Quaker United Nations Office

Dialogue to Action Series
Consultation on: Small-scale farmers, agricultural biodiversity and the role of the public sector

Government means of supporting small-scale farmers and agricultural biodiversity

November 7-8 2016

Prepared by the Quaker United Nations Office
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Scope and objectives

This document presents some examples of government means of supporting small-scale farmers in agro-biodiverse settings. This is not the universe of possibilities, but rather an overview of a range of options that we have seen national governments using. There also are clear overlaps and relationships among the measures discussed.

The objective of this background document is to stimulate brainstorming and critical thinking leading up to the first consultation in the Small-Scale Farmer and Agrobiodiversity Dialogue to Action Series (DtA Series) scheduled to take place November 7-8 2016 at Chateau de Bossey, Switzerland.

Participants are invited to consider their own experience and keep the following questions in mind while reading:

- Where have national governments implemented these types of policies and programs?
- What other government actions, policies and programs not represented here have contributed to small-scale farmers' livelihoods and agricultural biodiversity?
- Under what conditions have they benefited small-scale farmers and contributed to agricultural biodiversity?
- Where have they had unintended consequences?
- What combination of policies and programs might be required to ensure that small-scale farmers as well as the rest of the population (e.g. urban poor) are food secure?
- How might a national government determine the unique combination of policies and programs appropriate for its country's circumstances?
- What can we learn from the "islands of success" identified in this document (and supplemented by your experience)? Governments will need a coordinated and comprehensive policy or framework to address food security country-wide.

We are wary of solely identifying isolated islands of success, where individual projects undertaken or investments made by governments have yielded benefits to farmers but are limited in scope or are so context-specific that they may not be applicable elsewhere. Ultimately, what we are hoping to do is provide some sort of guidance to governments: 1) on the process of determining their appropriate role, with this first step being supporting small-scale farmers and agricultural biological diversity; 2) and ascertaining what this means government needs to play this role, including challenges that may arise from potentially conflicting international or national policies. What form(s) this support may come in (e.g. a methodology, key questions to ask, examples of how particular answers may lead in one direction or another, or some other sort of tool or tools) is something we hope to determine at this consultation. We will then determine next steps.

The remainder of this document highlights a series of national government policies and programs, in no particular order. Only a very brief overview is provided for each, along with (an) example(s) of where it has been implemented and, when most pertinent, a comment on how they relate with WTO and other trade rules. Many of the examples given are alliances amongst some combination of the state, the private sector, privately-funded NGOs, philanthropic foundations and multilateral organizations. While we have tried to focus on the role of the state, in reality there is often an opaque or blurred distinction between public and private sector actions. One concern is the examples are often related to donor project-based funding raising issues of their sustainability if funding is stopped. In addition, as noted in the Concept Note

distributed with the invitation to this consultation, the impetus for this subject came from a QUNO consultation on small scale farmer innovation where concern was raised about the need for increased government involvement to support small-farmer innovation. That consultation concluded that more was needed to understand how to government could best support innovation *by* small-scale farmers and not just innovation *for* small-scale farmers.

This document will hopefully stimulate thought around the answers to the three questions we will be addressing in Bossey as a means to help us identify what kind of tool(s) might be most useful to support governments. The three questions that will structure the beginning of the consultation are:

1) what do small scale farmers' in agro-biodiverse situations need to move beyond survival to thrive? (i.e., what is the basket of possibilities – we know actual needs will be context specific);
2) what does this require from government as producers, providers of goods and services and as regulators?
3) what does this imply for what government needs (capacity-wise to undertake these roles)?

We look forward to what we hope will be a very productive and engaging time together in Bossey.

National government policies and programmes

Land title — particularly for women

Land is considered to be one of the most valued resources for rural citizens and is an important source of livelihood security for many individuals. It is a crucial agricultural input, and also serves as a form of insurance against malnutrition, as it can reduce the impact of food price shocks for small-scale subsistence farmers. However, on a global scale, women have much less access to land than men. In countries such as India, Nepal, Indonesia, and Vietnam, female landholders make up less than 15 percent of all landholders.[1] This lack of title to land effects female farmers' ability to access goods and services, such as credit. The OECD Development Centre has produced research that concludes that in countries where women do not have legal land rights, there are 60 percent more malnourished children, in comparison to countries where women have some or equal land rights.[2] Studies have shown that when rural women have greater control over assets and production decisions, this results in better overall household nutrition.

Women often face greater barriers to land ownership due to the structure of inheritance and marriage laws in many countries. Even with some positive changes to legislation in countries such as India, which enacted the Hindu Succession Act giving women equal rights to natal family assets, women have not acquired more titles to land.[3] This is often because land legislation schemes may run counter to certain historical social norms. The enactment and implementation of legislation promoting equal access to land title is commonly hindered by the illiteracy of many poor rural women, a lack of legal literacy, and language barriers.

Women have been recognized at the international level for their efforts in environmental and agricultural biodiversity protection, as keepers of traditional knowledge and stewards of *in-situ* conservation. Women make up 43% of the agricultural labour force in developing countries, whose livelihoods are intertwined with using landraces and maintaining biodiversity.[4] Female smallholder farmers more commonly work with subsistence crops, which result in greater crop diversity, and are responsible for household collection and use of natural resources. Women also play an important role in selecting, improving, and adapting local plant varieties, compared to traditional male involvement in mono-cropping for export. However, insecure land tenure reduces the incentives to invest in improvements in farming methods which will be necessary for continued biodiversity conservation under pressures of climate change.[5] Women often cannot

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[1] FAO (2013). *Gender Equality and Food Security: Women's Empowerment as a Tool against Hunger.* Rome: FAO: 24.
[2] FAO (2013): 28.
[3] FAO (2013): 25.
[4] Evelyn Namubiru-Mwaura (2014). "Land Tenure and Gender: Approaches and Challenges for Strengthening Rural Women's Land Rights." *Women's Voice, Agency, and Participation Research Series 2014.* No. 6: 1.
[5] World Bank (unknown). "Gender and Natural Resources Management: Overview," Accessed Online: http://siteresources.worldbank.org/INTGENAGRLIVSOUBOOK/Resources/Module10.pdf : 426.

engage in adaptation and mitigation strategies, given their lack of access to credit, and often rely on common property resources.

The Committee on World Food Security, in conjunction with the FAO, put out the *Voluntary Guidelines on the Responsible Governance of Land Tenure* in 2012 with the objective of realizing the right to adequate food, among other goals. The Guidelines recognize the importance of gender equality, stating that "states should ensure that women and girls have equal tenure rights and access to land, fisheries and forests independent of their civil and marital status," and remove discrimination based on legal capacities and lack of access to economic resources.[6] While the guidelines call for the state not to interfere with women's access to land, and for an end to discrimination, they also recognize the need for states to provide gender-sensitive assistance, acknowledging women's barriers to accessing land and resources, as well as their role in agriculture.

Multiple land titling schemes have been enacted by governments in order to ensure that women have greater access to land. In India, the government has given preferential or at minimum equal status to women under land distribution programs.[7] Several of these programs require joint property registration in the names of both spouses, or in the names of only female members in certain cases. The Nepalese government has implemented the Hills Leasehold Forestry and Forest Development Project, which leased user rights of forest land to the landless poor, a large proportion of which are women.[8] Those participants in the program that received user rights were responsible for rehabilitating forest land, but were also entitled to forest produce for 40 years. Women's group promoters were also recruited to the program to provide training to program leaders on gender, and provide female participants with training on leadership, legal rights, and basic literacy. In 2003, the Ethiopian government introduced a land title certification scheme where land titles were issued in the name of both spouses, which allowed for land rights of both sexes to be documented and recognized.[9] A similar scheme was implemented in Vietnam, which resulted in 42 percent of participants under the Joint Titles program to use their Land Use Certificate for investment, either as collateral to access credit or shares for investment.[10] This increased control over assets has given Vietnamese women greater decision-making power regarding land use.

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[6] Committee on World Food Security (2012). *Voluntary Guidelines on the Responsible Governance of Land Tenure of Land, Fisheries and Forests in the Context of National Food Security.* FAO: 5

[7] FAO (2013): 27.

[8] FAO (2013): 27.

[9] International Institute for Environment and Development (2016). "Women's land rights and Africa's development conundrum- which way forward?" Accessed online: http://www.iied.org/womens-land-rights-africas-development-conundrum-which-way-forward

[10] Wael Zakout (2016). "How joint land titles help women's economic empowerment: the case of Vietnam," Voices: Perspectives on Development Blog, World Bank. Accessed online: http://blogs.worldbank.org/voices/how-joint-land-titles-help-women-s-economic-empowerment-case-vietnam

Pricing policies

Broadly, pricing policies include any measure to control or stabilize domestic prices, including but not limited to minimum price supports or guarantees, supply management, protection against dumping, public marketing boards, market price information systems and competition policies. Price supports may also take the form of income supports, such as direct transfers or insurance programs, which supplement the incomes of producers.[11]

Price support policies seeking price stabilization may also set a price ceiling (a maximum price for a product) in addition to a price floor, thus mitigating price volatility and ensuring producers have a minimum income while keeping food more affordable for consumers.

Supply management is used to control supply of a product on markets, and in doing so controls prices of a product on markets. In agricultural markets it is usually used to ensure a sustainable price for farmers and to increase the bargaining power of farmers in relation to buyers, such as in the case of the Canadian dairy industry.[12] With the intention of matching domestic supply with demand, quotas are assigned and/or limits how much land is put into production are put in place to limit supply. Trade barriers may also be used to limit supply coming onto and leaving markets. Supply management can be integrated into international commodity agreements[13] in order to ensure fair prices for producers of major global commodities (e.g. coffee, cocoa, tea).

State trading enterprises (STEs) are enterprises or bodies authorised to engage in trade that are owned, sanctioned, or otherwise supported by the government. Governments can run STEs directly, or authorize non-governmental entities to run them. Marketing boards – organizations run by producers to market their products – are one of the more prominent forms of agricultural STEs. Many STEs have a monopoly control over imports or exports.[14] Historically, they have been quite prominent in agriculture, though their prominence has shown decline in recent decades. Many developing countries were required to dismantle STEs as a condition of structural adjustment policies in the 1980s.[15]

In Senegal, the national government imposed import restrictions to support domestic production. Beginning in 2008, the import of onions during the period where onions were produced locally has been frozen. The resultant was a rise in production from 40,000 tons in 2003 to 235,000 tons in 2012, and a growth in the market from 5 to 35 billion FCFA during the same period.[16]

In Brazil, the Minimum Price Guarantee Policy for Biodiversity Products (PGPM-Bio) guarantees a minimum sales price to producers and gatherers of ‘sociobiodiversity’ products. Established in 2008, the policy currently regulates prices of 11 edible crops. If a producer sells one of these crops a lower price than the government-set minimum price they are eligible to receive a direct

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[11] http://www.fao.org/docrep/x5572e/x5572e0o.htm
[12] http://www.cfa-fca.ca/media-centre/commentaries/supply-management-canadas-success-story
[13] An International Commodity Agreement is “a treaty-agreement between governments of both producing and consuming countries to regulate the terms of international trade in a specified commodity” http://www.fao.org/docrep/013/i2107e/i2107e11.pdf
[14] https://stats.oecd.org/glossary/detail.asp?ID=2541
[15] http://www.iatp.org/files/WTO_Reform_of_State_Trading_Enterprises_and_th.htm
[16] International Food Security and Nutrition Civil Society Mechanism (2016). Connecting smallholders to markets: An analytical guide.

grant (a bonus) to compensate for the difference (Law No. 11,775, 2008). In 2013, R$20 million (USD 6,349,508) was paid in grants.[17] The program is administered by CONAB, the same government agency that administers the PAA public procurement program. These crops make up a relatively small proportion of the food purchased by the PNAE and PAA public procurement programs, possibly because Brazilian agriculture is mostly based on a few exotic crops: wheat, corn, sugarcane and soy.[18]

The relationships between different pricing policies and WTO trade rules vary considerably. Policies that explicitly distort domestic prices are often considered trade-distorting, and are thus highly contentious.

Some policies are permitted through the WTO rules under strict conditions such as insurance policies, grain reserves (public stockholdings), and supply management. But even these can be complicated. Regarding supply management, production quotas are permitted under the WTO rules, however there are restrictions on the extent to which imports can be tariffed (and tariffs are likely to be required in order for managed supplies to compete against imports). Regarding grain reserves, WTO rules permit stockholdings but require assurance that they are non- or minimally-trade distorting, that they don't contain price supports, and that they comply with the WTO rules for STEs (below). For example, a grain reserve that paid farmers a minimum price higher than the market price would be considered trade distorting.[19]

Bilateral and plurilateral trade agreements may put even more constraints on governments' abilities to use these policies than WTO rules.[20]

Other policies, notably import and export controls, as well as direct payments to producers that are linked to production, face heavy restrictions. Import tariffs are allowed as specified in the "tariff rate schedule" that each country agrees to when it joins the WTO, and some countries can implement protections in the case of a sudden increase in the volume of imports of a specific product (known as an "import surge") under the conditions of the Special Agricultural Safeguard. However, the role of using import protections to facilitate agricultural development and food security is an extremely contentious subject. Export bans are not permitted under WTO rules, with exception for times of food shortages. However, duties, taxes or other charges on exports can be applied without limit, which can effectively serve as the equivalent of an export ban because it creates strong disincentive to export.

