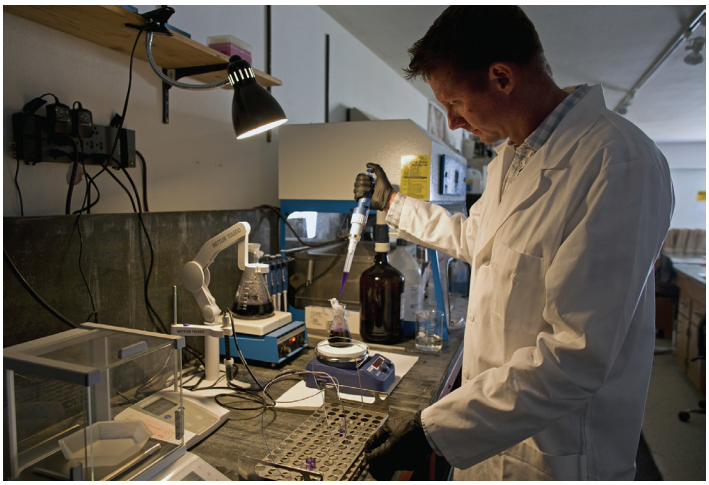
College of Agricultural, Consumer and Environmental Sciences

AGRICULTURAL EXPERIMENT STATION SYSTEM



Report of the Advisory Team for the **Future of Agricultural Research**

December 2018

Be Bold. Shape the Future.
New Mexico State University

Report of the Advisory Team for the Future of Agricultural Research
to
Dean Rolando A. Flores
College of Agricultural, Consumer and Environmental Sciences
New Mexico State University

December 2018

Natalie Goldberg, Interim Associate Dean/Director, Agricultural Experiment Station (co-chair)
Steven Loring, Associate Director, Agricultural Experiment Station (co-chair/facilitator)

The Advisory Team for the Future of Agricultural Research, consisting of NMSU personnel and external industry representatives, was formed by Dean Rolando A. Flores to conduct an objective and comprehensive review of the Agricultural Experiment Station (AES) system and its twelve off-campus Agricultural Science Centers (ASCs). The Advisory Team was charged with analyzing whether the right type of research is being conducted to meet the current needs of our stakeholders, what additional research is necessary to meet the future needs of our stakeholders, how we ensure that we continue to meet stakeholder needs with limited resources, and what options exist for increased funding.

Advisory Team members

NMSU
Shad Cox (Superintendent, Corona Range and Livestock Research Center)
Steve Guldan (Professor and Superintendent, Sustainable Agriculture Science Center at Alcalde)
Clint Löest (Professor, Department of Animal and Range Sciences)
Dave Lowry (Farm Manager, Leyendecker Plant Science Center)
Jane Pierce (Associate Professor and Extension Specialist, Agricultural Science Center at Artesia)
Shengrui Yao (Associate Professor and Extension Specialist, Sustainable Agriculture Science Center at Alcalde)
Aaron Scott (Farm Manager, Agricultural Science Center at Clovis)
Jerry Sims (Professor and Department Head, Department of Entomology, Plant Pathology and Weed Science)
Stephanie Walker (Associate Professor and Extension Specialist, Department of Extension Plant Sciences)

Industry
Dino Cervantes (Cervantes Enterprises, Inc.)
Bruce Davis (cattle rancher, Pi Diversified, Inc.)
Dr. Roland Sanchez (cattle rancher/farmer)
Blake Curtis (Curtis & Curtis Seed)
Dina Chacon-Reitzel (Executive Director, New Mexico Beef Council)
Craig Ogden (New Mexico Farm and Livestock Bureau)

Introduction
The Agricultural Experiment Station (AES) system is the research arm of New Mexico State University's College of Agricultural, Consumer and Environmental Sciences (ACES), consisting of scientists on the main campus and at Agricultural Science Centers (ASCs) throughout New Mexico. The off-campus centers support fundamental and applied research under New Mexico's varied environmental conditions to meet the agricultural and natural resource management needs of communities in every part of the state. The first separate research farm (now Fabian Garcia Research Center) was purchased in 1906, and the last, the Clayton Livestock Research Center, was added in 1978. ASCs consist of two types: 1) off-campus facilities with faculty stationed at the center and 2) facilities without resident faculty (Fabian Garcia Research Center, Leyendecker Plant Science Center, Chihuahuan Desert Rangeland Research Center, and Corona Range and Livestock Research Center), which serve as "research support field laboratories" for campus-based faculty. Despite challenges, the ASCs have greatly contributed to strengthening agricultural initiatives in the state.

Meeting the AES Mission
The AES system supports fundamental and applied science and technology research to benefit New Mexico's citizens in the economic, social, health, and cultural aspects of agriculture, natural resources management, and family issues. Faculty support the AES mission through work done at the science centers and NMSU's main campus, and through collaborative work with people and institutions across the state. While the ASCs were established to conduct research under the AES, community needs have prompted a broader approach over the years. Some faculty at ASCs now have majority Extension appointments. Half of the ASCs note Extension efforts in their own mission statements. Recent investments and incentives also promote increased engagement of ASC faculty in teaching and advising graduate students.

