WP5 to develop suitable business models for direct application to industry (T5.4).

# 3. Objective of the Implementation Plan

The following dynamic plan has been developed to support IPS leaders in the correct implementation of their respective IPS's. It will outline the main area of activities, the main characteristics of the pilots and the involved partners. Also the data exchange with ValproPath Workpackages is presented for each IPS. This is a dynamic document that will evolve through the project as each IPS delivers on its stated goals.

## 3.1. Areas to be covered by each IPS under the plan

The following implementation plan will describe for each IPS:

- IPS activities as included in project description
- IPS Key Performance Indicators
- IPS business cases (These will be further updated by each IPS leader, during the course of the project)
- Scientific Activities and collaboration with scientific partners in WP2, WP4 and WP5
- Reporting of IPS activities

The following sections will describe each IPS under the headings listed above.

## 3.2. IPS 1 - Realising the potential of on-farm technology and processing to deliver added value

| IPS | IPS Coordinator | Email |
|---|---|---|
| 1- On farm technology | Remigio Berruto, UNITO | Remigio.berruto@unito.it |

| Partners involved | Sites |
|---|---|
| UNITO | Italy |
| FSDC | Italy |
| BEOTANICS | Ireland, Portugal |
| MTL | Ireland |
| FARM B | All countries |
| KERRY | Luxembourg |

### 3.2.1. Description of IPS 1

IPS 1 will promote the development of new business models for on-farm processing that have the potential to create a paradigm shift in the value chain. Distributed on farm/research sites in up to 4 regions (IE, PT, IT), IPS1 will validate technologies currently in use by BT. These on-farm processing opportunities will improve circularity, create value for producers, and develop new resilient supply chains. Demonstrations will include studies of current on-farm processing practices for products (i.e. veggie burgers, home delivery, short supply chains by FSDC) with pilots adapting de-centralized (e.g. small scale) technologies (milling/dry separations strategies to obtain unrefined concentrates and co-products for animal feed, extrusion, low-temp drying and fermentations) using oilseed press cakes, pea, peanut, lentils, chickpea, to create value added, functional fractions to be utilized as ingredients with high nutritional and technological value.

Particular emphasis will promote residual by-product use for animal feed purposes to maximize circularity (BT, WP2). Identity preservation will be promoted using FMIS apps (FARMB), creating state-of-the-art approaches using IR technologies for rapid analysis of concentrates (WP2). Distribution potential will be also evaluated, to understand and co-create new food service/retailing and marketing strategies to shift the market power from traders, retailers and processors to producers/farmers/cooperatives and organizations.

### 3.2.2. IPS 1 Key Performance Indicators

| | |
|---|---|
| KPI 1 | Differential value created for farmers due to extra on-farm activities (up to 20% increase in EUR/kg of end product, due to processing, direct delivery, street food cooking and selling) |
| KPI 2 | Increased labour uses through the year for extra on-farm activities (>5% vs. baseline) |

| | |
|---|---|
| KPI 3 | Three-fold increase in social impact due to increased demand for labour through the full calendar year (as opposed to seasonal standard labour term) including diversity indexes and opportunities for vulnerable people (disabled individuals, migrants) |
| KPI 4 | Potential to exploit value of protein products in street food sector realised with involvement of up to 5 micro-SMEs validating products |

### 3.2.3. IPS 1 Business Cases

#### *3.2.3.1. Business case #1. Production of lentils burger and exploitation of chickpea flour*

Production of Lentil burgers. FSDC will begin trials to develop a lentil based burger. AU and MP will send lentil flour for inclusion. Beotanics and MP will send chickpea flour to AU for extrusion studies. AU to send extruded chickpea to FSDC for possible inclusion in end product. Shelf life studies will be undertaken by Teagasc.

#### *3.2.3.2. Business case #2. On farm deshelling and processing of peanuts*

BT will deshell peanuts using on-farm technologies and send the product to Teagasc and MTL to carry out fractioning and nutritional analysis.

