

Prix PIERRE & COLETTE Bauchau 2013

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2013



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Prix PIERRE & COLETTE
Bauchau
2013



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Earth and Life Institute



Préambule

Afrique

Potentiel de développement agricole important

Révolution « **doublement** »-verte

Intensification des fonctions naturelles des écosystèmes – services écosystémiques (utilisation de la biodiversité)

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Contribution des cultures « sous-utilisées » et de leurs partenaires mycorhiziens à la durabilité des systèmes de culture en Afrique Sub-saharienne

7 mai 2013

Stéphane Declerck

Les sols africains sont devenus les plus pauvres du monde

- Pertes équivalentes à 4 milliards \$/an en éléments nutritifs
- 8 kg engrais / Ha – (10% de la moyenne mondiale)

Déclaration d'Abudja

Révolution verte africaine

- Passer de 8 à 50 kg d'engrais par Ha.

Intégration avec des pratiques agricoles adaptées

Comprendre le fonctionnement des agro-écosystèmes dans le contexte local

Stratégies

Utilisation des cultures sous-utilisées

= cultures indigènes, souvent anciennes, utilisées au niveau local, national et parfois international, mais qui ont la capacité de contribuer de manière encore plus importante à la diversité des ressources alimentaires qu'elles ne le font actuellement.

Utilisation de microorganismes bénéfiques du sol

Objectifs:

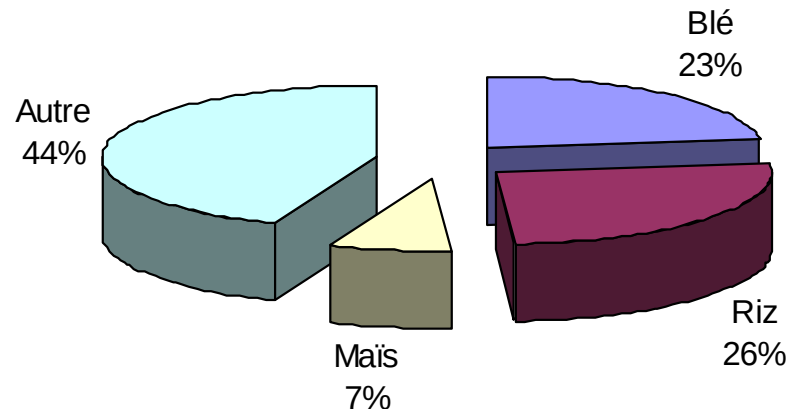
1. Promouvoir ces stratégies
2. Comprendre comment leur combinaison peut améliorer la durabilité de l'agriculture dans le contexte Sub-saharien

Les cultures sous-utilisées

± 7000 espèces de plantes ont été cultivées ou consommées comme aliments tout au long de l'histoire de l'humanité.

Aujourd'hui: le riz, le blé et le maïs constituent la base alimentaire de l'écrasante majorité des humains.

Contribution des cultures à l'alimentation globale



Potentiel des cultures sous-utilisées

- ➡ Sécurité alimentaire
- ➡ Réduction des déséquilibres nutritionnels « hidden hunger »
- ➡ Adaptation aux changements climatiques – aux conditions environnementales difficiles
- ➡ Nouveaux marchés
- ➡ Préservation de la diversité génétique

Les champignons mycorhiziens à arbuscules (MA)

➔ Association symbiotique entre le système racinaire de la plupart des plantes vasculaires (> 80%) et un petit nombre de champignons appartenant au phylum des Glomeromycètes.

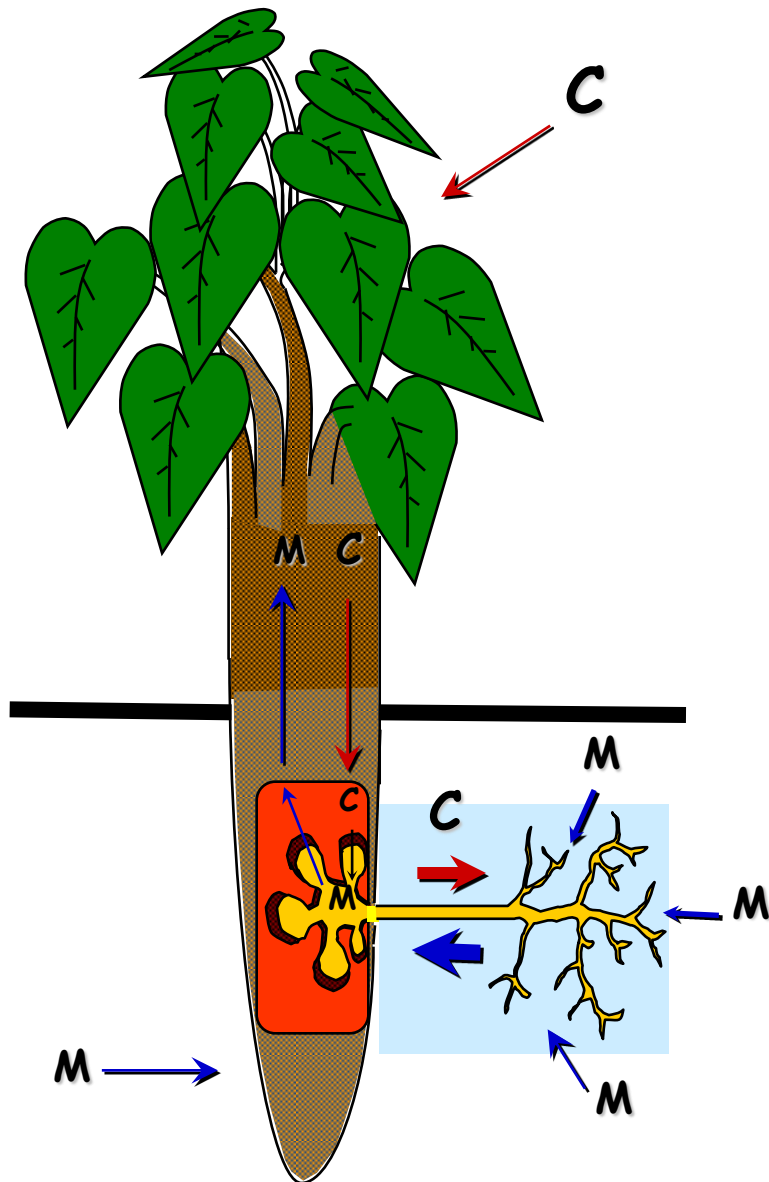
➔ Amélioration de la nutrition minérale (accroissement de biomasse)



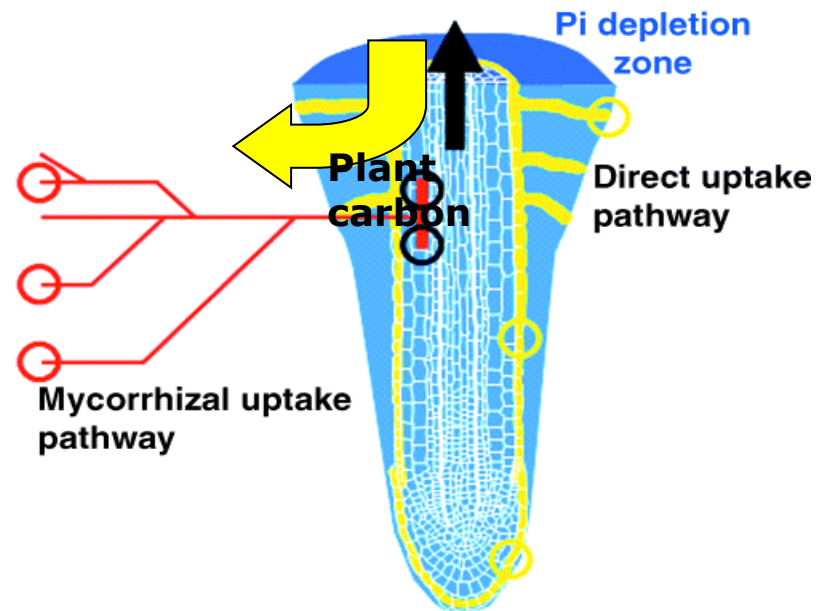
➔ Accroissement de la tolérance des plantes aux stress a/biotique