New Mexico is culturally, economically, and geographically diverse, and the approaches of the ASCs reflect that diversity. Impacts of some centers reflect the high economic potential of their target crops or livestock. For example, consultants in the Pecos Valley noted that soil testing software helped immensely in avoiding extreme remediation expenses from manure contamination that would have cost $43 million for just one 2,000-head dairy. Other ASCs have less obvious regional economic impacts, but nonetheless help enable low-income growers and ranchers to remain in their ancestral communities. Faculty and staff at Alcalde helped increase the income of more than 5,000 socially and economically disadvantaged farmers and growers, and also helped some growers learn to produce and market organic strawberries valued at $40,000 per acre.

Some research projects have had widespread national and international impacts. One Clayton Livestock Research Center publication, for instance, is among the top 25 cited publications in the *Journal of Animal Science*. Another example is the development of 1517 cotton, which began in the Pecos Valley and ultimately improved the quality of 45% of the cotton cultivars now produced in the world.

Efforts by the ASCs address current needs on major crops. Helping growers remain competitive is a focus. For example, developing a fresh green chile pepper cultivar that can be mechanically harvested will enable New Mexico to restore acreage of New Mexico's signature crop. This industry-changing mechanical harvest research is primarily housed at the Los Lunas ASC, though testing has occurred at other ASCs. Also, chile cultivar field trials are conducted at multiple ASCs, both to test performance in different climates and soils and to evaluate insect and disease resistance to new pests, which could reduce costly pesticide applications.

Traditional crops will remain economically important in New Mexico, but emerging issues continually prompt ASCs to undertake new challenges. Dwindling water supplies prompted new research on reclaimed municipal and produced water, the only new sources of usable water in New Mexico. Drought-tolerant alternative crops, including canola, guar, safflower, and glandless cottons, are being paired with more-efficient irrigation systems and reduced tillage practices. These are just a few examples of how the ASCs are working together to help stakeholders in today's environmental conditions.

Uniqueness of ASCs

New Mexico is the fifth-largest state in the nation geographically. Its 77,823,300 acres vary greatly in geography, climate, water resources, vegetation, soils, pests, land ownership, and land use. New Mexico possesses 11 of the USDA's 14 plant hardiness zones, three crop production regions (only one other state in the country—California—has as many as three), and five USGS-defined watersheds (no other state in the country has as many as five). In addition, New Mexico soil surveys identify 126 soil associations within the state, where each association has representative soil that defines specific properties useful for land managers.

New Mexico's environmental diversity presents challenges for agricultural production and affects decisions made by crop and livestock producers. Having ASCs strategically located in these diverse regions enables NMSU researchers to conduct relevant research programs that bring innovations, management enhancements, and other benefits to farmers, ranchers, and communities statewide. Through the characteristics of the land, the specialized knowledge of the ASC personnel, and the research infrastructure located at the ASCs, NMSU is able to target research to the right location. For example, rangeland and livestock research is facilitated primarily at three centers that together are able to address all types of livestock production systems across diverse environmental conditions. Crops of significant economic importance to New Mexico are studied and improved through research at multiple ASCs that, by their locations, are able to duplicate local farmer field conditions. The results from crop variety trials at these centers help researchers validate and quantify the performance of varieties across a wide range of environmental and soil conditions, and enable farmers to select varieties best suited for high performance on their farms. According to a recent report issued by TEConomy Partners[1], selecting the best-performing crop varieties has the potential to generate a $115 million benefit to the state of New Mexico. Forest health on New Mexico's 23 million acres of forested land is on the decline due to drought and an increase in catastrophic fires. Research conducted at the John T. Harrington Forestry Research Center at Mora focuses on restoring ecological functions and ecosystem services in the forest landscape of New Mexico.

The ASCs also possess unique features (Table 1, see appendix) that enable them to specifically meet the needs of their local stakeholders.

Future Research and Collaboration Potential

Active collaboration is occurring among ASCs and with NMSU's main campus. All ASCs are involved in graduate education either by ASC faculty having their own graduate students or through collaboration with faculty on NMSU's main campus. Increasing these efforts will enhance the overall impact of the work of the AES. The following are suggestions to encourage and increase collaboration with and between off-campus ASCs.

- On-campus faculty should be encouraged to collaborate with ASCs. Off-campus faculty normally have been expected to take the initiative to seek collaboration with on-campus faculty. With more involvement of faculty at ASCs, increased graduate student involvement at ASCs should follow. A recent example of an incentive for graduate students and their advisors was the internal ACES graduate student grants that gave additional funds for awarded projects occurring at off-campus centers.

- Graduate student housing should be available at all off-campus ASCs. Also, whenever possible, graduate courses should be online so students can take them while living at/near the ASC where they are carrying out their research. Off-campus ASCs should have high-speed internet to allow for distance learning opportunities and participation in other activities conducted on the main campus (e.g., department and college meetings, research collaboration meetings, seminars, trainings, etc.).