### 3.2.4. IPS #1 Scientific activities

| Activity # | Activity | IPS partner | Scientific Partner |
|---|---|---|---|
| IPS#1.1 | Baseline KPI | ALL | UNITO |
| IPS#1.2 | KPI monitoring | ALL | UNITO |
| IPS#1.3 | Evaluate circularity exploitation | BT | UNITO |
| IPS#1.4 | Farm Digitalisation | FARMB | UNITO |
| IPS#1.5 | Unrefined ingredient characterisation | BT | CSIC, AU |
| IPS#1.6 | Monitor nutritional data of the products developed at farm level | FSDC, BT | CSIC, AU |
| IPS#1.7 | Trials to develop a lentil based burger. MP will send lentil flour for inclusion | FSDC | AU, MP |
| IPS#1.8 | Shelf life studies of the lentil based burger | FSDC | TEAG |
| IPS#1.9 | Inclusion of chickpeas in the burger formulation | FSDC, BT | AU |
| IPS#1.10 | Establishment of short food supply chains | FDSC | FSH, UNITO |
| IPS#1.11 | Collection of data on traceability, emissions in the cultivation process but also in the farm processing. | FDSC,BT | FarmB, UNITO |

| | | | |
|---|---|---|---|
| IPS#1.12 | Experimentation of milling/dry separation strategies | TBC | AU |
| IPS#1.13 | Field trials with extrusion | TBC | AU |
| IPS#1.14 | Use of by-products of peanuts, chickpeas | BT, FSDC | AU |
| IPS#1.15<br>IPS#1.16 | Creation of new functional fractions from pea, lentils, peanut, chickpea | (MTL) | AU |
| IPS#1.17 | Establishment of new Identity preservation technologies with the exploitation of the FMIS apps | FARMB | UNITO |
| IPS#1.18 | Setting up of IR technologies for concentrates to do rapid analysis | TBC | AU |
| IPS#1.19 | Variety Field trials (peanuts, chickpeas, lentils) | BT | UNITO |
| IPS#1.20 | Evaluate street food and home delivery business | FSDC | FSH, UNITO |
| IPS#1.21 | On farm fermentation for feeding purposes. | BT | |

## 3.3. IPS 2 - Varietal selection based on regional suitability and nutritional characterization

| IPS | IPS coordinator | Email |
|---|---|---|
| 2 Varietal selection | Carl-Otto Ottosen, AU | coo@food.au.dk |

| Partners involved | Sites |
|---|---|
| Aarhus University | Italy |
| Prolupin | Italy |
| Beotanics | Ireland, Portugal |
| Teagasc | Ireland |
| Agricolus | Ireland |
| FARM B | Italy, Ireland, Denmark, Germany & Portugal |
| Kerry | Ireland |

### 3.3.1. Description of IPS 2

Choosing the right variety of crop is not an easy task, especially when you have to take into account locally adaptable varieties and nutritional benefits. In order to answer the questions; which variety to

grow? When and How? . IPS 2 will ensure climate controlled and field testing to understand composition changes in each region, and climate resilience. IPS 2 is constructed to capitalize on the learnings of the stress resilience profiling being carried out in T2.1. VALPRO Path partners will support the regional evaluation and demonstration of strategies designed to mitigate against vulnerabilities in current plant protein systems in up to 5 regions.

Existing data from national variety trials for major grain legumes on yield and crude protein will be complemented with data on minor legume species, and combined with new data on food quality composition, yields and agronomic parameters (tolerance to pests and diseases, and competition with weeds) for evaluation with focus on circularity, measuring protein concentrations, compositions, anti-nutritionals (supported by WP2, AU, TEAGASC, CSIC) and crop specific cost-benefit analyses (WP4). Importance of demonstration of by-product yields and composition for food and feed purposes by changes in harvesting methods, difference in plant stand and variation in composition of the seed to be processed (TEAGASC, UNITO, ZALF, Nordic Seed). A database will also be created and linked with that created in T2.1 to capture results.

### 3.3.2. IPS 2 KPI

| | |
|---|---|
| KPI 1 | Up to 3 added value varieties selected, for each pedo-climatic region |
| KPI 2 | Quantified for each variety the emission and nutrient profiles captured (collaboration with IPS4) |
| KPI 3 | Circularity improvements quantified for 10% change in waste recovery with new varieties and associated agronomic practises |

### 3.3.3. IPS 2 Business cases

#### *3.3.3.1. Business case 1.*

UNITO, CSIC and ZALF to collaborate on testing different chickpea varieties based on their nutritional composition (varieties mentioned were Kabuli, Desi and Goulabi)

#### *3.3.3.2. Business case 2.*

Teagasc/MTL will undertake sensory analysis of different plant proteins produced in IPS 2 to ensure that they are fit for human consumption.

