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PERENNIAL GRAINS: BEYOND BOOTLEGGING, FEASIBILITY AND PROOF-OF-CONCEPT

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ABSTRACT

This paper examines the need for perennial grain development from a donor perspective. Why are perennial grains needed, especially in fragile and more remote areas? What kinds of investments does USAID currently make in perennial grain development? What lessons can be drawn to ensure the derivation of compelling cases for donor consideration? The paper concludes that: perennial grains must contribute to sustainable intensification and not extensification; must be demand-driven by scientists and farmers in target regions; priority targets should be identified based on priority regions and needs; with an emphasis on complementarity with current farming systems and research programmes; and short, medium and long-term benefits should be identified at different scales, to encourage staged investments.

Keywords: sustainable intensification, demand-driven, priority regions and needs, complementary systems, short, medium and long-term goals; staged investments

WHY PERENNIAL GRAINS

Food security is a major issue for the world. In the 1960s, the Green Revolution raised yields and grain supplies to defer the shortfall of food to a rising world population. Its successes, however, were not universal, as they focussed on narrow considerations of yield alone. High-yielding semi-dwarf cultivars were released which were responsive to alluvial and nutrient-rich soils, application of inputs, availability of irrigation. Consequently, benefits accrued in areas already productive, while those in more marginal situations of lower soil fertility and more remote locations generally missed out. For example, sub-Saharan Africa was largely bypassed, where 80 percent of soils have serious limitations, including low soil organic matter, short and variable wet seasons, and low if any investment in inputs.

FIGURE 1. CONTRASTING SOIL PROFILES IN USA (LEFT) AND SSA (RIGHT).

USA

SS AFRICA

- >80% SOILS WITH SERIOUS LIMITATIONS
- LOW SOM
- 95% RAINFED
- HIGH VARIABILITY
- LOW INPUT INVESTMENT

Photo credit: Jim Richardson, Small World Gallery

Additional considerations needed to be taken into account, including broader considerations of yield (whole farm, livestock, nutrition), socio-economics (gender, cultural context) and natural resource management (soil, water, air, biodiversity). The likelihood is of further decline of the soil resource, with insufficient availability of organic matter (compost, manure, crop residues) to add to soil, leading to poor rainfall infiltration and retention as well as further decline and degradation of fragile soils. In this context, above-ground productivity will be low, with increased risk for investment in labour and inputs, and greater vulnerability to climate uncertainties. Farmer response is likely to require multiple planting operations, to address establishment and crop failure, requiring additional labour and necessitating lower yield potentials in the shorter seasons remaining. This may be partially compensated by extensification where additional land is available, but this in turn puts pressure on system sustainability via shorter or no fallow before the land is used again.

In this context, perennial grains could provide some relief by maintaining some stability of cover for land restoration, food and ecosystem security, nutrition and socio-economic considerations. For example, Dr Druba Thapa from the Nepal Agricultural Research Council sees potential for high-altitude perennial wheat on fragile soils in western Nepal "Perennial wheat may increase food and forage security significantly in the region, with deeper roots providing more stable grain and biomass yields. Deeper roots may increase uptake of selenium, zinc, iron and other minerals, and some of the 25 lines tested appear highly resistant to yellow rust."

