Incorporating Pulse Ingredients into New Products

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June 8th, 2017

Convergent Innovation Coalition
Pulse Innovation Platform

PEPSICO

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THE INCLEN TRUST

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health

Food and Agriculture Organization of the United Nations

Pulse Canada

sightandlife

JOHNS HOPKINS GLOBAL OBESITY PREVENTION CENTER

McGill Centre for the Convergence of Health and Economics

The case for pulses

Health Benefits

- help prevent and control NCDs
- blood pressure control
- reduce BMI and risk of obesity
- reduce risk of diabetes and CVD

Nutrition Benefits

- increase satiety
- source of protein, micro-nutrients, complex carbohydrates, and fibre

Sustainability Benefits

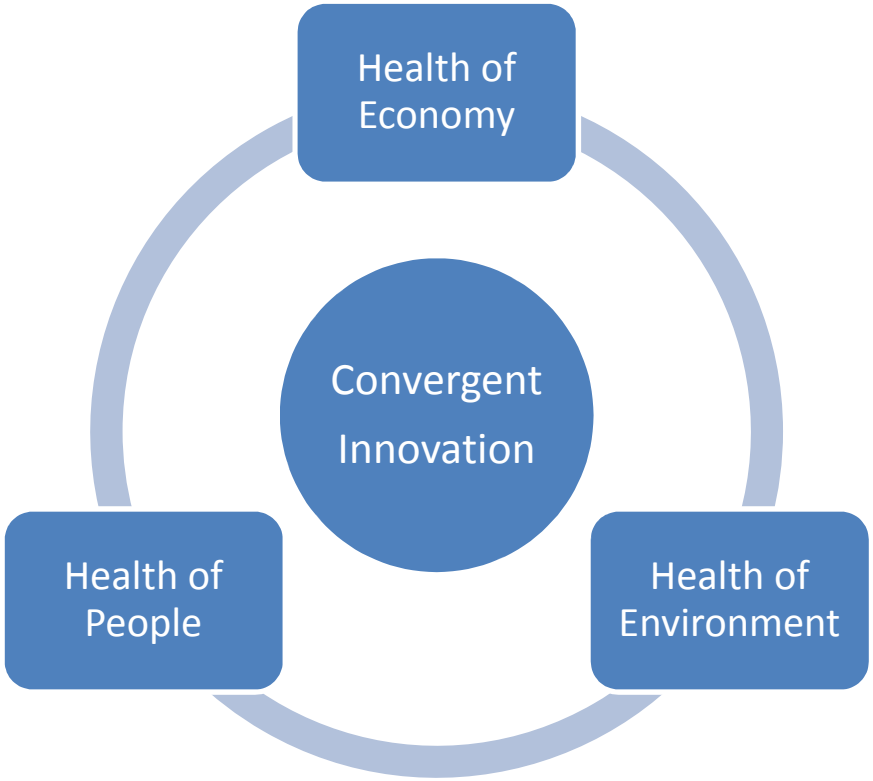
- Nitrogen-fixing crop
- improved soil health
- require less water than other crops

- Demand for alternative (non-animal) protein will be increasing

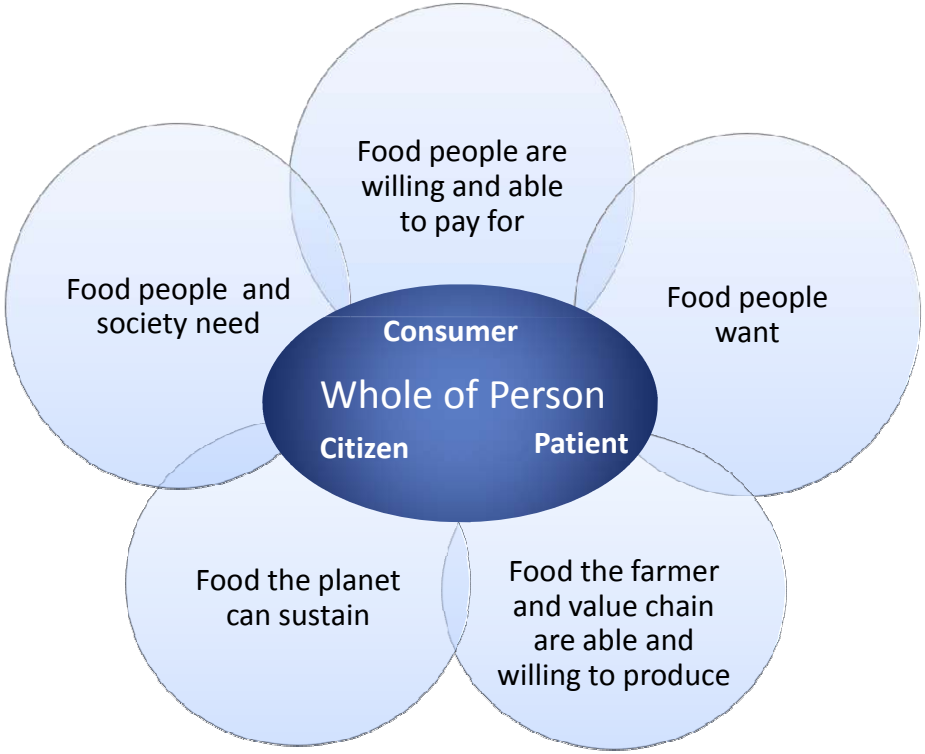
Convergence Innovation Platform

Economic Performance and Competitiveness of the Agri-Food Sector for Sustainable Development and Healthy Populations

