The International Year of Pulses: what are they and why are they important?

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Summary

The aims of the UN's International Year of Pulses are introduced. Pulses are defined and listed, and their contributions to health, nutrition, and agricultural sustainability (including adapting to climate change) are explained.

Introduction

Pulses have a special place this year because the United Nations (UN) General Assembly, at its 68th session, declared 2016 as the International Year of Pulses (IYP) (UN, 2013). However, despite the importance given to pulses by the UN General Assembly, I repeatedly hear the same question: "what are pulses?". According to FAO (1994), pulses, a subgroup of legumes, are crop plant members of the *Leguminosae* family (commonly known as the pea family) that produce edible seeds, which are used for human and animal consumption.

Only legumes harvested for dry grain are classified as pulses. Legume species used for oil extraction, (*eg* soybean (*Glycine max* (L) Merr) and groundnut (*Arachis hypogaea* L)), and sowing purposes (*eg* clover (different species belonging to the genus *Trifolium* L) and alfalfa (*Medicago sativa* L)) are not considered pulses. Likewise, legume species are not considered as pulses when they are used as vegetables (*eg* green peas (*Pisum sativum* L) and green beans (*Phaseolus vulgaris* L)). Thus, when common bean (*Phaseolus vulgaris* L) is harvested for dry grain, it is considered a pulse; but when the same species is harvested unripe (known as green beans), it is not treated as a pulse. A list of crops that are considered to be pulses (FAO, 1994) are presented in Table 1.

Pulses are important food crops that can play a major role in addressing future global food security and environmental challenges, as well as contributing to healthy diets. In recognition of the contributions that pulses can make to human well-being and to the environment, the UN General Assembly declared 2016 as the IYP. Pulses are inextricably linked to:

- Food security, since they are a critical and inexpensive source of plant-based protein, vitamins and minerals for people around the world, especially for subsistence smallholder farmers.
- Human health, since their consumption can prevent, and help to manage, obesity, diabetes, coronary conditions, *etc*.
- Sustainable agriculture, since they are able to biologically fix nitrogen and free soil-bound phosphorous.
- Climate change adaptation, since they have a broad genetic diversity from which climate-resilient varieties can be selected and/or bred.

Despite these benefits, the *per capita* consumption of pulses has steadily declined in both developed and developing countries. This trend reflects changes in dietary patterns and consumer preferences; but the most important reason is the failure of domestic production to keep pace with population growth in many countries. Additionally, despite the economic, social and environmental importance of pulses, their production has not increased at the same rate as other commodities such as cereals (Alexandratos & Bruinsma, 2012).

To overcome these challenges, relevant stakeholders must promote and implement appropriate policies, and increase investment in research and development, and extension services, focusing on pulses-based cropping systems. The main objectives of the IYP are therefore to: (i) raise awareness of the contribution of pulses to food security and nutrition, (ii) encourage stakeholders to increase production and improve productivity of pulses, and (iii) highlight the need for enhanced investment in research and development, as well as extension services, in order to achieve the previous objectives.

Table 1. Plants that are considered to be pulses according to the FAO (1994) classification

Vernacular name[a]	Scientific name[b]
Common bean	*Phaseolus vulgaris* L
Lima bean	*Phaseolus lunatus* L
Scarlet runner bean	*Phaseolus coccineus* L
Tepary bean	*Phaseolus acutifolius* A Gray
Adzuki bean	*Vigna angularis* (Willd) Ohwi & H. Ohashi
Mung bean	*Vigna radiata* (L) R Wilczek
Mungo bean	*Vigna mungo* (L) Hepper
Rice bean	*Vigna umbellata* (Thunb) Ohwi & H Ohashi
Moth bean	*Vigna aconitifolia* (Jacq) Maréchal
Bambara bean	*Vigna subterranea* (L) Verdc
Broad bean	*Vicia faba* L
Common vetch[c]	*Vicia sativa* L
Pea	*Pisum sativum* L
Chickpea	*Cicer arietinum* L
Cowpea	*Vigna unguiculata* (L) Walp
Pigeon pea	*Cajanus cajan* (L) Huth
Lentil	*Lens culinaris* Medik
Lupines[c]	Several *Lupinus* L species
Hyacinth bean[d]	*Lablab purpureus* (L) Sweet
Jack bean[d]	*Canavalia ensiformis* (L) DC
Winged bean[d]	*Psophocarpus tetragonolobus* (L) DC
Guar bean[d]	*Cyamopsis tetragonoloba* (L) Taub
Velvet bean[d]	*Mucuna pruriens* (L) DC
African yam bean[d]	*Sphenostylis stenocarpa* (Hochst ex A Rich) Harms

[a]All species listed here are considered to be pulses, but some of them are regarded as vegetables when harvested unripe.
[b]Scientific names are sourced from the updated taxonomic database Tropicos (www.tropicos.org).
[c]Used primarily for animal feed.
[d]Species of minor relevance at the international level.