FIGURE 2. HIGH ALTITUDE PERENNIAL WHEAT IN WESTERN NEPAL

Dr. Dhruba Thapa Nepal Agricultural Research Council Khumaltar Laitpur, Nepal

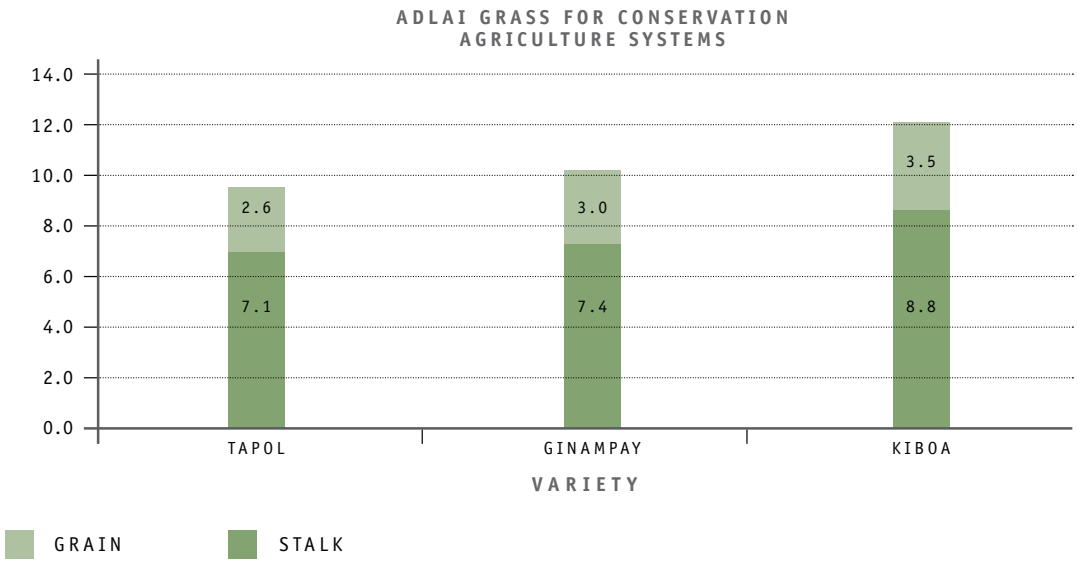
Photo credit: Dhruba Thapa

USAID PERENNIAL GRAIN INVESTMENTS

USAID is looking for opportunities where there is farmer demand for perennial systems that could assist their circumstances. These examples can be used to illustrate the criteria needed for priority to be assigned to such research investments.

Adlai grass has been identified for conservation agriculture systems in the Philippines. In diverse crop-livestock systems on acidic erodible hillsides, adlai grass has been shown to assist in providing a source of food, feed, resilience, ecosystem services complementary to farmer practice. Evidence is support of the concept is available from the World Agroforestry Centre and SANREM CRSP, where improved lines increased yield of both grain and stover.

FIGURE 3. ADLAI GRASS FOR CONSERVATION AGRICULTURE SYSTEMS. SANREM CRSP



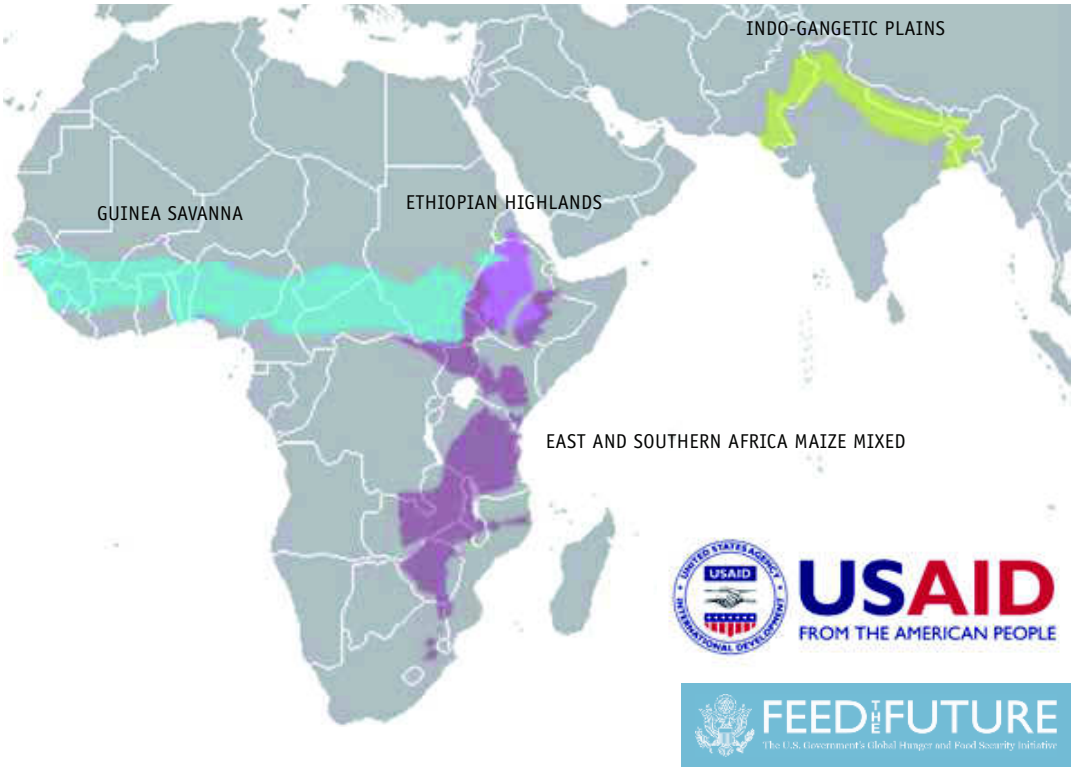
Likewise, the doubled-up legume systems presented by Snapp (this volume) allow diversification and intensification of traditional maize-dominated systems, using annual peanut, semi-perennial pigeon pea followed by maize, for substantial benefits in food, feed, resilience, ecosystem services, flexibility and complementarity with farmer practice. The system changes complement the role of fast maturing annuals along with the perennials.