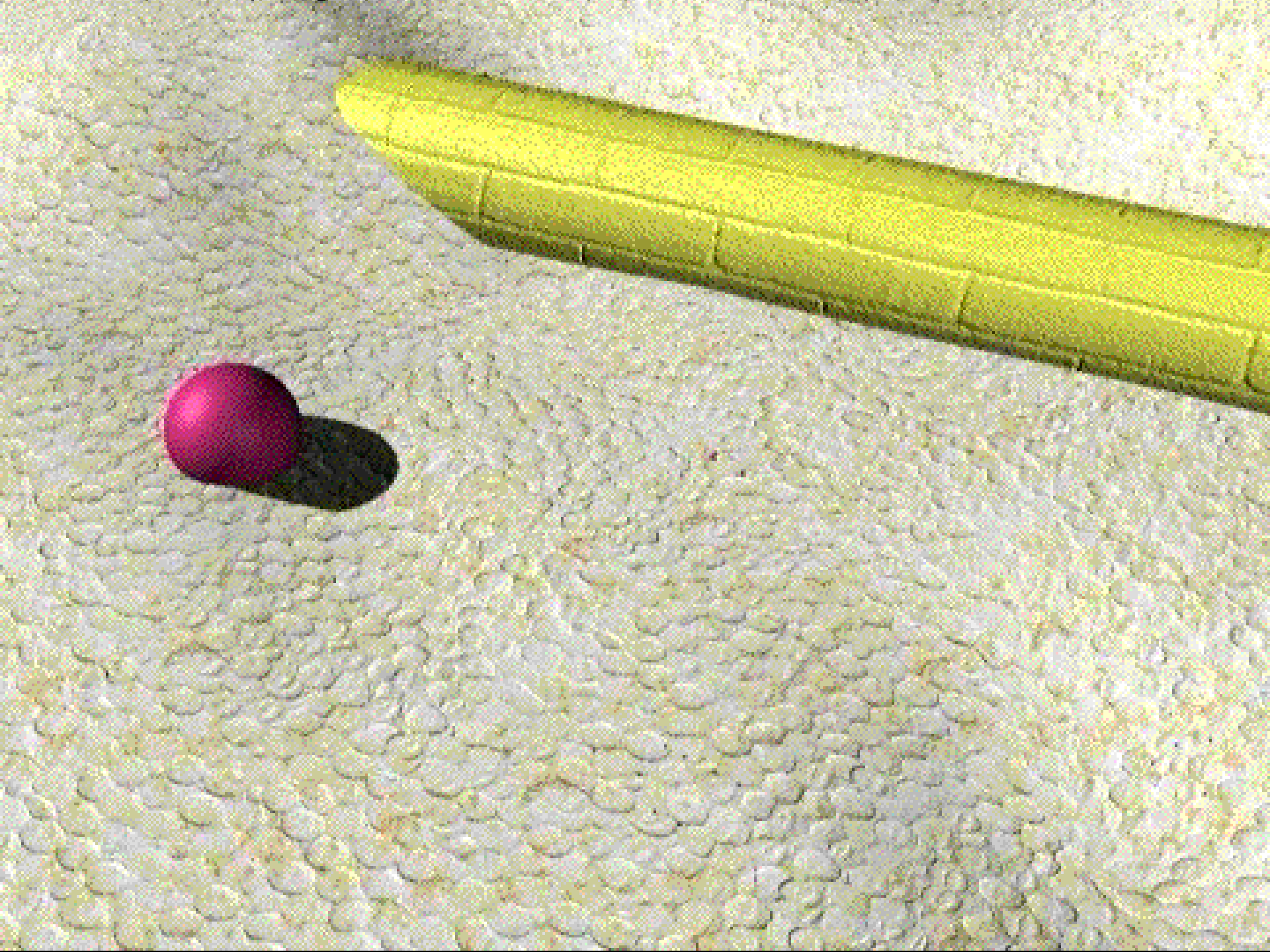


La relation plante-champignon MA



Mycorrhizes – voies de prélèvement du P





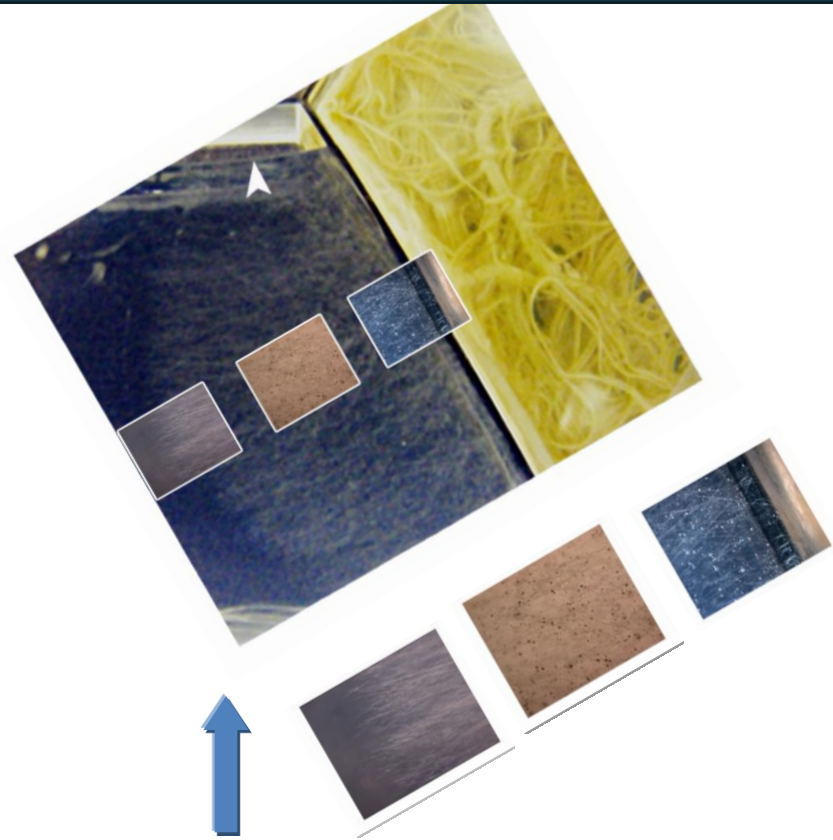
Les réseaux mycéliens – le world wide web souterrain



Photo crédit: <http://sarcozona.org/tag/mycorrhizae/>

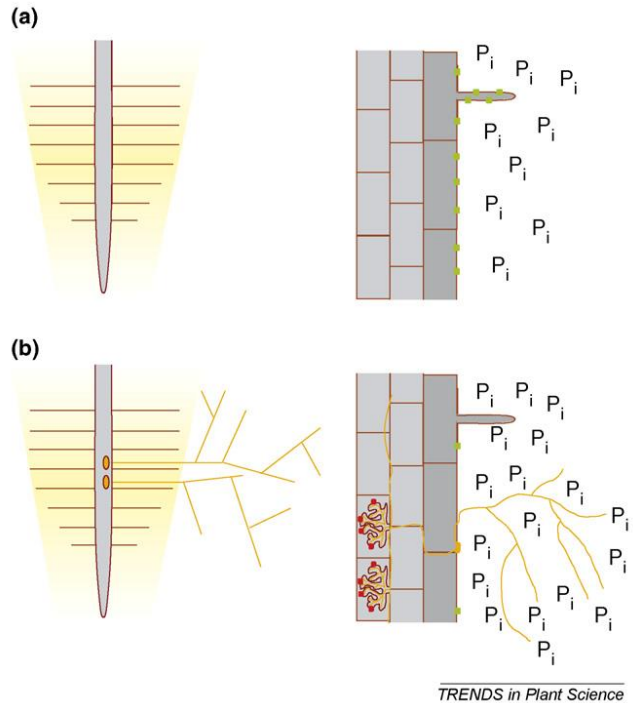


Et les champignons MA !!!





Les champignons MA représentent-ils un potentiel pour les cultures sous utilisées?



Hypothèse: plantes sous-utilisées doivent être particulièrement adaptée à la mycorhization.

