Developing the Strategies for the South East Asian Ministers of Education Organization Regional Center for Technical Education Development (SEAMEO TED): Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

Songheang Ai¹

Abstract

A strategic plan is a guiding compass for implementation of actions to achieve planned goals and objectives of the organization. A strategy is a broad cluster of actions for implementation. The document guides the organization in moving forward in the right direction aligning with the national/state strategic plans. The study aim is to explore the core strategies of the SEAMEO TED's five-year strategic plan. The strengths, weaknesses, opportunities, and threats (SWOT) analysis was employed to answer the research aim. 10 SEAMEO TED officers who have actively engaged in the core tasks and activities were asked to list down four quadrants of SWOT. Six core strategies were developed inductively consisting of (1) developing research competencies for informed decision making, policy formulation, journal publication and conference presentation; (2) enhancing the function and promotional mechanism for technical education; (3) reshaping constant regional and national cooperation and partnership with stakeholders for harmonious consensus; (4) developing legislative framework to achieve technical education effectiveness; (5) maximizing the professional development programs for staff growth; and (6) improving technical training programs for technical education teachers, school management, and supporting administrators in response to the regional needs. Findings suggest that SEAMEO TED should maximize its expertise, and financial resources in achieving these ultimate strategies to reach an optimal and regional need.

Key Words: technical education, strategic plan, SWOT analysis, training, and research and development.

1

¹ Center Director, South East Asian Ministers of Education Organization Regional Center for Technical Education Development (SEAMEO TED)

November 2020, E-mail: song.heang@yahoo.com

Introduction

South East Asian Ministers of Education Organization Regional Center for Technical Education Development (SEAMEO TED) was established by the Royal Government of Cambodia in 2017 and endorsed by SEAMEO Council president in the same year in Indonesia. The purpose of establishment of the regional center is to support SEAMEO education agenda priority area 4 among seven priority areas steadily focusing on technical education at secondary levels in the region. The major activities of SEAMEO TED encompass public relations and partnership, technical education and training, and research and development. Therefore, the regional center focuses on technical education at secondary level with its work scope covering eleven SEAMEO country members.

To guide its regional implementation and actions for alignment with relevant policies and strategies such as SEAMEO charter, SEAMEO strategic plan (2021-2030), and ASEAN charter, the strategic plan plays an integral part in light of doing actions in the region. The strategic plan acts as a means of communicating between SEAMEO charter and SEAMEO strategic plan (2021-2030) and its implementation activities in reality. It can be translated into action plans according to the timeframe and available resources. The strategic plan serves as a basic decision for an organization to guide its actions (Bryson & Alston, 2005; Bryson, 2004). The strategic plan builds regional foundation for the center growth and development with specific framework for action (Villanueva, Begin-Gillis, Sam, Yule, & Walsh, 2014). If no strategic plans for guiding the implementation, the day-to-day operations and organizational goals will not be achieved successfully.

South East Asian Ministers of Education Organization (SEAMEO) was established in purpose of enhancing regional cooperation in education and training (SEAMEO Secretariat, 2012). Specifically, the aim of SEAMEO TED is to work for the regional need in technical education at secondary levels among 11 SEAMEO member countries and associate members (SEAMEO TED, 2017). The center serves as the regional clearing house, and the center of excellence for research and development, and training in regional technical education for technical education specialists, policy makers, and practitioners (SEAMEO TED, 2017). Partnership, networking and collaboration, research and development, creativity and innovation, and training programs in technical education at secondary levels can be under a rigorous management and guideline (SEAMEO Secretariat, 2011). Therefore, the center plays an integral part in developing technical education in the region that is a newly global issue for the country development.

The cooperation among the SEAMEO countries can be enhanced by focusing on research and development initiatives, partnership and alliances that pave new ways of instruction (SEAMEO Council, 2019). Technical education at secondary levels is a global issue for equipping youth's vocational skills by linking with research and development, and training programs as a collective body. However, to guide technical education to the right direction with an alignment with SEAMEO's strategic plan 2021-2030, SEAMEO TED's five-year strategic plan can be formulated. The five-year strategic plan for each center should be developed when it enters the permanent stage after the establishment (SEAMEO Secretariat, 2018). Therefore, each individual government invest in strategic plan development to transform technical education to better meet the fast-changing technology (Ra, Chin, & Liu, 2015).