The WTO addresses STEs though the General Agreement on Tariffs and Trade (GATT). The GATT views STEs as legitimate participants in trade but requires that they are non-discriminatory towards importers and exporters and that they should act based on "commercial

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[17] http://www.conab.gov.br/OlalaCMS/uploads/arquivos/12_09_24_14_54_11_pgpmbio_2012-2013_icmbio.pdf

[18] https://www.aur.edu/wp-content/uploads/2016/08/BELTRAME_et-al_Opportunities-biodiversity.pdf

[19] At the end of 2014, India and the United States drafted an agreement that would allow countries to hold public reserves without risk of challenge through the WTO. See http://www.iatp.org/blog/201411/what-you-need-to-know-about-the-india-us-agreement-at-the-wto However, this only applies to those stockholdings already in place at the time of the agreement's draft, and is a temporary peace clause that does not apply to future agreements. The US and EU have maintained resistance to a permanent allowance for developing country public stockholdings. See http://www.twn.my/title2/wto.info/2015/ti150701.htm

[20] For example, Canada has frequently been challenged for its supply management in contemporary trade negotiations.

considerations." STEs may be challenged under the WTO rules if they provide a monopoly or engage in anticompetitive practices.[21] If an STE puts a price mark-up on an import, it is required to report this in its WTO submissions. However, the WTO has not received reports from all countries on their STE operations, which often lack transparency and accountability.[22]

Public procurement programs

Public procurement refers to the purchase by governments or publicly-owned entities of domestically produced goods and services. There is a wealth of literature available on how public procurement programs have been implemented to support small-scale farmers and contribute to rural development. The widely referenced *Fome Zero* (Zero Hunger) policy framework, launched by the Brazilian government in 2003, combined public procurement with school meal programs, affordable credit for farm capital and social protections such as cash transfers and food banks. Its main pillars were the Family Farming Food Acquisition Program (PAA), the National School Meal Program (PNAE) and the Bolsa Família Program (Family Grant Cash Transfer). This framework specifically channeled investment and skill development towards small-scale farmers and claimed to remove ten million farming families from poverty.[23]

There are outstanding concerns that *Fome Zero* has not addressed the structural causes of hunger in Brazil: landlessness and the increasing production of soy monocultures diverted to animal feed and ethanol, instead of staple food crops. Critics emphasize the urgent need for land reform, policies to prevent deforestation, and those that contribute to food sovereignty: where the country producers the necessary food for the domestic population rather than relying on imports.[24] The majority of food purchased through the PAA program is pork, milk, poultry, corn/maize and coffee[25] — products that contribute to diet diversity to an extent but not agricultural biodiversity more broadly.

In 2013, the Philippine government launched the *Partnership Against Hunger Program* (PAHP) in collaboration with the Brazilian government, the FAO and the World Food Program (WFP). The Philippines Department of Agrarian Reform, Department of Social Welfare and Development, Department of Agriculture, and Local Government Units (LGUs) of San Miguel, Molave, Midsalip and Pagadian City are working together to implement the three year pilot program. A key component is agrarian land reform. Food is purchased from beneficiaries of the reform, which is then supplied to community food hubs, child care centres and various feeding programs. Products purchased include livestock, crops, grains, and veggies in an effort to promote the health of undernourished school children.[26] The PAHP is being piloted in 9

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[21] http://www.policyalternatives.ca/sites/default/files/uploads/publications/National_Office_Pubs/competition_policy.pdf

[22] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.201.3319&rep=rep1&type=pdf

[23] Interview with Joao Pedro Stedile from MST and Via Campesina Brazil on FAO elections and the world's food problems. http://rajpatel.org/2011/06/28/blazing-brazilian-biofuel-beatdown/

[24] http://www.globaljustice.org.uk/blog/2013/sep/12/brazils-zero-hunger-programme-working

[25] Wittman, H. and Blesh, J. (2015). Food Sovereignty and Fome Zero: Connecting Public Food Procurement Programmes to Sustainable Rural Development in Brazil. Journal of Agrarian Change.

[26] http://www.dar.gov.ph/national-news/1285-dar-partners-with-da-dswd-against-hunger-poverty-in-pagadian-city

provinces, and has so far benefitted 72,722 children (recipients of food) and 5,040 farmers ("agrarian reform beneficiaries").[27]

The *Purchase from Africans for Africa programme* (PAA Africa) is currently being implemented by national governments in Ethiopia, Malawi, Mozambique, Niger and Senegal, with technical expertise from the FAO and the World Food Programme (WFP) and financial support from the Brazilian government and the UK's Department for International Development (DFID). By the end of 2014, governments had engaged 5,500 small-scale farmers to supply public institutions (particularly schools) to the metric of 128,000 students. In additional to improving small-scale farmer livelihoods, PAA Africa is seeking to strengthen markets for traditional crops, diversify diets and stimulate small-scale farmer innovation. The pilot project in Malawi in particular has procured a diversity of crops for schools (maize, beans, groundnuts, sweet potatoes, onions, tomatoes, banana, goat meat, fish and milk) — a unique aspect relative to existing public procurement programmes.[28]

Public procurement programs that buy from farmers at above the WTO market price and sell to consumers below market price operate similarly to grain reserves. This can be in violation of WTO rules on public stockholdings, if the Member country does not qualify for the temporary exemption recently negotiated by the United States and India, which exempts grain reserves for food security that were already in place when the agreement was passed.

The WTO's Global Procurement Agreement[29] could restrict local procurement initiatives and school feeding programs.[30] Currently, the agreement is plurilateral with 19 parties covering 47 WTO members (the 28 member states of the European Union included are as one party). Most parties are industrialized countries and thus should not apply to most developing countries.[31] However, as is the case with pricing policies, plurilateral trade agreements may impose additional restrictions upon contracting parties. For example, procurement contracts have been included in the Trans-Pacific Partnership (TPP) text, agreed by Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the US, and Vietnam in October, 2016. Signatories must give equal treatment to international companies in their domestic procurement processes.[32] Discussing the Transatlantic Trade and Investment Partnership (TTIP) being negotiated between the US and the EU, Karen Hansen-Kuhn, the Director of International Strategies at the Institute for Agriculture and Trade Policy (IATP), points that "both the U.S. and EU, for example, support farm-to-school programs that favor locally produced foods in school lunch programs, even if the cost is somewhat higher."[33] According to the IATP, this also threatens local food programs, such as the Los Angeles Food Policy Council's Good Food Purchasing Program, which seeks to get large institutions to pledge to specific food procurement procedures.

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[27] The Asian Farmers' Association for Sustainable Rural Development provides an overview of public procurement programs. See: http://asianfarmers.org/wp-content/uploads/2016/06/AFA-Issue_Vol-8-No-1_May-31.pdf

[28] Report from Phase I of the programme is available at http://paa-africa.org/wp-content/uploads/2015/02/Report-Phase-I_low.pdf

[29] https://www.wto.org/english/tratop_e/gproc_e/gp_gpa_e.htm

[30] http://fpif.org/food_security_and_the_wto/

[31] https://www.wto.org/english/tratop_e/gproc_e/memobs_e.htm

[32] https://www.cips.org/supply-management/news/2015/november/nations-agree-to-open-up-procurement-under-trans-pacific-partnership-deal/

[33] http://www.iatp.org/files/2014_05_01_Localization_KHK.pdf

Similarly, investment protections in the TTP, the TTIP as well as bilateral investment treaties and bilateral trade agreements could undermine local or national programs to set the conditions for appropriate investments in the production of healthier, more sustainable foods for local markets. Parties to those talks should establish broad exemptions to advance food security and sustainable development[34].

Access to affordable credit and insurance

Credit allows farmers access to inputs without payment, in trust that payments will be made in the future. Insurance compensates farmers for specified losses or damages due to climate variability or other unforeseen events. Access to affordable credit and insurance provides farmers with the means to invest in production and mitigate the risks of investment.

Many farmers take up illicit loans with exorbitant interest rates because they lack access to affordable credit. A rural financial system that facilitates savings, credit and insurance has come to be recognized as essential for rural and agricultural development, and food security. The challenge is to develop a system that will reach small-scale farmers in a way that is financially sustainable for the institution and affordable for the farmer. Cooperatives and group lending can assist with this, which can benefit from the economies of scale of grouping production and the reduced transaction costs compared to individual loans, and thus lower risk of default.

The FAO promotes credit guarantee systems for agriculture and rural enterprise development. Guarantees are a form of loan collateral subsidized by the government or a donor. Various types of guarantees help direct investment towards targeted groups or specific agro-industries that are deemed too risky to finance without risk-sharing incentives. In effect, they make lending more attractive and allow enterprises to borrow beyond their collateral limits. Such programs have been used around the world since the 1930s.[35] A 2013 FAO report documents four case studies of guarantee programs in Mexico, India, Nigeria and Estonia, including detailed financial assessments of each.[36]

Brazil's national policy for sustainable agricultural production: Agroecology and organic production (PLANAPO II 2016-2019)[37] offers credit and insurance, along with extension services, help fostering farmers networks and associations, access to local markets, and promoting the conservation and sustainable use of agricultural biodiversity. Credit and insurance is available to farmers transitioning to agroecological practices. Pronaf Agroecologia (coordinated by the Ministry of Agrarian Development - MDA) provides credit to family farms and traditional communities and land reform. The Low Carbon Agriculture Program (Programa de Agricultura de Baixo Carbono - ABC) (administered by the Ministry of Agriculture, Livestock and Supply, MAPA), provides credit to farmers investing in the improvement of organic production systems. The ALTER program (coordinated by MDA) has improved women's access

[34] http://fpif.org/food_security_and_the_wto/
[35] http://www.fao.org/docrep/017/i3123e/i3123e00.pdf
[36] http://www.fao.org/3/a-aq189e.pdf
[37] PLANAPO II 2016-2019 is an example of a comprehensive policy framework that seeks to support small-scale farmers and sustainable production. One area of work is 'socio-biodiversity,' emphasizing the indivisibility of the social, cultural and environmental aspects of agriculture.

to rural credit and government purchase programs government (Programa de Aquisição de Alimentos - PAA and Programa Nacional de Alimentação Escolar - PNAE).[38]

Facilitating financial services and credit in various forms are restricted under WTO rules. Grants, loans, equity infusion, and potential direct transfers of funds or liabilities (e.g. loan guarantees) are all forms of subsidies, which are restricted. It may also be considered a subsidy if a government entrusts or directs a private body to provide financial services even if it does not result in a government expenditure (e.g. if a government instructs private lenders to provide a preferential interest rate on a loan). Income and natural disaster insurance have explicit permissions under WTO rules. However, insurance payments are only allowed after a measurable level of loss, and require very specific accounting by producers and government that could be quite unmanageable in many developing country situations.

Integration of local food culture into school curricula

Governments may incorporate local food culture into health and nutrition curricula in schools to achieve behavioural changes at home.[39] The 2014 FAO report, 'Promotion of underutilized indigenous food resources for food security and nutrition in Asia and the Pacific' emphasizes that traditional foods have a much higher nutrient content than globally-traded species or varieties. It includes a number of case studies on the contributions of informal markets for edible insects to rural livelihoods, and concludes that policy-makers need be engaged in promoting indigenous foods and food biodiversity and underutilized foods should be integrated into school curricula.[40]

School garden programs have been shown to be effective in promoting the production and consumption of indigenous / traditional vegetables.[41] The Philippine Department of Agriculture's program, *Gulayan sa Paaralan*, has supported the establishment of 42,076 gardens in public primary and secondary schools, and is complemented by the nationwide campaign, '*Oh My Gulay*' where television personalities promote the consumption of vegetables, including indigenous vegetables.[42] No evaluations of this program in terms of its effect on agricultural biodiversity have been undertaken.

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[38] Brasil agroecológico : Plano Nacional de Agroecologia e Produção Orgânica – Planapo: 216-2019 / Câmara Interministerial de Agroecologia e Produção Orgânica. – Brasília, DF : Ministério do Desenvolvimento Agrário, 2016.http://www.mda.gov.br/sitemda/sites/sitemda/files/user_img_1068/Planapo%202016%202019.pdf?utm_source=emailcampaign411&utm_medium=phpList&utm_content=HTMLemail&utm_campaign=Boletim+informativo+da+2%C2%AA+Cnater

[39] Bundy D, Shaeffer S, Jukes M, Beegle K, Gillespie A, Drake L, Lee SF, Hoffman AM, Jones J, Mitchell A, Barcelona D, Camara B, Golmar C, Savioli L, Sembene M, Takeuchi T, Wright C. 2006. School-Based Health and Nutrition Programs. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, Jha P, Mills A, Musgrove P, editors. Disease Control Priorities in Developing Countries. 2nd edition. Washington (DC): World Bank; Chapter 58.