Whole of Society

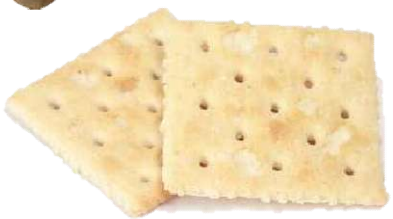


Whole of Person



HIP Foods

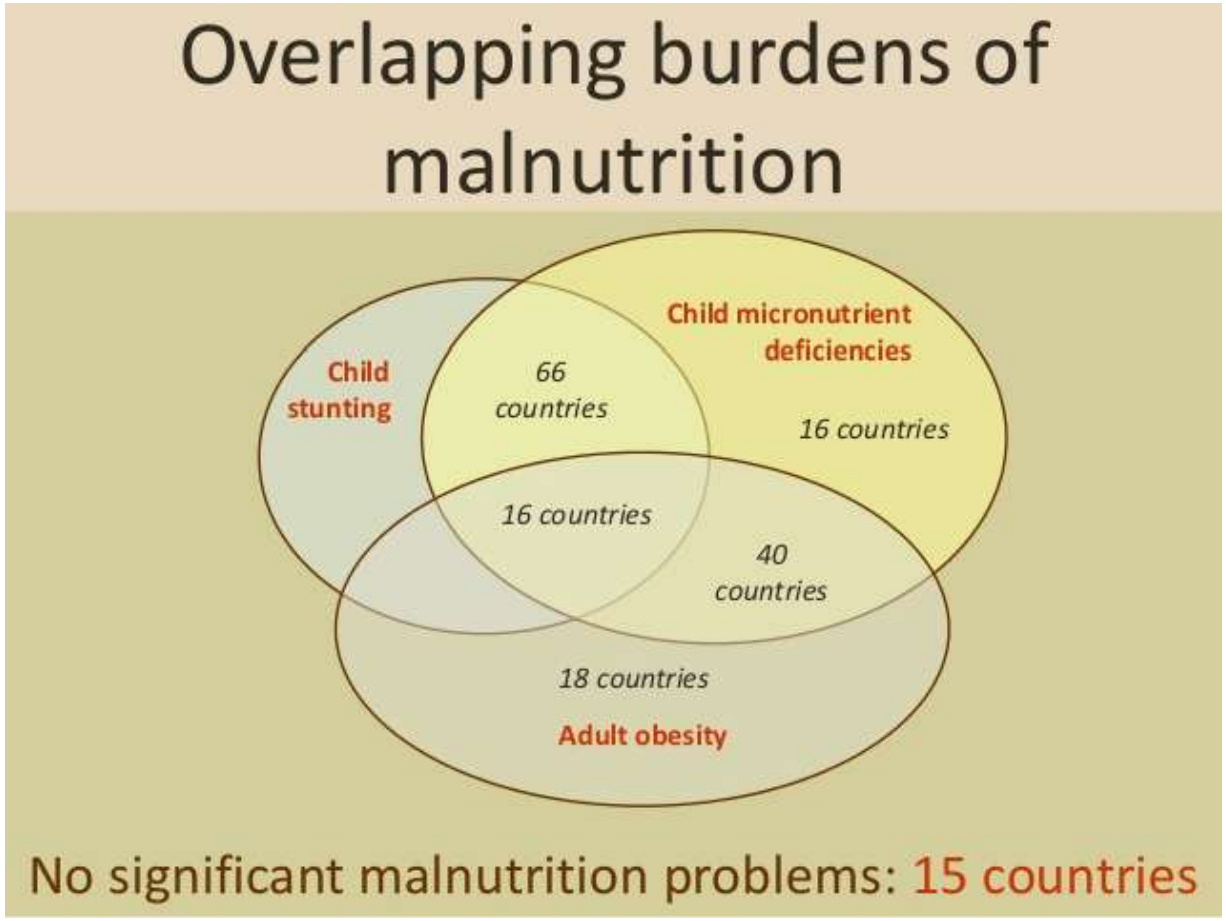
Health Innovation Platform Foods



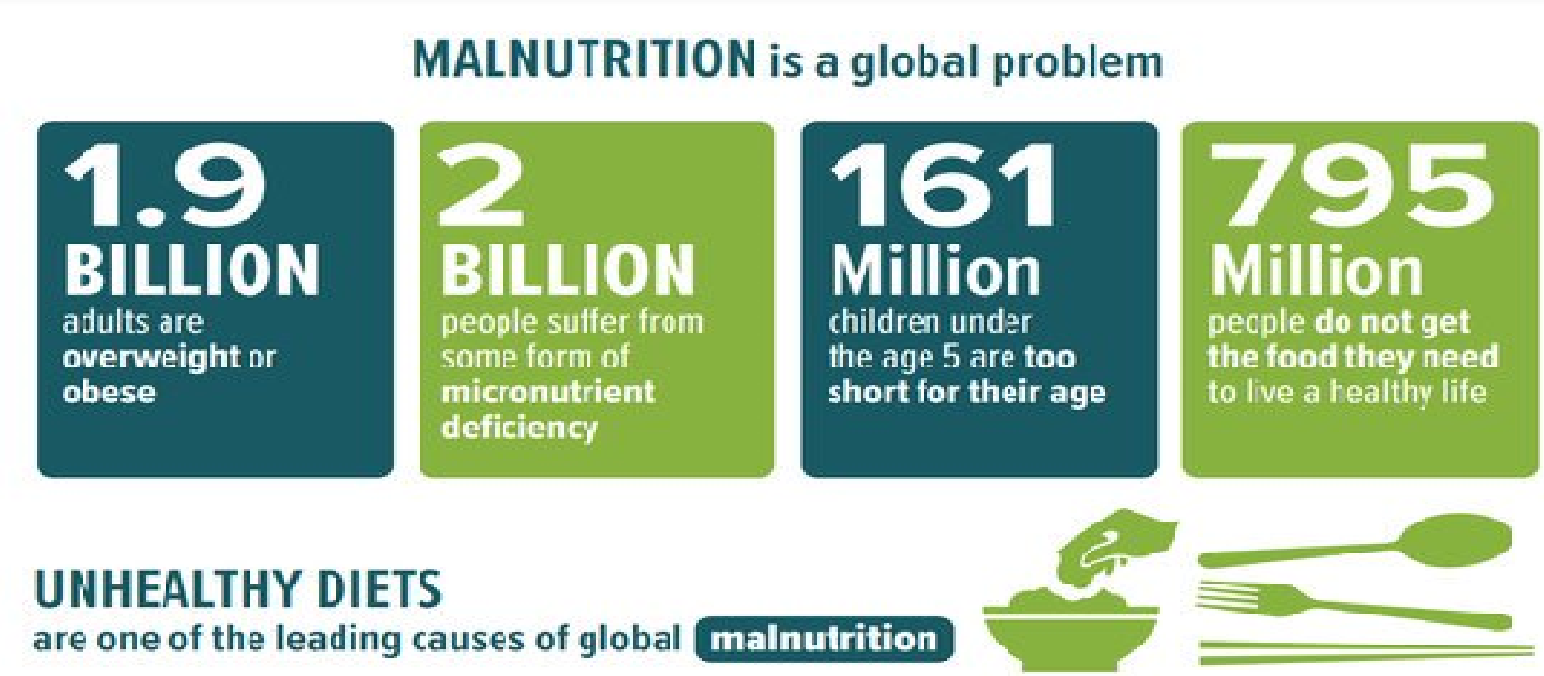
Nutrient density

The heart of today's subject

The triple burden of malnutrition!

