

Consumption Patterns and Underutilized Fruits as Resilience Strategies in the Face of the Global Environmental Crisis

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Abstract The food we consume defines our eating habits and transcends the economic, social or health conditions of individuals and societies. It is a fact that our consumption patterns respond to a food industry that places economic performance before health, food needs and environmental sustainability. The global environmental crisis forces us to rethink all the activities we do, including food. The consumption of local, wild, native, or naturalized foods allows us to have healthier and more sustainable diets. It is imperative to include diverse foods in our diet so that the consumption of monoculture foods diminishes in time. We need a systemic approach when deciding what to eat. Choosing local and varied foods improves the diet, the family and local economy, rescues the use of marginalized (underutilized) local species and contributes to socially and environmentally responsible food production systems. In the search for adaptations to the planetary environmental crisis, it is urgent to promote sustainable food production systems, and for this, it is necessary to make changes in current consumption patterns. In this paper, we focus on two aspects of the agricultural system in Venezuela: production and consumption, and we propose the rescue of underutilized agricultural diversity to diversify our food systems.

Keywords: food production, consumption patterns, resilience, environmental crisis, Venezuela.

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1. Introduction

In the world, current agrifood systems have been developed on a narrow and highly vulnerable basis. In the last 100 years alone, 75% of plant genetic diversity has been lost [1]. Currently, 60% of the energy consumed from plants, comes mainly from five cereals: rice, wheat, maize, millet, and sorghum [2]. In this sense, the food production model is based on a few plant species [3], leaving aside an enormous range of food possibilities; harming food consumption habits, nutrition, and human health; as well as the loss of local species knowledge that end up in disuse and oblivion. Furthermore, the global environmental crisis has very diverse causes [4], forcing us to analyze all human activities related to major ecosystem disruptions, and the role of food production is remarkable in this sense, therefore the pathways from production to consumption must be reconsidered. The impact of human beings on ecosystems has had dramatic consequences today, and the dynamics in the near future are hard to foresee, given the complexity of all processes involved [5]. Even though, the effects of this crisis are

already being felt in social, economic, and environmental levels [6,7].

Researches on these scenarios, food access and environmental crises, have determined that underutilized species have improved the possibility of accessing healthier diets in many localities [8]. Either for their nutritional contribution, as alternative medicine, or for their adaptations to unfavorable climatic and soil conditions, these species can contribute to sustainability in food production systems [8,9,10]. For instance, in Venezuela, 46 underutilized species destined for self-consumption, mainly in small communities, have been reported [11]. However, it is necessary to continue expanding the research on these species and to promote their consumption. In this work, we aim to gather information from two axes within the food production system. The first axis was food production under the scenarios of environmental crisis on the planet, and the second axes were related to modern consumption patterns and their environmental impact. Finally, we generated a proposal that promotes a change in the use of underutilized species with potential as a source of complimentary source of calories and nutrients.

2. Food Production and Environmental Crisis

Since the Industrial Revolution, an accelerated process of transformation in food consumption and the adoption of new alimentary habits began in the West [12]. The industrialization of the countryside brought with it several conditions that modified food production and shaped the markets since then, therefore this phenomenon influenced our diet, largely. The industrial agricultural production model implied the commercialization of food (as merchandise), the appearance of ultra-processed foods, and the consequent homogenization of the diet. For the agroindustrial production model, food is just another product, and this has contributed to the cleavage between the humans and nature, or between humans and food access [12]. In this way, nature (the countryside) became the source of raw material [13] to generate products (commodities) to be consumed (food) by the masses. Progressively, it was necessary to generate more efficient technologies to increase production, and thus, seeds and technological packages appeared, and new products facilitate the lifestyle imposed by modernity. This corporate agriculture defines much of the food available in today's markets.

The predominance of short-cycle crops (mainly cereals) in large cultivated areas was imposed through technological packages with the promise of reducing hunger in the world. However, the figures for hunger or people under conditions of undernourishment show a different reality [7].

