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Averting an Imminent Food Crisis: The Need for Alternative Crops

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Statistics published by the UN Population Division [1], show that the estimated world human population is expected to increase from 2.5 billion in the 1990s to 8.5 billion by 2025 and projected to 9.2 billion by 2050 (Figure 1, Table 1). These estimates having always been associated with the challenges of environmental sustenance and food supply now show that food production must increase by 60-70% in order to meet world demand and to minimize malnutrition [2]. How will this increase be realized? Would this achievement be different from the promise of the 1990s?

The promise of the 1990s which emanated from the projected food crisis then, produced an agricultural revolution that was built on improved crop varieties, better equipment and farm mechanization, cultivation of more land, as well as increased fertilizer use for optimum growth. This was shown to improve the condition and wellbeing of a lot of rural dwellers particularly in the developing countries where adoption of improved maize varieties was shown to significantly improve food security and alleviate poverty among rural households, while adoption of (improved) groundnut varieties significantly increased the net value of income [3,4].

Furthermore, recent advances in plant improvement including the adoption of Gene Modification (GM) strategies to create crop strains that are resistant to drought, diseases, pests, and other environmental stressors that diminish yield of crops and raise the cost of production have yet to meet general acceptance from farmers and other stakeholders. Adoption of genetically engineered crops with traits for pest management rose dramatically since their commercial introduction in the mid-1990s [5], and globally, acreage of GM crops increased 25-fold in just 5 years, from approximately 4.3 million acres in 1996 to 109 million acres in 2000 - almost twice the area of the United Kingdom [6].

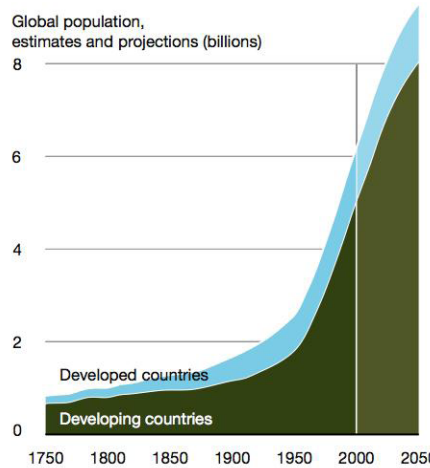

Figure 1: Human population growth in developed and developing countries [1].

Year	Total population
1950	2,535,093
1955	2,770,753
1960	3,031,931
1965	3,342,771
1970	3,698,676
1975	4,076,080
1980	4,451,470
1985	4,855,264
1990	5,294,879
1995	5,719,045
2000	6,124,123
2005	6,514,751
2010	6,906,558
2015	7,295,135
2020	7,667,090
2025	8,010,509
2030	8,317,707
2035	8,587,050
2040	8,823,546
2045	9,025,982
2050	9,191,287

Table 1: World Total Population 1950-2050. World Urbanization Prospects: The 2007 Revision Population Database (http://esa.un.org/unup/p2k0data.asp).

However, environmental activists, religious organizations, public interest groups, professional associations, and a section of the scientific community as well as government officials have all raised concerns about GM foods with regard to environmental hazards, human health risks, and economic concerns [6,7]. Moreover, although genetically-modified crops foods are targeted for high productivity, tolerance to environmental stresses, as well as other favorable mutations, their development contributes to a progressive narrowing of the genetic base in subsequent populations [8,9], as shown in Figure 2, which reduces genetic diversity leading to deleterious effects. The limited genetic diversity of crops following long-term breeding and selection renders them more vulnerable to disease, competition, climate change, and insect epidemics and jeopardizes the potential for sustained genetic improvement over the long term [9,10]. Coupled with the vertically integrated nature of food production and supply in advanced economies, these vulnerabilities could easily destabilize food delivery chains worldwide.

Negative propaganda against GM foods as well the dread generated thereof has produced a constituency that is strongly opposed to the idea of genetic modification and created a renewed

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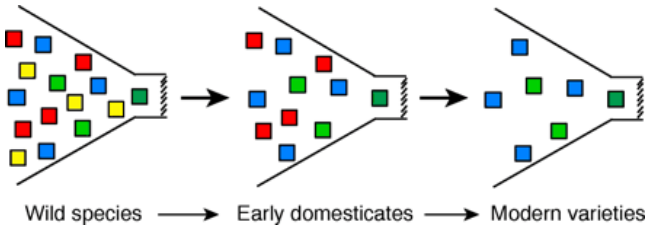

Figure 2: Genetic bottlenecks imposed on crop plants during domestication and through modern plant-breeding practices [8].

shift to small-scale production of organic crops through the adoption of what are deemed to be environmentally benign methods. To a certain extent, organic agriculture has become a hype that is both too expensive and technically unrealistic for meeting the demands of a growing population. Records show that approximately 37,000,000 hectares (91,000,000 acres) worldwide are now farmed organically, representing approximately 0.9% of total world farmland in 2009. Organic crop production is therefore a minor option among available alternatives for addressing future world demand for food and fiber.

What other possible solutions exist for meeting the looming crisis of food insecurity and hunger that will be triggered by population growth particularly in developing countries?

One overlooked alternative is the option of going back to the wild to revisit the vast reserve of wild and partially domesticated species that have a long history of usage as food, medicine, and raw material. These plants are resilient, well adapted to local environments, and for being wild, still retain highly diverse genetic bases and unique characteristics. Indigenous communities all over the world are familiar with a large diversity of flora and fauna that provide sustenance in form of food and medicine. The 'plants for a future' (PFAF) website lists more than 7000 underutilized species with both culinary and medicinal value. According to PFAF [11], examples of wild or partially domesticated species receiving top edibility rating include: *Zizania aquatica* (wild rice), *Urtica dioca* (stinging nettle), *Allium ampeloprasum* (wild leek), *Aloe vera* (Aloe), and *Phragmites australis* (common reed). The stinging nettle for instance, is commonly considered a noxious weed but it is a most versatile species whose leaves are used for food, forage, as a curdling agent, or tea. The stems could be used for fiber, biomass, or compost, while the roots can be boiled to extract a yellow dye, or used in alternative medicine.

The answer to the question of long-term food security lies in diversity of approaches and resources among which exploring the wild for alternative crops remains a mostly untapped frontier.

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