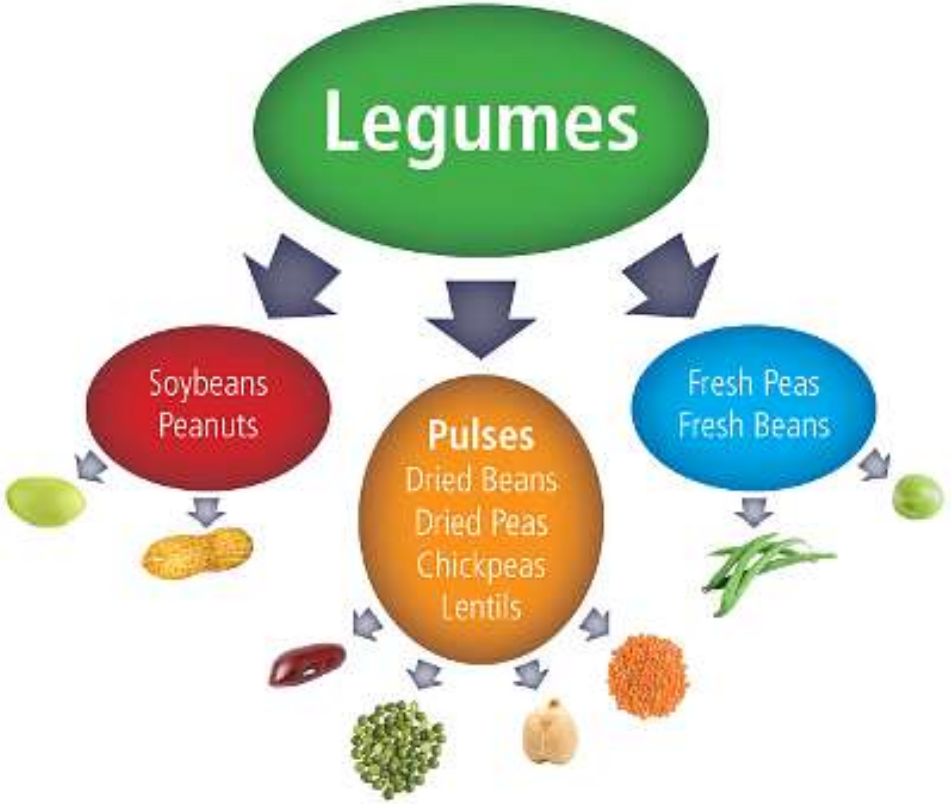


The world's biggest problem…



… and it is **growing.**

The rising importance of legumes



Beans

Lentils

Peas

Chickpeas

Common Pulses

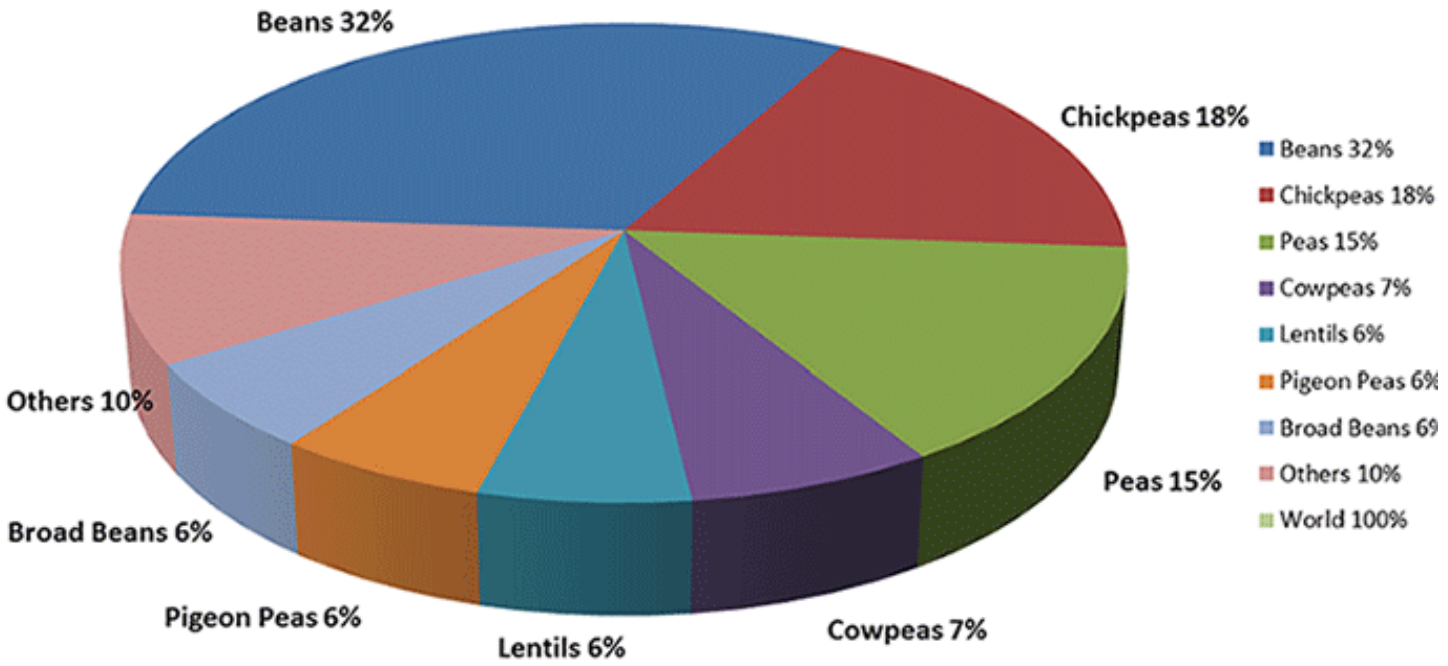
Beans

Peas

Lentils

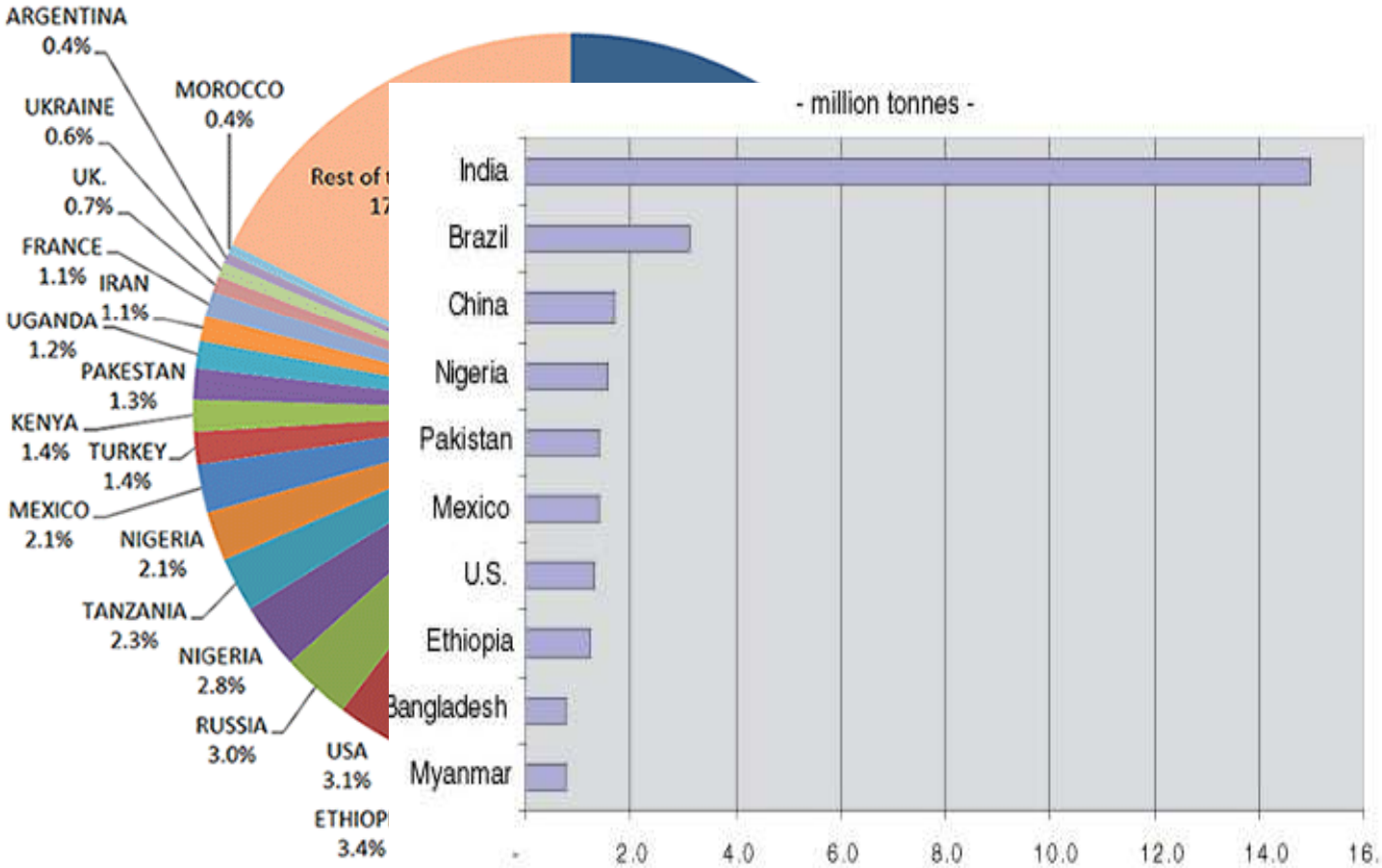
Chickpeas

Global Crop Production (2014)



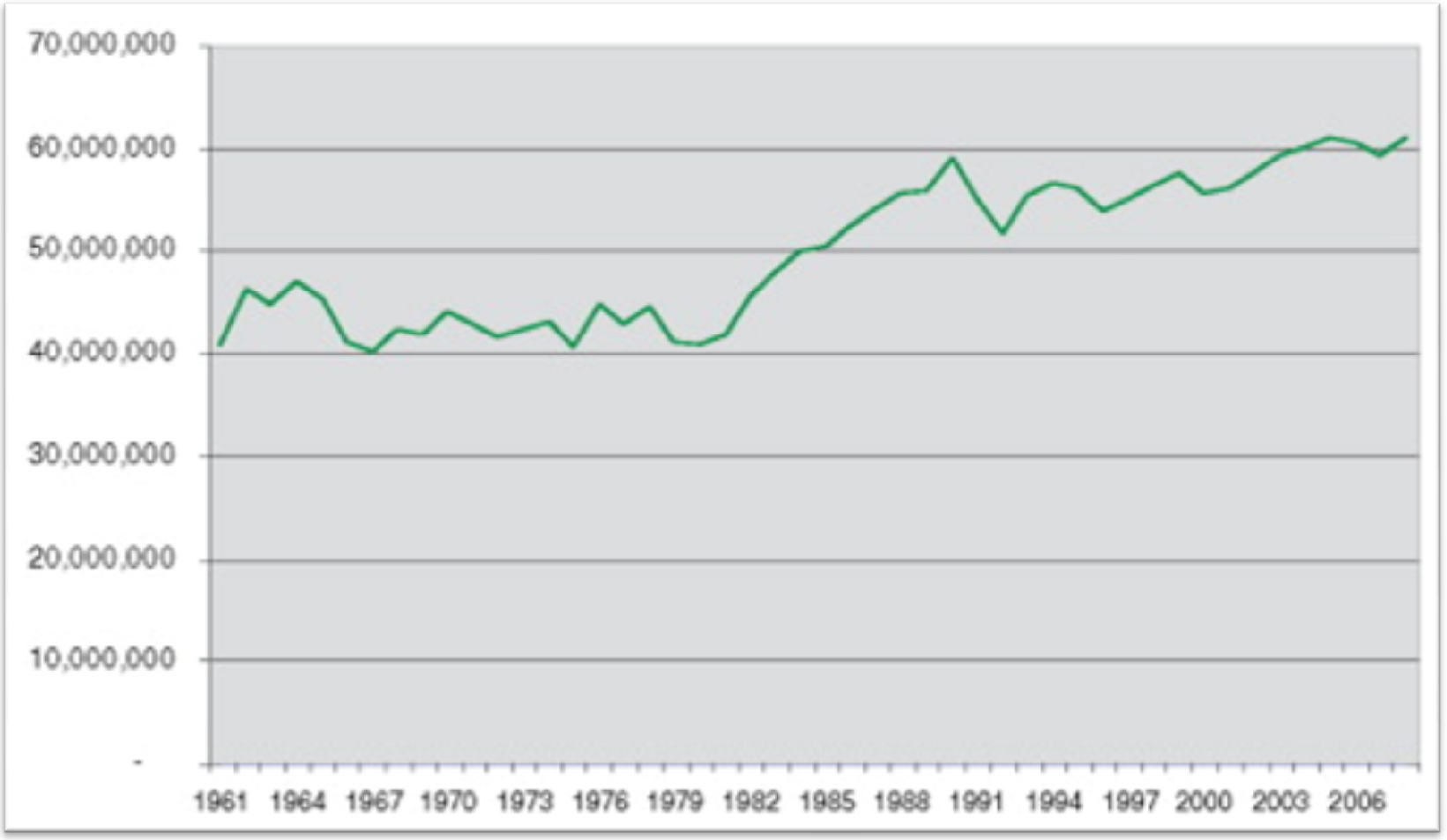
Around 78 million tons

Major Producers and Consumers (2014)