[1] Tripp, S., M. Grueber, and D. Cummings. The Economics and Functional Impact of the College of Agricultural, Consumer and Environmental Sciences (ACES), Agricultural Experiment Station, Cooperative Extension Service. September 2018. TEConomy Partners LLC.

- ASCs need better facilities to attract collaborators (such as USDA-ARS, other universities, and industry). Research facilities (labs, equipment, greenhouses) are either lacking or out-of-date. When writing large grants, researchers need to state that NMSU has adequate facilities to conduct the studies. Funding for improvements to our current ASC infrastructure is needed for our faculty to be successful in garnering resources through the competitive grant process.

- The ASCs need sufficient staff to be able to collaborate effectively. Even with grant monies, ASCs might not be able to hire the people with the needed skills and knowledge to carry out the planned research because the pay scales are too low to attract and retain personnel. A review by NMSU's Central Administration of the job categories, classifications, and pay scales available for agricultural staff and the development of greater diversity in positions is needed.

- Off-campus faculty should have the same resources available to them as on-campus faculty. For example, NMSU's Teaching Academy provides trainings on grant writing but does not put the trainings online.

- Indirect costs should be returned to the ASCs where the research was performed, regardless of which unit a researcher's Banner Org Number is assigned to.

- Some ASCs are already heavily involved with the Cooperative Extension Service because of an increase in the number of faculty positions at off-campus centers with official appointments in both research and Extension. Increasing joint research and Extension appointments would increase collaborative efforts across the college and could foster increased public outreach conducted by center employees.

- A joint AES-Extension session when Extension personnel meet at their annual in-service training would help alert Extension personnel to opportunities for collaboration.

To keep the ASCs viable in the future, they must continue to build on their long history of researching innovations that enable our agricultural stakeholders to advance their business enterprises. In this capacity, the centers need to be visionary in planning for the future research needs of their clientele (Table 2, see appendix). Input from advisory boards and local stakeholders is an essential part of the process of developing future research plans. Maintaining agricultural relevancy through innovative research plans will sustain the growth of the agricultural industries, thereby enhancing the socioeconomic resilience of rural communities.

Supporting the College Teaching Mission

In addition to supporting research and outreach, all ASCs should have influential roles supporting the teaching mission of ACES. Currently, some faculty at ASCs are members of the graduate faculty and serve as members of graduate student committees and/or as advisors to M.S. and Ph.D. students. Many of the ASCs host student tours and support graduate student research projects at the centers. There is potential for more ASC faculty to serve as guest speakers in undergraduate and graduate courses, and more ASC faculty should be encouraged to teach courses online to both students on campus and perhaps at other ASCs, provided there are additional Instruction and General (I&G) funds to support this effort and to upgrade the internet capabilities. There is also potential for increased summer internships and undergraduate student mentoring, which could potentially increase recruitment of graduate students interested in working with ASC faculty. ASC faculty are also well positioned geographically to extend the reach of ACES undergraduate student recruiting efforts and should be included in the college's recruiting strategy. Additionally, there is an opportunity to expand the ASCs into certificate learning (e.g., new and beginning farming and ranching) that are non-traditional, student-based learning tracks.

Effective Use of Advisory Boards

Effective ASC advisory boards are key to the mission of individual ASCs. The board membership should reflect the client base of the ASC, but including non-traditional clients will help bring insight from differing perspectives. Boards should be developed to be independent bodies that advocate for the essential work performed at the ASCs. Boards should be advisory in nature and not dictate research; they should be a sounding board to keep relevant research grounded to address key issues of our constituents, while understanding that the role of relevant and preliminary research may not be popular or immediately address current needs of our clientele. All ASCs currently have advisory boards, but some advisory boards are less successful and should consider restructuring. The Corona Range and Livestock Research Center, for example, identified a regional leader in the industry to start an independent advisory board that governs itself regarding its membership. The board chair and the superintendent work closely together to address the needs of the center and the board to accommodate meetings, calls to action, etc. This is true, too, of the Clovis and Tucumcari advisory boards. Additionally, an annual meeting of individual ASC advisory board chairs could share successes and issues to help individual boards achieve their goals more effectively, as well as highlight common issues that might be addressed collaboratively. This initiative could result in a statewide advisory board being developed to allow unified advocacy for the AES/ASCs and could include all the chairs, past chairs, or designated member from each individual board.

Communication and Dissemination of Research Impacts at ASCs

Many valuable research projects that provide both short- and long-term benefits to New Mexicans are conducted at NMSU's ASCs; ensuring that state clientele are familiar with ASC activities is key to continuing support of the facilities. Increasing awareness of the ASCs can be accomplished by creating or increasing existing partnerships with county Cooperative Extension Service personnel, increasing social media presence, and hosting events that encourage local partnerships. Increased collaboration with NMSU Marketing and Communications is necessary for improved publicity and marketing. Partnerships between ASC researchers and communications specialists have resulted in YouTube clips that have widely spread information on projects to state clientele as well as national and international audiences. These productive connections further research connections that increase external funding opportunities.

