Opportunities and Challenges of Alternative Specialty Crops: The Global Picture

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Abstract. Modern intensive agriculture has led to biodiversity loss by restricting the number of crops, resulting in a limited range of nutrients available to the community. Alternative specialty crops can contribute to crop diversification in agricultural production systems and enhance human health and well-being by providing a diverse array of food crops. Rapid demographic changes in the U.S. population have created higher demands for and sales potential of fruits and vegetables, and has brought new market opportunities for farmers in the United States to grow alternative specialty crops. The introduction of alternative specialty crops has many inherent advantages including economic benefits to farmers through multiple facets: diversifying crop with value-added crops, improving resilience to climate variability, maintaining yields with less resources, and boosting crop resistance to pests and diseases. However, there are challenges associated with the introduction and establishment of new crops, which include lack of information on candidates, cultural practices, and marketing as well as policy and institutional barriers. Farmers may face risk from poor economic returns and their businesses are likely to fail if proper management and marketing information are not available. This paper explores the opportunities and challenges associated with introduction of alternative specialty crops, and discuss how to mitigate potential problems associated with the introduction and establishment of alternative specialty crops.

With the development of modern agriculture and industry, crop production has become highly mechanized and intensified. Changes in equipment and farm inputs as a result of technological developments have promoted the cultivation of high-yielding crop species, leading to an increasing emphasis on a few major commodity crops. Many farms in the United States specialized in one or two crops for distance markets rather than in diverse crops to provide a range of foods for local communities (Halweil, 2002). Such practices have made farmers more vulnerable to extreme weather events, pests, and market forces, which are linked to swings in commodity prices, thus negatively affecting farm incomes. Loss of agricultural biodiversity can pose risks not only to ecological health but also to human health by restricting food and nutritional constituents available for human consumption (Burlingame and Deminri, 2010; Diaz et al., 2006). These concerns have stimulated interest in seeking alternative specialty crops in the recent decades (Janick et al., 1996).

Specialty crops are defined as fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops including floriculture. The value of specialty crop production in the United States accounted for ≈18% of the $422 billion in agriculture cash receipts collected in 2014 (USDA ERS, 2015). Specialty crops are gaining increasing attention across the nation as demonstrated in the 2014 farm bill (Agricultural Act of 2014, P.L. 113-79) with the increased number of provisions addressing specialty crop issues (Johnson, 2014), reflecting their growing role in the global economy. The estimated total retail sales of fresh and processed fruits and vegetables were over $100 billion in 2008, with a 14% increase from 2006 (Buzby et al., 2010). This rapid demand in consumption has been mainly driven by the changing U.S. demographics trends: more mature consumers, more ethnic diversity, increased population, and increased income (Bisnard et al., 2002). Such demographic changes can be translated into projections of fruit and vegetable consumption reflecting demands for and sales potential of alternative specialty crops (Blaylock, 2003), since many of which belong to these categories.

New or alternative crops refer to crops that are not traditional in a particular geographic region, and the manipulation of the crops can lead to the generation of some commercial products (Blade and Slinkard, 2002). However, it should be recognized that all the crops being cultivated in the States were once considered new or alternative crops (Janick et al., 1996). Alternative specialty crops usually serve to diversify the crops grown in a cropping system, rather than completely replacing traditional commodities. Consumer dietary pattern changes have generated new markets for alternative food products (Popkin, 2006), and the consumption of all forms of fruits and vegetables is expected to increase with greater awareness of their importance in healthy diets (Buzby et al., 2010). Further, the rapid demographic changes of the United States had a significant effect on the U.S. marketplace, including the demand for fresh fruits and vegetables. Immigrants and their descendants account for virtually all growth in the Hispanic population (76%) from 1965 to 2015 (Lopez et al., 2015). This changing ethnic composition of the population indicates expanding demand for commodities favored by Asians and Hispanics particularly for fresh fruits and vegetables as these two ethnic groups consume fruits and vegetables at higher rates than other population groups (Cook, 2011). The immigrant groups desire to buy what is part of their culture and readily available in their countries of origin, which has brought opportunities for farmers in the United States to grow alternative specialty crops.

This paper aims to highlight the advantages and opportunities of alternative specialty crops and the challenges and barriers to their successful commercialization. The objectives of this paper were to discuss the importance of alternative specialty crops, and to address how to mitigate potential problems associated with the introduction and establishment of alternative specialty crops.