### 3.3.4. IPS 2 Scientific activities

| Activity # | Activities | Industrial partner | Scientific Partner |
|---|---|---|---|
| IPS#2.1 | KPI Baseline | ALL | AU, UNITO |
| IPS#2.2 | KPI Monitoring | ALL | AU, UNITO |

| | | | |
|---|---|---|---|
| IPS#2.3 | Denmark - Trials on several varieties of lupin (Primadonna and 6 prebreeding lines), faba beans (Lynx). These trials will look at heat stress before and after flowers are developed. | AU | AU |
| IPS#2.5 | Denmark - Examining various pea varieties in field experiments (green, yellow, grey/brown). Some of the harvested crop from 2023 will be available for compositional analysis through WP 2 of VALPRO Path (VPP) | AU | AU |
| IPS#2.6 | Italy – Field trials with chickpea | UNITO | UNITO |
| IPS#2.7 | Italy – Field trials with soybean | UNITO | UNITO |
| IPS#2.8 | Italy – Field trials with green beans / field beans | UNITO | UNITO |
| IPS#2.9 | Italy – Field trials with peanuts | UNITO | UNITO |
| IPS#2.10 | Germany – Field trials of Faba Beans – crops tested under controlled environmental conditions, with rain shelters and irrigation. Drought tolerance tested during and post-flowering | ZALF | ZALF |
| IPS#2.11 | Kabuli, Desi and Goulabi field trials with common assessment of nutritional values | ZALF, CSIC, AU | ZALF, CSIC, AU |
| IPS#2.12 | Germany – Field trials of Lupin – crops tested under controlled environmental conditions, with rain shelters and irrigation. Drought tolerance tested during and post-flowering | ZALF | ZALF |
| IPS#2.13 | Germany – Field trials of Pea – crops tested under controlled environmental conditions, with rain shelters and irrigation. Drought tolerance tested during and post-flowering | ZALF | ZALF |
| IPS#2.14 | Ireland – Field trials in Irish green houses with peanuts. Further field trials with peanuts are expected in Portugal, France and Netherlands. Growth chambers available in 2024. | BT | TEAG |
| IPS#2.15 | Ireland –intercropping potential of several varieties of pea and faba bean. Further trials will take place with Lupin. Growth chambers available in 2024. | TEAG | TEAG |

| | | | |
|---|---|---|---|
| IPS#2.16 | Italy and Portugal – Same variety of Peanuts seeds | BT | UNITO |
| IPS#2.17 | Sensory analysis of different plant proteins produced in IPS 2 to ensure that they are fit for human consumption. | MTL | TEAG |

## 3.4. IPS 3 - Agronomic practices that mitigate yield loss and create crop synergies

| IPS | IPS coordinator | Email |
|---|---|---|
| 1- Agronomic actions | Sheila Alves, Teagasc | Sheila.Alves@teagasc.ie |

| Partners involved | Sites |
|---|---|
| Teagasc | Ireland |
| Agricolus | Ireland, Denmark |
| Kerry | Ireland |
| ZALF | Germany |
| Aarhus | Denmark |

### 3.4.1. Description of IPS 3

Field pea has long been recognized as a valuable source of protein for feed and food. It is the third most economically important grain legume after soybean and beans. The potential of pea flour and other constituents, as a high protein substitute in a range of food products, has already been demonstrated. Lodging risk can occur in the presence of intense rain/wind events, which have become increasingly frequent with climate volatility. IPS3 is based on successful proof-of-concept studies previously completed by TEAGASC that demonstrated the potential of intercropping field pea with faba beans to mitigate yield loss potential due to lodging, while increasing productivity and potentially contributing to increased yield stability. The intercropped product, a mixture of pea and bean grains, could be used in food ingredients production. While separation of the two grains, would potentially generate two streams for food and feed, according to grain quality. TEAGASC, in collaboration with European breeders will establish the best varieties of pea and faba beans that will be evaluated, taking into account the characteristics of commercial and pre-commercial varieties in terms of agronomic traits and resistance to biotic and abiotic stresses. The best varieties of pea and faba bean, as well as their proportion for minimizing pea lodging, will be evaluated for two seasons. The 2 best performing combinations will be validated in farmers fields (Ireland) and in research farms in Denmark, for one/two seasons. The potential uses of mixed and/or separated grain, will be identified by grain characterization and development of grain/flour separation methodologies.

### 3.4.2. IPS 3 Key Performance Indicators

| | |
|---|---|
| KPI 1 | Identification of high performing pea and faba bean variety combinations (up to 5) that support synchronous harvesting and optimum ratio of pea and faba bean for intercropping management, facilitating post-harvest segregation |
| KPI 2 | Characterization of intercropped grain and identification of potential uses, including potential separation methodologies |
| KPI 3 | Identification of optimal blends for post-harvest processing with target substitution of 30% change in traditional flour mixes for confectionery production |
| KPI 4 | Optimization of texture and sensory parameters to support >4 end-products meet current industry requirements for milling flour |

## 3.4.3. IPS 3 Business cases

### *3.4.3.1. Business case 1.*

Intercropping of field peas and beans on research farms in Ireland with the potential to roll out to commercial farms in years 2-4.