Increasing Role of Cooperative Extension Service: Although there is not an ASC in every New Mexico county, there is a Cooperative Extension Service office with at least one county agent with intimate knowledge of local challenges and concerns, as well as community leaders and politically connected individuals. To take advantage of these connections, the county's agent (or agent from an adjoining county) should be a member of the ASC advisory board and should also be consulted regarding soliciting other members. ASCs will provide updates semi-annually to county agents and the advisory committee. Agents will be engaged to spread information regarding ASC activities to their county clientele.

Increasing Social Media Communication: Social media is increasingly important as a conduit for information to and between people. While all the ASCs have a website and many use Facebook, Twitter, and other social media platforms, these activities should increase. At least one person at each station should be tasked with providing regular posts highlighting research impacts, activities, and events at the ASC.

Community Events to Foster Connections: Traditional field days raise the profile of ASCs and are conducted regularly at most sites, but increasing the number of events with hands-on activities and connections to local schools, community organizations, and other clientele can create partnerships with the ASCs. NMSU researchers without Extension appointments should have a small allocation of effort in outreach to ensure that their research results are disseminated to stakeholders. Likewise, the ASC superintendents should maintain an outreach allocation to facilitate the outreach efforts of their station. This could include serving on school boards and participating in service organizations.

Resource Needs and Funding Options

Adjusted for inflation, a 2003 estimate of $449,000 would be about $750,000 per year for proper maintenance of the current ASC system. As things stand now, the system is significantly underfunded with only a $124,000 annual allocation for building renewal and replacement. The options are: the New Mexico legislature increases funding to adequately maintain the current ASCs; funding remains static or decreases, but private/corporate partnerships and contributions allow adequate funding to run the ASCs; or close one or more of the ASCs. Likewise, the off-campus ASCs are understaffed with respect to research scientists. The number of scientists per station ranges from one to four, with most stations having just two on-site faculty researchers. Research collaboration between station faculty (and graduate students) and on-campus faculty is challenging due to the distance between the main campus and the ASCs, and the added costs in terms of time and travel expense.

All ASCs need more capital improvement on aging infrastructure, workforce resources, and funding for research capability. Aging infrastructure is a limiting factor for most ASCs, and scant re-investment into facilities has led to serious issues with deferred maintenance. This leaves major repairs to an insufficient Building Renewal and Replacement (BR&R) budget and the resources of the individual stations. With such limited resources, ASCs are only able to attempt to fix the most serious hazards. Table 3 (see appendix) lists current ASC needs for maintenance, equipment, and personnel.

On-site and campus-based faculty have developed funding sources through allocated federal and state research funding, industry funding, gifts, and competitive grants. Collaboration in developing grant applications is key to more successful funding efforts. Faculty need training, grant coordinators, grant writers, and multi-disciplinary collaborators to develop more attractive and less-deniable grant applications, as well as for developing industry support and gifting opportunities.

Any organization is made better by its employees. A lengthy hiring process and low starting pay coupled with a lack of flexibility in hourly wages and the impossibility of providing incentives to retain productive, loyal, quality employees are all significant barriers to the ASCs fulfilling their missions.

Evaluation Criteria/Matrix

Because the NMSU ASCs vary significantly from one another in number of faculty and staff, funding for operations, land, water, and primary research interests, comparing one ASC to another in terms of productivity and impacts is challenging. If insufficient resources force us to close ASCs, evaluation criteria must be established to allow fair and realistic comparisons of ASC performance and value to the state. We recommend that department heads, superintendents, college faculty, and stakeholders collaborate to establish those metrics. The strategic direction for the ASCs should align with the ACES strategic plan, and the evaluation metrics used to evaluate the ASCs should align with the metrics used to evaluate the College of ACES and its faculty. In addition to number of publications, field trials, outreach/Extension events/programs, research FTEs, grants/contracts submitted, and grant amounts awarded, evaluation criteria might include the following:

- Does the ASC have a strategic plan?
- What concerns/subject areas does the ASC address?
    - Can these concerns/subject areas be adequately addressed at other ASCs?
    - Can the research in these areas be enhanced with collaboration among ASCs?
    - Are there opportunities for industry partnerships to help address these concerns?
- Is research being done to benefit ASC stakeholders?
- Do stakeholders know/care about the work being conducted at the Center? (How would this be measured?)

Consequences of Closing ASCs

Closing ASCs has three areas of impacts: socioeconomic, political, and scientific. First, there is the cost to communities for jobs and local business lost. If an ASC were to close, all NMSU employees would be offered another position in the NMSU system. Some employees might move, while others who are place-bound would elect to resign, but in all cases, loss of incomes and buying power would adversely affect local communities. Local support for NMSU by communities, and by extension their legislative representatives, would suffer. Most importantly, the availability of locally relevant science-based information would be hampered.