The strategic plan can be used to guide the process of using the center resources to achieve its vision, mission, goals, and objectives in the long run (SEAMEO TED, 2020). The strategic plan posits the future anticipation, resource

utilization and decision making to achieve desired goals (Woods, Frye, & Ralstin, n.d). However, since the establishment in 2017, SEAMEO TED has no legitimate strategic plan to guide the center implementation and development. The strategies and action plans were not in place covering technical education extending from Cambodian perspective to regional perspectives (SEAMEO TED, 2020). Most of developing countries lack aligned strategic plans for TVET to guide their implementations (Ra et al., 2015).

A strategic plan can be used to communicate between the center management, its officers, and partners to ensure the scientific and effective management, labor productivity, and tangible results. The center strategic plan will be a main driver to promote quality and relevancy of regional technical education (SEAMEO TED, 2020). The plan will be used to enhance the center performance to ensure that technical education system will be rigorous and consolidated as a collective bond (SEAMEO TED, 2020). Effective workflow, improving economic efficiency, and guided implementation for the center activities will be reached. Moreover, increased effectiveness, increased efficiency, and enhancing an organization's ability to learn strategically can achieved with the strategic plan in place (Bryson & Alston, 2005). Because of limited resources for strategic plan implementation, its benefits are ultimately crucial as identified by Woods et al (n.d). They indicated remarkably efficient uses of scare resources, building consensus, improving public awareness, enhancing the center's competitive edge in the region, and promoting forward thinking. Finally, the center resources will used be in a saving manner following the planned actions, timeframes, and resource allocation.

A strategy is a tactical plan or a road map paving the way how to get that we want (Woods et al., n.d). Ultimately this study objective is to develop the core strategy of five-year strategic plan as a guide for implementation. Each of the developed strategy will be extended as actions with resources needed and timeframes. Alternative solutions and programs should be flexible and innovative in the implementation stage (Woods et al., n.d).

Literature Review

The strategic plan is an integral part for an organization enabling it to move forward in a right direction. Every organization should have it before embarking on its activity implementation as an operational plan. Time, efforts, and money are invested in developing it legislatively. There is extensive literature regarding the strategic plan for an organization. Some are empirical studies and others are blue papers mentioned in the following descriptions.

SEAMEO STEM-ED (2020) highlighted its 1st five-year development plan 2020/2021-2024/2025 for the starting point. SEAMEO STEM-ED postulated four major strategies to enhance STEM education quality consisting of (1) enhancing capacities of teachers and education personnel in providing quality STEM education; (2) developing STEM learning resources, education tools and platform for developing professional skills of teachers and education personnel; (3) building student aspirations in STEM careers and managing STEM education that caters to the world of work; and (4) identifying and developing research studies to support evidence-based STEM education policies and practices. The development process was rigorous in nature starting from reviewing relevant literature, collecting inputs from stakeholders through interviewing, group brainstorming, consultation workshops and meetings. Finally, it passed the governing board meetings for a primary validation before getting approval from the SEAMEO council president.

SEAMEO TROPMED network (2020), which specializes in tropical medicine in the region, has developed its five-year development plan 2018-2022. The development plan encompasses eight strategies for implementation covering (1) teaching excellence; (2) research and innovation excellence; (3) outstanding clinical outcome; (4) people excellence; (5) infrastructure excellence; (6) customer and community service excellence; (7) alliance excellence; and (8) leadership and management. However, a pool of consultation workshops and internal meetings has been undertaken to capture relevant inputs for the version revision.

SEAMEO INNOTECH (2016), which tackles technical and vocational education and training in the region, proposed its five-year development 2016-2021 to guide the direction of the center projects and programs. For implementation, the strategic goals were formulated as (1) regional relevance and leadership; (2) regional reach, client focus and visibility; (3) adaptive and responsive resource base. Many consultation workshops to collect fruitful inputs from stakeholders have been done subsequently.

