Introduction

The world is waking up to the urgent need to ensure that agriculture - through crop diversification - can help to address the world’s nutritional needs. The challenge is not the absence of scientific, technological and engineering knowledge. It is the absence of institutions that can transform the widely available knowledge into practical programs that can bring agriculture, nutrition and health together to help improve the human condition.
The state of world agriculture and nutrition

Based on energy intake, the Food and Agriculture Organization of the United Nations estimates that 12.5% of the world’s population (or nearly 868 million people) are undernourished. Some 26% of the world’s children are stunted while 2 billion people suffer from one or more micronutrient deficiencies. It is estimated that 1.4 billion people are overweight, of whom 500 million are obese.

Agricultural production has only partially addressed the challenges of undernourishment and overnourishment. In some cases, existing agricultural systems have contributed to the problem through lack of diversity in food systems.

World food production patterns and global nutritional needs have over the centuries evolved along divergent pathways. The four leading staples (maize, wheat, rice and potatoes) were selected through geographical serendipity, indigenous knowledge and salient agronomic and nutritional properties.

Because of the lack of detailed knowledge on human nutritional needs, energy intake became the dominant indicator of food needs. Agricultural systems became preoccupied with quantitative targets on crop yields. The challenge to improve nutrition took root outside the agricultural system with emphasis on measures such as fortification.

Over the centuries the two food strands have evolved along divergent paths. The challenge today is to find ways of ensuring that agricultural production can shift its attention and seek to meet nutritional needs.

Efforts to align global agricultural and nutritional goals will involve at least two strategic approaches. First, policy makers need to appreciate the significant contributions that advances in science, technology and engineering can bring to a new revolution in nutrition. A large part of the knowledge involves more detailed understanding of the role that niche crops can play in improving human health.

Second, such knowledge can hardly be put to effective use without significant institutional innovations aimed at bringing research, teaching, extension and product commercialization under one roof. In effect, the world needs a generation of institutions of higher learning that can do for nutrition what older agricultural universities did for food production.

Niche crops and nutritional path-creation

Despite the dominance of a few major food crops, cultures around the world still use a wide range of niche crops, many of which are called “ancient grains”, “orphan crops”, “lost crops”, “famine crops”, “local crops”, “neglected crops” or “wild foods”. In some countries, these crops were the subject of prejudice when exotic crop species were introduced.

However, it would be a mistake to ascribe the “neglect” to some willful conspiracy. The problem lies in the dynamics of moving along an established technological path along which low investments have yielded high returns until the concern for nutrition came along. The task is not to displace existing crops but to expand the size of the global food basket.

There are several building blocks that can be used to lay new nutritional pathways. First, advances in studies on areas such as the role of micronutrients as well as studies in human genetics now allow nutritionists to contribute significantly to the work of food scientists and agriculturalists. It is now possible to visualize health food systems in new ways.

Second, advances in fields such as plant genomics have put at human disposal the immense capacity to enhance existing crops and breed new ones to meet higher nutritional standards. Breakthroughs in genomic sequencing technologies and related reductions in costs have significantly lowered the entry barriers for crop research.

Third, local communities around the world still rely on niche crops to supplement their food intake. The nutritional qualities of some of the foods are known while thousands of others are understudied. For example, the US National Academy of Sciences has documented 14 grains, 18 vegetables and 14 fruits that could be part of an ambitious expansion of the market for nutritionally significant niche crops.

These efforts also need to be connected with the emerging concerns over climate change. Most of the major sources of starch are annual crops requiring extensive use of agricultural land. Little attention has so far gone into exploring the role of tree crops of nutritional significance whose cultivation may lead to less use of land.

Fortunately, advances in conservation biology and tissue culture propagation are contributing to the development of such tree crops. One leading example is breadfruit. The National Tropical Botanical Garden in Hawaii maintains 226 accessions and nearly 120 varieties of breadfruit from 34 Pacific islands as well as Indonesia, the Philippines, the Seychelles and Honduras.

The associated Breadfruit Institute is distributing on a small scale varieties developed from these collections but the effort could be part of a larger initiative to diversify nutritional sources while addressing the sustainability challenge.
The University of Hawaii has conducted studies of 20 of the varieties, examining basic nutritional content, chemical elements, total dietary fiber, vitamins and other essential compounds. There is a need to spread the benefits of such research to other tropical countries to address nutritional needs. But even more importantly, the work of the Breadfruit Institute serves as an important example that can be emulated to promote other niche crops, especially in centers of diversity.

Cultivating new strategies

Aligning agricultural production with nutritional goals will require bold institutional innovations that build on incremental ways that are being pursued today. Currently, much of the effort goes into raising awareness in the agricultural community on the importance of integrating nutritional objectives into plant breeding programs.

There is considerable work underway in finding ways to improve the nutritional content of African crops such as sorghum, cassava and bananas. Some of this has been inspired by advances in genomics and involves genetic fortification of existing crops. Similarly, efforts to sequence niche crops in Africa will yield important information that will help in future breeding activities. These efforts need to be supported and expanded.

Another option worth exploring includes the creation of a new generation of nutrition-based agricultural institutions of higher learning. Such institutions should help to bring research, teaching, extension, public education and community engagement under one roof. Their focus should be to create new pathways for enhancing nutrition through the expanded use of improved niche crops.

There are many strategic entry points for creating such institutions. Many existing universities and research institutes across the world already have programs that focus on improving niche crops. Similarly, many non-governmental and community organizations also work on such crops. Furthermore, these crops enjoy considerable local support and are conserved through a diversity of social networks.

The focus on the new institutional efforts would be to upgrade, consolidate or strengthen institutions working on niche crops of nutritional significance. But unlike conventional agricultural research facilities, such institutions should be guided by nutritional objectives that would include agriculture, health, genetic resource conservation and overall human development.

Political leadership is essential in guiding the integration of agriculture and nutrition given the entrenched separation between the two. One possible way to support such initiatives is to add strong nutrition departments to existing ministries of agriculture while forging close links with the medical community.

Conclusion

Many of the ideas proposed above are not novel, as many countries already have departments of food and nutrition. What is different is the creation of institutions of higher learning that are dedicated to advancing the revolution in nutrition. This cannot be achieved without dedicated champions with the entrepreneurial spirit and drive to promote improved health by combining nutrition and agriculture. Today’s niche crops represent an important starting point for growing a new nutrition revolution.