Emerging Horticultural Research and Education Opportunities in Myanmar

Tim D. Davis^{1,4}

Borlaug Institute for International Agriculture and Department of Horticultural Sciences, Texas A&M University, Rm. 202 HFSB, College Station, TX 77843-2133

Eric M. Bost²

External Relations, Borlaug Institute for International Agriculture, Texas A&M AgriLife Research, College Station, TX

Carmen N. Byce³

Borlaug Institute for International Agriculture, Texas A&M AgriLife Research, College Station, TX

Additional index words. agricultural development, Burma, capacity building, crop production, extension, food security, fruits, vegetables

Abstract. The Republic of the Union of Myanmar (also known as Burma) has been undergoing political transformation in recent years that has opened up new opportunities for agricultural development. Agriculture is an important component of the country's economy, and horticultural production has good potential for fostering development. Compared with many other developing countries, Myanmar is relatively rich in natural resources (e.g., water) that could support diverse horticultural crop production. Precipitation is relatively abundant but seasonable, and much of the country is frost free. Nonetheless, for the vast majority of fruit and vegetable crops, yields are well below world averages. The agriculture sector contributes 38% of the country's gross domestic product (GDP) and employs more than 60% of the workforce. However, Myanmar has only one agricultural university, and the supply of well-qualified graduates is far below that which is needed for a robust horticultural sector. Horticulture is one of the major departments at the agricultural university. Many faculty and students are enthusiastic, motivated, and open to professional development. Hence, there is a significant opportunity to increase academic and technical capacity in horticulture. Specific areas of need include seed science technology, improved fertilizer use, pest management practices, postharvest technology, improved genetic resources, application of biotechnology, and increased extension advisory services. Although there are many obstacles to overcome, improved and sustainable horticultural crop production provides a significant opportunity for addressing human nutrition and economic development issues in the country.

Myanmar (formally known as the Republic of the Union of Myanmar and still referred to as Burma by the United States, the name by which the country was known before its renaming in 1989) is the 25th most populous country in the world (World Bank, 2015) and is located in Southeast Asia, sharing a border with five other nations (Fig. 1). The country's area of about 67.6 million hectares is similar to the state of Texas (69.5 million hectares). But with a population of about 54 million [compared with about 27 million in Texas (U.S. Census Bureau, 2015)], Myanmar is much more densely populated. After a protracted

period of military dictatorship, this country has been undergoing political transformation in recent years which culminated in the rise of the National League for Democracy during their 2015 election. After decades of isolation from the western world because of systemic human rights violations, recent reforms have resulted in many economic and political sanctions being lifted from the country (Steinberg, 2015). This result, in turn, will provide new opportunities for collaboration between Myanmar and the Western world.

With its competitive advantages, such as climate, natural, and labor resources, and proximity to markets, Myanmar's agricultural sector has immense potential to contribute to overall economic growth in the country, a potential that is yet to be fully reached (Beed and Bahala, 2017; Raitzer et al., 2015). Agricultural development is also crucial in allowing Myanmar to reach food security in ways that will improve lives while expanding economic growth. Horticulture will be an important component for achieving food security and improving human nutrition. Although regional climates in the country range from tropical monsoon to hot semiarid, Myanmar's precipitation is seasonal and dictated by monsoonal patterns with average annual rainfall ranging from about 5000 mm in the wettest areas to about 1000 mm in drier regions such as central Myanmar (FAO,

2010). The country's reasonably good water resources, if managed properly, should be supportive of sustainable horticultural production. Furthermore, much of the country is frost free. With changes in global climate, Myanmar is experiencing increases in overall rainfall yet decreased rainfall in some regions, increases in average temperatures, rising sea levels, and a remarkably high occurrence and intensification of extreme weather events. Based on data from 2015, Myanmar's Climate Risk Index (which rates the impacts of climate change events such as flooding or storms to life, health, and the economy) is rated at 47.7 on a 100 point scale, compared with 77 for the overall risk index for the Southeast Asia region (Kreft et al., 2017). With the country's limited preparedness for such changes, the Myanmar Climate Change Alliance was formed in 2012 to infuse climate change mitigation and resilience strategies into public policy and programs (Global Climate Change Alliance, 2016).