Major Producers Major Consumers

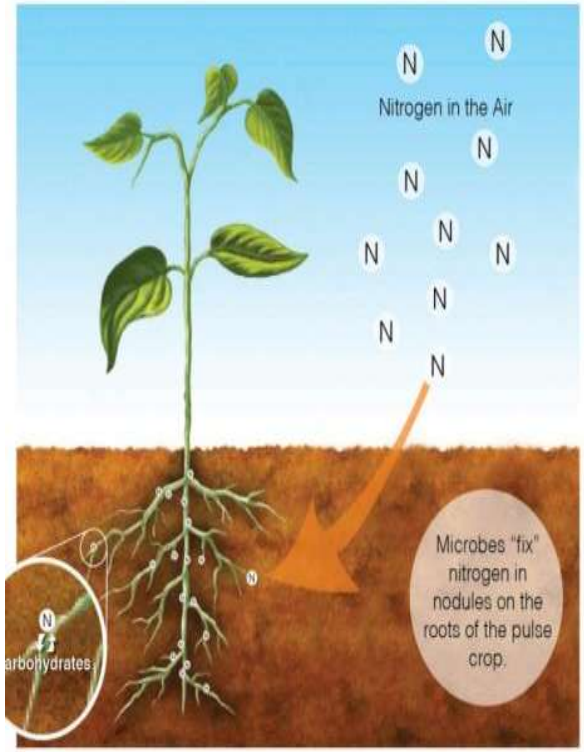
Historical Worldwide Pulse Production



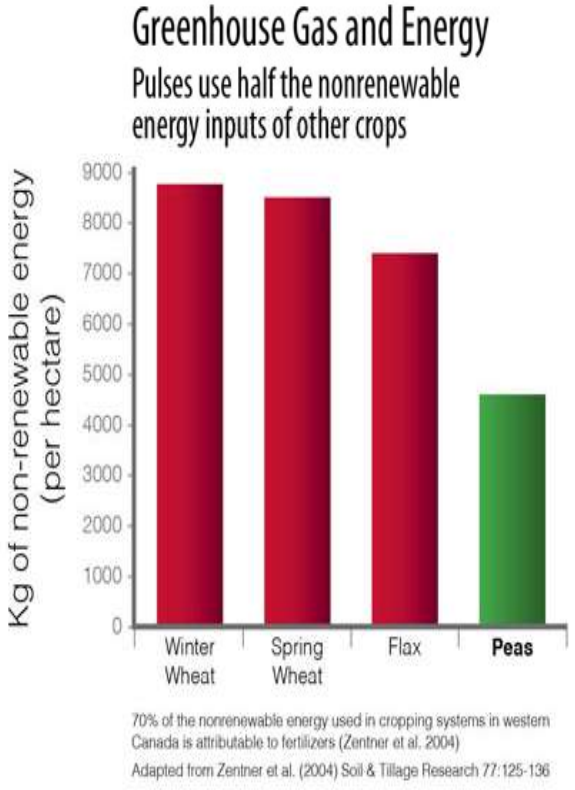
Pulses and Sustainability

41 gallons of water to produce one pound of pulses

1857 gallons of water to produce one pound of beef



Pulse crop with root nodules



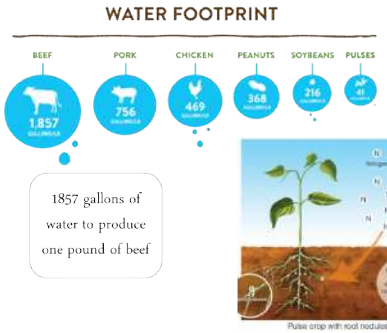
1.Growing Greenhouse Gas Emissions Due to Meat Production." UNEP, 1 Oct. 2012. Web. 10 July 2015.
2.Hoekstra, A.Y. and Chapagain, A. 2008. Globalization of Water: Sharing the Planet's Freshwater Resources. Wiley-Blackwell 3 Zenter et al. 2004. Soil and tillage Research. 77: 125-136

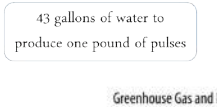
Pulses and Sustainability: Knowledge Gap

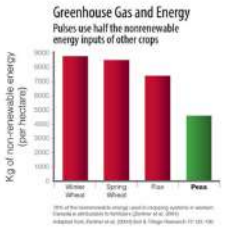
Knowledge Gap

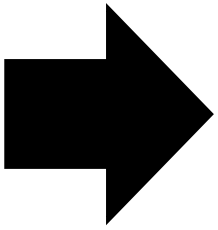
Application of sustainability metrics to food systems to determine the positive environmental impact pulses have on end-use food production.

- Translating the data for the food industry.









Pulses Unique Attributes and Nutritional Advantages

- **Protein 20-25 %** (**Twice** the levels of protein of traditional cereal such as wheat)

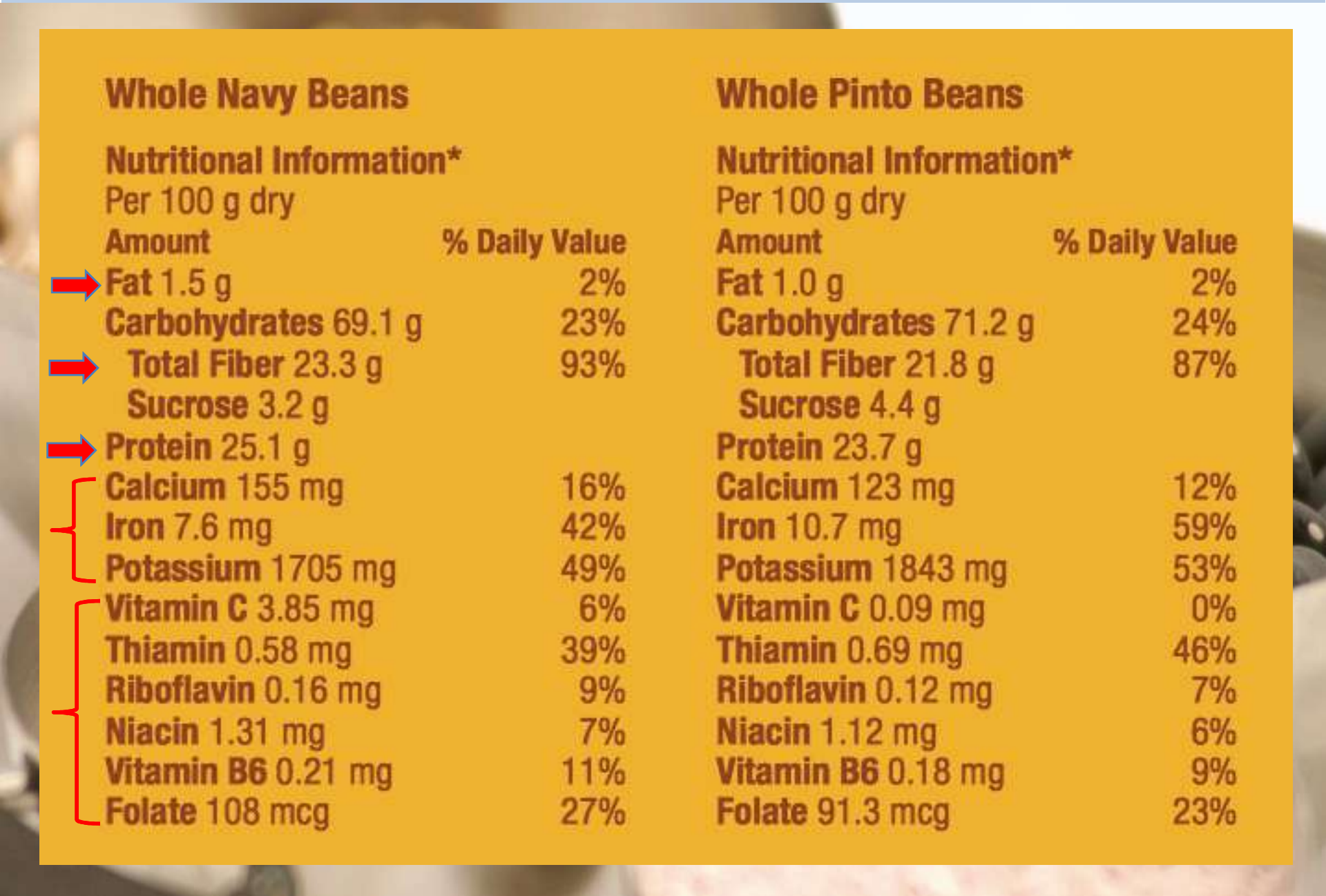
- **Gluten Free** (Safe to be used for people suffering from **celiac disease**)

