Practicing Agroecology in Iran

Driven by modern plant breeding, seed systems and the functioning of global markets in the past decades, agricultural production and food systems have shifted toward uniformity. Modern varieties, developed under high-input agricultural system, do not always perform well in marginal conditions and poor lands under the effects of climate change. The smallholder farmers in low-input production systems are most vulnerable to climate change, where they have to cope with unpredictable and severe weather patterns, droughts, soil salinization, etc. Their resilience is dependent on the diversity in their production system and access to seeds adapted to produce, stable yields under changing weather and low-input conditions.

Increased emphasis on agricultural inputs, homogenization and reduction in the number of seed companies, and the functioning of global markets, have pushed conventional agricultural production toward crops uniformity. This uniformity (i.e., large areas planted to single and limited varieties in formal seed systems) has come at the cost of reduced availability of crop and varietal diversity that are keys for the sustainability of agroecosystems, as well as the needs and resilience of low-input farmers.

Of the 3 billion people living in the rural areas of developing countries, 1.2 billion practice low-input traditional agriculture on small, largely family farms that use traditional or informal sources to meet their seed or planting material needs. These farmers depend on crop and varietal diversity to cope with climate change, resulting in unpredictable and severe weather patterns, droughts and floods, as well as changes in pests and pathogens, soil salinization, low soil fertility, land degradation, and market fluctuations. Management and use of these traditional crop varieties under low-input conditions has resulted in promoting farmers' capacities to cope with biotic, abiotic and economic shocks, which have led to increasing yield stability, food security and mitigation of poverty. The resilience and productivity of these poor smallholder farmers is dependent on the diversity in their farming and production system and access to seeds of adapted crop-planting material.

The diverse crop base of poor farmers is being put further at risk from new and exotic pests and pathogens through increased trans-boundary movements of living organisms brought about by globalization of trade and exacerbated by climate change. Despite this, the majority of varieties bred today are for large-scale farming solutions that assume

predictable temperature and precipitation patterns.

Government research has put its funding emphasis on large-scale single solutions, leaving few funds to exploit the huge potential of the crop genetic diversity that continues to be managed by smallholder men and women farmers in these heterogeneous environments. In both self-pollinated crops, such as wheat, barley, rice and common bean, and in cross-pollinated crops such as corn, breeding programs have led to the development of uniform varieties (homozygous lines and hybrids, respectively). Increasingly, the use of selected materials adapted to high-input farming techniques (irrigation, fertilizers and pesticide application) has resulted in a tendency for varieties to be developed from a narrow genetic base with limited use of the wide genetic diversity available in national and international gene banks.

The program on participatory plant breeding (PPB) and evolutionary plant breeding (EPB) in Iran is one example of what can be achieved when these challenges are overcome. Centre for Sustainable Development and Environment (CENESTA) has developed a model for giving a large number of farmers access to great amount of biodiversity in a short time. CENESTA has been trying to initiate a type of plant breeding that brings back diversity in farmers' fields.

By conducting trials in farmer's field, instead of research stations, CENESTA involves farmers in all the most-important decisions. Farmers participating in the PPB trails have developed a greater appreciation for biodiversity and this let them move beyond single varieties to working with mixtures of several varieties. Finally, CENESTA combines the participation with evaluation and cultivating evolutionary population mixtures of mega-diversity.

This method is not new. It was proposed in 1956 by U.S. agronomist Coit Suneson and consists of making very big mixtures of hundreds, or even thousands of varieties and letting these mixtures evolve.

Populations evolve differently under different conditions. Organic agriculture is also added here not because of difficult agronomic conditions, but because not enough research is done to develop specifically adapted varieties.

However, due to the natural crosses that will occur within this population, the seed that is harvested is never genetically identical to the seed that is planted. In other words, the evolving population becomes better with each harvest and slowly adapts to the environment around it, including climate changes.

The advantage of these populations is that they have a lot of time to adapt slowly, without knowing now what the climate will be in 20 years. In the case of evolutionary plant breeding, CENESTA uses the fundamental theorem of natural selection to our advantage.

On-farm management through EPB contributes to the dynamic conservation of plant genetic resources for food and agriculture (PGRFA), and this could be called a dynamic on-farm gene bank. It is always possible to use these populations as a sort of germplasm bank to make selection for the participatory breeding.

Also, CENESTA has brought biodiversity to the table. Woman and men farmers and bakers in two provinces of Iran have tried making bread from the flour of evolutionary populations, and they have been pleased with the results. All farmers involved in bread making confirmed that creating mixtures not only brings greater yield stability, but also greater aroma and quality to the bread. Some are now marketing the bread in local artisanal bakeries that are providing this bread to four organic shops in Tehran.

Evolutionary plant breeding brings back the control of seeds to the hands of farmers and makes them independent in ensuring seed supply and decreasing crop vulnerability by cultivating and generating new diversity. This method have proved to be an inexpensive and dynamic way to achieve in situ conservation of plant genetic resources and adapt crops to climate change, helping to increase sustainable production and resistance to weeds, diseases and pests.

Since farmers do not need pesticides, herbicides and fertilizer, the cultivation cost of evolutionary populations is lower than pure line varieties such as modern varieties. These populations also can provide the market with more-nutritious food and feed and, most importantly, evolutionary populations cannot be patented, which leads to greater local food sovereignty.

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