The purposes of this article are to briefly review the current status of agricultural higher education and horticultural production in Myanmar, and to outline future opportunities for horticultural research and education. The article is based on a workshop presentation made at the 2016 ASHS annual meeting in Atlanta (Davis and Bost, 2016).

Received for publication 2 Mar. 2017. Accepted for publication 22 May 2017.

Crop names used in this article are from the original sources, and we have purposely not included botanical genus/species because they were not given in the original sources, and it would be speculative to include them.

This paper was presented during the 2016 ASHS Annual Conference, Atlanta, GA, as part of the Workshop titled "Seize Your Future Internationally: New Opportunities in Horticultural Consulting."

¹Regional Director for Asia and Professor.

²Assistant Director and U.S. Ambassador (retired).

³Program Coordinator for Asia.

⁴Corresponding author. E-mail: t-davis5@tamu.edu.

STATUS OF AGRICULTURAL HIGHER EDUCATION IN MYANMAR

Before the transition to a military dictatorship, Myanmar had a relatively strong system of higher education which produced a variety of well-respected scholars. During the more recent period of military dictatorship, however, universities were at best neglected and at worst persecuted as a breeding ground for governmental opposition. As such, higher education in Myanmar has fallen far behind modern standards and universities have been in various states of disrepair and disarray. However, the Ministry of Education has increased the national budget for education by 107% since 2012 and, in partnership with international organizations, has formulated plans to revitalize higher education and improve international partnerships (UNESCO, 2013). This bodes well for future interactions between Myanmar and western universities.

The agriculture sector contributes 38% of the country's GDP and employs more than 60% of the workforce (World Bank, 2016). Despite this, however, Myanmar has only one higher education institution focused on agriculture: Yezin Agricultural University (YAU), located near the capital of Naypyitaw. The campus occupies about 146 ha including a research farm of about 40 ha. Enrollment is about 1000 students with an academic staff of about 160 and a relatively small graduate program. With this relatively low enrollment (just as one point of comparison, Texas with a population of about one-third of Myanmar and a more diverse economy, has about 6500 undergraduate students enrolled in agriculture and natural resources at Texas A&M University alone), there is a great need for human capacity development related to agriculture. YAU has seven major academic departments, which includes the Department of Horticulture. This department has several doctoral faculty members, but most are M.S. or B.S. degree holders. Based on a visit to the department in 2013, the authors found the faculty to be remarkably enthusiastic and motivated, with a strong interest in further professional development. Hence there appears to be considerable potential to work with YAU in strengthening human technical capacity related to horticulture.

OVERVIEW OF HORTICULTURAL CROP PRODUCTION IN MYANMAR

Myanmar produces a wide variety of fruit and vegetable crops, including many tropical species (Fig. 2). Mangoes and cashews are the leading fruit crops in terms of harvested area (Table 1). Reported 2011/2012 yield for mango was about 16% below the world average. Pineapple and lemon/lime yields in 2011/2012 were far below world averages. By contrast, cashew yields compared favorably with the world average and orange yields were well above the world average for 2012. But even where reported fruit crop yields in Myanmar compare favorably with the world

average, they are still well below top world yields. As an example, Myanmar cashew yield of 0.9 MT/ha in 2011/2012 is far below the leading countries of Peru, Philippines, and Viet Nam where 2012 yields were 5.1, 4.7, and 3.9 MT/ha, respectively (FAO, 2016). Even in the case of oranges where reported Myanmar yield is high, it is still below the world-leading U.S. yield of about 32.5 MT/ha (FAO, 2016). This all underscores the significant potential for improving fruit yields in Myanmar.