Impaired response to disasters and new threats to agriculture and the environment is one of many impacts of closing ASCs—but one of the most significant. It is particularly problematic in a state as large as New Mexico. Just hours after the Gold King mine spill in 2015, for example, scientists at the Farmington ASC were among the first emergency responders to collect baseline soil samples before the spill reached New Mexico. If scientists had not been in northwestern New Mexico, those critical samples would not have been collected in time. Collaborating with additional scientists, Farmington ASC faculty took advantage of the most current technology to further assess the situation; they continue to monitor heavy metals in the soils.

Forests provide many valuable resources to New Mexico, including water for both municipal and agricultural use. However, catastrophic fires are degrading these forestlands and associated water resources at an accelerating rate (141,663 acres in 2017 alone). The John T. Harrington Forestry Research Center at Mora is the only research program in the entire Southwest that is conducting research on post-fire planting to restore these forest environments and water resources.

Sugarcane aphid was a new and devastating pest of sorghum in 2015, with losses of $4.6 million in eastern New Mexico and $20 million in bordering Texas counties. Two ASCs and county agents in the affected area teamed up to conduct research trials to develop an integrated pest management program to ensure continued production of this valuable stress-tolerant crop. Pests continually adapt, and new pests such as pecan weevil make routine incursions into New Mexico. Growers cannot expect pesticide companies to develop integrated pest management programs when their primary responsibility is to simply sell their products.

No evidence-based, locally relevant research information will be provided to stakeholders in areas served by closed centers. Some sectors of agriculture and stakeholders will no longer be served directly by AES. Less locally/regionally relevant information will be available to Extension agents to provide appropriate recommendations in areas once served by those ASCs. Stakeholders will increasingly rely on salespeople to make decisions about their property. *"If the center closes, it just adds one more disconnect between taxpayers and the University that is supposed to be improving their lives and providing them with unbiased information." (ASC-Clovis stakeholder)*

Stakeholders will have less applied problem-solving research that directly impacts New Mexico farmers and ranchers. We cannot rely on universities in other states to solve New Mexico's problems. Regionalization has already resulted in less attention to New Mexico issues since scientists who receive federal dollars to do regional work rarely travel to New Mexico, let alone our rural counties.

ASCs already serve vast geographic areas, each one on average serving 11,063 square miles, an area larger than nine U.S. states. Visibility, recognition, and reliance on NMSU by residents in the service areas of ASCs will diminish, resulting in decreased support for NMSU in general. ASCs near state borders, particularly in eastern New Mexico, will have clientele students attracted to universities in neighboring states.

Variety trials would no longer reflect conditions unique to the ASCs and the counties they serve. Variety trial results are among the most frequent requests by growers. Specificity in performance under varied environmental conditions was itself the reason one of the ASCs was established by a grower group.

Closure Plan

The following steps should occur if the College of ACES is forced to close an ASC. All ASC personnel must be offered the opportunity to transfer to a position within the NMSU system. Some faculty members might be able and willing to transfer to another location, but non-exempt and non-faculty exempt staff might be place-bound and unable or unwilling to move to another part of the state. The net gain in personnel costs would vary by station and will be unknown until a closure decision is made. Farm and research equipment would have to be moved or sold. The fate of buildings would depend on whether the university owns the ASC land or whether the ASC land is leased. If the property is university-owned, the buildings and infrastructure would be part of a sale; if the land is leased, then arrangements would have to be made to transfer ownership of the buildings to the leaseholder or remove them to restore the land to its original conditions, which might cost significantly more than $1 million, depending on the lease contract and the materials used to construct the buildings. If the land is university-owned and sold, it is unknown how the proceeds from the property sale would be distributed within the university. The net financial savings to the AES system are unknown. The final decision on whether or not to close an ASC should be made considering the productivity and the value of the center to stakeholders, as well as the cost savings that would result from closure.

Summary of Recommendations

- Work to adequately fund ASCs to properly support high-quality personnel, equipment, and upgrades, which will significantly increase benefits to state clientele.
- Encourage on-campus faculty to collaborate with ASCs.
- Make the same resources available to off-campus faculty as on-campus faculty.
- Encourage off-campus faculty to teach courses via distance education to students on campus and at other ASCs.
- Ensure that ASC advisory boards are structured to provide independent feedback concerning research needs for each ASC region.
- Consider forming a statewide advisory board to allow unified advocacy for the AES/ASCs.
- Develop new, effective methods of communicating research benefits to the citizens of New Mexico, with increased collaboration with Cooperative Extension Service personnel in each county.
- Work to increase hourly wages to attract and retain employees.
- Return indirect costs to the ASCs where the research was performed.
- Develop ASC evaluation criteria.
- Conduct a comprehensive assessment of any ASC being considered for closure, including the center's productivity and value to stakeholders, as well as the socioeconomic, political, and scientific consequences that would result from closure.