### *3.4.3.2. Business case 2.*

Identification of protein ingredients for the food industry and/or for the formulation of high protein feedstocks

### *3.4.3.3. Business case 3.*

Production of confectionery products using combinations of pea x bean flour mixed with wheat, barley and oats.

## 3.4.4. IPS 3 Scientific activities

| Activity # | Activities | Industrial partner | Scientific Partner |
|---|---|---|---|
| IPS#3.1 | KPI Baseline | TEAG | TEAG |
| IPS#3.2 | KPI monitoring | TEAG | TEAG |
| IPS#3.3 | Test different varieties and combinations of pea/faba bean. Develop intercropping guidelines for pea/faba bean | TEAG | TEAG |
| IPS#3.4 | Identify and monitor commercial sites for Intercropping. Acquire seed and buy intercopping product | TBC | TEAG |
| IPS#3.5 | Characterization of intercopped grain and identification of potential uses, including potential separation methodologies | TBC | TEAG |
| IPS#3.6 | Development of product from pea and faba bean, the optimal blend and texture | KERRY | TEAG |

| | | | |
|---|---|---|---|
| IPS#3.7 | Evaluation of the use of satellite data to monitor and study lodging situations and growing rate of selected field trials. | AGRICOLUS | TEAG |
| IPS#3.8 | Data Collection | ALL | TEAG |

## 3.5. IPS 4 - Promoting new practices for farm-to shelf nutrient tracking and sustainability

| IPS | IPS coordinator | Email |
|---|---|---|
| 4 Nutrient tracking and sustainability | Mark Fenelon, Teagasc | Mark.Fenelon@teagasc.ie |

| Partners involved | Sites |
|---|---|
| Teagasc | Ireland |
| Agricolus | All |
| FARM B | All |
| BT | Ireland |
| Pepsico | Ireland |

### 3.5.1. IPS 4 Description

ISP4 will apply a systems engineering approach (FARM B, PepsiCo) to complete full supply chain nutrient tracking and environmental impact assessments during the process of product development and innovation (MTL, PepsiCo), using products obtained from IPS1 / 2 / 3 (AU, TEAGASC, UNITO). The use of advanced digital tools to track GHG emissions and carbon capture during the lifecycle of food products will be promoted, linked and replicated to the business models in the other IPSs. State-of-the-art spectroscopy technologies will be applied to trace nutrients across the protein journey from Farm to Fork and will be complemented with LCA studies (WP4) including processing resources and cost/benefit analysis, e.g. Siemens gPROMS Process and FormulatedProducts® software to model composition (protein, fat, CHO, minerals, vitamins, antinutritional components), energy and emissions/carbon capture will acquire data for Life Cycle Inventory and provide the output of LCA (WP4). Prototypes of innovative products with an ingredient label that displays not only nutritional composition but also carbon use efficiencies will be demonstrated (MTL, PepsiCo).

### 3.5.2. IPS 4 Key Performance Areas

| | |
|---|---|
| KPI 1 | Quantification of nutrients and carbon capture derived from protein crops vs. baseline |
| KPI 2 | 4 digital flow charts (digital) depicting the entire food system stages, fully demonstrating the nutrient and emissions balance for IPS (#1, #2, #3 and #5) |
| KPI 3 | At least 5 high value products for the marketplace with a ‘0’ carbon label of by-products and measure of circularity |
| KPI 4 | 3 new avenues for utilization of by-products and measure of circularity (% of by-product been used vs. baseline) |