In addition to the fruit crops listed in Table 1, the Myanmar Ministry of Agriculture and Irrigation (2012) also lists the following other crops being harvested (2011/2012 MT/ha yield in parenthesis): walnut (3.4), litchi (4.7), grape (8.1), apple (4.8), pear (17.1), plum (11.0), hog chestnut (5.6), and strawberry (10.0). Harvested areas for these crops are generally below 2500 ha and in some cases well below (e.g., strawberry at 161 ha).

The leading vegetable crop in Myanmar in terms of harvested area is tomato which is nearly three times that of the next leading crop (Table 2). For tomato, however, reported Myanmar yield is only about 37% that of the world average. Similarly, reported yields of cabbage, cauliflower, watermelon, lettuce, and beets are well below world averages. As with fruit crops, even where reported Myanmar yield is not far from the world average, it is still far below top world yield. For example, the reported 2011/2012 Myanmar asparagus yield of 4.5 MT/ha is far below the leading countries of Iran, Poland, and Peru where 2012 yields were 22.9, 15.2, and 11.4 MT/ha, respectively (FAO, 2016). This again underscores the potential for improving horticultural crop yields in Myanmar.

It should be mentioned that several crops which are considered vegetables in the United States and many other countries are not listed as such in Myanmar. For example, garden pea, chili pepper, and onions are listed under "Major Crops," not as vegetables (Ministry of Agriculture and Irrigation, 2012). Reported 2011/2012 yields for these three crops in Myanmar were 1.3, 1.1 (dried), and 15.9 MT/ha, respectively (FAO, 2016). These yields are all well below reported world averages. Reported 2011/2012 number of harvested hectares for these crops were 54,000 (garden pea), 117,000 (chili pepper), and 72,000 (onions).

EMERGING RESEARCH AND EDUCATION OPPORTUNITIES

Investments in education, particularly higher education, have relatively high returns on investment especially when considering economic returns, increase in income, and social returns, such as improved access to healthcare and improved standard of living (Montenegro and Patrinos, 2013). Given the relatively small size of YAU, there are opportunities to assist in capacity-building related to horticulture. Although there are

several viable approaches, in our view, all should work toward four main objectives: 1) improving technical capacity of professors and researchers; 2) strengthening and updating horticulture curricula for undergraduate and graduate level education; 3) connecting university research and teaching to extension efforts in ways that improve horticultural production in the field; and 4) advocating for collaboration between horticulture and other complimentary departments for a multidisciplinary approach that addresses development challenges.

Fig. 1. Map showing location of Myanmar (CIA, 2016).

Fig. 2. Vendors selling tropical fruits at a market in Yangon, Myanmar.

Table 1. Yields of the top 10 fruit crops in Myanmar in order of harvested area for 2011/2012 (adapted from Ministry of Agriculture and Irrigation, 2012). Yield values in parenthesis in right-hand column are provided for comparative purposes and were obtained from FAO (2016) for 2012.

Fruit crop	Harvested area (ha)	Yield (MT/ha)
Mango	74,189	6.6 (world average = 7.9)
Cashew	60,816	0.9 (world average = 0.8)
Pineapple	21,124	12.0 (world average = 23.9)
Jujube	21,038	14.9 (N/A)
Tamarind	17,998	8.2 (N/A)
Lemon and lime	16,908	3.1 (world average = 15.4)
Orange	11,562	30.3 (world average = 17.4)
Durian	8,046	5.1 (N/A)
Pummelo	5,546	14.6 (N/A)
Custard apple	4,110	5.4 (N/A)

World data not available for all crops listed (designated as N/A).

Table 2. Yields of the top 10 vegetable crops in Myanmar in order of harvested area for 2011/2012 (adapted from Ministry of Agriculture and Irrigation, 2012). Yield values in parenthesis in right-hand column are provided for comparative purposes and were obtained from FAO (2016) for 2012.