Particularly, the master plan for technical education at upper secondary level (2015-2019) for Cambodian context consists of eight strategies for establishing the direction of practice (MoEYS, 2015). The eight strategies comprise (1) establishment of legislative framework to support general and technical education system; (2) establishment of general and technical education system; (3) development and revision of technical education curricula and textbooks; (4) establishment of technical education facilities and installation of equipment; (5) training of technical education teachers and promotion of teacher qualification and competency; (6) accreditation and quality assurance of technical education; (7) establishment plan for sustainability of technical education; and (8) gender mainstreaming. In developing this version, a variety of research studies, workshops, and meetings have been done such as SWOT analysis, importance-performance analysis (IPA) approach, student perception survey, consultation workshops, and internal meetings with the taskforce members.

Concrete policies and strategic plans contribute to competitiveness and resilience for ASEAN citizen (ASEAN Secretariat, 2020). Effective policies meeting the skills needs for youth proposed flexible training approaches for technical education (ASEAN Declaration, 2020). ASEAN Secretariat (2020) highlights one of the objectives of the ASEAN declaration on human resources development for the changing world of work. The objective underscores the inter-sectoral cooperation and partnerships on education and training to promote skills development. To guide the implementation, capacity building as part of professional development programs for staff growth and lifelong learning is an ultimate strategy to achieve the objective. However, SEAMEO council (2019) proposed four strategic themes for SEAMEO strategic plan 2021-2030 specifying (1) regional leadership and international and global visibility; (2) program excellence and strategic development goal (SDG) relevance; (3) strategic partnership, stakeholder engagement, and linkages; and (4) digital transformation and rapid change adoption. If the strategic plan is concrete and rigorous in nature, the right direction for guidance will be reached.

The 3rd five-year development plan (2021/2022-2025/2026) of SEAMEO RECFON (2020), Indonesia embraced five strategies for its subsequent implementations and guides. The fundamental strategies covered (1) broadening and strengthening of the center's niches in food and nutrition along global and regional goals and protocols; (2) empowering and expansion of stakeholders' engagements in the center's programs to influence policy decision making; (3) ensuring stakeholders' wider and easy access to the center's quality and innovative products and services;

(4) Enhancement of capabilities and work productivity of the center's staff; and (5) strengthening of the center's resource mobilization and management. However, the strategies captured partnership, policy formulation, continuous professional development for staff growth, and good governance specializing in food and nutrition.

The 4th five-year development plan (2016-2021) of SEAMEO RETRAC (2016), Vietnam comprised three main central strategies consisting of (1) to continue to develop, expand, and implement activities related to the center's functions, areas of priority and expertise; (2) to develop and strengthen branding, public relations and marketing strategies to enhance the image and reputation of the center; (3) to expand and strengthen local, regional, and international collaboration and network; (4) to adequately develop HR (professional, academic and supporting staff) and continue to enhance staff competence to accomplish the center's mission and functions; (5) to upgrade the center's facilities and equipment to enhance the center's operations; (6) to internationally accredit the center's quality management system; (7) to seek for and mobilize national, regional and international available resources to strengthen the center's operations; and (8) to diversify income-generating programs and sources to ensure the center's financial viability). The center focused on regional training programs for stakeholders.

Finally, the 5th five-year development plan (2020/2021-2024/2025) of SEAMEO SEAMOLEC (2020), Indonesia encompassed five strategies as key result areas namely (1) improving program excellence and relevance; (2) enhancing quality and efficiency of management; (3) ensuring financial viability; (4) increasing access to markets of SEAMEO program; and (5) strengthening and increasing linkages with national, regional and international institutions. However, this development plan followed the strategic plan (2020-2024) of the ministry of education and culture, Indonesia as a guide.

Methods

To answer the research objective, strength, weakness, opportunity, and threat (SWOT) analysis was employed. SWOT analysis was useful for clarifying the organization's current conditions or situations in framing strategies (Bryson & Alston, 2005). Analyzing the internal environment (weaknesses and strengths), and the external environment (threats and opportunities), the prioritized strategies can be grounded for the organization (Andrews, 2020). The ten participants were randomly selected among 14 SEAMEO TED officers to fill out the SWOT table with four quadrants. The demographic information of the participant was shown in **<Table 1>**, **<Table 2>**, **<Table 3>**, **<Table 4>**.

