Pulses are a Smart Food and important for achieving the Sustainable Development Goals

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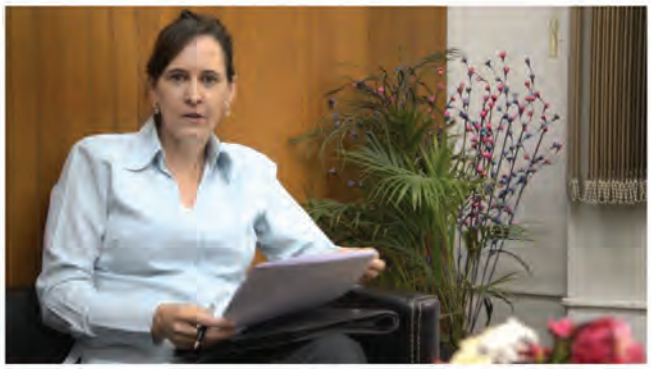
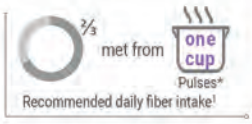


Smart Food is defined as food that is: **Good for you**; **Good for the planet**; **and Good for the small holder farmer.** Read ahead for a range of facts and stories globally that show how pulses are a Smart Food.



¹ Half cup pulses/day provides 7-17 g fiber accounting for 18-45% of recommended daily fiber intake in men and 28-68% in women. Calculation based on data from United States Department of Agriculture, National Nutrient Database for Standard Reference Release 28

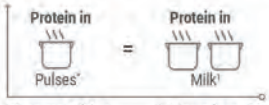
*1 cup= 448 g

While high fiber diet is healthy, drinking plenty of water is recommended as fiber works best when it absorbs water.

Pulses are GOOD FOR YOU

High in protein, micronutrients and fiber

Pulses are high in protein. The high dietary fiber lowers risk of diabetes, heart ailments and gastrointestinal diseases. The high iron, manganese and zinc content helps counter iron deficiency anemia – a serious health issue worldwide in women and children.



Benefits of pulses include:
- Zero cholesterol
- Low saturated fat

*1 cup= 164 g

¹ Based on data from http://ndb.nal.usda.gov/ndb/foods

Pulses + Cereals provide balanced protein diet comparable to meat or dairy foods. Pulses are high in protein (23%)[1].

1. Protein deficiency is mainly observed among the poor, infants and young children in developing countries
2. Pulses are an affordable source of protein
3. Chickpea has the highest protein bioavailability among pulses

Benefits of a high fiber (60-70%) diet

- Soluble fiber helps lower "bad" cholesterol
- Aids weight loss (more filling with fewer calories)
- Maintains bowel health and lowers risk of colon diseases
- Lowers risk of heart disease (reduces blood pressure and heart inflammation), stroke, hypertension, diabetes (slows sugar absorption and improves blood sugar levels), and gastrointestinal diseases
- Whole pulses have more fiber content than refined, processed pulse products and are better than fiber supplements
- Several cultivars [both *desi* (brown-seed) and *kabuli* (white-seed) types] developed by ICRISAT and others include - Early (90-100 days), Extra early (85-90 days) varieties, and Super-early desi (75-80 days) breeding lines

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An extra short duration pigeonpea variety (ICPL 88039[2]) developed by ICRISAT, matures in about four months, compared to the traditional variety that takes up to six months to mature. Recently, under a project in Rajasthan the short duration pigeonpea variety was introduced, with the aim to expand pigeonpea production through farmer participation.

"Before, we could not afford to buy *dal* (split pigeonpea) for our everyday meal. Now, with improved varieties, *dal* has become more available and affordable in the village, and I can prepare and serve my children *dal* anytime," says Prem Devi, Padasoli village, Jaipur district, Rajasthan, India.

Investor: Directorate of Agriculture, Government of Rajasthan, under the Rashtriya Krishi Vikas Yojana
Partner: Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan and ICRISAT

¹ Rohatgi K, Banerjee M and Banerjee S. 1955. Effect of germination on vitamin B12 values of pulses (Leguminous seeds). The Journal of Nutrition (http://jn.nutrition.org/content/56/3/403.full.pdf)
² Calculation based on data from United States Department of Agriculture, National Nutrient Database for Standard Reference Release 28 (http://ndb.nal.usda.gov/ndb/foods)

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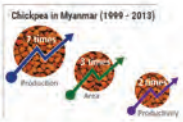
Chickpea variety ICCV 2 is the first extra-short-duration (85-90 days) kabuli variety with Fusarium wilt resistance and heat tolerance, and was initially released in Sudan, Myanmar and India.