- **Allergy-Friendly** (Free from 14 common **allergens**)

Pulses Unique Attributes and Nutritional Advantages

- Provide complementarity in **essential amino acids**
- High in **fiber** (~20%)
- Low in **fat** (~2 %)
- High in **minerals** & **vitamins**
- Low **glycemic index (GI)**
- **Non-GMO**

Beans



Whole Navy Beans

Nutritional Information*
Per 100 g dry

Amount	% Daily Value
Fat 1.5 g	2%
Carbohydrates 69.1 g	23%
Total Fiber 23.3 g	93%
Sucrose 3.2 g	
Protein 25.1 g	
Calcium 155 mg	16%
Iron 7.6 mg	42%
Potassium 1705 mg	49%
Vitamin C 3.85 mg	6%
Thiamin 0.58 mg	39%
Riboflavin 0.16 mg	9%
Niacin 1.31 mg	7%
Vitamin B6 0.21 mg	11%
Folate 108 mcg	27%

Whole Pinto Beans

Nutritional Information*
Per 100 g dry

Amount	% Daily Value
Fat 1.0 g	2%
Carbohydrates 71.2 g	24%
Total Fiber 21.8 g	87%
Sucrose 4.4 g	
Protein 23.7 g	
Calcium 123 mg	12%
Iron 10.7 mg	59%
Potassium 1843 mg	53%
Vitamin C 0.09 mg	0%
Thiamin 0.69 mg	46%
Riboflavin 0.12 mg	7%
Niacin 1.12 mg	6%
Vitamin B6 0.18 mg	9%
Folate 91.3 mcg	23%

Peas

Whole Yellow Peas

Nutritional Information*

Per 100 g dry

Amount	% Daily Value
Fat 1.2 g	2%
Carbohydrates 64.4 g	22%
Total Fiber 14.7 g	59%
Insoluble Fiber 13.1 g	
Soluble Fiber 1.57 g	
Sucrose 2.6 g	
Protein 23.3 g	
Calcium 81 mg	8%
Iron 6 mg	33%
Potassium 1230	35%
Vitamin C 0.55 mg	1%
Thiamin 0.51 mg	34%
Riboflavin 0.18 mg	11%
Niacin 1.55 mg	8%
Vitamin B6 0.05 mg	3%
Folate 33.8 mcg	9%

Whole Green Peas

Nutritional Information*

Per 100 g dry

Amount	% Daily Value
Fat 1.4 g	2%
Carbohydrates 64.8 g	22%
Total Fiber 16.3 g	65%
Insoluble Fiber 14.6 g	
Soluble Fiber 1.71 g	
Sucrose 3.0 g	
Protein 23.3 g	
Calcium 74.4 mg	7%
Iron 5.9 mg	33%
Potassium 1080 mg	31%
Vitamin C 0.55 mg	1%
Thiamin 0.51 mg	34%
Riboflavin 0.18 mg	11%
Niacin 1.55 mg	8%
Vitamin B6 0.05 mg	3%
Folate 35.5 mcg	9%

Chickpeas

Whole Kabuli Chickpeas

Nutritional Information*

Per 100 g dry

Amount	% Daily Value
Fat 5.9 g	9%
Carbohydrates 66.5 g	22%
Total Fiber 18.8 g	75%
Sucrose 3.84 g	
Protein 22.7 g	
Calcium 107 mg	11%
Iron 5.5 mg	31%
Potassium 1127 mg	32%
Vitamin C 1.34 mg	2%
Thiamin 0.49 mg	33%
Riboflavin 0.26 mg	15%
Niacin 1.22 mg	6%
Vitamin B6 0.38 mg	19%
Folate 299 mcg	75%

Whole Desi Chickpeas

Nutritional Information*

Per 100 g dry

Amount	% Daily Value
Fat 5.4 g	8%
Carbohydrates 68.4 g	22%
Total Fiber 27.8 g	111%
Sucrose 2.03 g	
Protein 23 g	
Calcium 162 mg	16%
Iron 5.9 mg	33%
Potassium 1216 mg	35%
Vitamin C 1.65 mg	1%
Thiamin 0.29 mg	19%
Riboflavin 0.21 mg	12%
Niacin 1.72 mg	9%
Vitamin B6 0.30 mg	15%
Folate 206 mcg	52%

Lentils

Whole Green Lentils

Nutritional Information*

Per 100 g dry

Amount	% Daily Value
Fat 1.1 g	2%
Carbohydrates 60.1 g	20%
Total Fiber 14.0 g	56%
Insoluble Fiber 12.3 g	
Soluble Fiber 1.7 g	
Sucrose 1.95 g	
Protein 25.8 g	
Calcium 73.9 mg	7%
Iron 8.1 mg	45%
Potassium 695	20%
Vitamin C 0.71 mg	1%
Thiamin 0.29 mg	19%
Riboflavin 0.33 mg	19%
Niacin 2.57 mg	13%
Vitamin B6 0.23 mg	12%
Folate 180 mcg	45%

Whole Red Lentils

Nutritional Information*

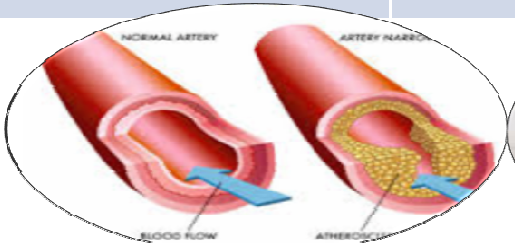
Per 100 g dry

Amount	% Daily Value
Fat 1.0 g	2%
Carbohydrates 59.1 g	20%
Total Fiber 14.2 g	57%
Insoluble Fiber 12.4 g	
Soluble Fiber 1.81 g	
Sucrose 1.79 g	
Protein 28.4 g	
Calcium 97.3 mg	10%
Iron 7.3 mg	41%
Potassium 1135 mg	32%
Vitamin C 0.73 mg	1%
Thiamin 0.34 mg	23%
Riboflavin 0.31 mg	18%
Niacin 1.73 mg	9%
Vitamin B6 0.28 mg	14%
Folate 186 mcg	47%

Pulse Type	Protein (g)	Fibre (g)	Folate (mcg)	Iron (mg)	Potassium (mg)	Magnesium (mg)	Phosphorous (mg)
				per 100 g			
Beans	**8.4**	**7.9**	**124**	**2.2**	**412**	**54**	**141**
Lentils	**9.0**	**7.9**	**181**	**3.33**	**369**	**36**	**180**
Chickpeas	**8.9**	**7.6**	**172**	**2.89**	**291**	**48**	**168**
Peas	**8.3**	**8.3**	**65**	**1.29**	**362**	**36**	**99**
Barley	2.3	2.5	16	1.3	93	22	54
Corn	3.1	2.8	31	0.6	251	29	75
Whole Grain Rice	2.6	1.5	4	0.4	43	43	83
Quinoa	4.4	2.8	42	1.5	172	64	152

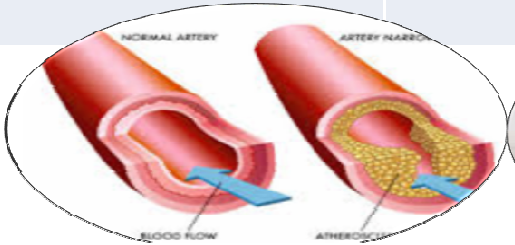
Potential Positive & Beneficial Effects of Pulses