<Table 1> Participants' Genders

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	7	70.0	70.0	70.0
	Female	3	30.0	30.0	100.0
	Total	10	100.0	100.0	

<Table 2> Participants' Ages

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	22-27	2	20.0	20.0	20.0
	28-33	2	20.0	20.0	40.0
	34-39	5	50.0	50.0	90.0
	46-51	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

< Table 3 > Participants' Positions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Deputy Director	4	40.0	40.0	40.0
	Officer	6	60.0	60.0	100.0
	Total	10	100.0	100.0	

<Table 4> Participants' Work Experience

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less than 1 year	3 7	30.0 70.0		
Total	10	100.0	100.0	

SWOT analysis can be used to identify the organization's critical success issues by clarifying the situations within the organization (Bryson & Alston, 2020). STOW creates the center staff's perceptions and pinpoints the projected future trends with proper policy responses crafting a vision, mission, goals, and objectives of the programs and activities (Villanueva et al., 2014). Grounded from the participants' ideas in each quadrant of SWOT matrix is a basis for TOWS analysis that is the next step. TOWS can be used to seize strength, address weaknesses, achieve the opportunities, and reduce threats (Villanueva et al., 2014).

Results

Based on the SWOT analysis, the strategic window model was constructed (Wang & Wang, 2020). SWOT has been highlighted in **Table 5**>. However, TOWS can be used to formulate strategic options as shown in **Table 6**>.

<Table 5> SWOT Table for SEAMEO TED

Strengths	Opportunities
-Financial supports for each planned activity	-The Cambodian government invests more on
from MoEYS	technical education at secondary levels
-All TED officers work at the best of their capacities	Unique function of the center on technical education at
with active participation	secondary levels
-Organizing the governing board meeting	-Officers have an opportunity for professional
annually -Strong relationships and constant	development programs
supports from MoEYS	

	-Increasing number of new general and technical high schools, students, teachers, and school management
Weaknesses	Threats
-The officers' capacities are limited	-Low awareness of SEAMEO TED functions locally
-No suitable offices for working	and regionally
-The budget support for activity implementation is	-New government political terms with new MoEYS
Constrained	management
-No legal frameworks such as strategic plans, policies,	-Under supervision of two management teams
and master plan to guide the implementation	
-Constrained cooperation with stakeholders	

Note: MoEYS (Ministry of Education, Youth, and Sport)

TOWS is strategic alternatives which are based on SWOT analysis for developing the strategies. According to Andrews (2020), Strengths-Opportunities (SO) that strengths can be used to maximize opportunities, Strengths-Threats (ST) that strengths can be used to minimize threats, Weaknesses-Opportunities (WO) that weaknesses can be minimized by taking advantages of opportunities, and Weakness-Threats (WT) that weaknesses can be minimize to avoid threats.

<Table 6> TOWS for Strategic Options

	Opportunities	Threats
Strengths	Strength-Opportunity (SO)	Strength-Threat (ST)
	-Developing research competencies for informed	-Enhancing the function and promotional mechanism
	decision making, policy formulation, journal	for technical education
	publication and conference presentation	
Weaknesses	Weakness-Opportunity (WO)	Weakness-Threat (WT)
	-Developing legislative framework to achieve	-Reshaping constant regional and national
	technical education effectiveness	cooperation and partnership with stakeholders for
	-Maximizing the professional development	harmonious consensus
	programs for staff growth	
	-Improving technical training programs for	
	technical education teachers, school management,	
	and administrators in response to the regional	
	Needs	

Discussion and Conclusion

Enhancing policies and strategic plans which are the key catalyst for technical and vocational education and training (TVET) for its implementation might meets the skills need in terms of career development (ASEAN Declaration, 2020). The results highlighted the current implementation covering research and development, training, and partnership. The ASEAN policies and action plans postulate education, training, and labor market needs (ASEAN Declaration, 2020).

The six strategies highlighted (1) developing research competencies for informed decision making, policy formulation, journal publication and conference presentation; (2) enhancing the function and promotional mechanism for technical education; (3) reshaping constant regional and national cooperation and partnership with stakeholders for harmonious consensus; (4) developing legislative framework to achieve technical education effectiveness; (5) maximizing the professional development programs for staff growth; and (6) improving technical training programs for technical education teachers, school management, and supporting administrators in response to the regional needs. The six of them reflected current major tasks of the center mentioning research and development; technical education and training; and public relations and partnership. Therefore, the findings were applicable for current context and implementation.

