case 02

Increasing plant genetic diversity in farmers' fields for resilient communities and food sovereignty in Iran

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Sustainable Devopment Goals:

CENESTA IS WORKING TO IMPROVE THE AGROECOLOGICAL SYSTEMS OF SMALL-SCALE FARMERS IN IRAN. SINCE 2008, THE ORGANISATION HAS IMPLEMENTED AN EVOLUTIONARY PARTICIPATORY PLANT BREEDING PROGRAMME TO RAPIDLY INCREASE BIODIVERSITY IN FARMERS' FIELDS, ENHANCE RESILIENCE TO CLIMATE CHANGE AND RECORD TRADITIONAL KNOWLEDGE. BY DOING SO, CENESTA IS CONTRIBUTING TO A SYSTEM OF HEALTHY FOOD PRODUCTION AND SUSTAINABLE ECOSYSTEMS.

Farmer's examining the quality of a evolutionary wheat population in the field. (Photo credit CENESTA)

LACK OF ACCESS TO GENETIC RESOURCES

Most of Iran's climate is considered hot and dry – 85 per cent of its land area is classified as either arid or semi-arid.[1] At the same time, the agriculture sector continues to play a key role in the countries' economy. The majority of farmers are smallholders as 75 per cent of them work on less than 5 hectares.[2] Most of them live in drylands with low soil fertility and high exposure to climate change, including severe droughts, low precipitation and water scarcity.[3] They lack access to plant genetic resources, including varieties that are adapted or resilient to climate change. As most small-scale farmers have been excluded from participation in formal agricultural research, their engagement with agricultural research stations is very low.

EVOLUTIONARY PARTICIPATORY PLANT BREEDING

The Evolutionary Participatory Plant Breeding (EPPB) approach is a combination of two specific breeding methods: evolutionary breeding and participatory plant breeding. Evolutionary breeding is based on a mass selection technique used by farmers for over 10,000 years of crop improvement and represents a dynamic and inexpensive strategy to enhance the adaptation of crops to climate change. It has been shown to increase yields, disease resistance, genetic diversity, nutrient food and adaptability of a crop population over time.[4] Participatory plant breeding on the other hand originated in developing countries and is designed to meet the needs of low-input, small-scale farmers in marginal environments – those who were often overlooked by conventional crop breeders.[5]

EPPB can be considered a living gene bank in farmers' fields which rapidly increases on-farm biodiversity as one of the fundamental elements of small-scale agroecological systems.[6] EPPB emphasises the utilisation of natural selection in combination with site-specific farmer selection in early segregating generations of a heterogeneous crop population. It represents a dynamic and inexpensive strategy to quickly enhance the adaptation of crops to climate change and promote in situ conservation of agro-biodiversity. EPPB enables production of varieties specifically adapted to an agroecological agricultural model and puts control of seed production back in the hands of farmers.[7]

Iran was among the first group of countries – together with Syria, Jordan, Algeria and Eritrea – where the idea of EPPB was first discussed with farmers and implemented with an evolutionary population of wheat and barley. Activities were started by one farmer in Kermanshah (rain-fed condition) and another in Garmsar (irrigated condition). The farmer in Kermanshah then served as a multiplier of the evolutionary population to several other farmers in Kermanshah and beyond. Today, populations cover several hundred hectares and are planted in 17 Iranian provinces. Although it was an innovative methodology, both farmers and the government have reacted positively to the programme.[8]

RESILIENT COMMUNITIES AND LOCAL FOOD SOVEREIGNTY

Evolutionary Participatory Plant Breeding helps building resilient communities and local food sovereignty, thereby contributing to several Sustainable Development Goals (SDGs), especially SDG 1, 2, 13 and 15. By supporting local food producers in reducing production costs and increasing both income and resilience, EPPB contributes to more reliable and sustainable agricultural productivity – thereby contributing to SDG 1 Target 1.5 of *building the resilience of the poor and reduce their exposure and vulnerability.* Recent molecular studies on evolutionary populations of barley in Italy confirmed their yield stability over time and under different agro-ecological conditions.[9] Evolutionary populations are able to control weeds, diseases and insects, and therefore can reduce production costs considerably towards a low/no input agroecological system. This protects farmers from dependence on subsidies and/or input price fluctuations, which in the past have considerably affected farmers' incomes. Equally, it returns control of genetic resources and agrobiodiversity to small-scale farmers and gives them crucial independence in both seed supply and genetic diversity.

Coupled with the fact that fields of evolutionary plant populations have shown increased yields[10], EPPB directly contributes to most SDG 2 Targets, in particular Target 2.3 of *doubling the agricultural productivity and incomes of small-scale food producers* and Target 2.5 of *maintaining the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species.* The evolutionary plant populations are a permanent asset in the hands of the farmers. They provided a valuable opportunity for small-scale farmers to engage in a 'learning by doing process' that can enhance their knowledge for reliable and sustainable productivity patterns based on natural selection and different types of agronomic management. Indications from the field (Italy, France, Iran, and Ethiopia) also suggest that the

evolutionary populations exhibited superior quality characteristics (protein content, cooking quality, taste, reduced gluten intolerance), require fewer chemical inputs and are well adapted to organic farming. For example, one of the important issues of rain-fed bread wheat in Iran is its low quality for making bread.[11] Following the EPPB programme, a number of women in Garmsar started using the evolutionary population of bread wheat in their bakeries. Both the farmers and bakers have been pleased with the results. They confirmed that creating mixtures not only brings greater yield stability, but also greater aroma and quality to the bread.[12]

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EPPB is also strengthening resilience and adaptive capacity to climate-related hazards (SDG 13 Target 13.1). By increasing genetic diversity, the approach offers a flexible and efficient strategy to enhance the adaptation of crops to climate change.[13] The genetic diversity serves as a way for populations to adapt to changing environments: EPPB mixtures of wheat and barley therefore have the opportunity to adapt to climate change, which in turn increases the resilience of the small-scale farmers who plant them. It is a highly suitable approach to in-situ conservation of plants and genetic material that incorporates traditional and indigenous knowledge.