OPPORTUNITIES

Promotion of biodiversity and human health. Plant biodiversity represents the primary source of food, feed, shelter, medicines, and many other products and means that make life on earth possible and enjoyable (UNEP, 1995). Limited numbers of plant species have been developed as major food crops for human consumption, resulting in agricultural simplification, a process that favors some crops instead of others for their simple cultivation requirements, easier processing, and storage (Paudelos et al., 2002). Biodiversity is a necessity for ecological health, which offers a pathway for improving human health and well-being (Burlingame and Deminri, 2010; Diaz et al., 2006). The use of underused natural plant resources is to promote biodiversity and the availability and sustainable utilization of plant genetic resources for present and future generations (Vietmeyer, 1996).
Agricultural biodiversity is a foundation for human health (Diaz et al., 2006; FAO and PAR, 2011). The promotion of agricultural biodiversity can confer significant benefits to human health by providing food diversity in the community. Indeed, the loss of biodiversity can be a significant threat to human health, sustainable livelihood, and future food and nutrition security (FAO and PAR, 2011). Increased food diversity can contribute to healthy diets and help meet nutrient requirements for human health and well-being. Many alternative crops are known for health benefits due to their content of bioactive compounds including phytochemicals and vitamins, minerals, and fibers (Chu et al., 2000; Janick, 1999; Janick and Whipkey, 2002, 2007; Williams et al., 2013). Although limited studies have identified many promising traits of alternative crops, these potentially valuable characteristics can add value to alternative specialty crops and meet the demands of a changing society.

Economic benefits. Engaging in the production of more than one crop will make a positive contribution by encouraging diversification of farm income, adding values to the existing crops, spreading out risks, reducing weaknesses in the farm system, or broadening the base of operations (Sauer and Sullivan, 2000). Alternatives crops are typically less affected by price fluctuations even when conventional crop prices fall due to overproduction and subsequent oversupply (Thompson, 1988). Farm diversification through alternative crops opens up opportunities to niche markets and increases potential profitability (Govindasamy et al., 2007, 2008). New crops also can spur sustainable economic development in the areas by creating local-based industries such as processing and packaging (Janick et al., 1996). Additionally, introduction of new crops can help nurture interest in locally produced foods, which in turn offers smallholder farmers with an opportunity to improve their farms’ viability.

New market opportunities. Today’s consumers are interested in new food, and are willing to try and pay more for new flavors (De Barcellos, 2009), making these alternative specialty crops appealing for their unique, delectable flavors and appealing appearance. To meet the regional demands for alternative specialty crops, it is necessary to understand existing supply chains and their requirements and consumer behavior (Mangan et al., 2008). Alternative specialty crops can help farmers gain access to regional, domestic, and global markets with new products. Most specialty crops for fresh consumption are sold through direct marketing channels such as farmers markets, roadside stands, local restaurants, and specialty ethnic markets, providing farmers new opportunities to market their products (Adam et al., 1999). A number of alternative specialty crops have been identified for their pest resistance as well as their flavors, which can be well suited for conventional markets as well as organic markets, and upscale and ethnic markets (Reich, 2007). Although many alternative specialty crops may not be suitable for long-term storage and shipping, they may open up opportunities to produce these crops near large metropolitan areas, which target local consumers as well as tourists visiting the region. Particularly, the rapid expansion of ethnic populations offers major opportunities for fruit and vegetable growers in the region to take advantage of their close proximity to densely populated areas (Govindasamy et al., 2007, 2008). Significant changes are taking place in the domestic and international demand for crop products due to improvement in income, better standards of living, and changing life styles. Influenced by trade liberalization and the rapid development of transport and communication infrastructure, more avenues have been opened up for farmers, allowing improved access to new and distant markets (Rola-Ruben and Hardaker, 2006). Success in commercial farming will depend largely on the ability of the farmers to integrate high-value specialty crops targeted at specific niche markets for competitive advantages (Govindasamy et al., 2011). Interest in greenhouse production of alternative specialty crop has been also increasing due in part to soilborne disease issues and issues associated with the soil fumigant methyl bromide and increased consumer awareness of environment issues (Tyson et al., 2001). Such change provides opportunities for year-round production of the highest quality fresh products at competitive prices.

Environmental protection. Farmers have resorted to the excessive use of inputs such as mineral fertilizers, water, and pesticides to increase crop productivity. These practices pose risks to human health by contaminating groundwater sources and damage both land and aquatic environments threatening all forms of life. Some alternative crop species have a potential to be exploited for protecting an environment as they do not require high inputs, perform well under water- and nutrient-limited conditions, and could be grown in marginal and degraded lands (Joshi et al., 2002). Crop diversity using alternative crops prevents epidemics of harmful insects and diseases in the region by breaking up insect pest, weed and disease cycles, and therefore, application of pesticides can be minimized (Thrupp, 2000). Facing extreme climate events and devastating diseases, alternative specialty crops may help keep the business viable and profitable by mitigating adverse environmental impacts.

CHALLENGES AND BARRIERS

Lack of cultivars. The lack of reliable information about available crop options is one of the most significant barriers to the successful commercialization of alternative crop species. Since alternative crops refer to plants that do not traditionally grow in the region, it is very likely that imported germplasm will not be adapted for local growing conditions. A concentrated effort to identify and develop suitable cultivars is essential for successful introduction of an alternative crop (Simmonds and Smartt, 1999). Identifying a few widely adaptable alternative crops may be necessary for commercial production destined for distant markets, while developing more diversified crops targeting local or specialized markets. If suitable crops and cultivars are identified, information may still be limiting for successful crop production (i.e., production window, fertility and water requirements, disease and insect control, and postharvest handling).