Strategy 1 was named *developing research competencies for informed decision making, policy formulation, journal publication and conference presentation.* Research and development are one of the major tasks to identify technical education problems and pinpoints alternative solutions. Research work is a fledgling and booming hotbed for Southeast Asian region to innovate unique things. Collaborative regional research contributes high expertise, innovative ideas, best practice sharing, industrial cooperation, and promotes regional competitiveness (Ra et al., 2015).

However, SEAMEO BIOTROP (2017/2018-2021/2022) consisted of seven strategies for its vision, mission, and goal achievements. Strategy 2 was *enhancing the function and promotional mechanism for technical education* was consistent with strategy 3 of SEAMEO BIOTROP namely implementing the center's mandates to restore degraded ecosystem sustainable management and conservation enhancement of unique ecosystem. In addition, SEAEO RETRAC (2016-2021) proposed one of its strategies focusing on the implementation of initiatives relating to the center's functions. Because a newly-established center and few experienced staff, SEAMEO TED enhances its function and mechanisms to become a fully recognized center.

Strategy 3 was called *reshaping constant regional and national cooperation and partnership with stakeholders for harmonious consensus*. It was consistent with ASEAN Declaration (2020) underlining the enhancement of partnership and cooperation between profit and non-profit organizations in terms of skills training. Close partnership and cooperation for mutual benefits between stakeholders for operational actions can be achieved with productive society under constant coordination. Regional integration promotes resource mobilization, experience exchanges, best practice exchanges, and learning opportunities for all (Ra et al., 2015). Finally, the global interconnectedness among eleven state members should be considered by formulating the clearing house for sharing and learning (The Asia Foundation, 2020).

Strategy 4 namely developing legislative framework to achieve technical education effectiveness is applicable for Cambodian context because every newly established organization has to formulate the mechanism for running and managing staff in a legislative manner. This strategy was consistent with one strategy of MoEYS (2015) namely establishing the legislative mechanics to support the technical education implementation. The legislative mechanism is the foundation for paving the way to set the direction.

Strategy 5 maximizing the professional development programs for staff growth is so critical for this context. Continued professional development policy was put in effect for all education staff to grasp this professional development opportunity initiated by the ministry of education, youth, and sport, Cambodia. This initiative is supported by the lifelong learning policy for its widening scope of work. All kinds of people are entitled to access a variety of educational and training forms to enhance work effectiveness and job productivity for economic growth (Royal Government of Cambodia, 2019). New approaches to continued professional development programs in terms of upskilling and credentialing should be considered to gain productivity (The Asia Foundation, 2020).

Strategy 6 namely *improving technical training programs for technical education teachers, school management,* and supporting administrators in response to the regional needs. Training programs for stakeholders as part of professional development programs for growth is one of the major tasks that SEAMEO TED has been delivered subsequently. Training needs assessment results pinpointed alternatives as a reference before making decision. Training is the last option that can be considered because it is time-consuming, much investment, and concerted efforts and commitment from trainers and trainees. However, this strategy was consistent with the strategy of MoEYS (2015) namely providing training programs for teachers to enhance their qualifications and competencies.

The findings have some limitations. Because of a newly-established regional center, a few participants' voices were captured with fledgling perception of SEAMEO tasks. Most of them are new to the center. A more pool of diverse participants should be enlarged to encapsulate a variety of relevant insights. Moreover, more seasoned officers should be involved in the research study. SWOT analysis approach has some drawbacks for implementation such as redundancy of strengths, weaknesses, opportunities, and threats; each factor is subjective; and no scientific approach to differentiate among each factor. Therefore, another scientific and rigorous method should be employed to capture objective results.

Finally, the six strategies encapsulated the flow of three main tasks of SEAMEO TED, namely starting from partnership reflecting research and development as part of diagnosing diseases before making decision on any training deliveries. Likewise, staff professional development programs can be taken into consideration because staff is the forefront for the center growth and prosperity. If these three tasks interwind together, a holistic approach can be reached.