Adoption of early-maturing chickpea cultivars led to an increase in area and productivity in Myanmar.

Six early-maturing chickpea cultivars (Yezin 3, 4, 5, 6, 8 and 11) developed from the breeding material supplied by ICRISAT covers over 95% of the total chickpea area in Myanmar.

Investor: International Fund for Agricultural Development-European Commission, Australian Centre for International Agricultural Research
Partners: Indian Council of Agricultural Research, Department of Agricultural Research, Myanmar Agriculture Service, Yezin Agricultural University and ICRISAT.

¹ http://www.cicilsiptic.org/downloads/cicils_mag_dubai_2012.pdf

Pulses provide substantial amounts of **Vitamin E, Vitamin B6** and **folic acid** (as folate)

Germinated pulses have higher levels of Vitamin B12 which increases 48 hrs after germination and is highest after 96 hrs[1].

- Percentage of daily recommended intake found in 100 g of cooked chickpea and pigeonpea[2]

Cooked chickpea
- 44.5% Folic acid (as folate)
- 24.5% Vitamin E
- 10.5% Thiamin
- 10.3% Vitamin B6
- 4.3% Vitamin K

Cooked pigeonpea
- 28.7% Folic acid (as folate)
- 13.3% Thiamin
- 5.4% Riboflavin
- 3.7% Vitamin B6

- Major vitamins found in cooked pulses are Vitamin B6, Vitamin E, Vitamin K, thiamin, riboflavin and folic acid (as folate)
- Chickpea and pigeonpea are mainly cooked before consumption, and water soluble vitamins are less in the cooked form
- Pigeonpea is also popular as a green vegetable

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ICPH 3762: The first pigeonpea hybrid crop released for Odisha in 2014.

ICRISAT with the support of the Odisha government promoted improved chickpea and pigeonpea cultivars, production technologies and seed systems while strengthening farmer capacities in various districts of the state. Early duration varieties for central Odisha and medium duration varieties for south-western regions will be released in the next 2-3 years.

Only one-third of farmers in Odisha grow pulses and seeds are saved for the next season. Low, unstable yields discourage them from growing pulses in large areas. Since 2011, high yielding varieties and hybrids are being popularized along with demonstrations of improved crop management technologies and seed systems in 8 districts of the state. New chickpea varieties appropriate for Odisha are being identified. This will help improve pulse consumption from the current level of 26.6 g/day/capita, which is lower than the intake of 35 g/day/capita recommended by the Indian Council of Medical Research.

Investor: Department of Agriculture, Government of Odisha, India
Partners: Department of Agriculture, Government of Odisha; Orissa University of Agriculture and Technology, Bhubaneshwar; Odisha State Seeds Corporation.

[1] Rohatgi K, Banerjee M and Banerjee S. 1955. Effect of germination on vitamin B12 values of pulses (Leguminous seeds). The Journal of Nutrition (http://jn.nutrition.org/content/56/3/403.full.pdf)

[2] Calculation based on data from United States Department of Agriculture, National Nutrient Database for Standard Reference Release 28 (http://ndb.nal.usda.gov/ndb/foods)

Pulses provide **iron, potassium, magnesium calcium, phosphorus, sulfur** and **zinc,** to our diet

Micronutrients, (vitamins and minerals) are essential for the utilization of proteins and calories and to fight infections[1].

- Iron deficiency anemia is a serious health issue[2,3,4] and ranges from 50-70%, in women and children, with pregnant women being particularly susceptible
- Zinc deficiency is prevalent in 31% of the world's population[5]
- The poor are most affected as their diet is generally low in bioavailable zinc and may contain inhibitors of zinc absorption
- Chickpea and pigeonpea are great sources of iron, manganese and zinc

Percentage of daily recommended intake of minerals in 100 g of cooked chickpea and pigeonpea[6]

Cooked chickpea
- 52.2% Manganese
- 27.5% Iron
- 19% Phosphorus
- 16.5% Zinc
- 14% Magnesium

Cooked pigeonpea
- 25.4% Manganese
- 13.5% Phosphorus
- 13.2% Magnesium
- 10.5% Iron
- 10% Zinc