L'application de RMC (avec des CMA sélectionnés) doit donc être importante pour la production et la résistance au stress abiotiques – au profit des populations locales

- ➡ La majorité des plantes cultivées sont mycotrophes
- ➡ L'amélioration génétique a sélectionné des plantes moins dépendantes
- ➡ La réponse des plantes est moins importante car cultivées dans des environnements moins stressés



Cassave

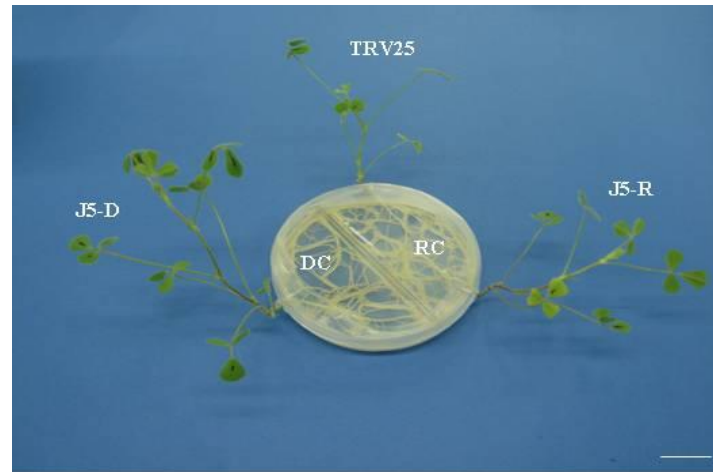


Yam



Niébé

Impact des RMC sur les cultures sous utilisées en présence/absence de stress nutritif et hydrique (modèles *in vitro*)



Voets *et al.*, 2008

➡ Dynamique de colonisation racinaire

➡ Structure des réseaux

➡ Comparaison d'organismes à stratégies évolutives différentes

➡ Balance C – nutriments (N – P) entre plantes interconnectées

Impact des RMC sur la qualité des sols et le rendement en conditions de champ

- ➡ Collaboration avec l'IITA (Dr. Piet van asten et B. Vanlouwen)
- ➡ Etablissement de CMN au champ entre plantes pérennes et sous utilisées
- ➡ Impact sur le rendement – macro et micro-nutriments – densités de pop des CMA

Conclusion

M. Graziano da Silva (Directeur Général FAO – Déclaration de Cordoue – 2012)

Les cultures sous-utilisées sont essentielles pour relever les défis agricoles et alimentaires du futur...

... si nous perdons ces ressources uniques et irremplaçables, il nous sera bien plus difficile de nous adapter au changement climatique et d'assurer une alimentation saine et diversifiée pour tous...

... les espèces sous-utilisées jouent un rôle crucial dans la lutte contre la faim et représentent une ressource essentielle pour le développement agricole et rural.

Les champignons MA et les Rhizobiums sont les organismes symbiotiques terrestres les plus importantes *'that help feed the world'* (Marx 2004).

La combinaison des deux offre des perspectives innovantes pour l'avenir

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Merci de votre attention

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Monsieur Emile Frison

Directeur général

Bioversity International

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Agricultural biodiversity: an under-utilized resource for reaching food and nutrition security:

Emile Frison
Director General, Bioversity International
7 May 2013



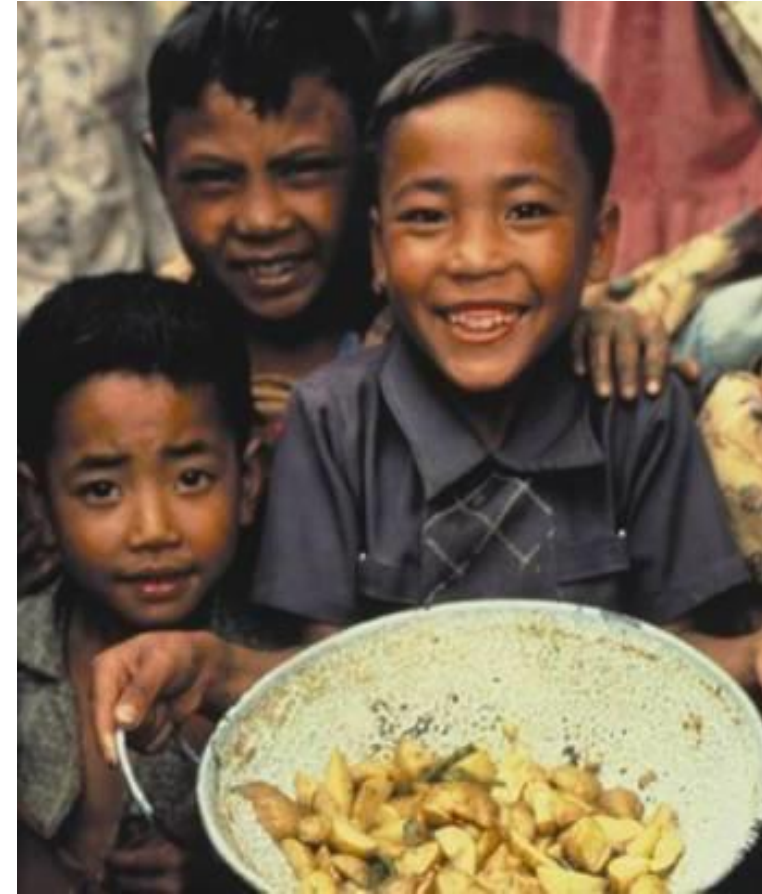
The challenges we face

Feeding a growing population

By 2050...

World population will grow
to 9.2 billion = **growth of 37%**

Food production must increase
by more than 60% ...
and be sustainable



Triple burden of malnutrition

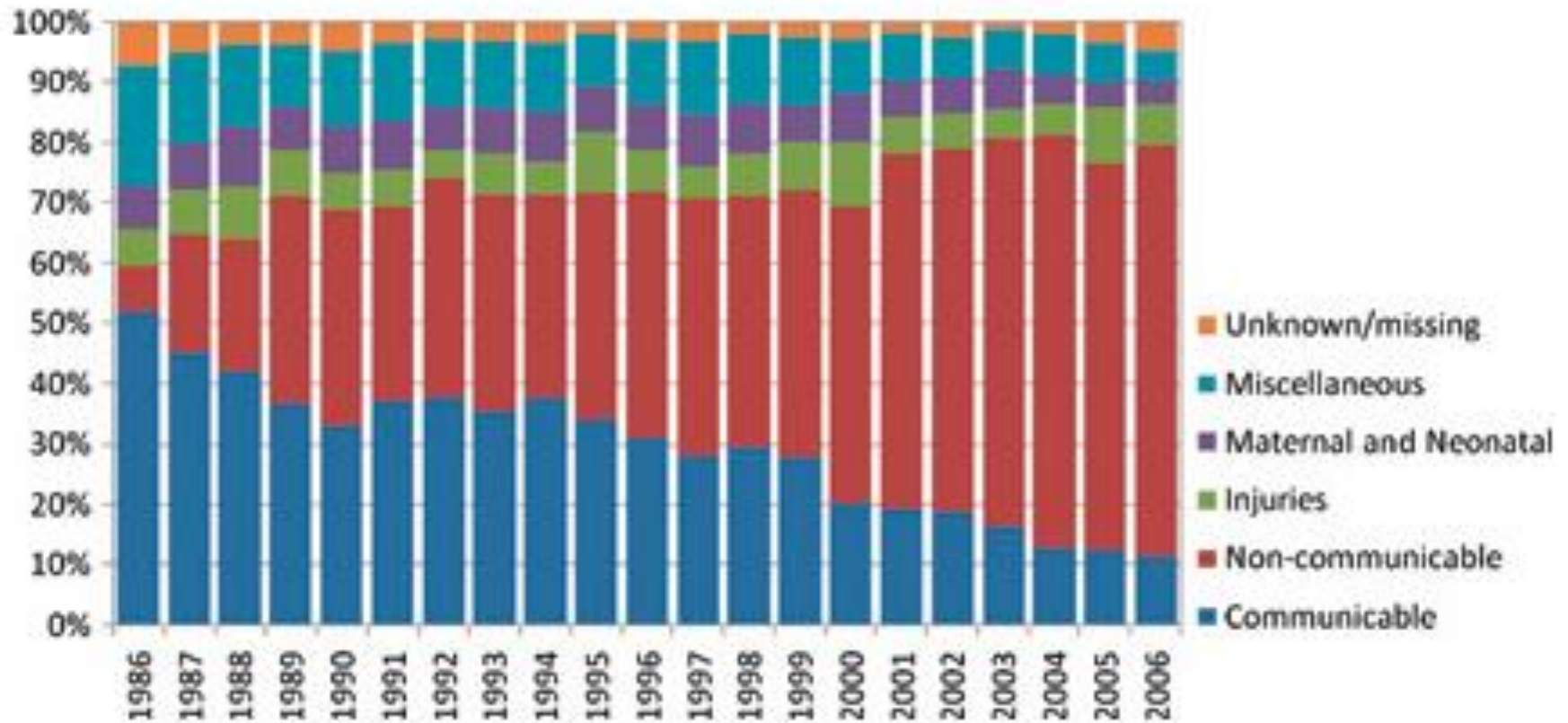
- **Hunger or Undernutrition** : Almost 1 billion people suffer from hunger and 3.5 million young children die of undernutrition every year.
- **Hidden hunger**: Young children and women are among those most at risk of developing micronutrient deficiencies.
- **Overnutrition and obesity**: More than 1.2 billion people are overweight globally. This number is rising quickly and dramatically everywhere.
- Increasingly in low income countries, under- and overnutrition exist side-by-side along with micronutrient deficiencies (the triple burden).