APPENDIX

Table 1. Important and unique features of the NMSU ASCs

Agricultural Science Center	Features
Sustainable Agriculture Science Center at Alcalde	• Only ASC located within the historic acequia irrigation community of northern New Mexico • Has certified organic land • Only ASC with research and Extension programs on tree fruits and small fruits • Focus on the needs of small-scale producers • Focus on high-value, high-elevation crop production
Agricultural Science Center at Artesia	• Soil type and environment are unique to the three counties the ASC primarily serves (research results from other ASCs are not applicable to farming in these three counties) • This area (along with the area served by the Clovis ASC) produces about two-thirds of the agricultural gross receipts (the work at Clovis complements the work at Artesia but cannot replace it because of different environment, soils, and crops)
Chihuahuan Desert Rangeland Research Center	• Only livestock grazing-oriented Chihuahuan Desert research center. Uniquely able to assist ranchers with cattle genetic selection and herd size, considering issues of significance for arid rangelands (e.g., drought, forage scarcity, natural resources management) • Home to long-term studies (over 80 years of data) on rangeland changes without grazing
Clayton Livestock Research Center	• Only ASC set up for feedlot production research (capacity to feed 960 animals at a time with variable diets) • Only feedlot in the region with an irrigated center pivot (a significant production system) for pasture studies
Agricultural Science Center at Clovis	• Located in the largest New Mexico crop production area • Able to conduct relevant research for area producers related to limited water resources • Elevation and soil types representative of a vast area of the high plains of New Mexico and the Texas Panhandle • Able to assist farmers with improved tillage, crop rotation, and soil management practices for traditional and alternative crops • Only plant breeding center located off-campus and engaged in development of Valencia peanuts. New Mexico is known for producing specialty peanuts, i.e., Valencia type (three- to four-seeded pods, red skin, sweet taste, and good flavor), in the USA
Corona Range and Livestock Research Center	• Production-scale research facility for livestock and rangeland (able to research issues related to nutrition, reproduction, plant ecology, grazing systems, etc.) • Large portions of the center are similar to 80% of New Mexico rangelands (and much of the Southwest U.S., Mexico, and other arid regions worldwide) • Centrally located in New Mexico, allowing for convenient outreach and demonstrations for New Mexico producers • Only ASC with the potential to conduct research on sustainable wind energy effects on rangeland, cattle, and wildlife

Fabian Garcia Research Center	• Proximity to NMSU main campus (less than one mile) provides the opportunity for a multipurpose outdoor living classroom with integrated teaching, research, and demonstrations • Works collaboratively with Leyendecker Plant Science Center to provide field research facilities for on-campus researchers (neither facility alone is sufficient to accommodate all of the on-campus faculty)
Agricultural Science Center at Farmington	• Located on the Navajo Nation (the only ASC located on sovereign First Nations land), this facility is ideally situated to work collaboratively with Native people on critical agricultural, environmental, and health-related issues • Only NMSU research facility located west of the continental divide (Upper Colorado River Watershed), and able to duplicate crop and environmental conditions for the Four Corners region • Able to conduct research relevant to both large- and small-scale producers, including urban clientele
Leyendecker Plant Science Center	• Conducts large-scale testing of crops relevant to the Mesilla Valley • Works collaboratively with the Fabian Garcia Research Center to provide field research facilities for on-campus researchers (neither facility alone is sufficient to accommodate all of the on-campus faculty) • Proximity to main campus provides another outdoor living classroom for integrated teaching, research, and Extension demonstrations
Agricultural Science Center at Los Lunas	• Only ASC involved in a longstanding cooperative agreement with the USDA; the facility is co-located and shared with the NRCS Plant Materials Center, and 50% of station costs are covered by PMC • Over three acres of certified organic land for research • Close proximity to Albuquerque, the largest city in New Mexico, provides the perfect location for urban farming, value-added farm products, and horticultural programs • Ideal location for resident Extension faculty with statewide appointment to efficiently deliver Extension education programs to large and diverse clientele • Fifteen different soil types allow for broad applicability of research findings for collaborative projects across the state
John T. Harrington Forestry Research Center at Mora	• Only university research facility focusing on forestry—forest nursery technologies, tree improvement, and restoration and reforestation—in the Southwestern U.S. • Maintains a unique multi-university/state agency collaboration for research, teaching, and outreach efforts • Largest producer of forest seedlings in the Southwestern U.S. These seedlings are used to restore disturbed forests after fire and mining operations on both public and private land
Agricultural Science Center at Tucumcari	• Only non-livestock-centered ASC with facilities and staff able to conduct research on both plants and animals • Can conduct both dryland and irrigated research using several different irrigation systems • Only ASC with the ability to conduct research on the use of municipal wastewater as an alternative water source • Able to conduct large-scale irrigated grazing studies • Location of the Tucumcari Feed Efficiency Test, a public-private partnership. • Location of the Bull Test and Sale, a region-wide testing site and source of superior genetic sires for cattle herd improvement

Table 2. Examples of potential future research and Extension efforts of the centers