Involved metabolism	Beneficial effect	Reference
Cardiovascular	22% lower risk of coronary heart disease 11% lower risk of cardiovascular disease	Bazzano et al. (2001)
Cardiovascular & diabetes	Modulation of glucose, insulin & lipid peroxidation in coronary artery disease patients	Jang et al. (2001)
Hypertriglyceridemia	Decreased triglyceride concentrations by inhibited pancreatic lipase activity	Maruyama et al. (2008)
Type 2 diabetes mellitus	20–30% lower risk of type 2 diabetes	Venn et al. (2004)
Glucose & lipid metabolism	Modify glucose and lipid metabolism favorably	Lerer-Metzger (1996)
Endometrial cancer	Low risk of endometrial cancer	Tao et al. (2005)
Breast cancer	Low breast cancer risk	Velie et al. (2005)



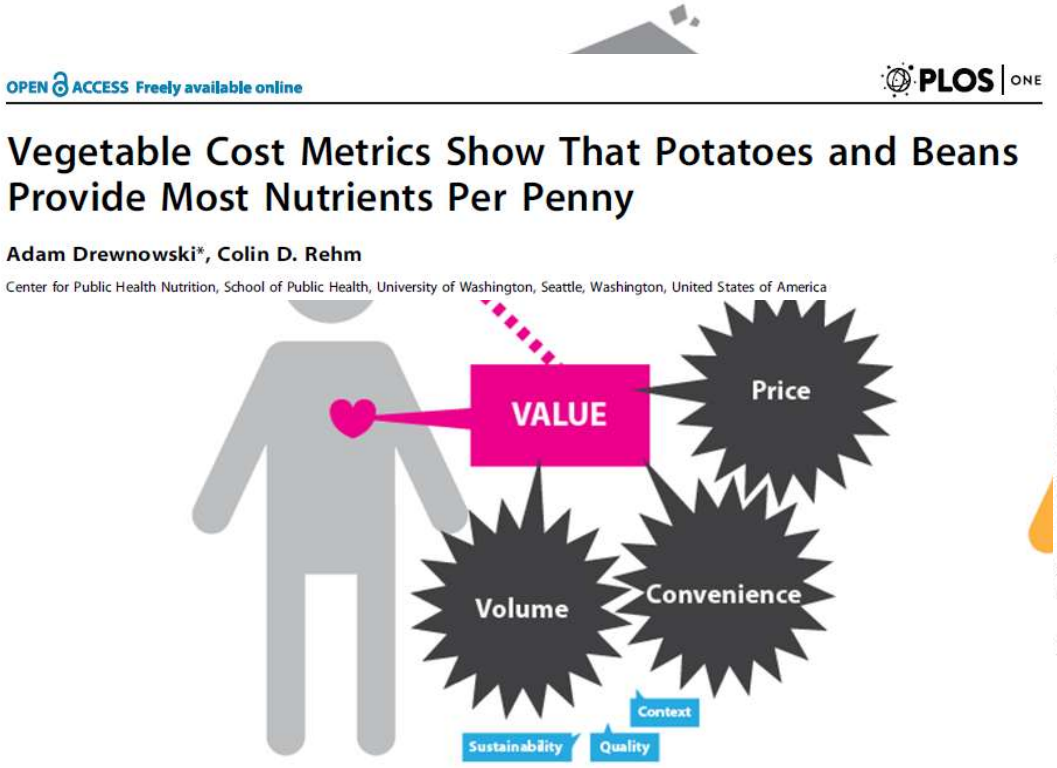

Potential Positive & Beneficial Effects of Pulses

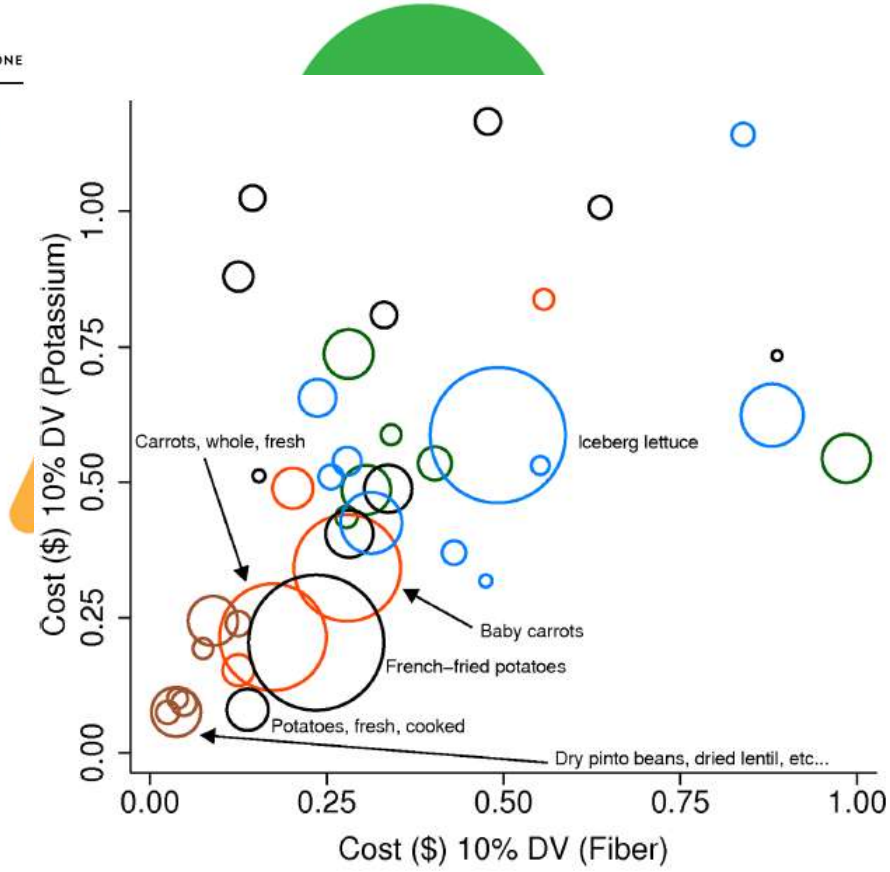
Involved metabolism	Beneficial effect	Reference
Obesity	Low average body mass index (BMI)	Greenwood et al. (2000)
Obesity	Low waist-to-hip (WHR) ratio	Williams et al. (2000)
Obesity	Low BMI and waist circumference (WC)	Haveman-Nies (2001)
Glycemia and obesity	Glycemic control and weight loss	Jimenes-Cruz et al. (2003)
Skin and ear inflammation	Low risk of skin diseases and ear inflammation	Warrier et al. (1995)
Colon cancer	Low risk of colorectal adenoma	Agurs-Collins (2006)
Lymphoblastic leukemia	Low risk of lymphoblastic leukemia	Petridou et al. (2005)




The Consumer will ultimately Drive the Adoption of HIP Diets: Behaviour and Economics

- Adoption of behaviours that facilitate dietary change must be affordable.





Anthesis. UK Defra Food Behaviors – Consumer Values. http://anthesisgroup.com/defra-food-behaviors-consumervalues/ Accessed August 19, 2016; Drewnowski et al. PLOS One. 2013. 8(5). e63277

Motivation

- **Development of High Protein Content Products**

- Healthy lifestyle trend for consumers :

1. **Nutritious High Protein Foods**

- Adding pulse flours :

1. High Protein Foods
2. Enable **Manufacturers** to diversify protein sources (other than **Dairy or Meat** Products)

- **Development of Low Glycemic Index (GI) Products**

- Minimize the blood sugar level during their digestion
- Significant overall health and easier weight control

- **Development of Gluten-free Products**

- Gluten-free is a diet that strictly excludes gluten
- Gluten related disorders include celiac disease (CD), non-celiac gluten sensitivity (NCGS), gluten ataxia, dermatitis herpetiformis (DH), wheat allergy

How Big is the Demand for Products Using Pulses?

- Today, lifestyle disorders are becoming more common, especially affecting the young urban population
- The current vast exposure to unhealthy lifestyle is increasing the prevalence of chronic diseases such as obesity, cancer, metabolic disorders and diabetes
- Pulses play an important role in regulating blood sugar and lipid levels in both diabetic and healthy individuals, and also can help prevent coronary heart diseases, regulate body weight, and improve bone mineral density

Recently there has been an increasing interest for pulse containing products as nutritious and wholesome foods

Applications

Manufacture Interest & Pulse Production

Applications

In the past decades, demands for diversity in food production has changed considerably

Novel foods are required that not only provide necessary nutrients but also prevent nutrition related diseases

Introduction of the Functional Food Concept (Japan, 1980s)

As food manufacturers become more aware of the **functionality** of **pulse ingredients**, they will be increasingly including them in products from snacks, meat & cheese analogues, breakfast cereals, snack bars, batter and breading, baking, etc.