1. Magnesium is critical for proper maintenance of body weight and for a number of metabolic syndromes related to cardiovascular disease[7]
2. Minerals required for bone formation and for bone related metabolic processes include calcium, magnesium, phosphorus, potassium, manganese, copper, iron, zinc[8]
3. Green pigeonpea seeds has 28.2% more of phosphorus, 17.2% potassium, 48.3% zinc, 20.9% copper and 14.7% iron compared to *dal*. The dal, however, has 19.2% more calcium and 10.8% more manganese[9]

[1] Indian National Science Academy. 2011. Micro-nutrient security for India–priorities for Research and action (insaindia.org/download%20form/Micronutrient_final_with_cover.pdf)

[2] National Nutrition Monitoring Bureau (NNMB), Prevalence of micronutrient deficiencies; Technical report No.22, National Institute of Nutrition, ICMR, 2003

[3] National Nutrition Monitoring Bureau (NNMB), Diet and nutrition status of populations and prevalence of hypertension among adults in rural areas;. Technical Report No 24. National Institute of Nutrition, ICMR, 2006

[4] National Family Health Survey (NFHS-3), International Institute of Population Sciences, Mumbai, India, 2005-2006; Jan.2011, 96 (1):

[5] Caulfield L E and Black R E. 2004. Zinc deficiency in Comparative quantification of health risks : global and regional burden of disease attributable to selected major risk factors Volume 1. Edited by Majid Ezzati, Alan D. Lopez, Anthony Rodgers and Christopher J.L. Murray. World Health Organization Geneva

[6] Calculation based on data from United States Department of Agriculture, National Nutrient Database for Standard Reference Release 28 (http://ndb.nal.usda.gov/ndb/foods)

[7] Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, Gordon DJ, Krauss RM, Savage PJ, Smith SC Jr, Spertus JA and Costa F. 2006. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement: executive summary. Circulation 112, e285–e290.

[8] Palacios Cristina. 2006. The Role of Nutrients in Bone Health, from A to Z. Critical Reviews in Food Science and Nutrition Vol.46 (8)

[9] Faris, D.G. and Singh, U. (1990) Pigeonpea: Nutrition and Products. In: Nene, Y.L., Hall, S.D. and Sheila, V.K. Eds., The Pigeonpea, CAB International, Wallingford, 401-434.

Pulses are Good for THE PLANET

Smaller water and carbon footprint

Efficient use of water: Chickpea and pigeonpea need less irrigation and thrive on residual soil moisture.

Improve soil health: Pulse crops fix nitrogen, increase soil microbe diversity, provide green manure through leaf droppings and help conserve top soil. The less fertilizer needed as a result of the naturally added nitrogen, means the carbon footprint is low.

1 kg | Pulses = 0.5 kg* | Beef = 9.5 kg*[1]

*CO_2 equivalent

[1] http://www.cicilsiptic.org/pulses.php?id=25

Pulses production has lower carbon footprint than most animal sources of protein.

Low in pulses CO_2 because
- Low water use results in low energy use
- Reduces nonrenewable energy in the entire crop rotation by 22-24%[1]
- Pulse-Pulse-Wheat cropping has 34% less carbon footprint compared to a Cereal-Cereal-Wheat cropping pattern[2]

- Better farming practices, including use of pulse crops, can lower the average carbon footprint by 24 to 37%[3]
- Nitrogen fertilizers contribute to carbon footprint as its energy footprint is over 7.5 times more than other fertilizers such as phosphate and potash[4]
- Pulses help reduce use of chemical fertilizers by fixing nitrogen

"LeasyScan", a high-throughput phenotyping platform at ICRISAT, is being used to measure:
(a) leaf canopy development in low and high nitrogen soil
(b) maximum nitrogen concentration in leaf tissue and stem tissue, at flowering time.

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An innovative climate change research initiative

A large genetic variation in chickpea, capable of fixing nitrogen symbiotically in early stages of growth, may exist. Further research is needed to capitalize on this.

Research on developing climate resilient chickpea using germplasm including cultivated chickpea introgressed with wild ancestors from a unique, diverse, and recent collection in Turkey, is underway.

Trait differences across 20 wild chickpea populations that affect the crop's responses to drought, heat and climate-resilient nitrogen fixation is being studied.