References

- Andrews, S. (2020). *Using the TOWS matrix: Developing strategic options from an external-internal analysis* [Blog post]. Retrieved August 07, 2020, from https://www.mindtools.com/pages/article/newSTR_89.htm
- ASEAN Declaration. (2020). ASEAN declaration on human resources development for the changing world of work.
- ASEAN Secretariat. (2020). *Zero-draft roadmap of the ASEAN declaration on HRD for the changing world of work* (Slide presentation). 2nd Drafting Team Meeting for the Development of the Roadmap to Implement the ASEAN Declaration on Human Resources Development for the Changing World of Work, 29-30 July, 2020.
- The Asia Foundation. (2020). The future of work across ASEAN: Policy prerequisites for the fourth industrial revolution.
- Bryson, J. M. (2004). *Strategic planning for public and nonprofit organizations* (3rd ed.). San Francisco: Jossey-Bass.
- Byson, J. M, & Alston, F. K. (2005). *Creating and implementing your strategic plan: A workbook for pubic and nonprofit organizations* (2nd ed.). San Francisco: Jossey-Bass
- MoEYS. (2015). *Master plan for technical education at upper secondary level (2015-2019)*. Phnom Penh, Cambodia: Ministry of Education, Youth, and Sport
- Royal Government of Cambodia. (2019). *National policy on lifelong learning* (Policy). Phnom Penh, Cambodia: Ministry of Education, Youth, and Sport.
- SEAMEO Council. (2019). Commitment to action: Southeast Asian ministers of education organization (SEAMEO) council on SEAMEO's strategic direction for 2021 to 2030 (Statement). Kuala Lumpur, Malaysia: SEAMEO Council
- SEAMEO INNOTECH. (2016). *INNOTECH launches its new five-year development plan* (Blog post). Retrieved August 14, 2020, from https://www.seameo-innotech.org/innotech-launches-its-new-five-year-development-plan/
- SEAMEO RECFON. (2020). *SEAMEO RECFON 3rd five-year development plan (2021/2022-2025/2026)*. SEAMEO Center Directors Meeting 2020, 15-16 July 2020, Bangkok, Thailand.
- SEAMEO Secretariat. (2011). *SEAMEO strategic plan 2011-2029* (Policy). Bangkok, Thailand: Southeast Asian Ministers of Education Organization Secretariat
- SEAMEO Secretariat. (2012). *SEAMEO charter* [Policy]. Bangkok, Thailand: South East Asian Ministers of Education Organization
- SEAMEO Secretariat. (2018). SEAMEO financial operations manual. Bangkok, Thailand: Southeast Asian Ministers of Education Organization Secretariat
- SEAMEO STEM-ED. (2020). Five-year development plan for FY2020/2021-2024/2025. Southeast Asian

- Ministers of Education Organization Regional Center for STEM Education.
- SEAMEO TED. (2017). Enabling instrument for the southeast Asian ministers of education organization regional center for technical education development in Cambodia (White paper). Phnom Penh, Cambodia: Southeast Asian ministers of Education Organization Regional Center for Technical Education Development (SEAMEO TED)
- SEAMEO TED. (2020). *Proposal on revision of the 1st SEAMEO TED's five-year development plan (FYDP) 2021-2025* (Working Paper). Online Center Director Meeting 2020
- SEAMEO TROMED network. (2020). *Regional center for regional medicine* (Blog post). Retrieved August 20, 2020, from https://seameotropmednetwork.org/thailand_vision.html
- Ra, S., Chin, B., & Liu, A. (2015). *Challenges and opportunities for skills development in Asia:*Challenging supply, demand, and mismatches. Mandaluyong City, Philippines: Asian Development Bank.
- Villanueva, M., Begin-Gillis, M., Sam, K. L., Yule, A., & Walsh, J. (2014). *Creating a strategic plan for local economic development: A guide*. The Federation of Canadian Municipalities: Caribbean Local Economic Development Project.
- Wang, J., & Wang, Z. (2020). Strengths, weaknesses, opportunities and threats (SWOT) analysis of China's prevention and control strategy for the COVID019 epidemic. *International Journal of Environmental Research and Public Health*, 17(2235), 1-17
- Woods, M. D., Frye, V. J., & Ralstin, S. R. (n.d). *Blueprints for your community's future: Creating a strategic plan for local economic development*. Oklahoma State University, Division of Agriculture Sciences and Natural Resources: Oklahoma Cooperative Extension Service