[40] Report available at http://www.fao.org/3/a-i3685e.pdf

[41] Holmer, R.J., Keatinge, J.D.H., 2012. Nourishing body and mind: How vegetable school gardens can contribute to achieving the Millennium Development Goals. Paper presented at the 2012 Rotary International Convention, 9 May 2012, Bangkok, Thailand.

[42] http://www.fao.org/3/a-i3685e.pdf

A report on the European gastronomic heritage: cultural and educational aspects (2013/2181(INI))[43] was adopted by the Committee on Culture and Education on 17 February 2014. The report calls for nutrition and gastronomy to be incorporated in school curricula as a compulsory component and for the development of related education policies. This document situates itself in the context of an obesity epidemic, poor diets, eating disorders among adolescents, high price of foods and inaccessibility of healthy foods in canteens, the homogenization of food production, and the importance of safeguarding and developing European gastronomy. It highlights the importance of fair remuneration for producers and the value of local procurement.

The report calls upon Member States to:

- Create awareness of the diversity and quality of the region's landscapes and products that are the basis of Europe's gastronomy;
- Support initiatives to maintain the high quality, diversity, heterogeneity and singularity of local, regional and national traditional products in order to combat homogenization;
- Support initiatives related to agri-tourism that foster knowledge of the cultural and landscape heritage, offer regional support and promote rural development;
- Promote and preserve all the territories, landscapes and products that make up their local gastronomic heritage;
- Promote local and dietetic gastronomy in schools and collective catering in association with local producers in order to preserve and enhance the regional gastronomic heritage, stimulate local agriculture and shorten supply chains.
- Request the inclusion of their gastronomic traditions and practices in the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage.

Promotion of culinary tourism and agritourism

'Culinary tourism' is a burgeoning industry.[44] Governments may develop culinary tourism strategies[45] and use government websites promote countries as tourist destinations for their local cuisine and food culture. Government websites provide significant marketing channels across Latin America[46] and Asia[47] in particular.

Government websites commonly provide information on:

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[43] Report available at http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-%2f%2fEP%2f%2fTEXT%2bREPORT%2bA7-2014-0127%2b0%2bDOC%2bXML%2bV0%2f%2fEN&language=EN

[44] Brulotte, R. L. (2016). Edible identities: Food as cultural heritage. Routledge.

[45] See for example the Ontario government's 2011-2015 Culinary Tourism Strategy, available at: http://www.mtc.gov.on.ca/en/publications/Culinary_web.pdf

[46] du Rand, G. E., Heath, E., & Alberts, N. (2003). The role of local and regional food in destination marketing: a South African situation analysis. Journal of Travel & Tourism Marketing, 14(3/4), 97–112.

[47] Case studies from Hong Kong, Japan, Korea, Singapore, Taiwan and Thailand reviewed in: Horng, J. S., & Tsai, C. T. S. (2010). Government websites for promoting East Asian culinary tourism: A cross-national analysis. Tourism Management, 31(1), 74-85.

- Culinary history and traditions, including table manners and common eating habits
- Cultural significance of particular exotic dishes or foodstuffs
- Link food to culture, ecology, spirituality of Indigenous Peoples and other communities
- Guide to cafes and restaurants that specialize in traditional dishes
- Restaurant certification to ensure quality
- DIY travel routes and guided food tours
- Information on festivals, farmers' markets and cooking schools

Horng and Tsai (2012) report that government's promotion of culinary cultural sectors is a key success factor for culinary tourism industries in seven countries in the Asia-Pacific region. Appropriate roles of government include:

- Establish marketing organizations at travel destinations to formulate and execute strategies for promoting culinary tourism
- Develop tourism resources including guides and other promotional materials, as well as sponsoring festivals.
- Integrate tourism into the country's overall development framework, ensuring coherence among policies and strategies; ensure communication and cooperation across departments/ministries
- Support private tourism-related and hospitality organizations through appropriate regulations, provide resources and integrate them into strategies; and clarify the relationship between government policies and tourism organizations
- Ensure quality control and management.[48]

Agritourism can likewise be promoted in order to support small-scale farmers and encourage the conservation of traditional agricultural landscapes. The Italian Ministry of Agriculture, in cooperation with all regional and national agritourism associations, promotes agritourism in accordance with the national law passed in 2006 (Law no. 96 of 20 February 2006 "Regulation of agritourism." Article 1 of this law outlines the aims this type of tourism:[49]

a) safeguarding, classifying and promoting the specific resources of each territory;
b) favouring the maintenance of human activities in rural areas;
c) encouraging multifunctionality in agriculture and the differentiation of farm incomes;
d) promoting initiatives by farmers for the conservation of soil, land and environment through increased farm incomes and improvements in the quality of life;
e) recovering the rural architectural heritage by protecting the features of the landscape;
f) supporting and promoting typical local products, high quality products, and related food and wine traditions;
g) promoting rural culture and education in nutrition;
h) encouraging the development of agriculture and forestry.

Starting in 2013, the sector has used the trademark, "Agriturismo Italia" to promote homestead stays for visitors.[50] All holiday farms across Italy may use the trademark in their advertising,

[48] Horng, J. S., & Tsai, C. T. S. (2012). Culinary tourism strategic development: An Asia-Pacific perspective. International Journal of Tourism Research, 14(1), 40-55.
[49] http://www.agriturismoitalia.gov.it/?page_id=1194
[50] An accompanying classification system gives visitors an idea of the level of comfort, hospitality and quality of the natural landscape to be expected. See http://www.agriturismoitalia.gov.it/?page_id=118 The

promotion and products. Mastronardi et al (2015) conclude that Italian agritourism operations tend to use more environmentally friendly agricultural methods, which have a positive impact on biodiversity, landscape and natural resources — possibly because national legislation stipulates that farmers must be dedicated mainly to traditional farming practices, promoting Italian farming heritage and landscapes.[51] Beyond accommodation, tourists pay for meals consumed on-site, locally produced wines, prepared meats, cheeses, jellies and jams, honey, baked goods, and crafts, which has raised the incomes of farmers. The growth of the agritourism industry (toted at 12.8% annually[52]) is encouraging farmers to stay on the land.[53]

Public marketing campaigns

Public marketing campaigns can be used as a policy tool in order to influence consumer behaviour and encourage the consumption of sustainably produced or biodiversity-conscious food. Campaigns and promotional activities can take a variety of forms, from traditional television, radio, and print ad campaigns, to sponsorship of sustainability-related events such as food fairs, farmers markets, and biodiversity education campaigns. As public sector actors have realized that it is difficult to compete with private sector actors for the attention of consumers, shifts have been made to a reliance on social marketing techniques that are more "customer-oriented" and employ concepts and tools of private marketing companies.[54]

Examples of such campaigns have included the Austrian Environment Ministry's partnership with other ministries, retailers, and NGOs to develop an annual Sustainability Week event to promote organic, locally-produced, and fair trade goods.[55] Evaluations of the event have shown augmented levels of consumer awareness and engagement, particularly among participating women, and has encouraged greater numbers of retailers to participate in subsequent years.[56] The German Development Cooperation Ministry has also implemented a 3.3 million Euro campaign to promote the consumption of Fairtrade goods through the promotional theme of "Fair Feels Good."[57] On the supply side, producers in vegetable markets of South India that cultivate traditional landraces of eggplants have received favourable market support, which has allowed them to capture a price premium on their goods.[58] This has allowed them to cover the opportunity cost of producing traditional landraces, in comparison with conventionally produced varieties. However, it is recognized that the wide margin between the price obtained on the market and what consumers are willing to pay indicates that more public awareness can be generated through labelling and certification schemes regarding agrobiodiversity conservation.

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online platform managed by the company Premiaweb s.r.l. allows tourists to search homesteads and operates similarly to the popular 'Airbnb' platform. See http://www.agriturismo.it/en/

[51] Mastronardi, L., Giaccio, V., Giannelli, A., & Scardera, A. (2015). Is agritourism eco-friendly? A comparison between agritourisms and other farms in Italy using farm accountancy data network dataset. SpringerPlus, 4(1), 1.

[52] https://www.openstarts.units.it/dspace/bitstream/10077/867/1/f6ivona.pdf

[53] http://www.card.iastate.edu/iowa_ag_review/summer_04/article4.aspx

[54] Organization for Economic Cooperation and Development (2008). *Promoting Sustainable Consumption: Good Practices in OECD Countries.* OECD: 22.

[55] OECD: 22.

[56] Ibid.

[57] Ibid.

[58] Vijesh V. Krishna et al. (2010). "Assessing the potential for labelling schemes for in situ landrace conservation: an example from India." *Environment and Development Economics.* Vol. 15, No. 2: 127.

A specific way that public marketing can be used in order to promote pro-poor growth and biodiversity conservation is through developing markets and capacity for the production of goods using Neglected and Underutilized Species (NUS). Currently, only approximately 30 plant species out of the entirety of global agricultural diversity are used to meet 95 percent of world's energy needs, with only 100 making up the total.[59] Therefore, the wealth of the world's plant genetic resources are not being utilized to achieve goals of food security, nutrition, and farmer livelihoods. Public efforts can be put into programs to improve the competitiveness of actors along the entire value chain, from input suppliers and producers to traders, processors, and retailers. In particular, governments can aid in marketing campaigns for products produced with NUS to stimulate demand and overcome stigmas against NUS foods that label it as "poor" foods. Incorporating NUS foods into food fairs, sustainability campaigns, and consumer education programs can create a market for foods that will generate income for small scale farmers. The public sectors can engage in market research and provide access to information about what crops to produce in what quantities, and how value-chains can be constructed to use traditional knowledge, cultivation and processing practices.

Examples of public marketing campaigns for NUS have included those for African leafy vegetables in Kenya, in which the government provided support to farmers to develop capacities in modern production techniques, quality control, and standardization of selling units, as well as promotional activities.[60] This allowed African leafy vegetables to be introduced into supermarkets, which has given the product legitimacy among consumers and increased sales, as well as creating greater dietary diversity and nutrient consumption.[61] This process also recognized the value of indigenous and women's knowledge, as well as the need for promotion at both the supply and demand ends of the value chain in order to facilitate greater market development.[62]

One possibility for greater public awareness around the cultivation, production, and consumption of NUS is the declaration of an International Year of Underutilized Food Resources, with international food and environment organizations dedicating resources to enable governments to enact policies that favour NUS markets.

Legal frameworks requiring disclosure and benefit sharing

In the context of plant genetic resources for food and agriculture (PGRFA), disclosure refers to obligations on behalf of users of genetic material (e.g. breeders, biotechnologists) to acknowledge any prior use of, or knowledge about, the material when seeking intellectual property protection in the form of patents.

Under different intellectual property rights regimes, requirements for what exactly needs to be disclosed vary. Around fifty countries include some form of biodiversity-related disclosure

[59] Margaret Will (2008). *Promoting Value Chains of Neglected and Underutilized Species.* Bioversity International: 4.
[60] Will: 80.
[61] Ibid.
[62] Ibid.

requirements (BRDRs) in their national legislation (biodiversity laws, patents and PVP, etc.),[63] which require disclosure of the geographical origin of genetic resources used in research (in particular the development of new varieties) in addition to evidence of prior informed consent (PIC), mutually agreed terms (MAT) and other access and benefit-sharing (ABS) provisions.[64] Many feel this is a prerequisite for the functioning of any ABS system, where the benefits from the commercialization of new varieties are to be shared with those who actively conserve the majority of world's PGRFA: small-scale farmers.[65]

Current discussions within the Intergovernmental Committee on Intellectual Property, and Genetic Resources, Traditional Knowledge and Folklore (IGC), a subsidiary body of the World Intellectual Property Organization, are struggling to reach agreement on whether BRDR should be made mandatory within an international IP legal instrument negotiated by WIPO in order to support ABS.[66] How this issue moves forward may have an impact on how small-scale farmers are formally recognized and rewarded for their innovation with respect to PGRFA.