Agricultural Science Center	**Future Research/Extension Activities**
Sustainable Agriculture Science Center at Alcalde	• Energy creation using acequias, rivers, and streams • A systems approach to making a small farm a viable enterprise • Soil microbiome and soil health research • Investigating the accuracy and reliability of the soil food web assessment (SFW) method • Innovations in composting • Alternative high-value tree fruit (e.g., jujube cultivar recommendations) • High-value berries (e.g., blackberries) • Renovating old apple orchards • Alternative crops (e.g., amaranth, lavender) • Using high tunnels for year-round production on small-acreage farms • Impacts of acequia irrigation systems in northern New Mexico on hydrology of entire Rio Grande basin • New/beginning farmer/rancher Extension education programs
Agricultural Science Center at Artesia	• Expand research on pecan production and pest management for southeastern New Mexico • Evaluate alternative crops for the region • Evaluate and develop best management practices for salt-tolerant crops
Chihuahuan Desert Rangeland Research Center	• Improved cattle production with fewer inputs and less impact on natural resources • Improved methods of restoring disturbed arid dryland ecosystems • Effects of grazing on climate change
Clayton Livestock Research Center	• Neonatal issues for dairy/beef crossed calves • Investigate the potential use of alternative forages with respect to water utilization (irrigated pasture research) • Nutrition and management effects on bacterial loads associated with bovine respiratory disease
Agricultural Science Center at Clovis	• Low-water-use alternative crops and improved crop water-use efficiency • Integrating drought-tolerant crops into existing cropping systems • Developing a soil health database for traditional and alternative cropping systems • Developing early maturing, drought- and heat stress-tolerant Valencia peanut cultivars adapted to eastern New Mexico and west Texas • New and alternative crops (e.g., industrial hemp)
Corona Range and Livestock Research Center	• New developments in nutraceuticals (products and technologies) • Improved dissemination of information to traditionally underserved, non-traditional, and new clientele • Watershed and natural resource management
Fabian Garcia Research Center	• New and alternative crops (e.g., industrial hemp) • Vegetable gardening demonstration plot • Hydroponic vegetable production
Agricultural Science Center at Farmington	• Strengthening private/public research partnerships • Expanding specialty crop research • Industrial hemp • Crops of craft wine, beer, and distilleries, including high-value crops for flavoring

	• Expanding organic crop production research • Cropping system research to promote soil health • Innovative food systems to support the Four Corners region • Expanding water conservation research, innovative irrigation methods, and precision agriculture • Greenhouse technology and aquaponics in combination with solar and natural gas energy resources • Long-term monitoring of effects of 2015 Gold King mine spill on agricultural lands, irrigation ditches, and irrigation water • Expanding community-supported environmental monitoring • Expanding ornamental horticulture to support water conservation in the urban landscape
Leyendecker Plant Science Center	• New and alternative crops (e.g., industrial hemp) • Ecological greenhouse crop production
Agricultural Science Center at Los Lunas	• Low-input, high-value alternative crops for small-scale producers • Improved forage systems through crop selection, reducing the use of water and other resources, and pest management • Long-term sustainability of urban landscapes (e.g., conserving water and managing storm water runoff, reducing heat island effects, improving/increasing use of native and adapted plants) • New/beginning farmer support and support of underserved and non-traditional clientele • Grape variety, rootstock, and trellis and training evaluation to improve wine grape composition and resultant wine quality and consumer acceptance
John T. Harrington Forestry Research Center at Mora	• Post-fire planting and associated research • Nursery practices to maximize outplanting survival and performance • Criteria for site selection for nucleation planting • Species mix and seed source selection for planting • Cellular-level measurements for genetic diversity • Seed source screening for desirable traits • Seed collaboration program to establish seed transfer guidelines based on common garden studies, micro- and macro-environmental restoration models, and ecotype selections
Agricultural Science Center at Tucumcari	• Soil/plant/water quality/environment relationships associated with the reuse of treated municipal wastewater for agricultural and horticultural irrigation • Range restoration and other riparian area issues • Small-scale, low-input horticultural production to meet the increasing demand for locally grown produce and the development/growth of farmers' markets • Improving resource-use efficiency using innovative cropping and management • Canola for cattle grazing • Cattle feed efficiency (continued expansion) • Small herd goat production • Aquaponics • Industrial hemp

Table 3. Current ASC needs for maintenance, equipment, and personnel

Agricultural Science Center	Repairs	Equipment	Personnel
Sustainable Agriculture Science Center at Alcalde	• Replace main office septic tank drain • Repairs to main office • Repairs to adobe sheds • Tree removal at main office • Connect community water to graduate student housing • Repairs to adobe residence • New shed for hay storage • New shed for equipment storage • Replace main office sidewalk	• Repair backhoe transmission • New seed drill • Walk-behind tractor and associated implements • Forage plot harvester • Small grain plot harvester • New baler and bale wagon • Chisel plow	• Senior laborer • Natural resources specialist • One or two CES ag agents • Two research faculty positions
Agricultural Science Center at Artesia	• Replace roof and renovate office building • Repair shop building • Repair or replace greenhouse • Renovate farm supervisor residence	• None needed	• Two faculty
Chihuahuan Desert Rangeland Research Center	• Renovate headquarters buildings • Renovate headquarters corral • Livestock water distribution pipeline • Replace barb wire fence • Rebuild existing camp, Mayfield and Selden corrals • Construction of new corral • Repair/update five water wells	• Portable welder • Skid steer with attachments • New gooseneck livestock trailer	• Full-time employee to assist with management
Clayton Livestock Research Center	• Conveyor replacement in feedmill • Processing barn restroom repairs • Paint feedmill to protect from rust • Downspout spider leg electronic controller for commodities • Incline belt for roughage boxes • Bin agitator • Person lift • Replace flaker and boiler • Asbestos abatement in office	• Repairs to feed truck • Second feed truck • Equipment for distance education • Vehicle for center • End loader • Skid steer • One-ton pickup • 24-ft stock trailer • Gooseneck flatbed trailer • 72-inch John Deere lawn mower • Side-by-side utility vehicle • Portable welder • Commodity barn • Equipment storage shed	• Two farm laborers • Graduate student support • Farm labor for calf research • Full-time administrative assistant • Lab technician • Two faculty positions