Historically, the agroindustrial food production model for agriculture and livestock has been one of the industries having the greatest impact on terrestrial and marine ecosystems, in addition to the atmosphere. Since the beginning of the industrial period, how we produce our food has changed and we are now facing the agriculture of transnationals [14]; for whom food is just another commodity.

Industrial food production requires the consumption of environmental resources such as water, electricity, use of fossil fuels [for the production of fertilizers and transportation involved in the production chain], soils, and pollinators, among others. This type of agribusiness production model transgresses several of the planetary boundaries [15,16] and puts life on the planet, as we know it, at risk. The expansion of agricultural frontiers is advancing at an accelerated pace to meet the needs and future changes in consumption habits that are predicted for the next decade [17]. In this regard, OECD-FAO [18] projections for global meat production by 2030 will increase in beef, pork, poultry, and sheep meat by 5.9%, 13.1%, 17.8%, and 15.7% respectively, to meet the demands of expanding countries such as China and India. Regarding agricultural production from 2020-2030, an increase in the production of cereals such as rice, corn, and wheat, mainly, is expected [18]. Given these forecasts of increased production of cereals and meat, we can only ask ourselves: How can we reduce the environmental impact of the increase in production?

Land use change is one of the main consequences of the industrial agricultural production model, threatening

spaces for biodiversity; the excessive use of mainly nitrogenous fertilizers released into water basins or the atmosphere. One example is nitric oxide, one of the most important greenhouse gases [19]. In addition, the replacement of natural cover by "agricultural cover" changes water flows within natural systems affecting the water balance of ecosystems [20]. This fact has produced the so-called "green deserts" (large land areas dedicated to timber and food species monoculture), drastically reducing local diversity.

Industrial agriculture is responsible for 80% of world deforestation, using 1/3 of the energy produced on the planet [17], consuming about 70% of the freshwater available, and generating between 23% to 37% of greenhouse gases. Also, if pre- and post-harvest activities inherent to agricultural activity are considered [5]: figures are even more impressive as this model only produces 30% of the planet's food [21]. These figures vary from one region to another implying that impacts may be greater in some places than others.

3. Modern Consumption Patterns and the Environment

Food has been a crucial element in the evolution of human beings [22]. The food we take to the table every day defines our consumption patterns, it defines us as individuals and as part of society. In this sense, consumption patterns are the customs or habits of groups of people in terms of food and reflect average and predictable behavior [23].

Everything we select when acquiring our food reflects our customs and the social and cultural influence we have received. The way we eat responds to multiple factors; it is related to our culture, geographic location, health, work capacity, and the development of all our activities [23]. Food consumption practices not only respond to the physiological need to eat but there are also psychological aspects involved, it is ultimately a social construction [24]. Consumption patterns have been shaped by other phenomena such as globalization, industrialization of agriculture, poverty in rural areas, and urbanization and/or concentration of the population in cities [25,26].

But it is not only agribusiness that plays a role in the food available on the market. What we choose as consumers is also a determining factor in food production and therefore in the use of natural resources and the consequent deterioration of the environment [26,27]. Our food choices also affect our health, since an unhealthy diet is associated with chronic non-communicable diseases [26,27,28]. Consumption pattern studies in Asia, where rice prevails as the major caloric source, have shown the relationship between an unbalanced diet with malnutrition [29]. Other studies have also pointed out that non-diverse diets are associated with chronic non-communicable diseases such as diabetes, coronary heart disease, overweight, and cancer, among others [26,30,31,32]. In this sense, it is also important to consider not only the number of calories ingested in a meal, but we must also consider the quality in terms of vitamins, minerals, and other indispensable nutrients for disease prevention. At this point is when fruit intake can improve the quality of

life due to the contribution of nutrients and other compounds healthy for the organism; diversity plays an essential role.

Responses to food demand have primarily focused on making monoculture-based production systems more efficient. From seed to food reaching the table, the food industry continues to intensify at every stage [14]. More diverse food systems, in terms of production and species, can be a solution to access healthier and more nutritious foods, and for other challenges facing the environmental crisis. In this sense, diets are a powerful tool to mitigate environmental and health crises [27] by promoting local foods (fruits and vegetables) and increasing the availability of non-industrialized and easily accessible products [17].