Benefit sharing provisions found in PVP laws of India, Malaysia, Costa Rica and Thailand attempt to recognize and reward farmers for their contributions to the conservation of PGRFA. Generally, breeders are required to disclose the parental lines used and the geographical location where they originate, including any knowledge of *prior art*. When individual farmers or communities register varieties they become eligible to share in the revenue collected from the sale and registration of these varieties.[67]

Benefit sharing, however, has not taken place in practice to the extent that proponents have envisioned. In India, the National Gene Fund, established with the intent of operationalizing the *right to recognition and reward* and the *right to benefit sharing* (Article 26, 45), has accrued little revenue.[68] Since 2007, the PVPFR Authority has granted financial rewards to approximately thirty individual recipients, and no awards have been granted since 2012.[69]

In Thailand, the Plant Variety Protection Fund (PVP Fund), established to promote the conservation of wild and domesticated plant varieties, has had even less success in distributing rewards to 'local custodians.' Procedural and technical complications have discouraged farmers from registering as beneficiaries through regional offices, and consequently farmers have been left uncompensated. [70] Farmers remain skeptical of the prospects of benefits accruing through

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[63] BRDRs are usually applied to patents and to a lesser extent to PVP. See Vivas-Eugui, D. and Anamika, I.P.A. (2012). Bridging the gap on intellectual property and genetic resources in WIPO's Intergovernmental Committee (IGC). ICTSD's Programme on Innovation, Technology and Intellectual Property (34). Geneva, Switzerland: International Centre for Trade and Sustainable Development.
[64] ibid. The relationship between the UPOV framework for PVP and BRDR is discussed in Section III/A/ii.
[65] ibid.
[66] Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore, Twenty-Ninth Session, February 15-19, Geneva, WIPO/GRTKF/IC/29
[67] De Jonge, B. (2014). Plant Variety Protection in Sub-Saharan Africa: Balancing Commercial and Smallholder Farmers' Interests. *Journal of Politics and Law*, 7(3): 100-111.
[68] Andersen, R. and Winge, T. (2013). *Realising Farmers' Rights to Crop Genetic Resources: Success Stories and Best Practices*. Routledge.
[69] The PVPFR Authority grants the 'Plant Genome Savior Community Award' and the 'Plant Genome Savior Farmer Reward and Recognition' See: http://plantauthority.gov.in/PGSFR.htm
[70] Lertdhamtewe (2014).

the fund.[71] It has been suggested that allowing NGOs or local government bodies to register on behalf of farming communities may help facilitate benefit sharing, recognizing the social, economic and educational conditions of local farming communities.[72]

In Brazil, a new ABS law (No. 13.123) was passed in May, 2015. The Brazilian ABS National Competent Authority is the Genetic Heritage Management Council (CGen), which hosts representation from federal public administration bodies (maximum 60% of members) and civil society (at least 40%; private sector, academia and indigenous peoples and traditional farmers in equal measure). What seems unique about this legislation is that it covers the use of genetic sequencing information published in public databases (GenBank), and microorganisms isolated from any genetic material (terrestrial and sea), as well as genetic resources and traditional knowledge.[73] An important element of the new law is the electronic registration system that commercial entities must use to notify CGen and submit a benefit-sharing agreement within one year of notification. Only manufacturers of finished products and producers or reproductive material are subject to benefit-sharing requirements. Monetary benefits are 1% of annual net revenue. Small companies and suppliers are exempt. Penalties are imposed upon non-compliant entities, however they have the option of signing an agreement with the Federal Government to reduce certain liabilities.[74]

Funds collected go into a National Benefit-Sharing Fund, which is invested in:[75]

- Conservation of biological diversity;
- Survey and inventory of genetic heritage;
- Recovery, creation and maintenance of ex situ collections;
- Training of human heritage associated with the use and conservation of genetic heritage and associated traditional knowledge;
- Support for the efforts of indigenous peoples, traditional communities and traditional farmers in the sustainable management and conservation of genetic heritage.

Investment in processing and post-harvest technology

Processing is the post-harvest conversion of food for storage, for preservation, or into supplementary food products/goods. Primary processing prepares crops for storage to help keep them from spoiling/ensuring sanitation, for example through drying, milling, and extracting oils for cooking. Secondary processing converts fresh foods into a variety of processed foods.

Investment in processing and post-harvest technology can:

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[71] Robinson, D. (2008). Sui Generis Plant Variety Protection Systems: Liability Rules and Non-UPOV Systems of Protection. *Journal of Intellectual Property Law and Practice*, 3(10): 659.
[72] Lertdhamtewe (2014).
[73] Manuela da Silva (2016). Presentation: OVERVIEW OF BRAZILIAN LEGISLATION ON ACCESS BENEFIT SHARING. Available at: https://portal.fiocruz.br/sites/portal.fiocruz.br/files/documentos/da_silva_m_2016_abs_brazilian_legislation.pdf
[74] http://www.mattosfilho.com.br/EscritorioMidia/memoamb190615en.pdf
[75] Manuela da Silva (2016).

- Expand the shelf-life of food, reducing losses (which currently can reach as high as fifty percent) and increasing food availability.
- Help expand the marketability of food by adding value to low-value staple crop products, diversifying marketable products, and allowing food to be sold out of season. Expanding the marketability of food increases and diversifies incomes.
- Provide off-farm rural employment, improving and diversifying livelihoods and creating new opportunities for youth and women. Secondary processing can also contribute to urban employment.
- Help to increase diversification of diets, improving nutrition, and ensure availability of foods appropriate to cultural and religious occasions.
- Help mitigate the sell-low, buy high market phenomena where many producers sell all their products at once for a low price to avoid food losses later, and then have to purchase their food later on markets with few sellers and higher prices. This contributes to food insecurity because producer households do not make enough money from the low-price sales to purchase sufficient food at higher prices later in the year.
- Investment in post-harvest technology can further reduce the unit costs of processing.

Small producers can face several constraints to successfully engaging in processing. Access to raw material supplies, production planning and packaging capacities, distribution and sales infrastructure, access to capital, market information and integration, and entrepreneurial and market power are all essential for a strong processing sector. Capacity to meet sanitary and phytosanitary standards (standards on hygiene, pests and pathogens related to food) when producing for export markets is also a major challenge to producers.

Post-harvest loss prevention has become an interest of donor agencies.[76] The U.S. Agency for International Development (USAID), the Swiss Agency for Development and Cooperation (SDC), the African Development Bank, the FAO, the World Food Programme (WFP), and the Gates Foundation are investing or exploring investments in postharvest activities.

The Papua New Guinea (PNG) government identified food processing and preservation as one of the priority programs in the National Agricultural Development Plan 2007-2016, reaffirmed in its 2014 Budget Strategy Paper.[77] The goal to generate employment and income opportunities for small-scale farmers and contribute to poverty reduction and food security. Chang and Mais (2015) assess the challenges and opportunities of developing a local processing sector in PNG for cassava -- a main staple crop for small-scale farmers. They suggest that sweet potato processing can be used as a pilot both to build R&D capacity in food processing and to develop an enabling environment for the development of small to medium size enterprises. Spillover effects from investment are anticipated for other food crops (cassava, yam and taro) and in other South Pacific countries.[78]

[76] See for example Rockefeller background paper, available at http://www.afdb.org/fileadmin/uploads/afdb/Documents/Events/DakAgri2015/Agriculture_Industrialization_and_post-harvest_losses.pdf

[77] Government of PNG. (2013). 2014 Budget Strategy Paper. Ministry of Treasury.

[78] Chang, H.S.C., and Mais, A. (2015). Key issues and policy implications for sweet potato processing in Papua New Guinea. *Economic and Social Development: Book of Proceedings*, 341.

Seed laws that support informal seed systems

'Seed laws' refer to the legal framework for variety registration, seed certification systems and quality controls, biosafety protocols and plant variety protection (PVP) legislation.

- Variety registration entails the confirmation of a new variety's utility through variety trials. Variety trials ensure that only varieties with superior traits are released onto the market and provide farmers with information on agronomic performance. Under the UPOV Convention, varieties must meet the criteria of distinctiveness, uniformity and stability (DUS).
- Seed certification guarantees a variety's identity and purity, and seed quality control guarantees a variety's sanitary and physiological quality. Certification and quality control entails field inspection, seed labeling and the establishment and maintenance of seed testing facilities. Seed certification requirements often have similar requirements in terms of DUS.
- Biosafety protocols outline procedures, guidelines and standards for the safe handling, transport and use of food products. The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (the "SPS Agreement") outlines food safety and animal and plant health standards. The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement covers living modified organisms (LMOs) resulting from modern biotechnology that may have an adverse effect on biodiversity.
- PVP legislation outlines the scope of breeders' exclusionary rights to commercialize new varieties and, in some cases, prevent farmers from re-using, exchanging and selling protected varieties. Article 27(b) of the WTO TRIPS Agreement requires Members to protect new plant varieties using patent rights, a *sui generis* (unique, standalone) system, or any combination thereof. The UPOV Convention is the most widely-adopted framework for meeting this obligation (a *sui generis* Plant Variety Protection (PVP) system), however WTO Members do have the flexibility to develop their own frameworks.

The scope of seed laws determines which crops and types of seed are regulated, and whether non-registered, non-certified seed can be legally sold on markets. The scope of seed laws varies by country:[79]

- Most countries' seed laws are based on the UPOV Convention that requires all commercialized seed to be registered and certified.
- In Ethiopia, national public companies produce a few varieties of maize and wheat seed (registered and certified), community-based system develops niche varieties not covered (not registered, not certified), and commercial companies focus exclusively on hybrid maize varieties (registered, certified and protected).
- In Indonesia, farmers' varieties are simply excluded from the scope of seed laws, which apply only to packed and certified seed. Seed produced on the farm and marketed at the village level is exempted from laws. This is the *de facto* situation in many countries, but is in this case made explicit.
- In the US, there is a voluntary system for variety registration and seed quality testing, rather than compulsory. Farmers/seed producers can choose which market they want to

[79] https://www.grain.org/article/entries/473-seed-laws-biases-and-bottlenecks

enter by certifying or not certifying, and farmers/seed buyers can choose to buy seed with or without a label.

In most developing countries, unregulated seed exchange through informal markets and networks is the primary source of most seed for small-scale farmers (e.g. more than 80% across Sub-Saharan Africa, and up to 100% in the case of NUS).[80] Farmers' varieties do not typically meet variety registration standards or seed certification criteria, and farmers do not typically apply for plant variety protection (or other forms of plant breeders' rights) for their varieties.[81] When seed laws are enforced strictly, there is a risk that the production, exchange and marketing of unregistered, non-certified varieties (including restocking after a disaster) may be restricted, along with their use in participatory plant breeding efforts and their sale in local seed fairs. For a number of reasons, this may be to the detriment of small-scale farmers:

- DUS trials prioritize uniformity and rewards and encourages standardization and homogeneity, to the detriment of agrobiodiversity.[82] [83]
- Farmers typically do not participate in variety evaluation during trials so their preferences are not reflected in the new varieties released.
- Seed registration and certification is costly. This creates an incentive to register and certify fewer and more widely adapted varieties, which do not benefit farmers in marginal growing conditions. Farmers often cannot afford to register and certified farmers' varieties even in the event that flexibilities are introduced into certification schemes.[84]
- Administrative and technical requirements of maintaining seed certification and quality control facilities, enforcing quality control standards, and subsidizing certification costs for farmers and small enterprises are beyond the technical capacities and resources of many national governments. The value of certification diminishes without high compliance rates.
- Seed quality control is not economically viable for minor food crops (neglected and under-utilized species) such as millets, sorghums and pulses and is more challenging in the case of vegetative propagated crops such as potato and cassava.

Alternative frameworks allow flexibility and exemptions built into variety release procedures and certification schemes, such that variety release committees can use differentiated evaluation criteria for seed destined for local, national and international markets. Seed companies or cooperatives may also develop the capacity to offer certification, reducing the administrative burden on public officials, reducing the costs of certification, and increasing the number of

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[80] Louwaars, N.P., De Boef, W.S., Edeme, J. (2013). Integrated Seed Sector Development in Africa: A Basis for Seed Policy and Law. Journal of Crop Improvement, 27: 186–214.
[81] http://www.upov.int/resource/en/dus_guidance.html
[82] DUS trials commonly favour varieties that do well in ideal growing conditions, require additional inputs during trials, have the best performance on average across multiple field sites (rather than under specific conditions), have very strong resistance to a particular pest or disease (as opposed to 'horizontal' resistance to many different pests of strains of a disease, which makes a variety more durable), and are high-yielding rather than having specific quality traits valued by farmers (e.g. those relating to harvest, post-harvest, nutrition, local food culture. See https://www.grain.org/article/entries/473-seed-laws-biases-and-bottlenecks
[83] Louwaars, N.P., De Boef, W.S., Edeme, J. (2013). Integrated Seed Sector Development in Africa: A Basis for Seed Policy and Law. Journal of Crop Improvement, 27: 186–214.
[84] Louwaars, N.P. and De Boef, W.S. (2012). Integrated Seed Sector Development in Africa: A Conceptual Framework for Creating Coherence Between Practices, Programs, and Policies. Journal of Crop Improvement, 26: 39–59.

certified varieties available on the market.[85] The FAO Quality Declared Seed (QDS) standards[86] allow countries to establish different categories of marketable seed and release a greater diversity of varieties onto the market. This benefits farmers operating under a wider range of growing conditions, supports community-based seed enterprises and rural entrepreneurship and contributes to agricultural biodiversity. Differentiated standards for NUS in particular reflect the reality that most of this type of seed/propagating material is destined for local markets.