Development of High Protein Content Products

Pulses Protein Content $\approx 25\%$

Meatless Alternatives

Meat Analogues

A few examples of recently introduced pulse containing products

Pureed Chickpeas Hummus dip
Roasted Chickpeas for a crunchy snack
Lentil Burgers
Split Pea cheese analog
Baked Beans dip
Black Bean dip
Curry Lentil dip

Salsa with Black Beans, and Corn
Chickpeas and Cauliflower Curry
Bean Chocolate Chip Cookies
Lentil Granola Bars
Pulse Flours in baked goods
Pulse flour deep frying batters

Why concentrate on pulses?

They have great health/nutritional value

They have great techno-functionalities as food ingredients

Allowing to think outside the box

Example: Reformulate Pasta with Pulses to Increase Nutrient Density

100% Durum Semolina Pasta

(traditional formulation)

Reformulated: 25% Lentil, 75% Durum

- ↑100% in fiber
- ↑ 25% in protein
- 13-26% lower carbon footprint

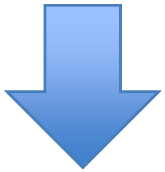
Development of Low Glycemic Index (GI) Products

In the battle against diabetes, pulses offer a wide range of means to fight:

- Firstly, due to their effects on weight control, they provide a front line defense
- Secondly, the **slow** rise in blood sugar gives **pulses** the distinction of being a **low GI** food

This rises the attention of food manufacturers, specially for introduction of new breakfast cereals, snack bars, and bakery products

- In a single reported study Pulse ingredients were incorporated into 94 different food products
- Products included pastas, breads, crackers, extruded snacks, cookies, cereal bars, and muffins
- All 94 products were screened for estimated glycemic index using an **in-vitro** method
- five products (pasta, bread, cracker, granola bar, & cookie) were selected for **in-vivo** GI testing
- For each control (100 % wheat flour), a pulse variant (up to 50 % of pulse flour) was developed



Mean GI difference between control and pulse variant was 4.8±2.6 with all pulse variant falling into the low GI category

Development of Gluten-free Products

- Pulses ⊘ **Gluten** → Development of new gluten-free products like gluten-free snacks and snack bars, breakfast cereals, bakery products

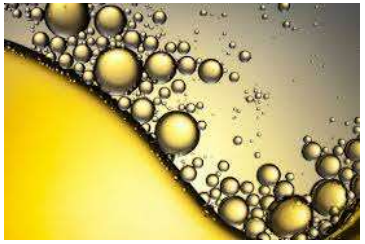
Hence the opportunity to pursue the
"**Development of Gluten-Free Products Using Pulse Ingredients Project**."

- Develop an understanding of global gluten-free markets
- Expand knowledge on the functionality of pulse and other gluten-free ingredients
- Improve the quality of pulse based gluten-free foods
- Identify challenges and present solutions during scale up production of pulse based gluten-free foods
- Provide technical support to promote pulses as ingredients in the gluten-free industry

Incorporation of pulses in food formulation

Relies on their multiple functional properties;

- Emulsification
- Solubility
- Foaming
- Gelling
- Texturing
- Water and
- Fat Binding Capacity



can be modified through specific processing treatments and optimized for specific food matrices (beverages, meat, bakery, extruded products)