Investor: United States Agency for International Development (USAID)
Partners: The University of California (UC) and ICRISAT

[1] Life Cycle and Socio-Economic Analysis of Pulse Crop Production and Pulse Grain Use in Western Canada. Saskatchewan Research Council Publication No. 12135-1E11, March 2011. (not published as of February 2012)

[2] http://www.cicilsiptic.org/pulses.php?id=25

[3] Zentner RP, Lafond GP, Derksen DA, Nagy CN, Wall DD and May WE. 2004. Effects of tillage method and crop rotation on non-renewable energy use efficiency for a thin Black Chernozem in the Canadian Prairies. Soil & Tillage Research. 77: 125-136.

[4] http://www.pulsecanada.com/environment/sustainability/non-renewable-energy

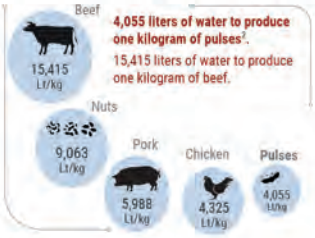
Well adapted to **semi-arid regions** pulses use
- **less water** and are
- **drought tolerant**

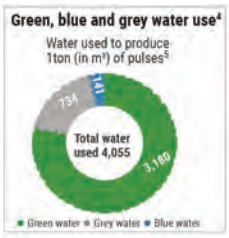
More efficient to obtain protein from crop products than animal products.

Water used to produce 1g protein in milk, eggs and chicken meat is 1.5 times, for mutton it is 3.3 times and for beef 6 times more than that used for pulses[1].

- Dryland tropics are generally water deficient and water management is a primary requirement

  Here it is critical to calculate water footprint of crops
- Many pulses use water differently by extracting water from shallower depths, leaving deep soil water for the following crop[3]
- Water use characteristics of pulses effectively increases the water use efficiency of the entire crop rotation





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In Muduvatti village, Kolar district, Karnataka, two farmers have water collection ponds to collect untreated wastewater and use it to irrigate their vegetable crops. These ponds, have been converted into a decentralized wastewater treatment system, using constructed wetlands. This system piloted by an ICRISAT-led consortium of 11 partners in India, as a business model, treats grey water through constructed wetlands and render it safe for agricultural use.

ICRISAT in collaboration with Coca-Cola Foundation and MYRADA, an NGO, work with the Muduvatti village farmers on agricultural productivity and livelihoods.

Partners: District administration, Government of Karnataka, MYRADA and ICRISAT
Investor: Coca–Cola India Foundation for Rural Water Infrastructure

[1&2] http://temp.waterfootprint.org/?page=files/Animal-products

[3] Gan YT, Zentner RP, Campbell CA, Biederbeck VO, Selles F and Lemke R. 2002. Conserving soil and water with sustainable cropping systems: Research in the semiarid Canadian Prairies. Presentation to 12th ISCO Conference, Beijing, China.

[4] **Green water**= rainwater consumed; **blue water**= surface and groundwater consumed and **grey water**= freshwater required to assimilate pollutant load based on existing ambient water quality standards.

[5] Mekonnen MM and Hoekstra AY. 2010. The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No. 47, UNESCO-IHE, Delft, the Netherlands.

Pulses produce about **21 million tons** of nitrogen per year[1]

[1] Herridge DF, Peoples MB, Boddey RM (2008) Global inputs of biological nitrogen fixation in agricultural systems. Plant Soil 311:1–18

Pigeonpea adds[2]
8-16 kg N/ha;
2.5-5 kg P/ha;
13.5-24 kg K/ha
(in entire crop cycle as leaf drop)

Pulses in the crop cycle play a major role in nitrogen fixation and in reducing carbon footprint worldwide.

- Pulses fix atmospheric nitrogen through a symbiotic relationship with nitrogen fixing soil bacterias living inside their root systems
- Chickpea leaves 20.4 kg/ha of residual nitrate in the soil after harvesting which is the highest among pulses[1]
- Production and application of nitrogen fertilizer accounts for 57% to 65% of the carbon footprint of each crop[3]
- Pulses help in efficient use of soil phosphorus by breaking down insoluble phosphates in the soil

@ ICRISAT[4]

Pulse crop fixing Nitrogen[5]

Access to good pigeonpea seeds transformed the lives of John Msuku and his family. As part of ICRISAT's smallholder farmer seed production clubs in Chambogho, Karonga district, North Malawi, he grew high-yielding certified seeds, contributing to a successful seed distribution system. In this unique agribusiness model, smallholder farmers grow certified seed that are loaned to other smallholder farmers.