In Zambia — while national and international companies engaged in global value chains are required to certify commercial seeds — a community-based system (comprised of civil society and small-scale private seed enterprise) manages the exchange and marketing of local food crops, both local and improved varieties. A separate entity (comprised of NGOs and public sector) provides healthy planting material for roots and tuber crops only during times of drought of occurrence of disease. This latter entity has been key when the yield of hybrid maize crops drops due to drought, and farmers opt for the cassava planting material available. Quality control is also subsidized by the government, allowing small-scale seed producer associations access to testing facilities. The Seed Control and Certification Institute (SCCI), under the government department under the Ministry of Agriculture and Livestock, provides capacity-building services to seed companies and seed producers' associations. Local seed businesses and being promoted and emerge from community-based systems.[87]

Trademarks and Geographical Indications

Trademarks (registered signs, symbols or designations) and geographical indications (GIs)[88] are used to differentiate and promote high-value products on the market based on their distinctive properties, and protect producers against underhand competition. Labeling provides farmers with an opportunity to compete with industrial food chains by differentiating their products. Increasing market demand for 'ethical' and 'natural' products that, for example, support small-scale producer cooperatives, agroecological production methods, and agrobiodiversity conservation, as well as provides opportunities for small-scale farmers.

Ordinary trademarks exclude others from producing identical goods without the consent of the trademark owner. Collective and certification trademarks can be used by anyone complying with certain specifications. The key difference between the collective and certification trademarks is

[85] ibid.
[86] http://www.fao.org/docrep/009/a0503e/a0503e00.htm
[87] Louwaars, N.P., De Boef, W.S., Edeme, J. (2013). Integrated Seed Sector Development in Africa: A Basis for Seed Policy and Law. Journal of Crop Improvement, 27: 186–214.
[88] Other types of indications offer slight variations on GIs. 'Appellations of origin' (AO) or 'denominations of origin' (DO) are limited to the use of geographical names on products produced in a designated area. 'Traditional specialty guaranteed' (TSG) is used in Europe to denote traditional agricultural and food products with specific characteristics attributable to a human characteristic rather than environmental factors. Regulation 1151/2012 sets out rules on the EU's quality labeling schemes for Protected Designation of Origin" (PDO), Protected Geographic Indication (PGI) and Traditional Specialties Guaranteed (TSG).

that compliance for collective trademarks is enforced internally within associations while independent certifying bodies control compliance for certification trademarks.[89]

GI registration involves a description of the characteristics that make the product distinctive, such as rivers or other physical features, soil characteristics, elevation, human characteristics, method of production, or other historical or traditional factors. Rights are extended to any producers who fit the description.[90] Collective or certified trademarks linked to a geographical area are analogous to GIs in theory, however are potentially costly to enforce and may be less effective in supporting small-scale farmers.[91]

Collective trademarks have been used successfully to differentiate high value products internationally and achieve higher returns for domestic small-scale producers. The Ethiopian Fine Coffee Trademarking and Licensing Initiative, financed by the UK's Department of International Development, has drastically improved farmers' incomes and increased the volume of coffee exports. In this case it was decided that trademarks were more appropriate than a GI or certification scheme.[92] National government maintain control over trademarks has allowed for centralized distribution, increased production for export and increased benefits to small-scale producers.

There is some evidence that collective trademarks are beyond the legal and financial capacity of small-scale farming communities in developing countries.[93] In Europe, producers with collective trademarks have had to spend considerable amounts of money to enforce their claims and prove that their products are distinctive rather than generic, in absence of *sui generis* GI legislation.

Ordinary trademarks have also been used and maintained by producer cooperatives. The Pecuaria Development Cooperative Inc. in the Philippines has registered trademarks for a variety of rice and sugar-based products.[94] Trademarks have helped to raise the incomes of participating small-scale farmers and have provided farmers with an incentive to innovate in response to changing consumer demands and to use diverse mixtures of varieties best suited to the land and not rely on chemical fertilizers.[95]

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[89] Kireeva, I. and O'Conner, B. (2010) Geographical Indications and the TRIPS Agreement: What Protection is Provided to Geographical Indications in WTO Members? T*he Journal of World Intellectual Property,* 13(2): 275–303.

[90] ibid.

[91] Kireeva, I. and Vergano, P. (2006). Geographical Indications and the Interface between Trade Mark Protection and Sui Generis Protection: The Example of China, Thailand and Vietnam. *International Trade Law and Regulation,* 12(4): 97–108.

[92] Trademarks relate to a commercial origin rather than a geographical origin. Maintaining a GI for Sidamo coffee, for example, would require every bag to be produced, processed or prepared in the Sidamo region and have unique qualities particular to the region. This was deemed to be impractical and costly. See: http://www.wipo.int/ipadvantage/en/details.jsp?id=2621

[93] Argumedo, A. (2013). Collective trademarks and biocultural heritage: Towards new indications of distinction for indigenous peoples in the Potato Park, Peru. International Institute for Environment and Development, London.

[94] They have a reputation for their signature varieties of white, red and black rice, and producers participate in the development, packing and marketing of value-added 'healthy' and 'natural' final products for high-end markets.

[95] See http://www.wipo.int/ipadvantage/en/details.jsp?id=3510

GIs have a long history of use in Europe, and today about 90 percent of GIs come from OECD countries.[96] Thus the majority of experience comes from countries where boundary-setting, standardization and quality control measures are enforced – the lack of which presents challenges to using GIs in the context of small-scale and widely dispersed producers in developing countries.[97] Such institutional challenges in developing countries may account for the negligible effects, negative trends and contradictory outcomes sometimes reported with the implementation of GIs.[98] Developing countries use of GIs as well,[99] however some noteworthy successes pre-date their GI status so it is hard to isolate their direct impact.[100]

In developed countries, GI value chain development has promoted agricultural biodiversity,[101] while the experience in developing countries has been less straightforward. There have been cases where GIs have been too narrowly defined (i.e. the main distinctive characteristic is a particular variety) and have incentivized uniformity. The GI for tequila in Mexico includes only one variety of agave and as a result, many varieties are no longer being grown.[102] Bolivia's AO for quinoa likewise promotes the production of one variety over underutilized landraces. Broader descriptions promote the use of landrace varieties and wild species and create positive incentives to conserve genetic resources.[103]

In developed countries GIs have contributed to local economies and improved the livelihoods of small-scale farmers in marginal areas (i.e. mountainous regions, arid climates) where producers have less purchasing power and contribute lower volumes to regional and national markets. In developing countries, farmers are not typically involved in the production of final products on the market, and power has in some cases been concentrated in the hands of processors and distributors.[104] Farmers' cooperatives and organizations participating in the processing and packaging of final products may help ensure that GIs raise the incomes of small-scale farmers in such cases.

There is some evidence that poorly designed and managed GIs – developed in the interests of a few enterprises – exclude the poorest producers and may contribute to the dissolution of traditional practices.[105] There is also a risk that GIs may raise the price of staple, nutritious and culturally significant foods through the creation of niche markets, thereby limiting access by poor producers and consumers. It is important that governments work with farmers' organizations to

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[96] Dutfield, G. (2011) Intellectual property tools for products based on biocultural heritage. A legal review of geographical indications, trademarks and protection from unfair competition. International Institute for Environment and Development. London.
[97] ibid.
[98] Larson, J. (2007). *Relevance of geographical indications and designations of origin for the sustainable use of genetic resources.* Global Facilitation Unit for Underutilized Species, Rome, Italy.
[99] Examples include wines from Brazil, white maize and Pisco from Peru, Mezcal and Tequila from Mexico, Darjeeling tea and Basmati rice from India, fish sauce from Thailand and Rooibus tea from South Africa. India alone, as of November 2015, had registered 237 GIs for agricultural products, foodstuffs, handicrafts and manufactured goods. See http://ipindia.nic.in/girindia/
[100] Examples include Darjeeling tea, coffees from Colombia and Guatemala and Tequila.
[101] GIs for cheese in France have had an overall positive effect on landscape and genetic resource conservation, valorization of local knowledge, and local and regional economies.
[102] Dutfield, G. (2011).
[103] Larson, J. (2007).
[104] ibid.
[105] Giovannucci, D. et al (2009). Guide to geographical indications: Linking products and their origins (summary). Available at SSRN 1736713.

develop differentiated policies and regulations for local, regional, national and export markets to avoid these pitfalls.[106]

Support for community seed banks

Community seed banks include centralized locations managed by rural communities where seed is stored, managed and exchanged, as well as seed-saver networks wherein farmers have a coordinated exchange of varieties maintained on-farm.[107] More broadly defined, they may include participatory plant breeding teams, local farmer research groups and seed production cooperatives.[108] Community seed banks range significantly in scale, infrastructure, technical sophistication and governance structures, as well as drivers of their establishment, which include (but are not limited to) relief following famine or natural disasters, crop improvement and conservation practiced by hobby farmers maintaining heritage varieties.[109] Most community seed banks are small-scale organizations that provide seed on a short-term basis to nearby communities. Some provide seed multiplication services. What they have in common is that they seek to restore, revitalize and strengthen community seed systems and increase the control of farmers and local communities over seed.[110]

Vernooy, Shrestha and Sthapit (2015) have compiled a comprehensive review of the history of community seed banks, their functions, governances structures, and technical issues, and 35 case studies of in situ conservation strategies involving community seed banks from around the world.[111] They report that while most seed banks established since the1980s were created with the financial and technical help of NGOs,[112] a number of national governments have developed plans and committed monetary and technical resources for community seed banks in recent years.

Summarized, the objectives of government policies and laws that support community seed banks are as follows:

- Encourage the conservation and recovery of local plant species;
- Value and reward farmers' efforts to safeguard agricultural diversity;
- Maintain fair access to these resources (through effective benefit-sharing agreements);
- Facilitate links between local, national and international efforts;
- Provide technical and financial support to farmers to organize themselves;
- Increase awareness of and disseminate results achieved by community seed banks.

Examples of public policies and laws that support community seed banks include:

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[106] Larson, J. (2007).
[107] Physical seed banks [with seed storage] have been established in Bangladesh, Brazil, Ethiopia, India, Nepal, Nicaragua, the Philippines and Zimbabwe. Seed savers-networks have been established in Australia, Canada, the US and US.
[108] Vernooy, R., Shrestha, P., & Sthapit, B. (Eds.). (2015). *Community Seed Banks: Origins, Evolution and Prospects*. Routledge.
[109] Nabhan (2013).
[110] Vernooy, R., Shrestha, P., & Sthapit, B. (Eds.). (2015).
[111] ibid.
[112] The pioneering work of the ETC Group (formerly RAFI) and USC Canada is in particular emphasized.

- In Mexico, community seed banks are receiving financial support from the national government in the Oaxaca state.
- In Nepal, the department of agriculture has mainstreamed community seed banks in its plans and programs and has relaxed its registration criteria, allowing farmers' to register locally-bred varieties. The government released a Community Seed Bank Guideline in 2009 which outlines a community capacity and empowerment plan. The National Agricultural Genetic Resources Centre has incorporated community seed banks in its complementary conservation plans.
- In Bhutan, the National Biodiversity Centre likewise developed guidelines in 2014.
- In Brazil, three states have enacted laws providing legal frameworks for community seed banks (which include legal definition of seed banks and protections for farmers in terms of access and availability of seed), and bills are being discussed in the legislative assemblies of four others.
- In Zimbabwe there are ongoing discussions on a comprehensive legal framework for implementing farmers' rights. Support for the establishment of community seed banks, working closely with the South African Development Community Regional Gene Bank, is included in the proposed framework.

Sustainable Rice Intensification (SRI) Practices

Sustainable Rice Intensification is an agro-ecological method for increasing the productivity of irrigated rice. This is done by altering the management of plants, soil, water, and nutrients, using the cropping principles of enhancing soil conditions with organic matter and improving irrigation methods, early and healthy plant establishment, and reducing and controlling water application.[113] With these principles, farmers are able to adapt SRI practices to their local contexts, weather patterns, labour availability, access to organic inputs, and agro-climatic environments. Similar practices have been put in place for other crops, such as wheat, sugarcane, teff, finger millet, and pulses. Farmers using SRI practices have demonstrated increased yields from conventional planting practices. SRI implementation in over 50 countries has led to a 20-100 percent (or greater) increase in yields, a 90 percent reduction in seed requirements, and a 50 percent reduction in water usage.[114]

SRI involves transplanting rice seedlings at a very young age, doing so carefully and quickly in order to reduce the shock to the plant incurred by transplanting, into a wide space to encourage root growth. Soil is enriched with organic matter and water is introduced only when cracks in the soil become visible from dryness (a process referred to as "intermittent irrigation").[115] SRI can contribute to the conservation of rice biodiversity as traditional varieties have been shown to produce significant yields, even compared to high-yielding varieties, preventing farmers from feeling pressured to switch in order to generate greater income, and can also reduce input costs

[113] Cornell University (2016). "SRI International Network and Resources Center." Cornell University. Accessed Online: http://sri.ciifad.cornell.edu/.
[114] Cornell University (2016).
[115] Cornell University (2016). "SRI Methodologies," Cornell University. Accessed Online: http://sri.ciifad.cornell.edu/aboutsri/methods/index.html

by maintaining agro-ecological methods.[116] SRI has the potential to create resilience against climate change as well, due to improved crop root systems that protect against degeneration under flooded conditions.[117]

In Sri Lanka, SRI programs were implemented in 1998 in partnership with the Ministry of Agriculture and Lands (now the Ministry of Lands, Land Development, and Export Agriculture), NGOs, and farmers groups. SRI practices have been implemented in an estimated 3000 farms in 18 districts.[118] Farmers have been able to implement SRI in three distinct agroecological zones (dry zone, wet zone, and intermediate zone), where rainfall can vary from 500-3175 mm, and average temperatures range from 14 to 28 degrees.[119] Traditional varieties of rice ranked in the top three highest yielding varieties in the project. SRI trials are undertaken throughout the country by various government departments, but farmers are often encouraged to experiment with SRI on their own and absorb the costs. SRI has been recognized as responding to the needs of farmers to increase land productivity while maintaining traditional varieties and the biodiversity of rice species. Because of this, the Ministry of Agriculture and Livestock has recognized the importance of continued adoption of SRI and supports the efforts of SSFs.