		• Automated calf feeding system • Remodeling barn • Growsafe system • Bud box system • Portable corral for wheat pasture • 175-hp tractor, disc, grain drill • 15-ft bat wing brush hog • Box blade for grading roads • Natural gas engine and pump for irrigation well • Solar array and/or wind generator • Manure spreader	
Agricultural Science Center at Clovis	• One new or good used three-bedroom mobile home for temporary quarters	• One large-capacity drying oven to dry forage samples • Two incubators for research	• Increase in pay for laborers, higher base pay
Corona Range and Livestock Research Center	• Kitchen remodel in north camp residence • Roof replacement on north camp residence • Stucco exterior on north camp residence • Kitchen remodel in HQ residence • Roof replacement on HQ residence • Stucco exterior of HQ residence • HQ scale house replacement and scale repair • HQ south barn replacement	• None needed	• Full-time ranch technician • Part-time administrative assistant • Contract/part-time janitor
Fabian Garcia Research Center	• New shade house roofing • Extensive repairs to all buildings and greenhouses • Extensive tractor repairs • Repairs to rain gutters on caretaker trailer • Update internet networks	• Tractor with hydraulic power system • Laser level components • Spray boom implement • Planter implement for grains	• Increase in pay for laborers, higher base pay
Agricultural Science Center at Farmington	• Greenhouse and head house repairs • Main building repairs • Renovate farm manager office • Renovate shop bathroom • Insulate/reinsulate building	• 100-hp general purpose tractor • 60-hp general purpose tractor • Dedicated three-point hitch for 200- to 300-gallon application of fungicides and insecticides	• Office manager • Research assistant • Mechanic • Two faculty positions

	• Install energy-efficient heating	• Six-foot-wide reverse tine tiller • Deep ripper • Rotary cuter • Precision seed planter for agronomic crops • Hay baler • Hay wagon • Plot combine • Backhoe front-end loader • Mini excavator	
Leyendecker Plant Science Center	• Overflow pipe infrastructure • EBID dispersal pipe infrastructure • New main irrigation line • Additional irrigation well	• 100-hp open station or orchard cab tractor • 10-ft disc • 10-ft Schmeiser • Five-bottom plow	• Increase in pay for laborers, higher base pay
Agricultural Science Center at Los Lunas	• Refrigerated air and heat in teaching lab • Remodel/repair head house/lab/office space • Supplement submersible irrigation well • Bring three septic systems up to code • Temporary quarters for visiting scientists • Repair irrigation risers on west side of farm • Dehumidifier in seed storage room • Two greenhouse heaters • New phone system in office • Paint office building exterior and interior	• 100-hp tractor • 75-hp tractor • Plow • Bed shaper • Row crop cultivator • Three-quarter-ton pickup • Angel blade	• Faculty superintendent • Administrative assistant • Two seasonal laborers • IPM specialist • Master Gardner coordinator
John T. Harrington Forestry Research Center at Mora	• Re-roof main building • Replace damaged light fixtures • Replace damaged wall coverings • Upgrade wiring in office/lab • Update plumbing in break room • Main building ADA compliance • Install perimeter drain for flooding issues • Remove swamp coolers due to leaks	• Generator for greenhouse power outages	• Two faculty positions • Two farm laborer II positions

	• New exterior door for lab • Replace heaters • Replace garage doors in shop • Replace/repair freezer/cooler motor in greenhouse • Update electrical service to greenhouse • Re-roof head house in greenhouse • Replace heater in greenhouse • Replace motors for cooling fans in greenhouse • Replace motors for cooling panels in greenhouse • Air conditioning unit for cold storage in greenhouse • Re-roof old housing trailer • Repair/replace front and back porches on old housing trailer • Repair heater on old housing trailer • Upgrade main power service on old housing trailer • Concrete pad for chemical shed • Upgrade chemical storage area • Fuel tank spill/containment structure		
Agricultural Science Center at Tucumcari	• Water system replacement • Shop facility replacement • Office, lab, and conference building replacement (one building) • Greenhouse built • Residence rebuilt • Second restroom addition to residence • Current office/lab building renovation • Irrigation system replacement	• Small plot combine • Stock trailer • One-ton truck	• Additional farm laborer • Support staff • Research asst. • Second lab tech. • Two faculty positions (rangeland expertise)