John started in 1 ha land, to grow a new variety of pigeonpea, maturing in six months rather than nine and is less prone to water stress and risk of being eaten by livestock. John reaped a healthy harvest and re-invested to increase his production.

"I had never thought of agriculture having a business potential," he says. "I am happy to admit now I was wrong. Nothing goes waste. I use the stalks as fodder for my animals, and the leaves are good for fertilizing the soil," says John who now has two houses, 6 ha land, oxen, pigs and goats.

"We have nutritious food to eat and a good life," says Linley, John's wife. The key for him was to diversify and keep evolving.

Partners: Ministry of Agriculture, Irrigation and Water Development, Smallholder Producer Groups, the private sector and ICRISAT
Investor: Irish Aid

[1,2] Singh KK, Ali M and Venkatesh MS. 2009. Pulses in Cropping Systems. Technical Bulletin, IIPR, Kanpur

[3] Gan, Liang, Hamel, Cutforth, Wang. Strategies for reducing the carbon footprint of field crops for semiarid areas. A review. Agronomy for Sustainable Development, Springer Verlag, 2011, 31 (4), 643-656. pp. <10.1007/s13593-011-0011-7>.<hal-00930478>

[4] Story first appeared on the Thomson Reuters Foundation website. Read the full story here http://www.trust.org/item/20151009123820-sbq6o/

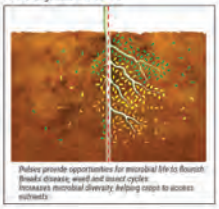
[5] http://www.pulsecanada.com/environment/sustainability/non-renewable-energy/how-do-pulses-help

Different compounds from pulses feed soil microbes and this benefits overall soil health

Crops grow better in soils with diverse soil organisms as they help break down and cycle nutrients more efficiently.

- Crops grow better in soils with diverse soil organisms as they help break down and cycle nutrients more efficiently
- Presence of diverse soil organisms tend to 'crowd out' disease-causing bacteria and fungi, resulting in healthier plants
- Growing pulse crops in rotation enables the other crops to benefit from these large, diverse population of soil organisms

Diversity in rotations[1]



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"I would never have thought chickpea could bring me such high returns," said 53-year-old Ms Temegnush Dhabi in 2013, standing in her grain store, filled with bags of harvested chickpeas. "From 1.5 ha, I harvested 42 bags (about 4 tons) of grain. "Temegnush a farmer for 29 years now, saw dramatic changes, when in 2008 she started working with researchers from the Ethiopian Institute for Agricultural Research and ICRISAT to test improved resistant chickpea varieties. Temegnush has since seen dramatic increases in her chickpea yields. Earlier, she grew teff (a popular cereal native to Ethiopia), that fetched a reasonable price at her local market, but required expensive fertilizer and was labor-intensive to harvest.

The project works closely with smallholder farmers to ensure that they access seed of improved grain legume varieties developed under the projects.

Partners: The International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA), National Agricultural Research Systems (NARS) partners in target countries across sub-Saharan Africa and India, and ICRISAT

Investor: Bill & Melinda Gates Foundation

[1] http://www.pulsecanada.com/environment/sustainability/sustainability-cropping-systems/whats-the-pulse-impact-on-soil

Pulses are GOOD FOR THE SMALLHOLDER FARMER

Resilience, diverse use brings in extra income

Survive weather fluctuations: Chickpea can thrive in desert-like regions; pigeonpea crops hit by unseasonal rain have potential for a second flush.

Diverse food basket and extra income: As an intercrop with cereals and other crops, pulses bring in extra income for farmers and also increase the yield of the main crop.

Pulses are

- Consumed by humans
- Used as livestock feed
- Green manure
- Fencing, and basket weaving

Leaves, pod coats and bran are fed to animals as dry fodder. Some pulse crops are also fed as green fodder.