Rice intensification practices have a long history in Indonesia as the country required higher yields in order to feed a growing population. However, sustainable rice intensification practices were not introduced until 1995, when it was recognized that conventional intensification was no longer effective and technologies were disturbing environments and "ecological balance."[120] SRI was implemented in the country in a participatory and farmer-centred approach in order to increase capacities of farmers. The project partnered with the Rice Institute, a national organization, to educate farmers and develop their skills in sustainable rice production to increase their welfare and create sustainability in the rice production system. Indonesia implemented the three components of increasing organic matter, using intermittent irrigation, and transplanting seedlings at a young age. This resulted in a 30 percent increase in yields from conventional farming methods during the dry and wet seasons of 2000-2001.[121] The project has since been expanded into the provinces of Bengkulu, Lampung, and Yogyakarta, and greater interest has been generated in the Ministry of Agriculture to support these programs.

Payment for agrobiodiversity conservation (PACS) schemes

In short, PACS schemes provide farmers with additional incentives to actively maintain on-farm diversity and internalize the costs of conservation. Incentives are required because society cannot rely on farmers' choices and market forces alone to ensure that diversity will be available

[116] Norman Uphoff (2013). "The System of Rice Intensification and its Implications for Agriculture." Agricultures Network. Accessed Online: http://www.agriculturesnetwork.org/magazines/global/ecological-processes-at-work/the-system-of-rice-intensification-and-its.
[117] Danielle Nierenberg (2014). "Five ways System of Rice Intensification (SRI) practices and ideas can help 'feed the world.' Food Tank. Accessed Online: http://foodtank.com/news/2014/01/five-ways-system-of-rice-intensification-sri-practices-and-ideas-can-help-f.
[118] Gamini P. Batuwitage. "Adaptation of the System of Rice Intensification in Sri Lanka," Sustainable Rice Intensification International Network. Cornell University: 70.
[119] Batuwitage, 70.
[120] Anichan Gani et al. "The System of Rice Intensification in INDONESIA," Sustainable Rice Intensification International Network. Cornell University: 58. .
[121] Gani et al., 59.

in the future.[122] In theory, the monetary or non-monetary benefits paid to farmers to offset their costs support rural livelihoods, extend project ownership and grant public recognition to farmers. To our knowledge, no governments have yet implemented such payment programs.

Valuation and incentive schemes have become mainstream tools for achieving conservation outside of the context of agriculture -- but not without significant debate. While proponents emphasize its role as a conceptual tool for assisting decision makers allocate resources in a way that ensures the sustainable use of biodiversity,[123] critics remind us of the unwanted consequences of reducing nature to a series of tradable monetary units.[124] Many outstanding questions remain, such as in what contexts are supplementary incentives appropriate, given the heterogeneity of value systems regarding communal ownership of plant genetic resources. Rather than venturing to adjudicate this debate, it may be prudent to acknowledge that incentive schemes will likely be a popular strategy for achieving agricultural biodiversity conservation among donors and an interest of many national governments.

Economists have described the public goods market failure associated with agricultural biodiversity loss.[125] Crop diversity has immense public value. However, when higher yielding modern varieties are introduced, farmers have financial incentives to abandon traditional varieties and farming systems of which agricultural biodiversity maintenance and further development is inherent.[126] This dynamic is accentuated when government subsidies are put in place that encourage the adoption of modern varieties.[127]

Correcting for this market failure demands a two-fold approach: eliminating policies which encourage the abandonment of traditional farming systems by subsidizing the adoption of modern varieties; and putting policies in place which reward conservation.

A series of contingent valuation studies have been conducted to estimate compensation payments that farmers would require in order to conserve specific types of agrobiodiversity.[128]

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[122] Wale, E., Drucker, A.G., Zander, K.K. (Eds.). (2011). The economics of managing crop diversity on-farm: Case studies from the genetic resources policy initiative. Routledge.

[123] Pascual, U., Muradian, R., Rodríguez, L.C., Duraiappah, A., (2010). Exploring the links between equity and efficiency in Payments for Environmental Services: a conceptual approach. Ecological Economics, 69(6): 1237–1244.

[124] Keulartz, J. (2013). Conservation through Commodification? Ethics, Policy & Environment. Taylor & Francis.

[125] See for example Brush, S.B. (2002). The lighthouse and the potato: internalizing the value of crop genetic diversity. Political Economy Research Institute Working Paper, 37; Bertacchini, E. E. (2008). Coase, Pigou and the potato: Whither farmers' rights? Ecological Economics, 68(1-2): 183–193; Kontoleon, A., Pascual, U.; and Smale, M. (2009). 'Agro-biodiversity for economic development: what do we know?' in A. Kontoleon; U. Pascual; M. Smale (eds.), Agro-biodiversity Conservation and Economic Development, Routledge, London and New York: 1-24.

[126] Heywood, V., Casas, A., Ford-Lloyd, B., Kell, S., & Maxted, N. (2007). Conservation and sustainable use of crop wild relatives. Agriculture, ecosystems & environment, 121(3): 245-255; Wale, E., Drucker, A.G., Zander, K.K. (Eds.). (2011). The economics of managing crop diversity on-farm: Case studies from the genetic resources policy initiative. Routledge.

[127] See for examples Mariano, M.J., Villano, R., Fleming, E. (2012). Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines. Agricultural Systems, 110: 41-53; Mendelsohn, R. (2003). The challenge of conserving indigenous domesticated animals. Ecological Economics, 45(3): 501-510.

[128] See Wale, E. (2008). A study on financial opportunity costs of growing local varieties of sorghum in Ethiopia: implications for farm conservation policy. Ecological Economics, 64 (3): 603–610; Fuwa, N.,

For example, Krishna et al. (2013) estimate the compensation that farmers in Tamel Nadu, India, would require in order to plant neglected varieties of finger millet. They report that supplementary incentives would be required to compensate farmers' private costs of maintaining diversity and slow the adoption of high-yielding varieties of crops with export markets. It is noteworthy that agrobiodiversity services are distinguishable from other ecosystem services in that they produce significant private use values in the form of food and fibre. Thus supplementary incentives required are likely to be less than is the case of other ecosystem services and have the potential to be a low-cost and pro-poor conservation scheme.

The UNDP/GEF supported project 'A Dynamic Farmer Based Approach to the Conservation of Ethiopian Plant Genetic Resources', initiated in 1994, paid farmers for conserving traditional landraces of sorghum and wheat based on differences in yield between traditional and improved varieties. An evaluation of this project, carried out in 1999, is critical of the fixed compensation given to farmers but does not include an analysis of the effects of payments on small-scale farmer communities in its terms of reference.[129] Based on the experience of this project, Wale (2011) reports that conserving one landrace of sorghum would cost the government between US$41 and US$202 annually; and between $109 and $349 annually for one landrace of wheat. Levels and types of compensation demanded by farmers vary significantly according to a number of factors and personal attributes.

Bioversity International piloted PACS projects in Peru, Bolivia, Ecuador, India and Nepal over the 2010/2011 agricultural season with support from the Syngenta Foundation. In Bolivia and Peru, farming communities submitted competitive tenders for conserving priority endangered species. The minimum payment demanded by communities to secure one hectare of a priority landrace ranged from US$143 in Bolivia to US$2,400 in Peru. In-kind payments of agricultural equipment, inputs, construction equipment and school supplies were provided instead and provided sufficient incentives.[130] Narloch (2012) simulates Andean farmers' conservation behaviour in response to external rewards based on the experience of this pilot project, and concludes that collective rewards are ineffective and crowd-out social norms, while individual rewards increase conservation by creating a 'crowding-in' effect that ends up encouraging collective action.[131] However, a subsequent publication describes the multiple considerations that make it very difficult to design payments that are 'fair'.[132]

Sajise, A.J.U., (2009). Exploring environmental services incentive policies for the Philippines rice sector: the case of intra-species agrobiodiversity conservation. In: Lipper, L., Sakuyama, T., Stringer, R., Zilberman, D. (Eds.), Payment for Environmental Services in Agricultural Landscapes: Economic Policies and Poverty Reduction in Developing Countries. Food and Agriculture Organization of the UN, Rome: 221–238; Krishna, V.V., Pascual, U., Zilberman, D., 2010. Assessing the potential of labelling schemes for in-situ landrace conservation: an example from India. Environment and Development Economics, 15: 127–151; Krishna, V.V., Drucker, A.G., Pascual, U., Raghu, P.T., E.D. Israel Oliver King (2013). Estimating Compensation Payments for On-farm Conservation of Agricultural Biodiversity in Developing Countries. Ecological Economics, 87: 110–123.

[129] http://www.thegef.org/sites/default/files/council-meeting-documents/GEF_C15_Inf.21_5.pdf

[130] Exhaustive list of fact sheets, research findings and technical notes available at http://www.bioversityinternational.org/pacs-related-publications/

[131] Narloch, U., Pascual, U., & Drucker, A. G. (2012). Collective action dynamics under external rewards: experimental insights from Andean farming communities. *World Development*, *40*(10), 2096-2107.

[132] Narloch, U., Pascual, U., & Drucker, A. G. (2013). How to achieve fairness in payments for ecosystem services? Insights from agrobiodiversity conservation auctions. *Land Use Policy*, *35*, 107-118.

Bioversity International piloted an incentive mechanism for the conservation of wild species related to domesticated crops (crop wild relatives, or CWR) in Zambia using a similar competitive tender scheme. This was part of a larger initiative to do baseline surveys and develop national CWR conservation strategies in Zambia, South Africa and Mauritius -- member states of the South African Development Community (SADC) -- funded by the EU-ACP Programme (African, Caribbean and Pacific Group of States). The project was initiated in January, 2014 with representatives from national governments, conservation authorities and agriculture departments and forestry departments. Evaluations of the incentive mechanism are not available.

Outside of these examples there is very limited experience with PACS schemes in practice. We can look to examples of payment or ecosystem services (PES) schemes for relevant lessons learned. For example, Hayes et al (2015) report on two case studies of PES programs in South America, neither of which were specific to agricultural biodiversity, and conclude that contracts restrict decision-making power to buyers and the market and offer minimal flexibility to change resource-use practices during the contract term. They call for greater participation of communities in the institutional design of payment schemes.[133] The so-called 'PES curse' refers to a lack of concern over social equity issues related to decision-making, access and benefit sharing may undermine the success of conservation interventions.[134] There also practical concerns regarding enforcement, monitoring and evaluation and the availability of long-term funding. Secured land tenure for farmers is a prerequisite for the functioning of any payment system.

Protected area designation

Protected areas are defined by the International Union for Conservation of Nature (IUCN) as 'clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.' The designation of areas for the protection of agricultural biodiversity is, relatively speaking, uncommon practice compared to other forms of biodiversity.

Governments can designate areas as a means of zoning (e.g. controlling urban development), curbing deforestation and over harvesting and attracting tourism. Special area designation may go hand-in-hand with the use of geographical indications or collective trademarks that identify products and services with a specific geographical area.

Types of protected areas in the context of agriculture include, *inter alia*, agricultural biodiversity conservation areas, Globally Important Agricultural Heritage Systems (GIAHS) and UNESCO Biosphere Reserves. Government involvement in each varies.

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[133] Hayes, T., Murtinho, F., Camacho, L. M. C., Crespo, P., McHugh, S., & Salmerón, D. (2015). Can conservation contracts co-exist with change? Payment for ecosystem services in the context of adaptive decision-making and sustainability. *Environmental management*, *55*(1), 69-85.

[134] Narloch, U., Drucker, A. G., Pascual, U. (2011). Payments for agrobiodiversity conservation services for sustained on-farm utilization of plant and animal genetic resources. Ecological Economics, 70(11): 1837–1845.

The Potato Park is an example of an agrobiodiversity conservation area (also self-defined as an Indigenous Biocultural Heritage Area) focused on retaining the cultural and spiritual aspects of traditional agricultural systems along with a diversity of landraces, crop wild relatives[135] and other wild species of medicinal value and cultural significance.[136] The park is a centre of diversity for important Andean crops including quinoa, oca, and potato. In 2009, Asociasion ANDES and the GEF/UNEP Crop Wild Relative Project collaborated to host an international training workshop on 'Design and Planning of Agrobiodiversity Conservation Areas' with the communities of the Potato Park and farmers and researchers from Ensete Park, Ethiopia. The park follows an endogenous development model, and is thus community-managed with the support of Asociasion ANDES (a local NGO) and limited government involvement (although regional authorities are supportive).