Vegetable crop	Harvested area (ha)	Yield (MT/ha)
Tomato	107,457	12.0 (world average = 32.6)
Mustard	37,958	7.8 (world average = 7.7)
Cabbage	32,337	14.6 (world average = 28.7)
Cauliflower	26,609	12.5 (world average = 17.4)
Bottle gourd	22,767	11.1 (N/A)
Radish	22,731	12.3 (N/A)
Watermelon	16,571	13.0 (world average = 30.6)
Lettuce	10,665	7.0 (world average = 22.2)
Beet	2,758	9.4 (world average = 54.7)
Asparagus	502	4.5 (world average = 5.6)

World data not available for all crops listed (designated as N/A).

Improving technical capacity of professors and researchers. Faculty members at YAU are keenly interested in professional development and would benefit from meaningful interaction and exchange with U.S. horticulture faculty members. To strengthen the overall level of expertise within the department, those faculty with Master's degrees are potential PhD students for U.S. and regional partner universities. In addition to long-term graduate studies, faculty may benefit from short to medium-term exchange programs in the United States or even at regional universities and centers designed to provide high impact experiences focused on technical knowledge transfer and emphasis on connecting research, extension, and advisory services. The potential for collaborative research between U.S. universities and faculty at YAU is also quite promising, although securing funding for such activity could be challenging.

Strengthening horticulture curricula for undergraduate and graduate level education. A thorough review and strengthening of curricula for all undergraduate and graduate programs at YAU has been identified as a critical and initial need (Cho, 2013). A thorough curricula review is needed with the aim of identifying gaps in curricula offerings and updating curricula that may be outdated. Faculty and students from the United States could provide a valuable perspective for improving horticultural curricula at YAU. Investments in curricula strengthening and updating should be coupled with support to improve pedagogical skills. Particular emphasis should be placed on infusing experiential

learning opportunities, through laboratory and field research and practical learning, into the traditional lecture-based education system. Visiting professors would be a tremendous resource in this regard.

Connecting university research and teaching to extension efforts. Under the purview of the Ministry of Agriculture, YAU has a mandate to provide proactive research that addresses needs and spurs growth in the agricultural industry (Cho, 2013). In this role, YAU has potential to connect research related to best management practices and even cutting edge technologies to address farmer needs. In addition to the need for applied research, there is an urgent need for improved extension advisory services in Myanmar for which U.S. land grant Extension faculty members could play an important role in providing relevant training and mentoring.

Collaborating for a multidisciplinary approach to development challenges. It is important to also consider the opportunities for cross-disciplinary collaboration between faculties of horticulture from the United States and Myanmar to partner with faculties from complementary fields. In particular, collaboration between nutrition, agricultural economics, public policy, and social sciences is needed. The challenge of meeting the growing global demand for food requires public and private stakeholders who are able to evaluate challenges from a holistic perspective and work collaboratively toward evidence-based solutions (Eigenbrode et al., 2014). Universities have unique potential to lead multi-stakeholder initiatives to address global "wicked problems" in ways that address

not only challenges to agricultural development but also improve nutrition, empower communities, and strengthen economies (Dentoni and Bitzer, 2015).

Investments in higher education and research to address needs in the horticulture industry. It is critical that investments in the higher education and research institutions be integrated into efforts that address priority needs for improving horticultural crop production in Myanmar. Chief among these is the need for better water management. Although the country has reasonably good water resources, growing population pressure and climate change mandate that water be used judiciously for crop production. Recent projects (Rowell and Soe, 2015, 2016) are helping to achieve the goal of improved water management by helping farmers better understand how to efficiently use drip irrigation for fruit and vegetable production. More such work is needed to achieve sustainable crop production.

In addition to effective water management, there is need for other improved crop management practices (Beed and Bahala, 2017). This includes more efficient fertilizer use and better pest management strategies. More diversified cropping systems are needed for sustainable production and for preserving biodiversity. The country is relatively rich in biodiversity and although beyond the scope of this paper, Myanmar could be a valuable source of germplasm for ornamental horticulture.