Multiple Uses of Pigeonpea

- As green manure, pigeonpea produces 13,619 kg/ha of dry matter and 23 kg of N/t of dry matter[1]
- Pigeonpea leaves and forage, high in protein and easily accessible, are largely used as fodder for cattle and other animals
- The stems and branches of pigeonpea are used to prepare baskets, fencing and thatch, and serve as an additional income source for women
- In Thailand, pigeonpea is host to insects that produce lac, used for various products such as:
  - Color-fast dye used on animal fibers (wool and silk) and for coloring soft drinks and food
  - Shellac used for painting and furniture manufacturing[2]
- Farmers in Africa grow pigeonpea for its firewood more than for its grain. The calorific value of the pigeonpea stalks is about ½ that of the same weight of coal[3]
- A wind breaker/shade crop for young cocoa plants in Nigeria[4]
- Pigeonpea acts as a cover crop or support crop for vanilla in Southeast Asia and as a substrate for mushroom production in China[5]

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About 90% of southern China is covered with mountains bare of vegetative cover, resulting in soil erosion and landslides. In 1997, the first set of newly developed ICRISAT medium-duration pigeonpea varieties was sent to China, which showed high adaptation in various agro-ecological zones of southern China. It helped conserve valuable topsoil and rejuvenate infertile marginal lands. It led to greening of 25 million ha of degraded mountain slopes, and is an afforestation crop in major government reconstruction projects, growing on roadsides, hillsides and riverbanks. Southern China's shortage of quality fodder has been resolved by introducing pigeonpea.

[1,3&5] Mula M G and Saxena K B. 2010. Lifting the Level of Awareness on Pigeonpea - A Global Perspective. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Hyderabad, Telangana, India. ISBN 9789290665359

[2] FAO, 1994. Non-Wood Forest Products in Asia. Eds. Patrick B. Durst Ward Ulrich M. Kashio. RAPA Publication, FAO, Bangkok

[4] Ogbe FMD and Bamidele JF. 2007. Potential of pigeonpea (Cajanus cajan) for planted fallow in Edo State, Nigeria. Asian Journal of Plant Sciences 6(3): 490-495.

Known as orphan crops, pulses **receive much less attention** from researchers and policy makers compared to major commercial crops

There is a great scope for developing improved varieties of pulses, with higher resilience to drought, salinity and diseases, as they will play a vital role in the face of adverse climate change impacts on crop productivity.

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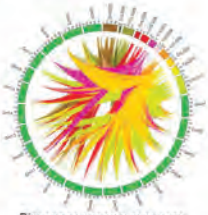
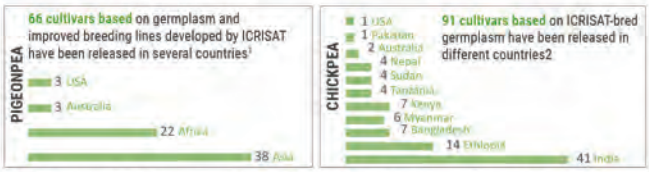


Pigeonpea genome sequence

- ICRISAT has been involved in dryland crop research since the 1970s, including research on chickpea and pigeonpea, which are among its mandate crops
- ICRISAT phenotype and genotype research makes adoption of these crops profitable for the smallholder farmers
- Working with several partners, ICRISAT has decoded genome sequence of pigeonpea and chickpea
- Large-scale genomic resources have been developed in these crops and resulted in being elevated to "genomic resources rich crops"
- These genomic resources are being used to develop improved varieties through molecular breeding approaches
- Several drought tolerant and disease resistant lines have already been developed in chickpea using molecular breeding approaches



Major contribution to work on developing improved varieties and hybrids has been under the projects, Tropical Legumes I & II. Some broad impacts in chickpea research are -

1. Wilt and sterility mosaic **disease resistant** varieties and recently released short and medium duration **hybrids** have **made a significant impact** in Asian countries
2. **Long and medium duration** varieties with **Fusarium wilt resistance** and **consumer preferred** large, cream colored seeds have **created impacts** in eastern and southern Africa
3. In India during 2013-14, **49%** of the **total indent for chickpea breeder seed** was from ICRISAT-India partnership varieties

Huge untapped potential of pulses can be enhanced by

- **Increasing production**
- **Value addition**
- **Building better marketing options**

Smallholder farmers and rural poor, can benefit from development of institutions and strategies that promote market coordination and reduce transaction costs.

- Helping smallholder farmers break the vicious cycle of subsistence production and poverty is a great challenge to ongoing research in reducing poverty and hunger worldwide
- Underdeveloped and imperfect agriculture commodity markets undermine smallholder farmers participation and hinder their ability to benefit from improved agricultural technologies and policy reforms
- Linking farmers to markets through efficient value chains will reduce intermediaries in the chain
- Strengthening value-adding by improved technology, infrastructure and inputs, processing and exports, can raise farmers' income and provide incentives to improve their management practices towards higher farm productivity

@ ICRISAT

Mini *dal* mills increase income

A group of 20 women belonging to the Garima self-help group, in Padasoli village, Tahsil-Bassi of Jaipur, Rajasthan, were trained in *dal* making and a mini *dal* mill was established through an ICRISAT project in 2012-13.