Limited information on cultural practices. The lack of reliable information about cultural practices may be one of the principal barriers to the successful commercialization of alternative crop production (Fletcher, 2002). For example, cultivars that perform well in one place may do poorly in other regions due to their specific growing requirements: temperature requirements, planting time and regions, solar radiation, and water requirements, etc. Due to the climate change that has global impacts on food production, temperature may be one of the critical factors that affect the production of alternative crops. Specialty perennial crops are semipermanent, and therefore potentially more vulnerable to climate change impacts than are annual crops (Lobell et al., 2006). However, this may generate some positive impacts and opportunities such as the ability to cultivate some specialty crops in new areas (Ackerman and Stanton, 2013). Although alternative specialty crops have a higher potential return per unit area than traditional crops, their intensive labor and management requirements usually restrict them to small acreages. It can be difficult to scale-up the operation without a large investment to capture the economies of scale (Blade and Slinkard, 2002).

Marketing and handling issues. The major impediments for a successful crop diversification enterprise include limited knowledge of market demands, the high risks inherent in establishing a viable supply chain for a new crop product, and a long period before profits are measured (Babb, 1990; Fletcher, 2002). Farmers may not be successful without acquiring information for their products or properly assessing the market potential and needs.

The availability and location of a market are crucial factors for the acceptance of alternative specialty crops. Marketing opportunities, product standards, price fluctuations, and competitiveness need to be studied before embarking on new crop production, which is considered essential for both internal and external markets. It should be recognized there is a large measure of risk and a lack of security involved with any new specialty crop. Few growers are comfortable with the ambiguity of not knowing the market situation in precise detail (Polling, 1999). Consumer demands should be generated before introducing new crops into the market to ensure a successful outcome.

Managing alternative crops presents different challenges compared with traditional crops. Exotic and unusual fruit and vegetable varieties may bring a higher price than traditional commodities. However, many of them are perishable, and require special packaging, handling, storage, and transportation, and
must be transported quickly from field to consumer before they perish or lose visual appeal. The postharvest losses in horticultural crops annually account for 20% to 40% in most countries (Papademetriou and Dent, 2001). Due to the lack of postharvest and handling information, it can be difficult to properly handle alternative specialty crops after harvest and to provide fresh produce to consumers. Rigorous quality control standards need to be established for the expansion of many niche crops. 

**Policy and research issues.** Agricultural policy can have a significant effect on the viability of both producers and individual crops (Williams and Haq, 1993). Unfortunately, little public funding is available for research and development of new crops. Conventional crops have received major attention from the decision-makers and institutions, which have interfered with creating new funding initiatives for alternative crops. Alternative crop research and development have been delayed due to the lack of attention, leading to the failure to make progress on these priorities (Vietmeyer, 1996). Historically, specialty crops had not benefited from the federal farm support programs compared with the long-standing support provided to the main program commodities. It should be emphasized that practically all crops in the United States were once considered new. However, there are numerous examples of successful introduction and establishment of new crops in the 20th century including soybean, canola, pearl millet, avocado, pistachio, kiwifruit, and quinoa (Janick et al., 1996). These examples clearly demonstrate that it is not possible to successfully commercialize new crops without integrating essential multiple components: strong support of government, especially funding for research and development in plant breeding, production, product development and marketing, multiple institutional involvement; dedicated leadership; and coordinated efforts from economic sectors for crop commercialization (Janick et al., 1996).

Due to the changes and challenges within the agricultural sector over the past few years, the promise and potential for crop diversification is gaining attention at multiple government levels, and therefore, more funding opportunities have become available. However, the high-risk nature and complexity of new crops development are common barriers to mobilizing private sector interest (Williams and Haq, 1993). Most crops (Williams and Haq, 1993). Consequently, there have been a number of barriers to successful commercialization of alternative specialty crops, ranging from a lack of information and market development efforts to policy and institutional barriers. The development of new crops is a complex process, and therefore, the path to success for each new crop can be long and challenging. With expanding interest on the part of legislators, consumers and producers, consistent and concentrated efforts are required to develop alternative crop opportunities into commercial products. In addition to close partnerships between government, research institutions and industry, substantial research and extension efforts are needed to support the growth of alternative specialty crop industry.

**CONCLUSIONS**

Alternative specialty crops provide opportunities for environmental and economic sustainability; however, they have benefited from a lack of barriers to successful commercialization of alternative specialty crops, ranging from a lack of information and market development efforts to policy and institutional barriers. The development of new crops is a complex process, and therefore, the path to success for each new crop can be long and challenging. With expanding interest on the part of legislators, consumers and producers, consistent and concentrated efforts are required to develop alternative crop opportunities into commercial products. In addition to close partnerships between government, research institutions and industry, substantial research and extension efforts are needed to support the growth of alternative specialty crop industry.

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