A serious constraint to horticultural crop production in Myanmar is the lack of quality seed and other propagules. High-quality genetic resources are the basis for sustainable crop production and food security (FAO, 2013). Accordingly, Myanmar either needs the capacity to develop these genetic resources themselves through plant breeding and selection programs, have a good mechanism for importing them into the country from elsewhere, or both. The former is a better long-term solution but will likely not be attainable in the near future. With regard to genetic resources, improved seed technology is critically needed as is increased capacity to conduct applied research trials to determine local suitability of fruit and vegetable cultivars. Improved matching of cultivars with local environments would certainly boost production in many areas of the country. In addition, the application of biotechnology to the improvement of genetic resources seems worthy of further pursuit and is of interest to faculty members at YAU (K.T. Myint, personal communication). This, of course, would be a long-term effort.

As is the case in many developing countries (e.g., Indonesia) (Davis and Hariyadi, 2011), postharvest crop losses are quite high in Myanmar. For fruits and vegetables, post-harvest losses are estimated to be in the range of 25% to 40% (Myanmar: National Action Plan for Agriculture, 2016), and access to refrigeration is limited in most areas. The lack of a cold chain coupled to high field temperatures in Myanmar results in high potential for

postharvest losses. Research and education in the area of postharvest horticulture would greatly help in identifying ways to counter such losses. Furthermore, access to cost-effective technologies that would aid in removing field heat from fruits and vegetable would be a significant benefit to the Myanmar horticulture industry.

OBSTACLES AND CONCLUSIONS

Based on the foregoing, there are many needs for improving Myanmar horticulture. One challenge will be to establish and follow clear priorities for improving fruit and vegetable production. Not all challenges can be addressed simultaneously, and the relevant stakeholders in Myanmar should be at the forefront of setting priorities. Myanmar is becoming a popular target for donors interested in fostering agricultural development, but it is and will continue to be a significant challenge to coordinate and manage the diverse groups who want to help. Coordination of efforts will be critical to avoiding duplication of efforts and filling in gaps that constrain production.

Funding for agricultural development in Myanmar will be dependent on continued and sustained progress in human rights reforms. Although Myanmar is making some progress toward these reforms, the country still ranks significantly below average in political freedoms, rule of law, freedom from corruption, and civil liberties (USAID, 2014). Further reform will be a complex and delicate political process. Hence, funding will be subject to the ebbs and flows associated with complex international politics. Such a situation can be a significant challenge to agricultural development work where it is difficult to start and stop work without disrupting momentum and stalling progress.

Notwithstanding the previously mentioned challenges, significant opportunities are emerging for research and education activities related to horticulture in Myanmar. To be successful in attracting the required funding, however, it will be important to clearly tie horticultural activities to critical issues of importance to Myanmar such as

conservation of biodiversity, improvement of human nutrition and health, and/or economic development. Fortunately, horticultural research and education activities can indeed be valuable in addressing such issues.