Increasing contribution of NCDs to cause of death

Rural Bangladesh (Matlab area, 1986–2006)

(Type 2 diabetes, cardiovascular diseases, some cancers, obesity)



Source: <http://www.globalhealthaction.net/index.php/gha/article/view/19/2301>

Climate change

Temperatures rise up to 2.5 degrees C

Changes in growing conditions

New pests and diseases

Water scarcity and desertification

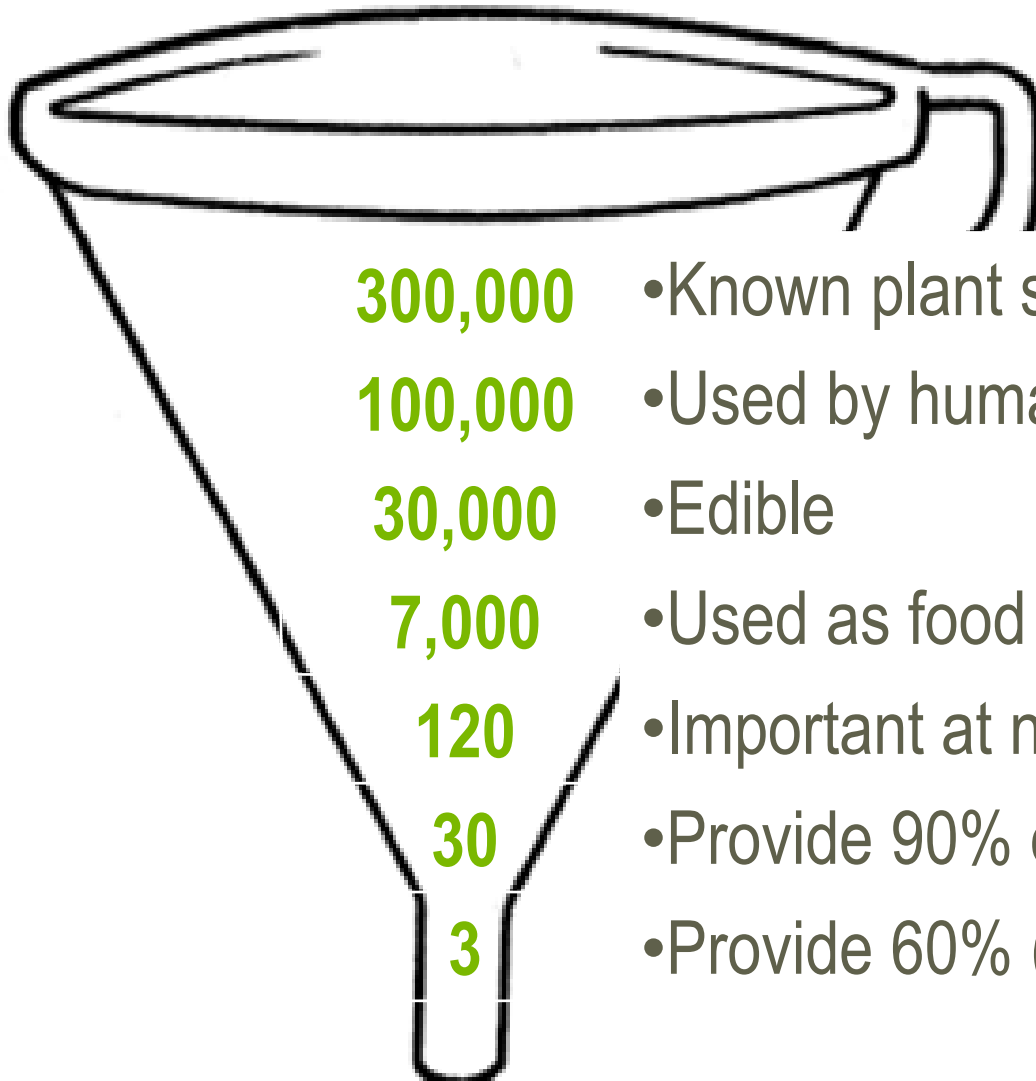


Climate change: more frequent extreme events

Less predictable seasons, greater risks...



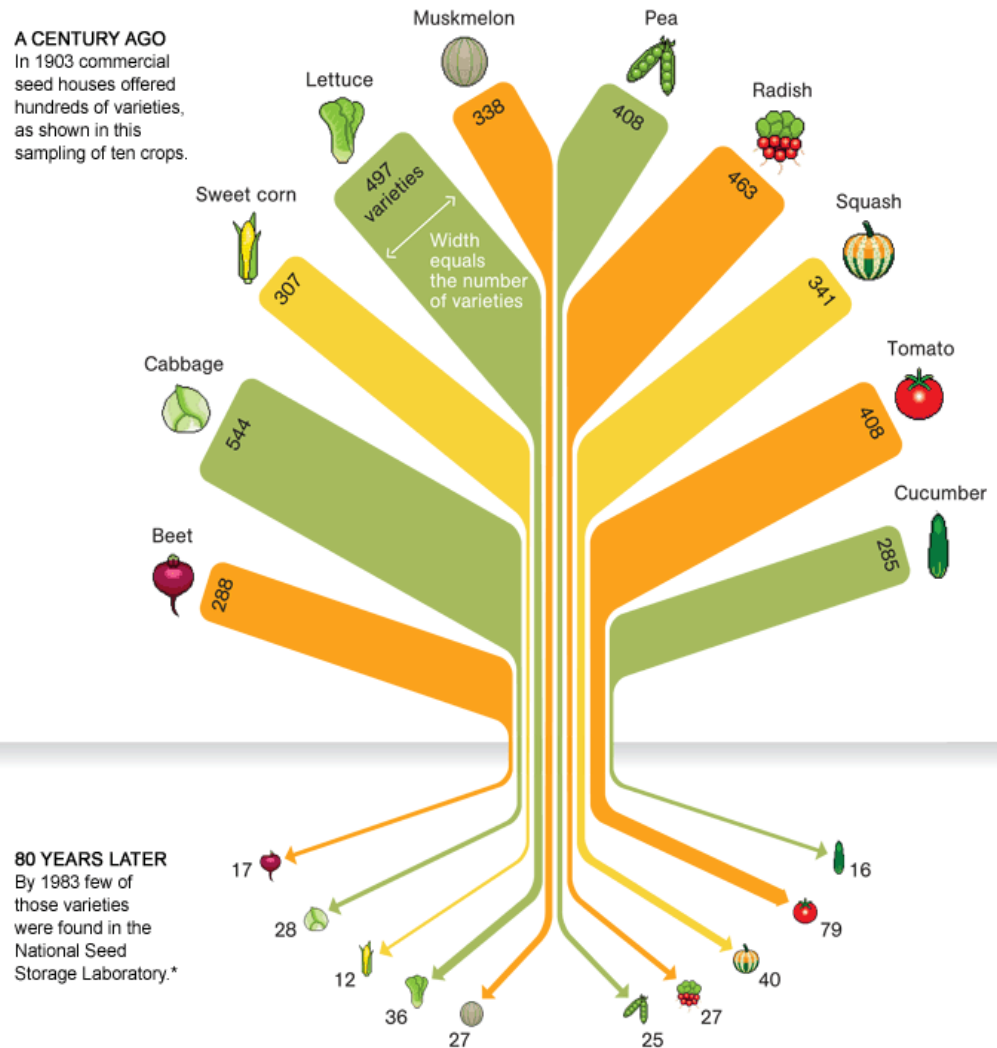
Increasing reliance on few plants



Loss of agricultural biodiversity



A CENTURY AGO
In 1903 commercial seed houses offered hundreds of varieties, as shown in this sampling of ten crops.



80 YEARS LATER
By 1983 few of those varieties were found in the National Seed Storage Laboratory.*

* CHANGED ITS NAME IN 2001 TO THE NATIONAL CENTER FOR GENETIC RESOURCES PRESERVATION

JOHN TOMANIO, NGM STAFF. FOOD ICONS: QUICKHONEY
SOURCE: RURAL ADVANCEMENT FOUNDATION INTERNATIONAL

How can agriculture meet these challenges?

We need to adapt...

Agricultural systems that produce more and better food under harsher conditions while protecting the environment

If we want to focus on the needs of the poor and hungry

→ we need a different paradigm



Better use of agricultural and forest biodiversity and agro-ecological intensification

In order to simultaneously:

- Improve smallholder livelihoods
- Enable resilient ecosystem services
- Provide better nutrition and health
- Create system sustainability.