The EPPB approach is strongly contribution to SDG 15 Target 15.6 of *promoting the fair and equitable sharing of the benefits arising from the utilisation of genetic resources and promote appropriate access to such resources, as internationally agreed.*[14] The programme in Iran offers a model for giving a large number of farmers access to a great amount of biodiversity in a relatively short time . Contributing to agricultural biodiversity, including conservation and use of landraces (domesticated, locally adapted, traditional varieties) and crop wild relatives, is widely recognised to be essential for adapting successfully to climate change.[15] Moreover, EPPB promotes the fair and equitable sharing of genetic resources with all stakeholders through customary systems of farmer-saved seed and seed exchange that enable small-scale farmers to access and benefit from gene diversity. The EPPB programme provides a valuable opportunity for small-scale farmers to 'learn by doing' and enhance their knowledge of reliable and sustainable productivity patterns based on natural selection and in different types of agronomic management.

BROADENING THE EPPB APPROACH

The evolutionary populations of wheat and barley continue to be spread throughout Iran, both through farmer-to-farmer exchanges and through exchanges organised by the *Dryland Agricultural Research Institute (DARSI),* the Department of Agriculture of Fars Province, and CENESTA. In addition, DARSI established a similar programme for bread wheat. Evolutionary populations of a variety of crops are now also grown in several other countries.

The EPPB programme will continue in Iran and beyond (Jordan, Bhutan, Nepal, Ethiopia and Uganda) with the aim of sustainably increasing crop productivity and enhancing resilience to climate change of farming communities under low-input, rain-fed and less favoured production conditions.[16] The continuing programme specifically aims to enhance resilience of farmers in partner countries through higher and stable yields under the agronomic and stress conditions of local farms, including drought, salinity, pest and diseases.

CENESTA believes that the establishment and recognition of organisations of small-scale farmers at local, regional, national and international levels is critical. More focus is also needed on women's role in the process of local agroecological systems. Policies to support, disseminate, up- and out-scale EPPB achievements and best practices are also needed, as is capacity building to enhance participation among small-scale farmers and agricultural research institutions. Finally, promotion of EPPB and evolutionary crop populations in general will contribute to more resilient communities and ecosystems.

NOTES

1 Naghizadeh, N., Didari, A. & Farvar, M.T. (2012). *Recognition and Support of Territories and Areas Conserved by Indigenous, Peoples and Local Communities in Iran, A National Case Study.* ICCA Consortium, IUCN/TILCEPA, Kalpavriksh, and Natural Justice. Retrieved from: http://www.cenesta.org/wp-content/uploads/2012/12/publication-cbd-technical-series-no64-iran-en.pdf

2 CENESTA. (2010). *Implementation of Farmers' Rights in the Islamic Republic of Iran.* Report for the 3rd Session of the Secretariat of the International Treaty on Plant Genetic Resources for Food and Agriculture. Retrieved from: http://www.cenesta.org/wp-content/uploads/2015/10/farmers-rights-in-iran-2010-en.pdf

3 Jamshidi, O. et al. (2018). Vulnerability to climate change of smallholder farmers in the Hamadan province, Iran. *Climate Risk Management, 23,* 146-159. DOI: 10.1016/j.crm.2018.06.002

4 Raggi, L. et al. (2017). Evolutionary breeding for sustainable agriculture: Selection and multi-environmental evaluation of barley populations and lines. *Field Crops Research 204,* 76-88. DOI: 10.1017.01.011

5 Murphy, K. et al. (2007). Breeding for organic and low-input farming systems: An evolutionary–participatory breeding method for inbred cereal grains. *Renewable Agriculture and Food Systems 20* (1), 48-55. DOI: 10.1079/RAF200486

6 Rahmanian, M., et al. (March 2014). *Evolutionary Populations: Living Gene Banks in Farmer's Fields.* Farming Matters 30.1. Cultivating Diversity. Retrieved from: https://www.ileia.org/wp-content/uploads/2017/02/30_1_Agrobiodiversity.pdf

7 See 6

8 CENESTA. (2014). *Using Agricultural Biodiversity and Farmers' Knowledge to Adapt Crops to Climate Change.* Grant completion report, Grant #1214

9 See 4

10 See 4

11 Haghparast, R. et al. (2009). Review on Participatory Bread Wheat Breeding Program in Kermanshah, Iran under Rainfed Condition: Importance, Opportunities and Challenges. *Middle Eastern and Russian Journal of Plant Science and Biotechnology, 3* (1), 1-4

12 See 8

13 Ceccarelli, S., Galie, A. & Grando, S. (2013). Participatory Breeding for Climate Change-Related Traits. C. Kole (ed.), *Genomics and Breeding for Climate-Resilient Crops, 1*, 331-376. DOI 10.1007/978-3-642-37045-8_8

14 See 6

15 FAO. (2019). *The State of the World's Biodiversity for Food and Agriculture,* J. Bélanger & D. Pilling (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Retrieved from: http://www.fao.org/3/CA3129EN/CA3129EN.pdf

16 For more information, visit: http://www.libird.org/app/projects/view.aspx?record_id=82

Diversity of different barley populations grown in the same field. (Photo credit CENESTA)