## 3.5.3. IPS 4 Business Cases

### *3.5.3.1. Business case 1.*

Production of plant based beverage by Pepsico

### *3.5.3.2. Business case 2.*

Development of nutrient tracking tool by Teagasc and Pepsico

## 3.5.4. IPS 4 Scientific activities

| Activity # | Activities | Industrial partner | Scientific Partner |
|---|---|---|---|
| IPS#4.1 | Baseline KPI | TEAG | TEAG |
| IPS#4.2 | KPI monitoring | TEAG | TEAG |
| IPS#4.2.1 | Data Collection about business cases for WP4, WP5, WP1 | TEAG | TEAG |
| IPS#4.3 | Data on nutrient profiles, capturing data also on LCA, nutrient tracking trials on peanuts | AGRICOLUS, FARMB, BT | TEAG |
| IPS#4.4 | Data on nutrient profiles, capturing data also on LCA, nutrient tracking trials on chickpeas | AGRICOLUS, FARMB, BT | TEAG |
| IPS#4.5 | Tracking GHG emissions, advanced digital tools to track GHG, and carbon capture, nutrients throughout food products | PEPSICO | TEAG |
| IPS#4.6 | Application of IR spectroscopy | AU | TEAG |
| IPS#4.7 | Trials on plant based drink using lupin | PEPSICO, PROLUPIN | TEAG |
| IPS#4.8 | Enhanced product formulation. Use Siemens G Proms process and formulated products. | | TEAG |
| IPS#4.9 | Validation of tower technology | MTL | TEAG |
| IPS#4.10 | Ecolabel design. Design of a label that traces also carbon use efficiency. | Pepsico | TEAG |

## 3.6. IPS 5 - Demonstrating the value of building synergies with cross regional applications

| IPS | IPS coordinator | Email |
|---|---|---|
| 5 Cross regional applications | Remigio Berruto, UNITO | Remigio.berruto@unito.it |

| Partners involved | Sites | Crops |
|---|---|---|
| AU, MP, APT | Italy | Pea, lupin, chickpea |
| KERRY | Belgium | Pea, lupin, chickpea |
| BT | Ireland, Portugal | Pea, lupin |
| CSIC | All | All |

### 3.6.1. Description of IPS 5

IPS5 will develop cross-regional partnerships, by studying value chains integrated through Europe based on the pre-determination of suitable crops for the right pedo-climatic area (from gap analysis of WP1) and end use, and by the exploitation of innovative post-harvest technologies, storage, logistics and processing that enhance the value of the final product and reduce the overall emissions related to it. AU, MP, FSDC, FarmB, APT, TEAGASC, BT and KERRY will evaluate regional data from IPS1, 2 and 3 demonstrations and together with researchers (UNITO, AU, TEAGASC) and farmers organizations will ideate new models (WP1/WP5) with a focus on production, logistics and processing innovations. IPS5 will demonstrate how the creation of high value protein products, their efficient transfer, and attention to circularity by utilizing by-products from residual biomass (either from cultivation or processing) can create sustainable business models. Exploiting the varietal evaluations of IPS2 across pedo-climatic regions, IPS5 will consider the impact of different cropping practices (conventional/organic), while demonstrating optimized crop sourcing considering yields, quality and environmental indices (UNITO, TEAGASC, AU, BT). Computation of environmental indexes across the pedoclimatic regions will be used for assessing innovative storage/logistic solutions, for high value functionality (WP2) or to enhance identity preservation, quality, shelf life, with the intent to demonstrate the business opportunities and value generated by transferring the ingredients through regions in the EU, capitalizing on optimal environmental footprint and optimal market uptake (WP3). Three crops (pea, lupin, chickpea) will be evaluated for flour production (MP, TEAGASC) with different milling diagrams (pearling intensity; stone or roller mills, different fractionations) and evaluated by end users in innovative products (APT, Kerry, PepsiCo) and fully analysed for nutritional and functional properties (TEAGASC, CSIC, AU). Furthermore, the by-products obtained from milling will be evaluated (CSIC) for potential exploitation for feed purposes. This activity will also include peanuts in Portugal, as BT will test a model of optimized synergy between best growing location (Portugal), on-farm processing for production of protein concentrate (IPS1) and supply chain transportation solutions (WP2, WP4 and WP5).

### 3.6.2. IPS 5 Key Performance Indicators

| | |
|---|---|
| KPI 1 | Up to 10% differential value created through the exploitation of the technologies used within this IPS (e.g. Increase of protein kg/ha, margin vs. baseline EUR/kg) |
| KPI 2 | 25% decrease in waste vs. current due to logistic improvement and combined added value (EUR/kg vs. baseline) |
| KPI 3 | Improvement of circularity (20% increase in by-product exploitation for feed purpose vs. baseline) |
| KPI 4 | Exploitation of cross-regional scheme on protein consumption (10% potential market increase in EU) |

### 3.6.3. IPS 5 Business Cases

#### *3.6.3.1. Business case 1.*

UNITO is evaluating a bagging system with INTA to improve transportation/shipping opportunities. For this purpose UNITO and INTA will engage trials for small scale shipment of food grade legumes and flours.