Agricultural biodiversity for improved livelihoods

Creating more opportunities for Neglected and Underutilized Species (NUS)

Dried vegetables
and fruits



Pressure-popping



Noodles made from
sorghum and millets

Shaded coffee intercropped with bananas for greater productivity in Latin America

- In Colombia, >80% of plantains produced in mixed systems with coffee, cocoa, cassava or fruit trees and contribute 10% to 20% to income.
(Espinal 2005; Castellon 2010, Rajala 2010, Martinez 2011)
- In East Africa, mixed systems are less common, but economic benefits as compared to monocrop are significant.
(van Asten et al., 2011)



Soil health for plant health and enhanced productivity

- In Costa Rica research on suppressive soils in banana growing areas: a focus not only on soil-associated microorganisms and macrofauna, but also endophytes microorganisms: less disease incidence and better yields



Tropical fruit tree diversity: multiple strategies to ensure benefits to smallholder farming communities

- Piloting good practices that reduce risk and increase productivity
- Identify and improve access of best trees and information
- Increase the demand for the material marketing information, diverse products and value addition
- Ensure rights and provide recognition to custodian farmers and their networks
- Consolidate roles of smallholders farmers as conserver, innovator and promoter on community based approaches (CBM; PPB, CSB, FFS etc.)



Creating more opportunities for Neglected and Underutilized Species (NUS)

New uses for traditional crops: Enset

Traditional use is limited. But through innovation, new value added, new use and market for NUS created.



Growing Enset for animal feeding (*Ensete* sp)



早ければ12月下旬から出



Agricultural and forest biodiversity for agro-system stability, resilience and ecosystem services

Agricultural and forest biodiversity for ecosystem services: improving ecosystem function

- Nutrient cycling and soil fertility
- Pollination
- Water management
- Erosion control
- Pest and disease regulation
- CO₂ sequestration and climate regulation



Disease management through diversification: cultivar mixture against rice blast in China

- Row interplanting of susceptible glutinous rice together with resistant hybrid rice

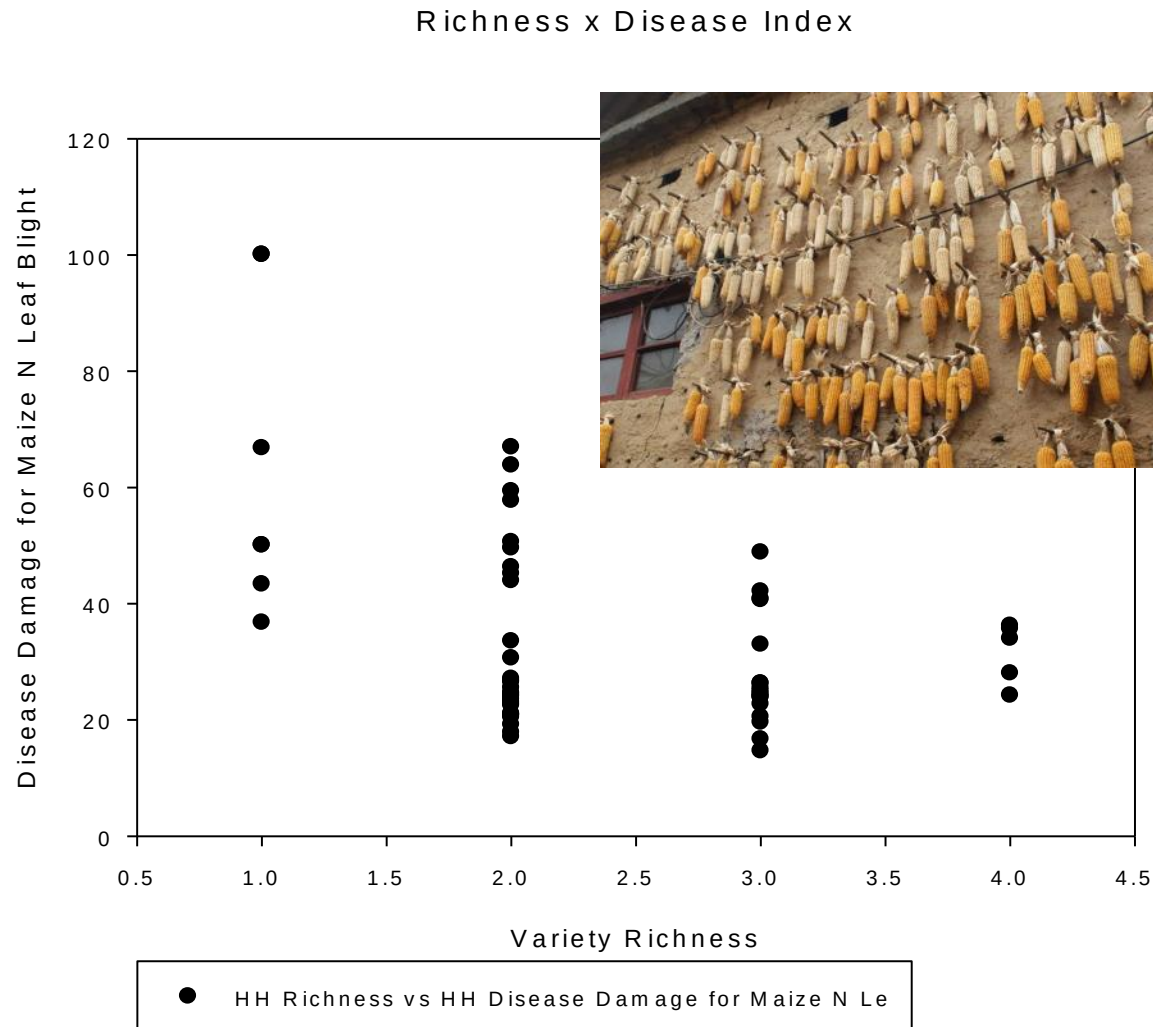


Blast-susceptible
glutinous variety

Blast-resistant
hybrid variety

- Re-introduction of traditional glutinous rice varieties (formerly replaced by blast-resistant rice hybrids)
- Lesser use of fungicides, reduced production cost; higher profit, yield increase of glutinous rice.
- Farmer's adoption of the practice:
1997: 15ha → 2002: 260,000ha → Continued expansion

Diversity and field resistance: Higher varietal richness less variance and damage



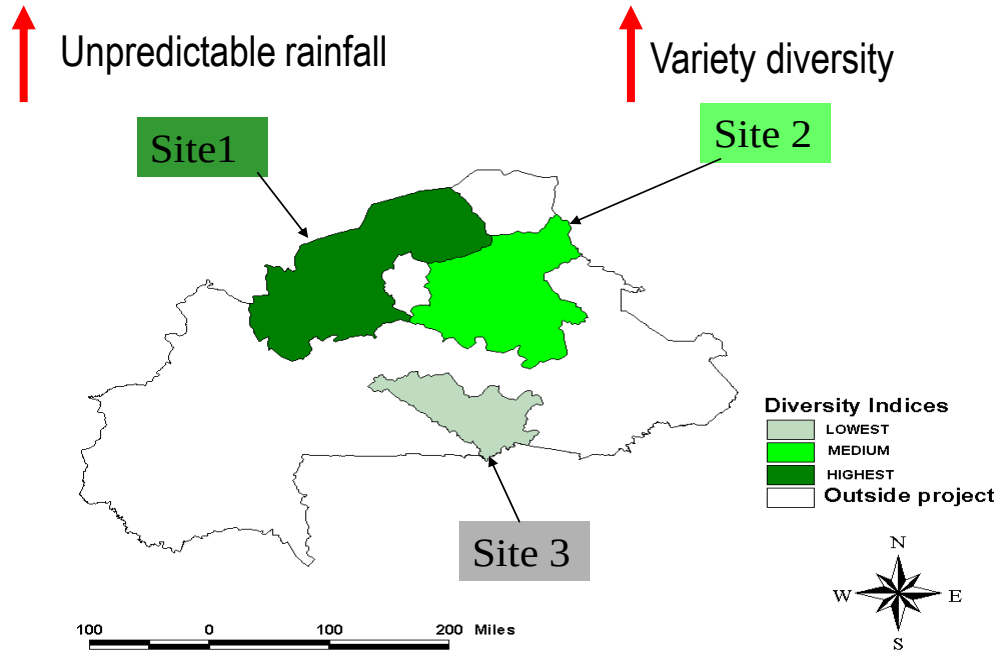
Peng et al., 2010,
unpublished data

Participatory plant improvement with poor farmers in Nepal: use of pro-poor traits

- Breeding goal set by farmers:
 - Improve taste of *Mansara* landrace rice and productivity
 - Retain its traits for specific adaptation to marginal conditions (poor soils)
- Continue to select and maintain seed of segregating lines under target niches until preferred traits are fixed-address G x E interaction