FIGURE 4. INTERCROPPING OF PIGEON PEAS AND GROUNDNUT

Photo by Jim Richardson, Small World Gallery

A third example is the recent investment of US$5 000 000 over 5 years in the Feed the Future Innovation Lab for Climate Resilient Sorghum with University of Georgia and partners including West Africa and Ethiopia.

FIGURE 5. PROGRAMME FOR SUSTAINABLE INTENSIFICATION



Using these three case studies, it is possible to identify common features that encourage potential investment from a donor. These issues should be carefully considered by perennial grains researchers in proposing projects for donor support, noting that they require statements of interest and participation from target scientists and farmers in host countries.

ISSUES AND SOLUTIONS IN PERENNIAL GRAIN DEVELOPMENT FROM A DONOR PERSPECTIVE

1. Perennial grains are "supply-driven" solutions from developed country institutions

Issue: The development community seeks demand-driven solutions for targeted issues, regions, and farming systems. They can be identified by the international research community, national governments and farmers.

Solution: Constituency building is required: CGIAR, national research institutes, national governments, farmers.

FIGURE 6. PERENNIAL GRAIN BREEDING PROGRAMMES

Only the perennial wheat breeding programme in Nepal is located in a developing country that is of high-priority for development assistance (highlighted in green) for agencies like the United States Agency for International Development.

2. Focal crops and regions are based on scientist's interests and locations

Issue: No systematic analysis of highest-potential crops and regions, little overlap with high-priority regions already identified, and unclear how efforts will fit into or impact high priority farming systems.

Solution: Global survey and screening of high potential crops, "What is out there?" Opportunity analysis of high priority regions, crops, socio-economic conditions, "What is needed?" Modelling and early field trials in priority regions, "What is possible?"

3. Discussion remains focussed on annual vs perennial (or organic vs conventional, or polyculture vs monoculture)

Issue: "Either - or", "instead of" and "replace" narrow the possibilities, and suggest rotations are not possible. Annuals are and should be here to stay. Such language increases anxiety of all but full proponents, and blurs into "Low input vs Industrial systems".

Solution: "Both" and "Complementary" open up opportunities. "Perenniation," the integration of perennials into annual-based systems, with "complementary parallel breeding" and "Complementary parallel management".

4. Too much bootlegging; too little leveraging and coordination

Issue: Individual projects are not fully benefiting from other efforts. Information transfer is slow. Cost is presented in years; as time is required. Impairs production of international public good.

Solution: (This has equal responsibility with donors). Each programme needs to emphasise communication and coordination with the global community (beyond specific crops). Develop a professional society with formal lines of communication. Establish a World Perennial Grain Research Centre.

Use the perennial grains blog at Michigan State University for resources and announcements, pwheat.anr.msu.edu/index.php/about/, e.g. "Polyculture and Perennial Grains for Sustainable Agriculture" Symposium at the ASA-CSSA-SSA Annual Meetings in Tampa Florida in November 2013; e.g. Special Symposium "Perennial Grains for Food Security in a Changing World: Gene to Farm Innovations" at the AAAS Annual Meetings in February 2014.

CONCLUSIONS

To attract sufficient support for perennial grain research and development, we must better understand and communicate the multiple sustainability benefits of perennial grain systems, especially in the area of climate change adaptation and mitigation. The greater use of websites, blogs (e.g. the Michigan State University blog), professional conferences, and webinars can help communicate the scientific results to wider audiences, including scientific funding agencies and policymakers. Current efforts lack effective coordination and leveraging. A more formal framework for communicating information, transferring research results and germplasm, and identifying priorities needs to be developed via organized international organizations and professional societies.

To specifically address the needs of developing countries, particularly those regions most in immediate need of increased food and ecosystem security, perennial grain advocates should address additional issues as follows:

1. Perennial grains must contribute to sustainable intensification and not lead to extensification, which would require more land for production of the same amount of food;
2. Perennial grain development for international development contexts must include scientists, policymakers, and farmers in target regions. Currently, efforts are primarily 'demand-driven' by scientists working in developed countries (Figure 6);
3. The crops and regions on which current efforts are focused are primarily based on scientist interests and locations, not on systematic analyses of priority regions and needs. Computer modelling combined with on-the-ground trials can help identify priority farming systems and crops on which to focus limited resources;
4. Much of the discussion about perennial grains to date has been on the costs or benefits of annual crops versus perennial crops; most farmers in target priority regions rely on both. Greater attention must be paid to complementarity of annual and perennial crops and systems, from complementarity in plant breeding programmes to complementarity at the farm management level;
5. The timeline for widespread impact of perennial grains is long for traditional development funding streams. While some funding has been directed toward long term, high risk, high reward projects ("blue sky" projects), there are potential short and medium term benefits derived from investigating and/or developing perennial grains at multiple scales.