Linking pulses to nutrition and health

Like all legume species, pulses have high protein content, which is particularly important for human nutrition. They contain 20-25 percent of protein - two to three times more protein than cereals. When pulses are eaten together with cereals, the protein quality in the diet is significantly improved (Singh & Singh, 1992).

Pulses are part of a healthy diet. They have low fat content and, like other plant based foods, they do not contain cholesterol. The Glycaemic Index, an indicator of blood sugar, is low in pulses; and they are also significant sources of dietary fibre. Since they do not contain gluten, they are also suitable for celiac patients. Additionally, pulses are rich in minerals (iron, magnesium, potassium, phosphorus, zinc) and B-vitamins (thiamine, riboflavin, niacin, B6, and folate), all of which play a vital role in human nutrition and health.

According to Campos-Vega *et al* (2010), consumption of pulses may reduce the risk of cardiovascular disease; pulses may have a role in preventing diabetes and reducing breast cancer risk; and increased consumption of pulses may protect against obesity. Additionally, pulses are important crops for subsistence farming around the world (see Figure 1), and one of the major staples of poor smallholder farmers (Martiin, 2013). Pulses are therefore considered an inexpensive source of protein that can improve the diets of people worldwide.

Figure 1. Common bean (*Phaseolus vulgaris* L) planted for own consumption in Rio Grande do Sul, Brazil (Photo: Teodardo Calles)

Pulses and sustainable agriculture

An important attribute of pulses is their ability to biologically fix nitrogen. In symbiosis with certain types of bacteria (*ie*

Rhizobium and *Bradyrhizobium*), these plants are able to convert atmospheric nitrogen into nitrogen compounds that can be used by plants, while also improving soil fertility (Nulik *et al*, 2013). Some varieties of pulses are also able to free soil-bound phosphorous, and this nutrient plays an important role in the nutrition of plants (Rose *et al*, 2010). The presence of pulses in agro-ecosystems helps to maintain and/or increase vital microbial biomass and activity in the soil, thereby nourishing those organisms that are responsible for promoting soil structure and nutrient availability (Blanchart *et al*, 2005). A high level of soil biodiversity not only provides ecosystems with greater resistance and resilience against disturbance and stress, but also improves the ability of ecosystems to suppress diseases (Brussaard *et al*, 2007). These features are particularly important for low-input agricultural production systems.

Figure 2. Cultivation of orange tress (*Citrus* L species), cassava (*Manihot esculenta* Crantz) and common bean (*Phaseolus vulgaris* L) in an agroforestry system in Rio Grande do Sul, Brazil (Photo: Teodardo Calles)

Pulses cannot improve on-farm diversity *per se*, so if a farmer changed from cultivating a single cereal species to cultivating a single pulse species, there would not be any change in the on-farm diversity. However, pulses are a critical component of multiple cropping systems *eg* intercropping, crop rotation, agroforestry (see Figure 2), and these cropping systems obviously have greater species diversity than monocrop systems. Increasing species diversity of cropping systems not only results in more efficient use of resources, namely light, water and nutrients (Giller & Wilson, 1991), but also increases yields and lowers the risk of overall crop failure. Furthermore, intercropping systems not only permit greater underground utilisation efficiency due to their root structures (Li *et al*, 2006), but also deep rooting pulses like pigeon peas can provide groundwater to intercropped companion species (Sekiya & Yano, 2004). The use of indigenous pulses such as bambara beans can contribute to improved food security because they are adapted to local production and consumption systems.

How are pulses related to climate change?

Pulse species have a broad genetic diversity from which improved varieties can be selected and/or bred - an attribute that is particularly important for adapting to climate change because more climate-resilient varieties can be developed from this broad diversity. According to Russel (2015), scientists at the International Center for Tropical Agriculture (CIAT) are currently developing pulses that can grow at temperatures above the crops' normal 'comfort zone'. Since climate experts suggest that heat stress will be the biggest threat to bean production in the coming decades, these improved pulse varieties will be of critical importance, especially for low-input agricultural production systems.

Pulses also help mitigate climate change by reducing dependency on synthetic fertilisers. The manufacture of these fertilisers is energy intensive and emits greenhouse gases into the atmosphere, thus their overuse is detrimental to the environment. Finally, many pulses also promote higher rates of accumulation of soil carbon than cereals or grasses (Jensen *et al*, 2012).

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