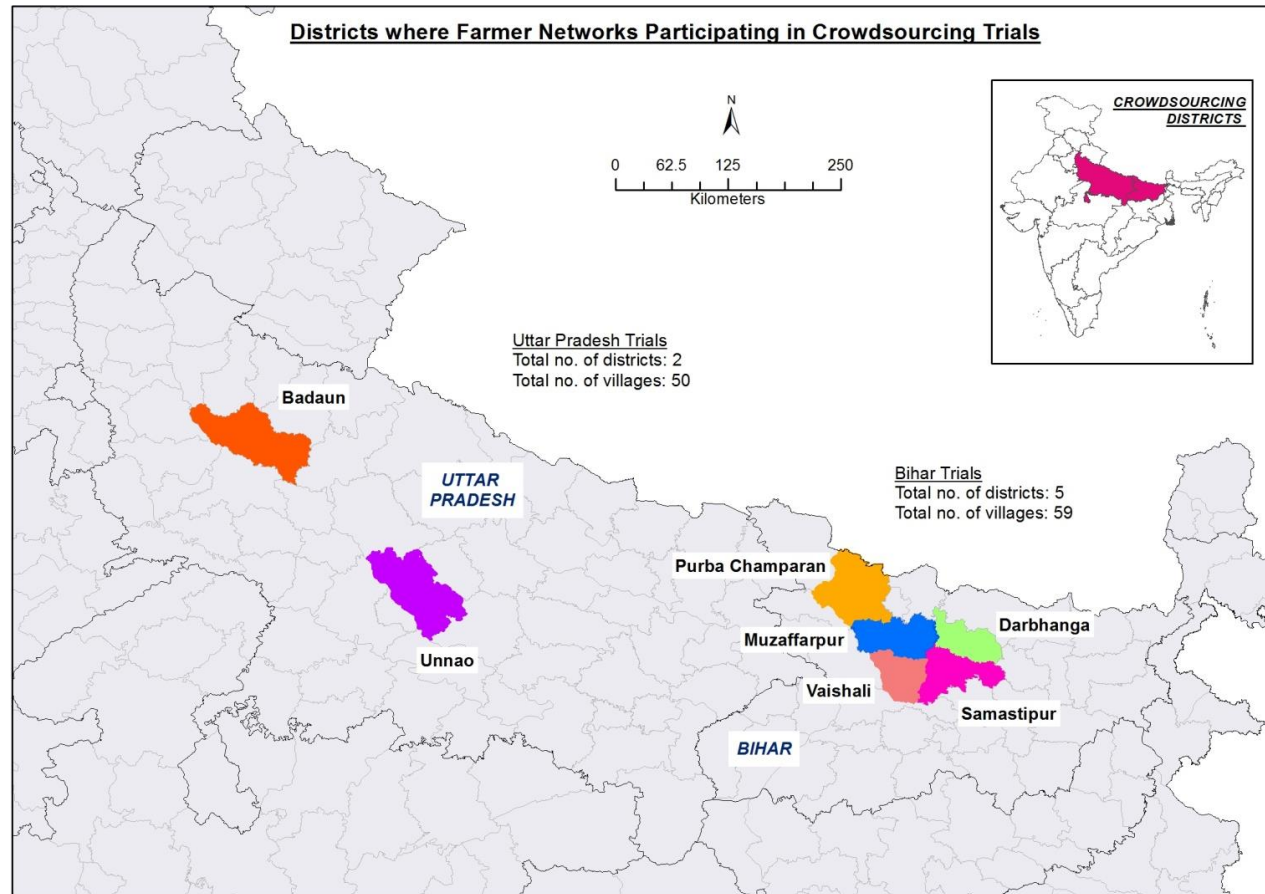
Minimizing risk for unpredictable environmental conditions in Burkina Faso



4-5 traditional sorghum varieties per farm (1.2 ha) and 23 per community with any two plants drawn at random within a farm differed in 69% (within a community 91%)

(Sawadogo et al., 2005 and 2006)

Broadening the genetic base of crop cultivation and empowering farmers for climate change adaptation through crowdsourcing

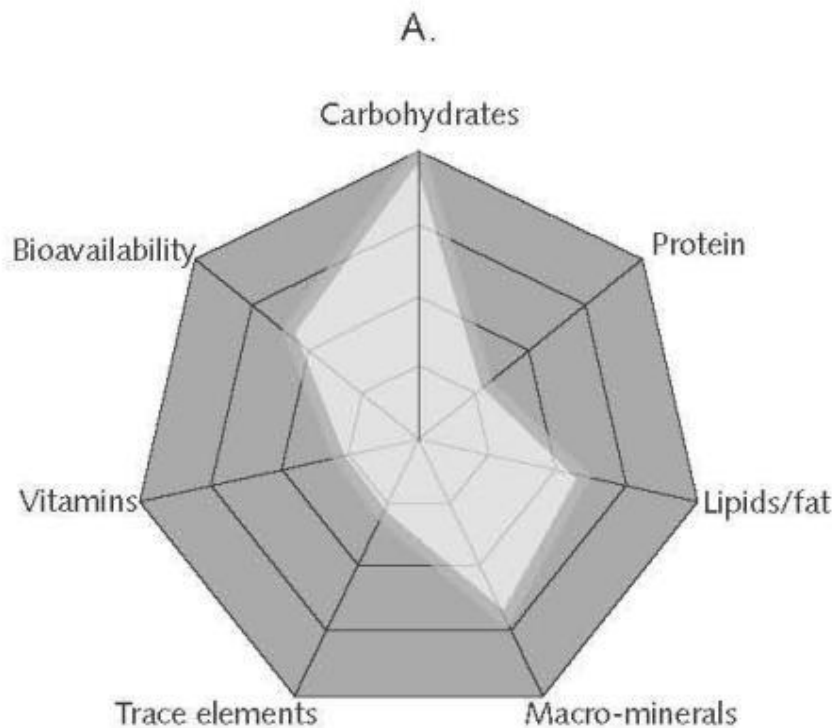


Citizen science approach scales out participatory crop research.

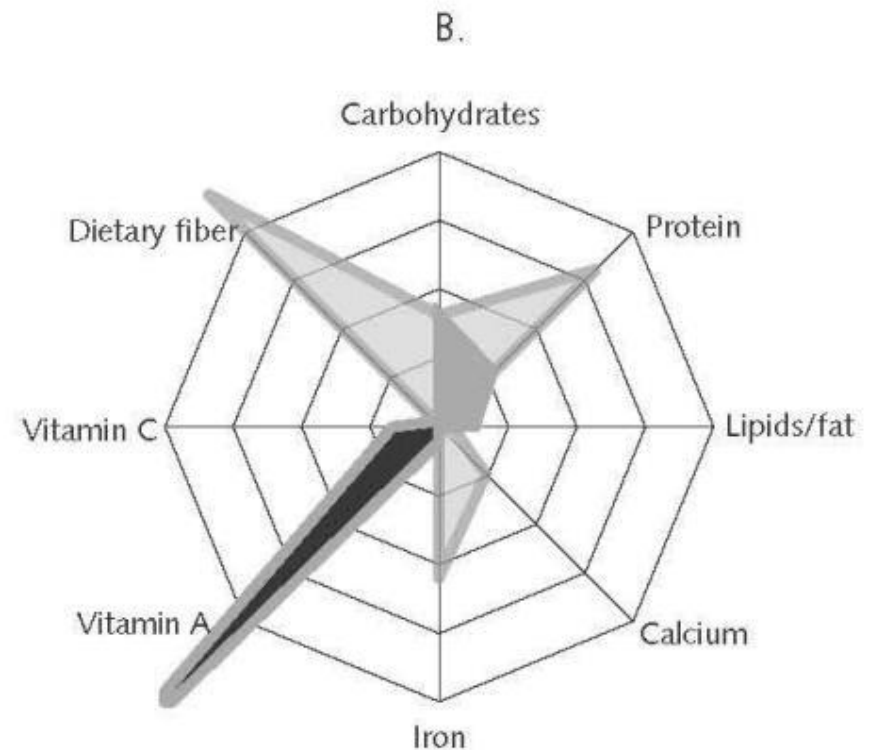


Agricultural and forest biodiversity, dietary diversity, sustainable diets and human nutrition

Nutrient diversity requirements



A. Ideal diet: dark gray; lack of protein and micronutrients: light gray.



B. Nutrient composition of 3 food crops shown as % of daily requirement: Corn: dark gray; Black beans: light gray; Pumpkin: black line.