#### *3.6.3.2. Business case 2.*

APT will undergo trials on pasta production using lentil and chickpea flours. AU and UNITO are supporting them by testing different flour combinations.

#### *3.6.3.3. Business case 3.*

MP will provide flour to (i) APT for inclusion in pasta trials and to (ii) CSIC for testing nutritional composition. KERRY will help with evaluating the product in a consumer space.

#### *3.6.3.4. Business case 4.*

MP will provide flour with dry separation (i) to APT for inclusion in pasta trials and to (ii) CSIC for testing nutritional composition.

### 3.6.4. IPS 5 Scientific Activities

| Activity # | Activities | Industrial partner | Scientific Partner |
|---|---|---|---|
| IPS#5.1 | Baseline KPI | | UNITO |
| IPS#5.2 | KPI monitoring | | UNITO |
| IPS#5.3 | Legume's Flour shelf-life. Studies on shelf life of pre and post-treated flour or legumes. The tests will consider Pregelification aflatoxins and other toxins check, presence of antinutritional factors, microbes, spores and enzymes | MP | AU, CSIC |

| | | | |
|---|---|---|---|
| IPS#5.4 | Pasta produced with different milling samples | APT, MP | AU |
| IPS#5.5 | Sensory test and analytical results on amino acidic profiles of pasta composition | APT, MP | AU |
| IPS#5.6 | Trials with non-conventional, minimum tillage, monitoring the different field plots with the FarmB software | FARMB | UNITO |
| IPS#5.7 | Same varieties/same crops in various fields across Europe. Pea, chickpea, lupin, lentils, will be monitored, with composition and yields from field trials. | ZALF | AU |
| IPS#5.8 | Test a model of optimized synergy between best growing location, on-farm processing for production of protein, best transportation solution | BT | UNITO |
| IPS#5.9 | Evaluate pea, lupin, lentil and chickpea for flour production (MP) with different milling diagrams (pearling intensity; stone or roller mills, different fractionations) and evaluated by end users in innovative products | MP, KERRY,APT, PEPSICO | UNITO, TEAG |
| IPS#5.10 | Evaluate pea, lupin, lentil and chickpea for flour production evaluated by end users in innovative products | KERRY | AU |
| IPS#5.11 | Evaluate pea, lupin, lentil and chickpea for flour production (MP) with different milling diagrams (pearling intensity; stone or roller mills, different fractionations) and fully analysed for nutritional and functional properties | TEAG, CSIC, AU | TEAG, CSIC, AU |
| IPS#5.12 | Join test with IPS5 IPS2 about chickpeas varieties | BT, ZALF, APT | CSIC, AU |
| IPS#5.13 | Potential use of by-products (hulls) | CSIC | CSIC, AU |
| IPS#5.14 | Co-fermentation of products for feeding purposes | BT | AU |
| IPS#5.15 | Shipment of flours and processed products with hermetic bags. | INTA | UNITO |

# 4. IPS Monitoring

## 4.1. IPS Reporting

Each partner contributing to activities within an IPS must provide a report every two months (to be sent by email to the specific IPS coordinator). Reports can be delivered in PowerPoint format so that they can be used later in meetings where the activities carried out are discussed and future activities are planned.

The report will indicate for each partner involved in an IPS, the:

- Type of activity carried out in the past two months
- Lessons learned and major achievements
- Results from the scientific activities
- Type of activities to be carried out in the following two months

The following table indicates the names of the IPS co-ordinators to whom each IPS contributor must send their report every two months

| IPS | Name | Email |
|---|---|---|
| 1- On farm technology | Remigio Berruto, UNITO | Remigio.berruto@unito.it |
| 2- Varietal selection | Carl-Otto Ottosen, AU | coo@food.au.dk |
| 3- Agronomic actions | Sheila Alves, Teagasc | Sheila.Alves@teagasc.ie |
| 4- Nutrient tracking and sustainability | Mark Fenelon, Teagasc | Mark.Fenelon@teagasc.ie |
| 5- Cross regional applications | Remigio Berruto, UNITO | Remigio.berruto@unito.it |

## 4.2. IPS Progress Meetings

It is essential that there are regular meetings to inform all IPS partners about the progress of IPS research and development activities by the individual partner. During these meetings the overall progress of each IPS will be presented by the IPS coordinator or a delegate. All the IPS contributors will be expected to participate to enable the developement of collaborative actions and cross-IPS synergies. Minutes of these meetings will be made available one week after the meeting, with key actions and targets highlighted for the coming two months.