GIAHS are defined as "remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development" (FAO 2002).[137] A common characteristic of GIAHS is that they tend to be transboundary, requiring collaboration among national governments. Participating governments must commit funds from their country biodiversity allocation (co-financed with GEF, The Government of Germany, and in-kind support provided by the Government of the Netherlands through Wageningen International). Chile, Peru, China, Philippines, Algeria, Morocco, and Tunisia are the piloting counties and have prioritized the GIAHS project under their national biodiversity projects.[138]

Biosphere Reserves are "areas of terrestrial and coastal/marine ecosystems or a combination thereof, which are internationally recognized within the framework of UNESCO's programme on Man and the Biosphere (MAB)."[139] They are managed by national government ministries and generally collaborate very little with the either the umbrella organization or its smaller regional consortiums[140] in practice. The Biosphere Reserve model itself (concentric circles or zones in which varying levels of human activity is allowed) is a commonly recognized standard for protected areas that integrate conservation and development objectives. Few Biosphere Reserves have been established specifically for agricultural biodiversity conservation, however there is precedent for doing so.[141] There are many examples where agricultural biodiversity happens to be concentrated were reserves are established. Governments are responsible for applying for special designations and reporting.

Maxted and Kell (2009) map priority areas for protecting crop genetic diversity.[142] Their criteria for prioritization include areas where agricultural biodiversity is most concentrated, as in 'Vavilov

[135] Crop wild relatives are species closely related to to agricultural crops or other species of socio-economic value.
[136] See Argumedo, 2008; http://www.parquedelapapa.org/
[137] http://worldagriculturalheritage.org/wp-content/uploads/2014/12/GIAHS_Booklet_EN_WEB2011.pdf
[138] http://www.fao.org/fileadmin/templates/giahs/PDF/GIAHS_B_terminalReport.pdf
[139] Art. 1 Seville Strategy, UNESCO, 1996.
[140] Regional networks include: AfriMAB; IberoMAB; EuroMAB; ArabMAB; PacMAB; EABRN; SACAM; SeaBRnet; REDBIOS; and the World Network of Island and Coastal Biosphere Reserves
[141] The first site to attain designation on account of being a centre of origin / domestication for socio-economically important food crops was the Tehuacan Cuicatlan biosphere reserve, Mexico, in 2012.
[142] Crop wild relatives are species closely related to to agricultural crops or other species of socio-economic value.

centres of origin' or 'centres of domestication'[143]; the presence of species currently underrepresented in gene bank collections and/or of established high socio-economic value; and where there already exist established national parks or nature reserves.

Biodiversity for Food and Nutrition (BFN)

Biodiversity for food and nutrition (BFN) is an initiative started in 2012 by the Global Environmental Facility in partnership with Bioversity International and the governments of Brazil, Kenya, Turkey, and Sri Lanka. Its purpose was to provide evidence on the nutritional value of biodiversity and how it can improve farmer and consumer livelihoods, as well promote healthy diets.[144] The initiative seeks to influence policies in partner countries to support agricultural biodiversity and the scale-up of biodiverse diets, value chains, and community action.[145] In only four years, positive results have begun to emerge, such as in Brazil's school feeding program, where 30 percent of the food provided through the program is procured through local farmers engaging in biodiverse farming methods. In Sri Lanka, nutritional species are being promoted through food fairs and awareness weeks.[146] This project intersects with a number of others presented throughout this document, such as culinary tourism, public procurement, and public marketing campaigns.

This initiative is undertaken by investigating how value chains can be adapted to link rural producers of biodiverse products with urban and peri-urban consumers, and by analyzing exiting dietary diversity in order to see where biodiversity can improve current nutrition and health indicators. This involves researching neglected or underutilized species (NUS), wild foods, and foods available from local sources, in order to see where foods could be used to fill in the gaps during lean seasons. Using biodiverse farming methods can also contribute to nutrition by improving adaptability to local conditions and providing greater dietary diversity. This can reduce micronutrient deficiencies in consumers and enhance sustainability of local crops.

In Malawi, the Biodiversity for Food and Nutrition initiative, titled "the Soils, Food and Health, and Communities (SFHC) project" worked with small-scale farmers in Northern Malawi to select and test varieties of legume species to grow with maize varieties in an inter-cropping method.[147] Children in communities where the project has been implemented have experienced better nutrition, and 9000 Malawian farmers have adopted this method. Intercropping has reduced land and soil degradation and reduced rates of "hidden hunger" from vitamin A, zinc, and iron deficiencies. The use of grain legumes have produced ecological and nutritional benefits such as greater availability of iron and zinc, and have enhanced soil fertility, reduced the incidence of pests and diseases, and created more resilient farming systems. The project has since been scaled up and presented at the Malawi Parliament, who have shown interest in promoting the integration of a wide range of food legumes to improve soil fertility and nutrition.

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[143] These are large geographical areas where domesticated species have survived the longest and where their genetic variation is most highly concentrated.
[144] Biodiversity for Food and Nutrition (2016). "About Us." Biodiversity for Food and Nutrition. Accessed Online: http://www.b4fn.org/about-us/
[145] Biodiversity for Food and Nutrition (2015). "Harnessing agricultural biodiversity to reduce hunger and malnutrition," BFN. Accessed Online: http://www.b4fn.org/fileadmin/templates/b4fn.org/upload/documents/Flyers/BFN_flyer_new.pdf
[146] Ibid.
[147] Biodiversity for Food and Nutrition (2015). "Legume Intercropping: Malawi" BFN. Accessed Online: http://www.b4fn.org/case-studies/case-studies/legume-intercropping/

With the support of the Brazilian government, Trees for the Future (TREES) has worked in two schools in Marilia, Brazil, in growing and using *Moringa oleifera* for improved nutrition and as a component of agroforestry in school gardens.[148] Moringa is used for its ability to tolerate poor soil environments, the fact that it grows quickly, and its dense nutritional profile. Teaching children about agroforestry and using Moringa powder in foods has shown improved environmental awareness among participating children and parents, as well as better educational outcomes such as attendance and grades.

The Innovation System

Investment in small-scale farmer innovation

Providing support for small-scale farmer innovation is itself not a mainstream concept and has yet to be championed by any national government, perhaps with the exception of India. Most support for small-scale farmer innovation (which has been very limited compared with investment in innovation *for* farmers) has come from international organizations and donor agencies. The role of governments is generally limited to the participation of representatives of agricultural ministries in 'innovation platforms', which bring together government, industry and farmer representatives and other stakeholders in the planning and implementation of national or regional innovation strategies.

This section identifies ways that farmer-led innovation may be supported, whether by donor agencies or public sector entities. Donor investment is time-limited, thus public sector involvement may be preferable from a sustainability standpoint. Support may come in these forms:

- Providing direct financial support and control over budgets for on-farm experimentation and breeding programs.
- Providing in-kind support and expertise, upon request, to build the capacity of farmers to experiment by conducting diagnostic studies, improving designs, filling in information gaps relating to non-observable phenomena, etc.
- Increasing exposure of farmers' innovative capacity through innovation fairs, media coverage, documentation of traditional knowledge in national databases.
- Facilitating knowledge and experience sharing through online innovation platforms and/or networks among geographically disparate farming communities.

Two large-scale interventions in Sub-Saharan Africa focus on increasing productivity of small scale farms through support for on-farm innovation: the US$26 million 2006– 2010/12 Sub-Saharan Africa Challenge Programme (SSA-CP) supporting 32 multi-stakeholder Platforms in eight countries; and the €4.5 million 2008–2013 Convergence of Sciences: Strengthening Innovation Systems (CoS-SIS) research program supporting nine platforms in Mali, Benin, and Ghana.

[148] Biodiversity for Food and Nutrition (2015). "Moringa Leaves: Brazil." BFN. Accessed Online: http://www.b4fn.org/case-studies/case-studies/moringa-leaves/

The initial phase of the CoS-SIS program involved participatory technology development in Benin and Ghana. An impact study of this original investment reported that the adoption of some technologies depended on conditions over which farmers had no control and thus did not continue after the program ended.[149] The subsequent phase explicitly focused on creating institutional arrangements that allow for farmers' participation in project planning and larger policy debates. The CoS-SIS program also focuses on informing decision makers in national, regional and African agricultural research organizations, universities, NGOs and other stakeholders about ways to encourage SSF innovation. The program seeks to influence university curricula, research institute programmes, government policies and the structure of value chains. Farmer-led experimentation is facilitated by post-doc students.[150]

The Prolinnova (Promoting Local Innovation in Ecologically Oriented Agriculture and Natural Resource Management) program organizes events to facilitate exposure to local innovations such as farmer innovation markets, workshops, agricultural exhibitions and conferences. Innovations are also publicized in catalogues, on the radio, etc. and farmers receive support in documenting their own innovations.[151] This exposure facilitates mutual learning and creates opportunities for innovations to be disseminated to a wider audience, and will help change the dominant discourse which depicts farmers are recipients rather than originators of innovation, which will in turn fuel institutional innovation.[152]

The Honeybee Network in India and The Social Technology Network (RTS, Rede de Tecnologia Social) in Brazil are two databases showcasing grassroots innovation, traditional knowledge and social entrepreneurship. The Honeybee Network documents innovations of small farmers, women and artisans across India and beyond and disseminates results from farmer field trials in newsletters in six languages (http://www.sristi.org). The emphasis here is to share traditional knowledge being applied in novel ways in horizontal networks. RTS showcases social entrepreneurship in the areas of agroecology, recycling, sustainable energy, housing and infrastructure and rainwater harvesting in electronic newsletters (http://rts.ibict.br/). This initiative aims to create more vertical connections between grassroots innovators and large investors.[153]

The National Innovation Foundation (NIF) (www.nifindia.org) was established in 2000 to develop a national register of innovations and provide innovators access to rewards, recognition, exhibitions, mentoring, *in situ* incubation of grassroots technologies, financial support and investment and enterprise opportunities. This is an autonomous body of the Department of Science and Technology, Government of India. A database of over 225,000 technologies,

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[149] Hounkonnou, D., Kossou, D., Kuyper, T.W., Leeuwis, C., Nederlof, E.S., Röling, N., ... van Huis, A. (2012). An innovation systems approach to institutional change: Smallholder development in West Africa. Agricultural Systems, 108: 74–83.

[150] CoS-SIS (Convergence of the Sciences: Strengthening agricultural innovation systems in Benin, Ghana and Mali) (2013). New Pathways for Innovation: Creating conditions in which West African smallholders can capture opportunity. Available at http://www.cos-sis.org/pdf/CoS-SIS%20Brochure%20EN_FINAL_LR.pdf

[151] Wettasinha, C., Wongtschowski, M. and Waters-Bayer, A. (2006). Recognising local innovation: experiences of PROLINNOVA partners. C. Wettasinha (ed.). International Institute of Rural Reconstruction (IIRR).

[152] Waters-Bayer, A., van Veldhuizen, L., Wongtschowski, M. and Wettasinha, C. (2009). Recognising and enhancing processes of local innovation. In Sanginga, P.C. (ed.). Innovation Africa: enriching farmers' livelihoods. Earthscan: 239-254.

[153] Smith, A., Fressoli, M., & Thomas, H. (2014). Grassroots innovation movements: Challenges and contributions. Journal of Cleaner Production, 63: 114–124.

innovations and traditional knowledge practices is maintained with the help of the Honeybee Network volunteers. As of 2016, NIF has awarded 816 grassroots innovators and school students with National Biennial Grassroots Innovation and Dr A P J Abdul Kalam Ignite Children awards. NIF has also established a Micro Venture Innovation Fund (MVIF) with support from the Small Industries Development Bank of India (SIDBI) and has provided risk capital to 193 projects.

In 2003, Gupta et al. highlighted the lack of micro venture capital available to grassroots innovators as both a reason why innovation does not lead to enterprises, and as evidence of a lack of appreciation for the potential of grassroots innovation on behalf of national governments. Micro finance facilities for small innovations are almost nonexistent. The lack of venture capital and research funds was cited as a major constraint to technology development.[154]

Local Innovation Support Funds (LISF) have been piloted by Prolinnova partners in Cambodia, Nepal, Ethiopia, Ghana, Kenya, Nepal, South Africa, Tanzania and Uganda with financial support from the Netherlands and French Governments and Rockefeller Foundation. These are decentralised funding mechanisms to support farmer-led research and development initiatives. A lack of public funds available remains a significant challenge to the sustainability of LISF.[155]

The FAO (2014) underscores the positive effect that ICT infrastructure can have on innovation by reducing transaction costs associated with obtaining information on new techniques and practices, improving advisory services and strengthening the bargaining power of producers organizations. Mobile phones and the internet support rural entrepreneurs by informing them about weather conditions, input availability, dealers, financial services, market prices and consumer demand. Asenso-Okyere and Mekonnen (2012), in review of studies on the use of ICT for agricultural development in Africa and Asia, report that some studies found significant improvements in market access, farmers' income, farm productivity, crop diversification and environmental stewardship.[156]

Investment in R&D based on the needs of small-scale farmers

The public sector must invest in research that is in the public interest and where the private sector either will have no interest or it is not in the public interest for the private sector to be the primary actor, if at all. Areas where there is a public interest need and no private sector interest because of a lack of market, likely include NUS, varieties adapted to sub-optimal growing conditions, and in hard to reach, remote areas.