The mini *dal* mill became operational from 2013 onwards, making *dal* initially for family use, but later they began selling *dal* in the local market and doubled their profit.

The women plan to increase the members in the group, register the SHG and create awareness among women in the neighboring villages.

Additional benefit to the women is the use of *dal* husk for livestock feed, and the income from the sale of pigeonpea stalks as fuel wood (₹20,000/ha).

Investor: Directorate of Agriculture, Government of Rajasthan in collaboration with Swami Keshwanand Rajasthan Agricultural University, Bikaner, under the Rashtriya Krishi Vikas Yojana

Partners: Swami Keshwanand Rajasthan Agricultural University, Bikaner and ICRISAT

Short duration pulses have paved the way for **crop diversification** & **intensification**

Diversification strategies include crop rotation, double cropping and intercropping.

- Diversity is the relative abundance of each crop in the overall cropping pattern
- Major benefits of farm diversification to smallholder farmers are increased revenue, low input costs, adaptability to climate variation, and resilience to overcome risks and uncertainties
- Pulses are grown as a sole crop, intercrop, catch crop, relay crop, cover crop, green manure crop, etc, in different agroecological regions
- Intercropping helps obtain sustainable production even under adverse weather conditions
- On hill slopes, pulses act as an excellent cover crop and are also grown on rice bunds
- Relay cropping (paira) facilitates double crop and is sustainable. Here, pulse seeds are broadcast in the standing crop of rice about two weeks before harvest, enabling use of available soil moisture. Pulse yield was more than when planted after harvesting rice
- Catch crop is a short duration crop grown between successive plantings of main crops or are crops sown to prevent minerals being flushed away from the soil. It may be harvested or plowed under to improve soil fertility
- Ratoon cropping, a multiple-harvest system, where instead of cutting the crop, pods are picked and plants allowed to bear next flush of pods. Short-duration pigeonpea has created ratooning interest

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Studies[1] in Wenchi and Kade in Ghana indicate strong potential of pigeonpea in improving soil fertility and farm profitability. Crop rotation with pigeonpea as a long-term soil fertility management strategy is popular, and according to farmers, crops grown after pigeonpea (especially maize), look greener, grow faster, and yield more.

- In Kade, Ghana, pigeonpea in the cropping cycle resulted in 100–200% increase in maize grain yield, over continuous maize.
- It gave a 108% return on investment compared to 31% by continuous maize without fertilizer application to maize crop.

The above responses were recorded under the International Development Research Centre funded, climate change adaptation in Africa project in 2008, where farmers evaluated three early maturing and three late maturing pigeonpea varieties obtained from ICRISAT, India.

[1] S. Adjei-Nsiah, "Role of Pigeonpea Cultivation on Soil Fertility and Farming System Sustainability in Ghana," International Journal of Agronomy, vol. 2012, Article ID 702506, 8 pages, 2012. doi:10.1155/2012/702506

For more information about pulses see: www.icrisat.org/iyp/

For more information about Smart Food see www.SmartFood.org (coming soon)

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Over 62,000 MT pulses procured by government agencies

The government agencies have procured over 62,000 MT of pulses till now which include 50,424.07 MT of Tur and Urad from Kharif Marketing Season (KMS) 2015-16, and 11,754.06 MT of Chana and Masur from Rabi Marketing Season (RMS) 2016-17. This information was given by the Minister of Consumer Affairs, Food and Public Distribution, Shri Ram Vilas Paswan in a written reply in Lok Sabha.

The Minister says in addition, imports have been contracted for about 13,500 MT of Tur and 12,500 MT of Urad respectively. Domestic searches and surveys have also been conducted on a number of importers, traders and financiers engaged in pulses trade. Till now, request for allocation of pulses from buffer stock has been received from Andhra Pradesh, Telangana, Maharashtra, Tamil Nadu, and Rajasthan.

According to 3rd Advance Estimate pulses production declines marginally to 17.06 MT in 2015-16 from 17.15 MT last year, due to back-to-back drought and poor monsoon. Retail prices of pulses have been rising due to fall in production in the wake of poor monsoon and currently rates are ruling as high as INR 195 per kg.