(DeClerck et al., 2011)

The nutrition transition

Simplification of diets:

- Increased fats, sugars and processed/refined foods
- Energy rich but nutrient poor



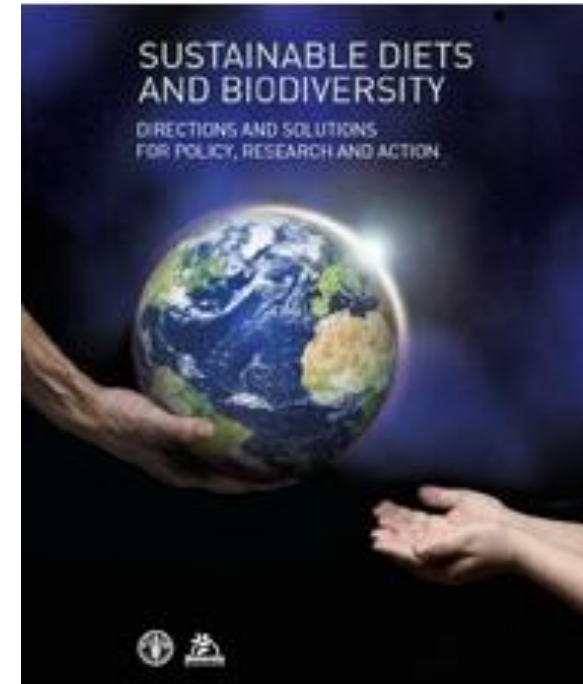
What is a Sustainable Diet?

Sustainable diets are those diets with **low environmental impacts** which contribute to **food and nutrition security** and to **healthy life** for present and future generations.

They are:

- protective and respectful of biodiversity and ecosystems
- culturally acceptable
- accessible
- economically fair and affordable
- nutritionally adequate, safe and healthy

...while optimizing natural and human resources.



INTERNATIONAL SCIENTIFIC SYMPOSIUM: *BIODIVERSITY AND SUSTAINABLE DIETS UNITED AGAINST HUNGER*,
3-5 NOVEMBER 2010, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS HEADQUARTERS, ROME

Agricultural biodiversity for nutrition

Promoting the use of agricultural biodiversity to provide affordable, nutritionally-rich food sources which contribute to dietary diversity and improved nutrition and health.

What has been tried in agriculture to improve nutrition?

- Fortification of commodities
- Biofortification of staple products
- Home gardening of fruits and vegetables
- Animal programmes to increase animal source proteins



Agricultural biodiversity (traditional foods, varieties...) is under-researched

Traditional African leafy vegetables (ALV) in Kenya

- Local ALV - nutritious, affordable, adapted to local growing conditions and cultural traditions.
- Identifying key issues hindering cultivation, conservation and marketing of traditional ALV in Nairobi peri-urban areas.

IMPACT

Of those growing ALVs, half of them (52%) participated in marketing.

Two-thirds of households increased their incomes, while half had increased their consumption.

(Gotor and Irungu, 2010)



Minor millets in India

- High in iron and calcium
- High tolerance to drought → more productive than other grains.
- Worked with 200 farming families to increase production and marketing of three minor millets.
- By training the women in quality standardization, packaging and production, new millet based recipes developed into popular snack foods, which led to increased sales of millet-based products and malt in urban markets.

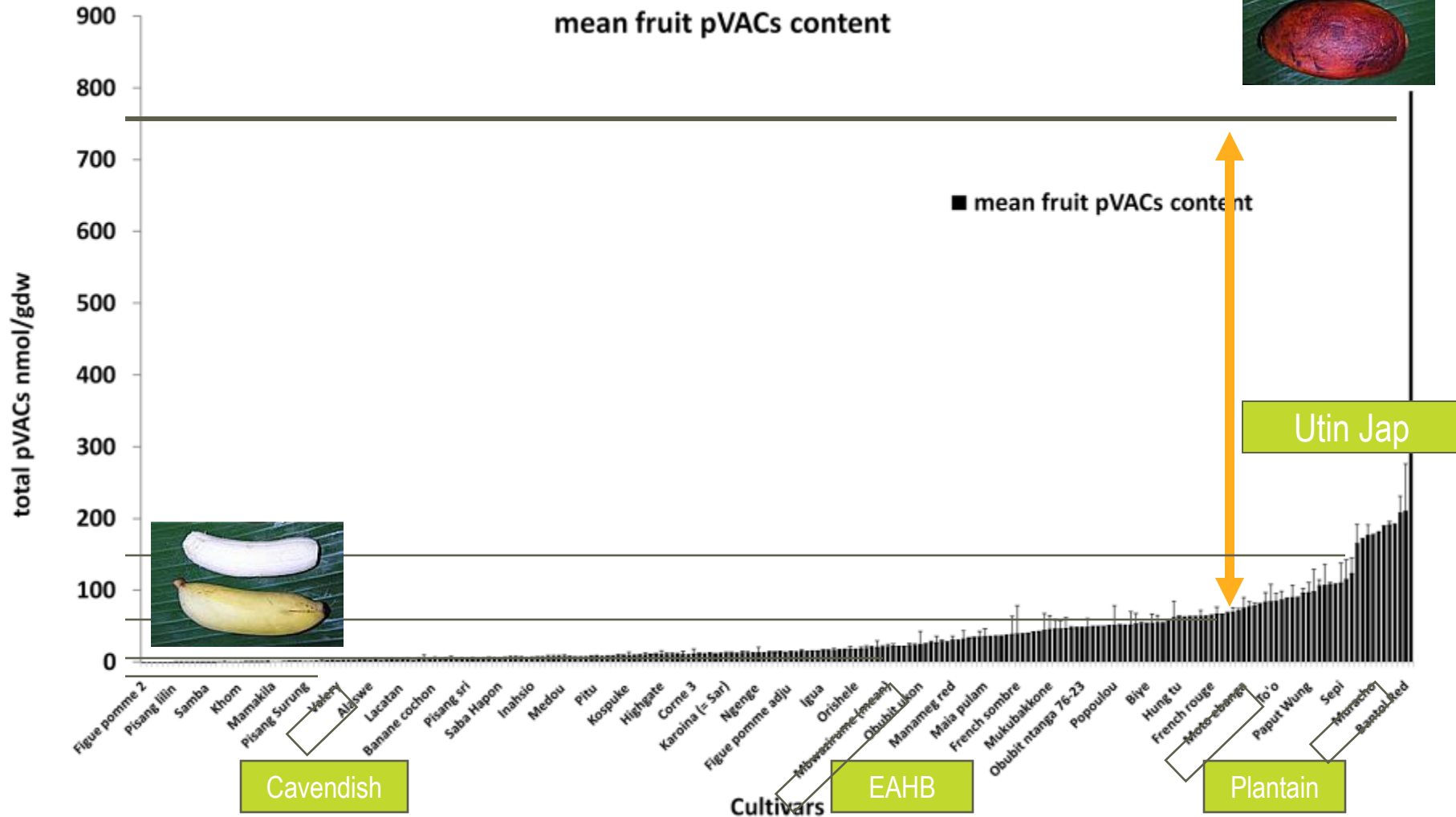


IMPACT

Monitored farmers increased yields by 70%.

Processing the millet into malt added value, and increased income, with some women tripling their profits by selling only the malt.