Main current food processing steps for pulses

- Dehulling

- Germination

- Milling

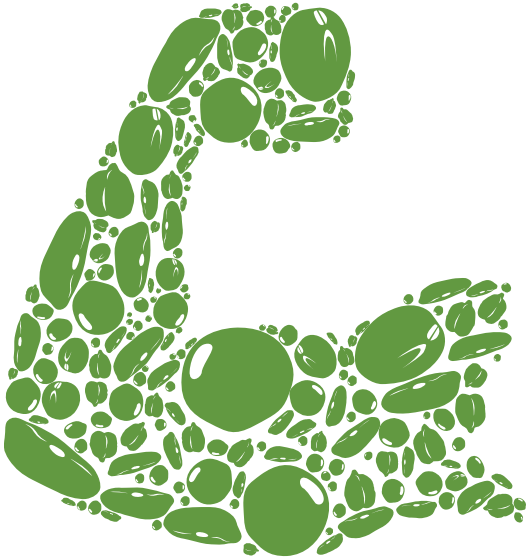
- Fermentation

- Soaking

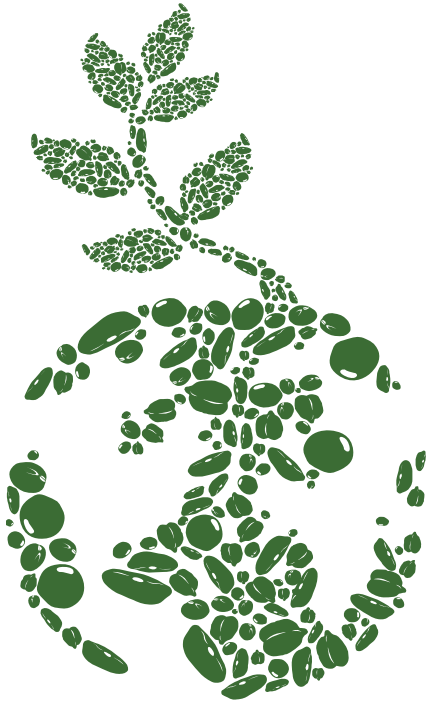
- Thermal Treatments

Aligning consumer Wants and Needs with Pulse Attributes

Health

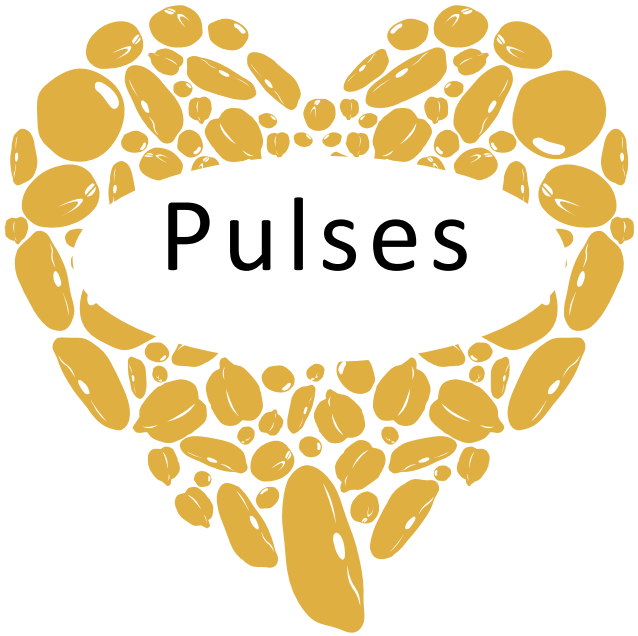


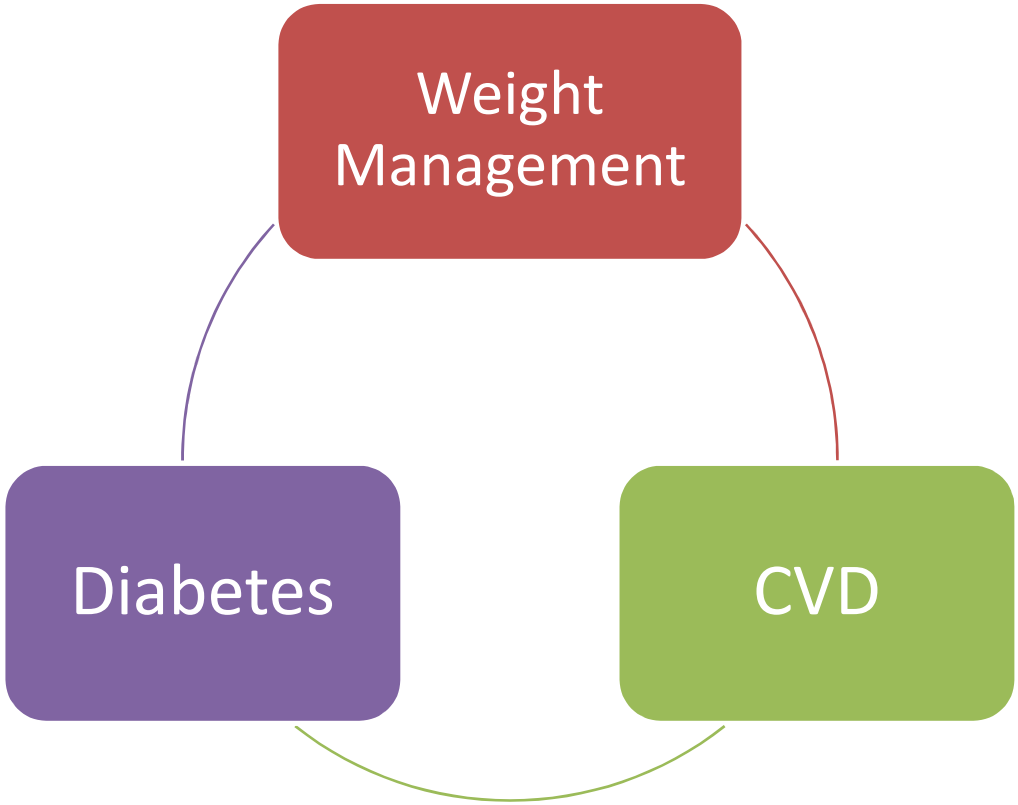
Nutrition



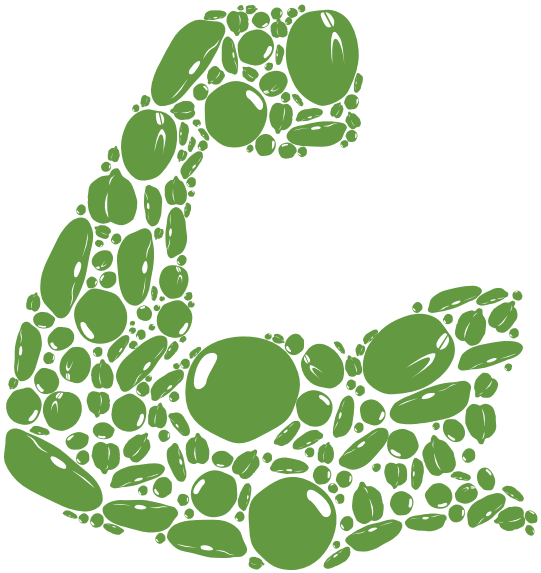
Sustainability

Health





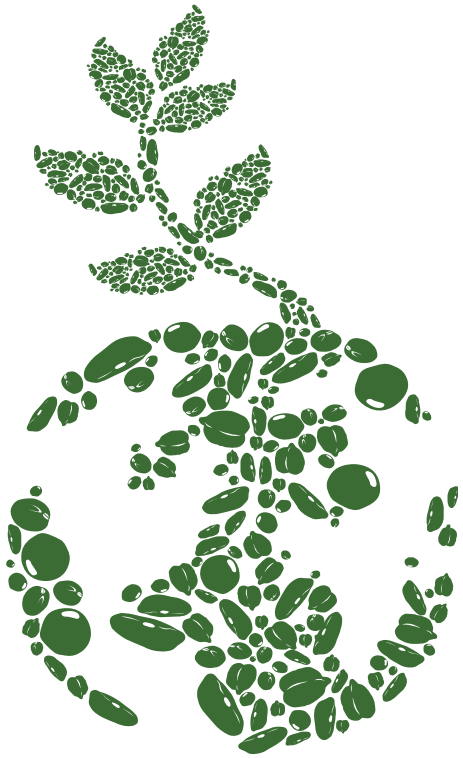
Nutrition

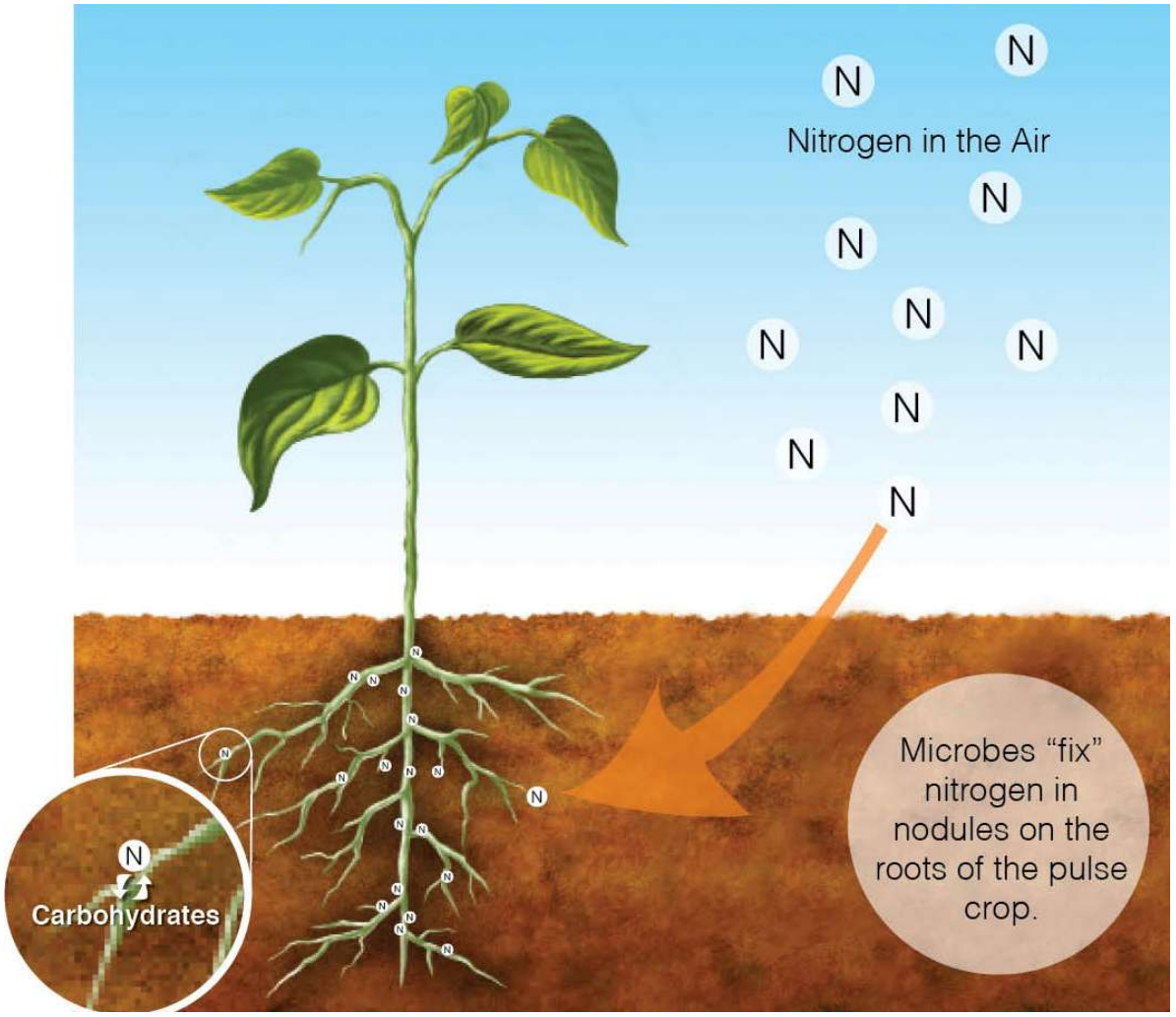


Pulses

½ Cup Cooked	Protein (g)	Fibre (g)	Fat (g)
Rice	2	0.3	0.2
Wheat	1.8	3	0.4
Corn	2	1.6	1.0
Quinoa	4	2.6	1.8
LENTILS	**9**	**8**	**0.4**

Sustainability





Conclusion

- The incorporation of pulses with cereals, through the application of different technologies has far-reaching nutritional benefits to a wide range of the population worldwide

- The development of exciting new pulse products has the potential to raise significantly the profile of pulses as a highly nutritious and globally available protein source

- In addition to their functional and nutritional properties, the presence of bioactive peptides within pulse proteins should further motivate industries to consider their application in the development of novel enriched food products

Acknowledgements


CRSNG
NSERC

Fonds de recherche
Nature et
technologies
Québec


Agriculture et
Agroalimentaire Canada

Agriculture and
Agri-Food Canada
Canada


IDRC | CRDI

International Development Research Centre
Centre de recherches pour le développement international


Global Affairs
Canada

Affaires mondiales
Canada

Thank you and Questions?

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