4. Underutilized Fruits as a Strategy of Resilience to the Global Crisis

Only 6% of the population in Venezuela maintains a healthy diet, the rest of the dietary sub-patterns are based on high fat intake, refined flour, and low consumption of fruits and vegetables [23,33]. This reality makes us vulnerable from a health point of view and decreases our quality of life. Although, the high consumption of refined low nutritional cereals is a transversal matter to eating habits all over the world.

Humanity is far from achieving sustainable food systems, with a few exceptions, due to the low diversity of nutritious foods present in the diet [26]. The incorporation of a greater diversity of foods, produced under alternative, extensive, and low ecological impact schemes, is necessary to lead toward healthy and more sustainable food systems.

In rural areas, underutilized fruit species have been of great help for subsistence and have demonstrated their resilience in the face of adverse climate and soil conditions [34]. These fruits represent sustainable options to meet food demands in the face of the unfavorable scenarios predicted under the climate crisis. Some authors outline underutilized species as the smart or survival crops of the future [35]. Generally, these species are kept in wild conditions or sheltered in backyards and *conucos* (traditional shifting agriculture method), surrounded by other species without any systematic growth management and even so, they are very productive. The diversity of these growing spaces is precisely what allows underutilized species to produce fruits in unfavorable environments. In diverse ecosystems, the presence of natural enemies for pests and phytopathogens, the generation of favorable microclimate for soil moisture, and nutrient cycling enrich growth opportunities. In this sense, Nicholls and Altieri [36] point out that the complexity of agroecosystems allows better adaptations and resilience to climate change.

In Venezuela, more than 40 underutilized species have been detected in rural and peri-urban communities, most of which are fruit species [11]. Most of the species are used for self-consumption, representing savings for the family and more diverse diets which represent and improve in quality of life.

In a study conducted in small communities of a rural area in Aragua state (2022), (data unpublished by the

authors), 43 underutilized fruit species were detected that have served as a food supplement or facilitated access to other food resources through barter (exchange where there is no money for the transaction) in times of economic crisis, shortages or difficulties for mobility; this strategy was applied during 2020, as a consequence of the pandemic by Covid-19. The results of this study, still in progress, suggest that communities prefer to keep their fruit trees in backyards and *conucos* for local consumption, although some species are used only as shade, despite their great nutritional value. Such is the case of the tropical almond tree (*Terminalia catappa* L.), which is a species appreciated for its medicinal properties and the nutritional content of the almond contained in its fruit [37].

It is a fact that underutilized fruits are an alternative to fight poverty, hunger, and malnutrition that current diets have caused [29,38,39], while contributing to improving environmental stresses locally and globally.

To contribute to the objective of varied and sustainable diets, from the project "Potential fruit species for food, to strengthen food sovereignty in Venezuela" we have detected 67 fruit species that can be used as fresh or processed fruit for human consumption. With this line of research, we proposed to make these species visible, as they have been absent from conventional markets. This idea will incorporate a catalog of species with technical aspects for management, as well as nutritional information and gastronomic suggestions for these fruits to be successfully reintroduced into the Venezuelan diet.

5. Conclusions

The relationship between production, food consumption patterns, and environmental crisis is undeniable. Today, more than ever, it is necessary to address this reality diminishing conventional technical options and enhancing local perspectives in each territory. From each locality, there may be consumption alternatives, such as underutilized fruits, that allow us to satisfy our food and nutritional needs sustainably, without the deterioration of the planet. We urge those who produce food to consider the impact that agricultural practices have on ecosystems and to select items with truly sustainable production systems associated. As consumers, we should be conscious of choosing local foods and introducing variety into our diets, giving preference to unprocessed foods. We urge public policy decision-makers to generate proposals for food education and the design of strategies that favor the diversity of species with food potential, through productive projects that promote the presence of these species in the field and the markets. We urge those involved in research to consider potential species as a niche for reproducing situated knowledge on food, health, nutrition, and environmental sustainability. The time to adopt a new food paradigm is now.

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