Literature Cited

- Beed, F. and A.M. Bahala. 2017. Exploring opportunities for collaboration with Myanmar. Fresh—News from the World Vegetable Center. 26 Jan. 2017. <<https://avrdc.org/exploring-opportunities-collaboration-myanmar/>>.
- CIA (United States Central Intelligence Agency). 2016. The world factbook. East & Southeast Asia: Burma. 27 Feb. 2017. <<https://www.cia.gov/library/publications/the-world-factbook/geos/bm.html>>.
- Cho, K.M. 2013. Background paper No. 5: Current situation and future opportunities in agricultural education, research and extension in Myanmar. Michigan State University.
- Davis, T.D. and E.M. Bost. 2016. Emerging horticulture research and education opportunities in Myanmar. *HortScience* 51:S64–S65.
- Davis, T.D. and P. Hariyadi. 2011. Horticultural research and education opportunities in Indonesia. *HortScience* 46:S64.
- Dentoni, D. and V. Bitzer. 2015. The role(s) of universities in dealing with global wicked problems through multi-stakeholder initiatives. *J. Clean. Prod.* 106:68–78.
- Eigenbrode, S.D., L.W. Morton, and T.A. Martin. 2014. Big interdisciplinarity to address climate change and agriculture: Lessons from three USDA Coordinated Agricultural Projects. *J. Soil Water Conserv.* 69(6):170A–175A.
- FAO (Food and Agriculture Organization of the United Nations). 2010. Myanmar geography, climate, and population. FAO AquaStats Survey. 22 Dec. 2016. <http://www.fao.org/nr/water/aquastat/countries_regions/mmr/MMR-CP_eng.pdf>.
- FAO (Food and Agriculture Organization of the United Nations). 2013. Climate smart agriculture sourcebook. Food and Agriculture Organization of the United Nations, Rome. 1 Feb. 2017. <<http://www.fao.org/docrep/018/i3325e/i3325e00.htm>>.
- FAO (Food and Agriculture Organization of the United Nations). 2016. FAO stats: Food and agriculture data. FAO. 24 Jan. 2016. <<http://www.fao.org/faostat/en/#home>>.
- Global Climate Change Alliance. 2016. About MCCA. 15 Jan. 2017. <<http://www.gcca.eu/national-programmes/asia/gcca-myanmar>>.
- Kreft, S., E. Eckstein, and I. Melchior. 2017. Global climate risk index report 2017. German Watch. 21 Jan. 2017. <<https://germanwatch.org/en/cris>>.
- Ministry of Agriculture and Irrigation. 2012. Myanmar agriculture at a glance. Department of Agricultural Planning, Ministry of Agriculture and Irrigation, Republic of the Union of Myanmar.
- Montenegro, C. E. and H.A. Patrinos. 2013. Returns to schooling around the world. Background paper for the world development report, 8258024-132095074719.
- Myanmar: National Action Plan for Agriculture, 2016 Working paper 13: Post-harvest and Agro-Industry.
- Raitzer, D., L.C. Wong, and J.N. Samson. 2015. Myanmar's agriculture sector: Unlocking the potential for inclusive growth. Asian Development Bank Economics Working Paper Series. Vol. 470.
- Rowell, B. and M.L. Soe. 2015. Design, introduction, and extension of low-pressure drip irrigation in Myanmar. *HortTechnology* 25: 422–426.
- Rowell, B. and M.L. Soe. 2016. Simplified water requirement calculators for fruits and vegetables. *HortTechnology* 26:530–541.
- Steinberg, D.I. 2015. Myanmar and the United States, closing and opening doors: An idiosyncratic analysis. *Soc. Res. (New York)* 82(2): 427–452.
- UNESCO (United Nations Education, Scientific, and Cultural Organization). 2013. Empowering higher education in Myanmar: A vision for Myanmar's universities. 22 Dec. 2016. <<http://www.unescobkk.org/news/article/empowering-higher-education-in-myanmar-a-vision-for-myanmars-universities/>>.
- USAID (United States Agency for International Development). 2014. Myanmar sector details: Human rights, democracy, and governance. 23 Jan. 2017. <<https://idea.usaid.gov/cd/burma-myanmar/democracy-human-rights-and-governance>>.
- U.S. Census Bureau. 2015. Texas quick facts. 22 Jan. 2017. <<http://www.census.gov/quickfacts/table/PST045215/48>>.
- World Bank. 2015. World development indicators, population ranking. 24 Jan. 2017. <<http://data.worldbank.org/data-catalog/Population-ranking-table>>.
- World Bank. 2016. Unleashing Myanmar's agricultural potential. 18 May 2017. <<http://blogs.worldbank.org/eastasiapacific/unleashing-myanmar-agricultural-potential>>.