Exploiting existing diversity



Source: Davey et al., 2009



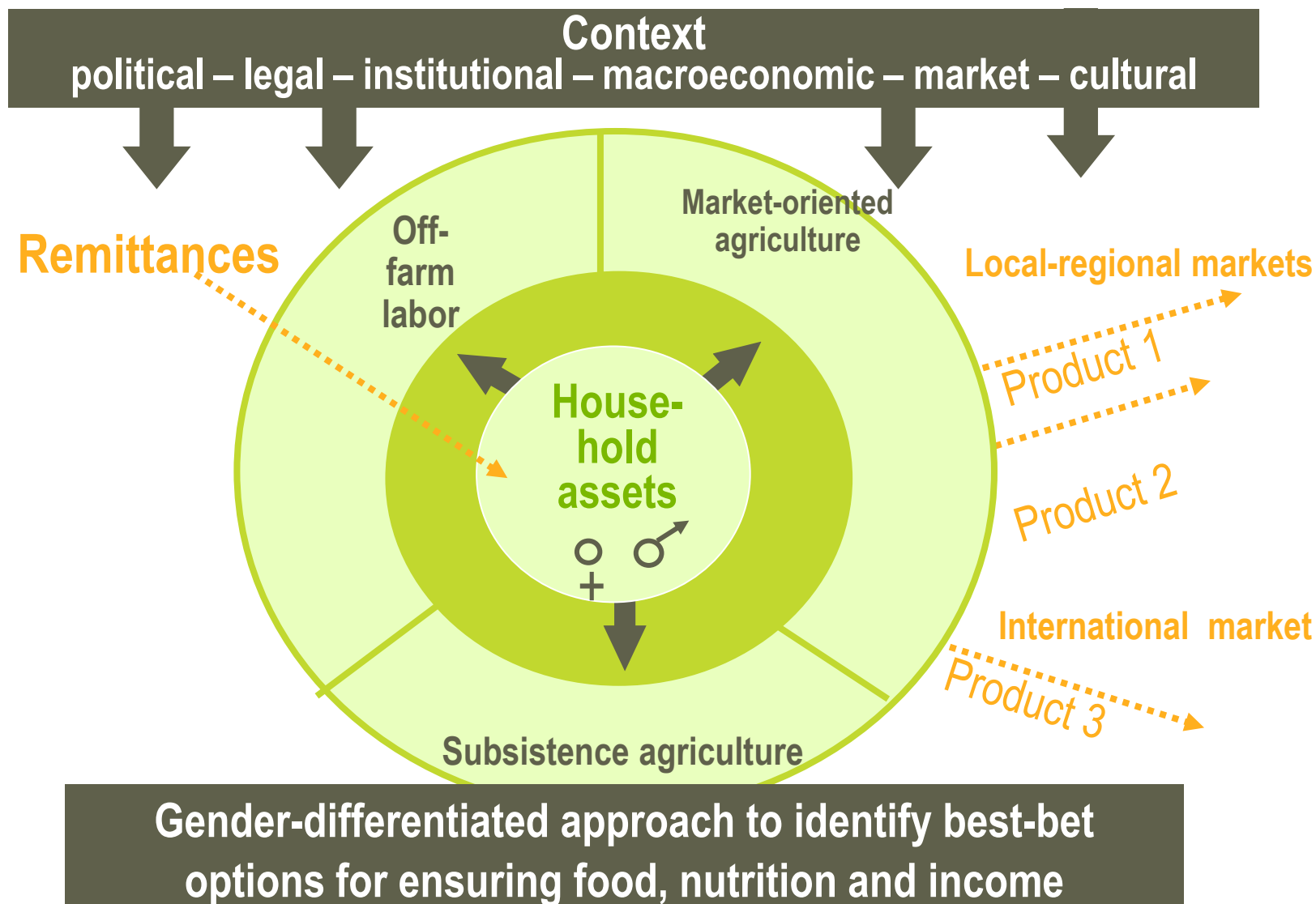
Value chains and institutional innovations supporting use of agricultural and forest biodiversity

Multiple values of agricultural and forest biodiversity

**Total Economic Value of agricultural biodiversity =
DUV + IUV + OV + BV + XV**

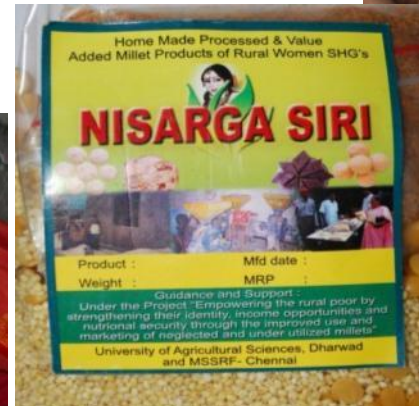
DUV	IUV	OV	BV	XV
Direct Use Values	Indirect Use Values	Option Values	Bequest Values	Existence Values
Food Animal feed Fibres Fuel Construction materials Traction and transport Source of income	Agroecosystem resilience; Symbiotic/synergistic effects Maintenance of geneflow, evolutionary processes, indigenous knowledge and culture, soil and water quality, pollinators	(for an uncertain future)	Satisfaction arising from passing specific genetic resources/ diversity on to future generations	Satisfaction arising from knowing that a specific genetic resource / diversity exists
Private Goods	Public Goods			

Multi-chain approach to value chain and livelihood development



Enhancing private values for the poor through innovations across the value chain

Elimination of drudgery makes millets viable options and more attractive food for households.



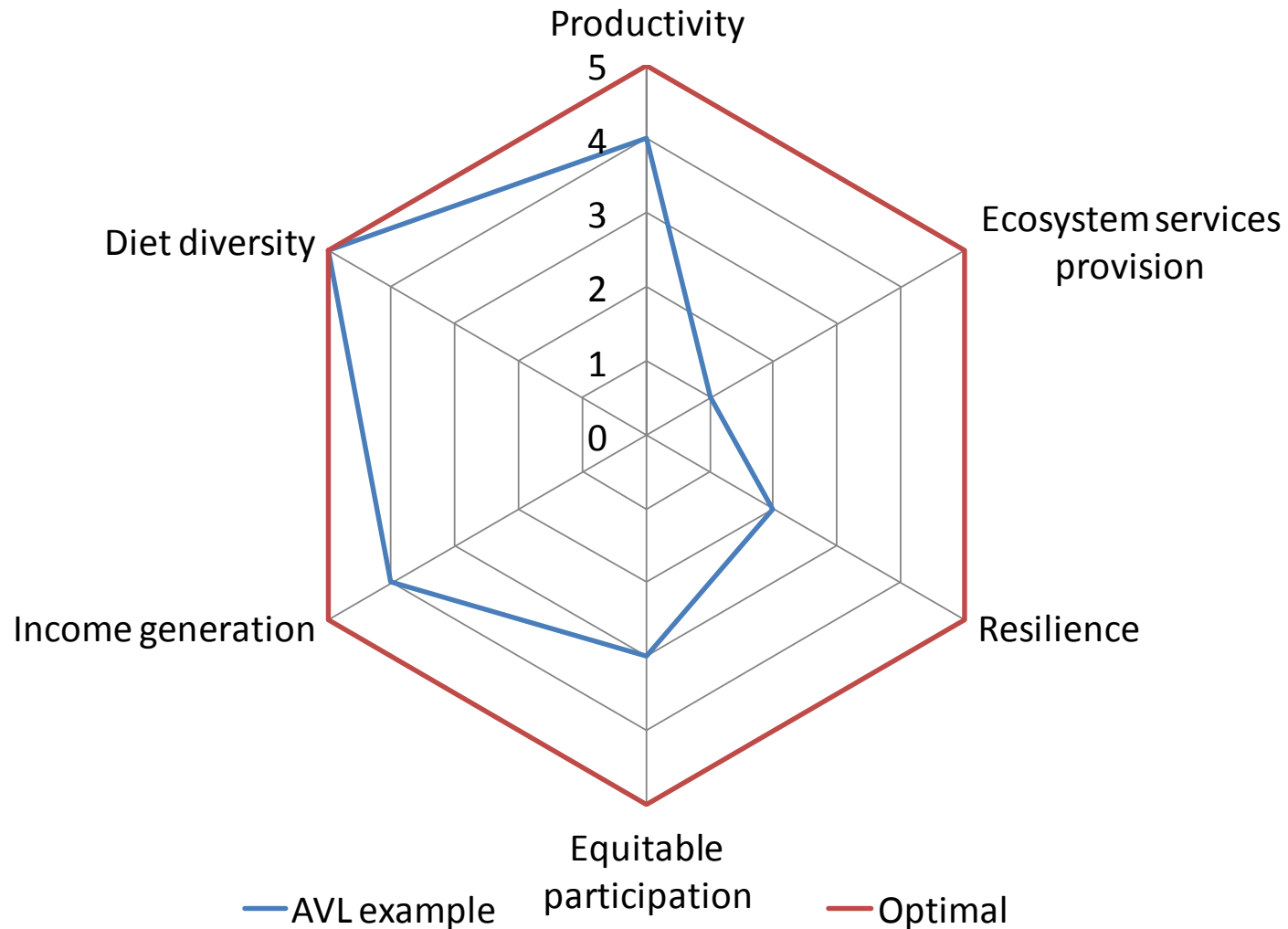
Develop new dishes and identify most suitable diversity.

(Padulosi et al., 2009)



**Integrating across
livelihoods,
nutrition and
sustainability**

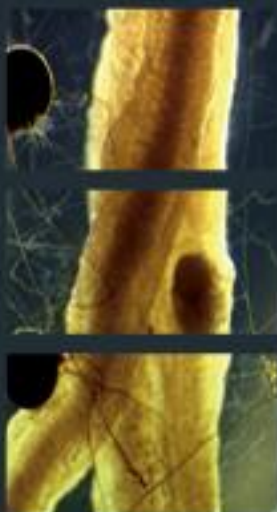
Integrating across outcomes



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Thank you



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