Examples of investment that serves the needs of small-scale farmers may include:[157]

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[154] Gupta, A.K., Sinha, R., Koradia, D., Patel, R., Parmar, M., Rohit, P., ... & Vivekanandan, P. (2003). Mobilizing grassroots' technological innovations and traditional knowledge, values and institutions: articulating social and ethical capital. Futures, 35(9): 975-987.

[155] https://www.uni-hohenheim.de/fileadmin/einrichtungen/fsc/FSC_in_Dialog/previous_FSC_in_dialog/2012/Farmers_as_researchers_-_Waters-Bayer.pdf

[156] See FAO (2014). The State of Food and Agriculture. Innovation in Family Farming. Rome. Available at http://www.fao.org/publications/sofa/2014/en/

[157] http://www.fao.org/3/a-i3685e.pdf

- Baseline surveys of crop diversity;
- Breeding programs for cassava, millets, legumes and other minor crops;
- Participatory plant breeding programs for all crops;
- Research on the implications of over harvesting wild species;
- Research into techniques for domestication of wild plants;
- Development and dissemination of improved low-input production methods; and
- Nutraceutical and allergen screening of indigenous foods.

The 2014 FAO report, 'Promotion of underutilized indigenous food resources for food security and nutrition in Asia and the Pacific,' documents examples of, and the need for, government research and development efforts targeting underutilized foods important to human health and wellbeing. It is the product of a two-year collaboration with Khon Kaen University in Thailand, culminating in a conference where the following papers, among many were presented.[158]

A paper from Viet Nam documented the development of a porcupine breeding and farming project in Quang Ninh Province. Porcupine farming was originally promoted in Viet Nam ten years ago by FAO and at the end of the trial project, the local government funded further development. Local villages successfully breed and rear the animals for sale as a meat delicacy at local restaurants. Domestication has taken pressure off the wild population and farming has contributed to rural incomes.

A paper from Cambodia called upon national governments to investigate the effects of wild harvesting of crickets and other insects on biodiversity and the bioavailability of micronutrients and proteins from consumption of processed and unprocessed insects. In both rural and urban areas of Cambodia there is widespread consumption of crickets, spiders, water beetles, bugs and aquatic animals (snails, frogs). Insects contribute significantly to the income of people in rural areas, particularly during the dry season. Cricket trade is increasing through exchange with Thailand and local consumption is increasing. The market is highly informal and awareness among government, national and international organizations is limited.

Another paper from Cambodia described how the government is working to reduce wetland losses in order to improve the sustainability of production of indigenous micronutrient-rich small fish, which have superior nutrition to larger fish and may prevent malnutrition, assist bone formation and prevent anemia. While the focus on the study is on the unique nutrition profiles of indigenous fish, it is emphasized that the role of the government is to control overharvesting and invest in the development of sustainable harvesting techniques.
The Royal Government of Bhutan provided financial support for studies on the role of wild mushroom collection in the livelihoods of rural communities and the diversity, availability, distribution and usage of edible wild plants in Bhutan, as well as indigenous knowledge regarding their contributions to human health. The first study highlighted inadequate support from government organizations in remote villages. Despite the importance of mushrooms in the livelihoods of the poor, very little scientific research has been undertaken to understand their importance in rural incomes as well as issues relating to collection, marketing and sustainable resource management.

[158] http://www.fao.org/3/a-i3685e.pdf

Farmer-led extension

Farmer-led research and extension approaches focus on developing active participation and a controlling role for farmers in the development of technology, the improvement of methods, and the dissemination of information. There can therefore be overlap between farmer-led research and extension and investment in small-scale farmer innovation

Rather than centralized and prescriptive, farmer-led extension programs emphasize the need to be responsive to locally identified needs and priorities, value indigenous knowledge, and facilitate partnerships between extension professionals and farmers themselves. These may exist as "farmer field schools," that have responded to the traditional "training and visit" approach to extension that was structured through a top-down model of dissemination and programming that has been largely unsuccessful.[159] Farmer-led extension aims to build farmer capacity through farmer organizations, and create a model that develops their ability to analyze their situations, identify problems, create a plan of action to remedy those problems, and report to extension support professionals to implement solutions. The FAO, in their Farmer Field School Training Manual, have recommended a high level of decentralization in farmer-led extension programs in order to take into account diversity of soil type, water, resources, and transportation infrastructure.[160]

By prioritizing farmer and indigenous knowledge, farmer-led research and extension has had positive impacts in the protection of agro-biodiversity. Supporting local practices and building capacity to maintain biodiversity has resulted in increased resilience of crops to environmental hazards, pests, and diseases.[161] Farmer-led research programs have also had the positive externalities of improved nutrition and food security through improved production methods, better storage methods and post-harvest management, as well as overall greater yields and household incomes compared with conventional farming techniques.

In a number of case studies produced in partnership with the CGIAR, farmers were given space to experiment with a wide range of technologies, however, the identification and use of local resources proved to be more relevant to the poorest households.[162] Most farmer-led research models involved methods that supported land reclamation or improvement, as well as soil and water conservation.[163] Participating farmers also engaged in research on plant breeding, selection of plant varieties, and the management of biodiversity as key areas of focus. However, key concerns with farmer-led research and extension programs focus on the sustainability of programs in the long-term. Monitoring and evaluation of farmer-led extension programs after the end of project funding show farmers' organizations as being near collapse shortly after funding

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[159] Swanson, Burton E. (2010). "Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems." *Agriculture and Rural Development Discussion Paper 45.* World Bank: 14.
[160] Food and Agriculture Organization of the United Nations (2016). "Farmer Field School Approach." Accessed Online: http://www.fao.org/agriculture/ippm/programme/ffs-approach/en/
[161] MD. Mofakkarual Islam et al. (2011). "Developing Sustainable Farmer-led Extension Groups: Lessons from a Bangladeshi Case Study," *Journal of Agricultural Education and Extension.* Vol. 17, No. 5: 425.
[162] Wettasinha, Chesha et al. (2014). *Study on Impacts of Farmer-Led Research Supported by Civil Society Organizations.* CGIAR Research Program on Aquatic Agricultural Systems: 27.
[163] Wettasinha et al., 20.

ceased.[164] It is posited that these programs may cause farmers to become dependent on funding, rather than developing the capacity to carry on the project in a self-sustaining manner. In a report by the World Bank, it was noted that power imbalances needed to be taken into account, as many farmer organizations end up being led by large-scale, commercial farmers who possess greater leadership, organizational, and technical skills.[165]

Examples of farmer-led extension and research programs emerge from Bangladesh and the Philippines. In Bangladesh, the farmer-led extension model was implemented in 1999 through a partnership between the Department of Agricultural Extension, sub-districts of North and North-East Bangladesh, and the Department for International Development in the United Kingdom.[166] While the project improved yields and crop varieties, saw greater use of technologies, and increased incomes for households, many concerns were expressed about post-project sustainability.[167] In the Philippines, farmer-led research programs were implemented by the highly decentralized MASIPAG network. This program led to the conservation of over 1000 traditional rice varieties through farmer-led breeding programs, as well as 1000 additional site-adapted varieties and 185 farmer-selected lines.[168] Farmers participating in the program also exhibited greater crop diversity, with an average of 4.8 varieties of rice per farmer, compared to 1.6 varieties per conventional farmer.[169]

National Agricultural Research Systems (NARS)

National Agricultural Research Systems (NARS) are defined by the FAO as "encompassing all institutions, public or private, devoting full time or partially their activities to agricultural research and committed to a national research agenda."[170] This includes National Agricultural Research Institutes; higher education institutes that focus on agriculture and related disciplines; technical departments of related ministries and development agencies that engage in research; and relevant NGOs and the private sector. Although NARS vary from country to country, a sample of NARS from various countries in Sub-Saharan Africa show common principles of being influenced by the agricultural development policy agenda; being responsive to the needs of end-users and including them in the decision-making process; and being holistic and cover all agro-climatic regions and subsectors. Furthermore, it is agreed upon that NARS should contribute to improving food security and raising people about of poverty through diversified production; should be environmentally sustainable; and should be made up of sustainable funding structures for projects.[171]

Over time, NARS have evolved from research systems to agricultural innovation systems (AIS) which encompass both the generation and the diffusion of agricultural systems, as well as the application of generated knowledge into practice. Therefore, there is a wider range of actors, and there is a much greater significance for the role of markets in AIS, which is related to the declining role of the public sector and public investment in agricultural research

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[164] MD. Mofakkarural et al., 425-443.
[165] Swanson, Burton E., 17
[166] MD. Mofakkarual Islam et al., 425-443.
[167] Ibid.
[168] Wettasinha et al., 21.
[169] Ibid.
[170] FAO (2002). *Impact of foreign Assistance on Institutional Development of National Agricultural Research Systems in Sub-Saharan Africa.* Rome: FAO: 2.1-2.5.
[171] FAO (2002): 2.1-2.5.

and development. For about 30 years, public investment in agricultural research has stagnated around an average of 0.5 percent of agricultural GDP in low and middle income countries, where it has risen from 1.5 percent in 1981 to 3 percent in 2008 for high-income countries.[172] USAID has identified this lack of investment as being part of the explanation for poor agricultural performance in many parts of the world, due to fiscal constraints and lack of political will on behalf of governments. At the same time, Public-Private Partnerships in agricultural research and development have not fulfilled their full potential due to poor enforcement and tenuous intellectual property rights.[173]

However, certain developing countries have demonstrated strong political will through committing resources towards NARS. In Uganda, The National Agricultural Research Act was put into place in 2005 to stimulate the development of an agricultural research system to improve research services delivery, financing, and management.[174] The Act has provided the impetus for the creation of a network of public and private entities, including public agricultural research institutes, universities, farmers' groups, CSOs, and the private sector. Nevertheless, note the objectives of the system are to create an agricultural system that is based in "modern" science and is market-oriented. These principles are thought to increase efficiency, profitability, and growth while improving farmer livelihoods and protecting the environment. The system is governed by a semi-autonomous National Agricultural Research Organization Council, which includes representatives from relevant government departments and other stakeholder groups. A number of coordination committees at the district and regional level have been developed in order to decentralize agricultural research and ensure that it is responsive to the disparate needs of different zones.

In Kenya, the creation of the NARS was supported by the establishment of the Amended Science and Technology Act of 1979, which has provided for the development of the Agricultural Advisory Research Committee to advise the minister on issues of agriculture, agricultural education, and the coordination of research.[175] Kenya exhibits one of the highest government expenditures in agriculture as a percentage of total expenditures in the region, at 7.1 percent, trailing behind only Madagascar and Malawi, both at 11.3 percent.[176] The system is composed of six agricultural research centers, and 25 stations and research sites that cover all different agro-ecological zones in the country.[177] Financial resources committed to the NARS have grown steadily from 1985 (from 21 percent in 1983 to 45 percent in 1991 alone), and this is composed of less than 50 percent of external donor funding, showing a strong commitment from the public sector.[178] Research intensity of the Kenyan NARS has been consistent at a ratio high above 1 percent, around 1.54, while the average in SSA is 0.78 percent.[179] Capitalizing on funding from the World Bank, USAID, and GIZ, Kenya has established some of the best public research institutes in the country in their NARS. The NARS is made up of a system of National

[172] Anderson, J. et al. (2016). "Technical Brief: USAID to Re-Engage in Supporting National Agricultural Research Systems." USAID: 3.
[173] Anderson, J. et al. (2016): 3.
[174] National Agricultural Research Organization (2016). "The National Agricultural Research System," Uganda: NARO. Accessed Online: http://www.naro.go.ug/data/smenu/4/NARS.html
[175] FAO (2002): 2.4.2.
[176] FAO (2002): 2.1.
[177] FAO (2002): 2.4.
[178] FAO (2002): 2.5.3.
[179] Ibid.

Research Centers, and authority and responsibility for implementation has been delegated to these centers in order to respond to local needs and contexts.

Although the formal establishment of NARS can stimulate greater public investment into agriculture, many existing NARS networks focus on growing the productivity of agriculture through improved varieties and increasing inputs such as fertilizer and pesticides, which can have negative impacts on small-scale farmers and their protection of biodiversity. A report by the ODI emphasized the importance of including research on traditional crops and research on low-input agricultural systems in a manner that results are accessible to small-scale farmers. An example of such a research methodology is the use of participatory plant breeding.[180]

[180] Cromwell, Elizabeth (1999). *Agriculture, biodiversity, and livelihoods: issues and entry points: ODI Final Report.* London: Overseas Development Institute: 52.