Annual Program Assessment Report

Academic Year Assessed: 2019-2020
College: Agriculture
Department: Plant Science and Plant Pathology
Submitted by: Mac Burgess

Assessment reports are to be submitted annually by program/s. The report deadline is September 15th .

Program(s) Assessed:

Indicate all majors, minors, certificates and/or options that are included in this assessment:

Majors/Minors/Certificate	Options
Sustainable Food Bioenergy Systems	Sustainable Crop Production

Annual Assessment Process (CHECK OFF LIST)

1. Data are collected as defined by Assessment Plan
   YES_____ NO__x__
2. Population or unbiased samples of collected assignments are scored by at least two faculty members using scoring rubrics to ensure inter-rater reliability.
   YES_____ NO__x___
3. Areas where the acceptable performance threshold has not been met are highlighted.
   YES__x___ NO_____ NA_____
4. Assessment scores were presented at a program/unit faculty meeting.
   YES__X___ NO_____
5. The faculty reviewed the assessment results, and responded accordingly (Check all appropriate lines)
   Gather additional data to verify or refute the result. _____
   Identify potential curriculum changes to try to address the problem __x__
   Change the acceptable performance threshold, reassess _____
   Choose a different assignment to assess the outcome _____
   Faculty may reconsider thresholds_____
   Evaluate the rubric to assure outcomes meet student skill level _____
   Use Bloom's Taxonomy to consider stronger learning outcomes _____
   Choose a different assignment to assess the outcome_____

OTHER: Continue to monitor student performance on case studies, increase the number of courses included in the evaluation.

6. Does your report demonstrate changes made because of previous assessment results (closing the loop)? YES ___x__ NO_____

1. **Assessment Plan, Schedule and Data Source.**
   a. Please provide a multi-year assessment schedule that will show when all program learning outcomes will be assessed, and by what criteria (data). ***(You may use the table provided, or you may delete and use a different format).***

Cropping systems and sustainable agriculture (AGSC 428) taught by Perry Miller and Plant Nutrition and Soil Fertility Management (AGSC 356) taught by Mac Burgess are required courses for Crop Science and SFBS Sustainable Crop Production majors in the College of Agriculture (CoA) at Montana State University. Both courses are also taken by students from other majors, including Environmental Horticulture and Agricultural Business.

Charlie Watt is a PhD student in PSPP, Mentored by Mac Burgess. Charlie is planning to apply to the interdisciplinary PhD program this spring with collaboration with Faculty from the College of Education specifically researching outcome assessment from active and participatory learning focused courses. Charlie has been a TA for AGSC 428 and guest presenter and assessment participant in AGSC 356. AGSC 428 builds upon and requires synthesis of concepts from AGSC 356, ENSC 245 and several other courses.

Consistent with verbal advice from the Provost's office, assessment activities have been done for students from the different undergraduate programs enrolled in these courses together. This complicates reporting of outcomes on a program basis since the different programs have different thresholds and schedules. It is suggested that this reporting template should allow more flexibility for this situation.

Here we report on an ongoing effort to document and improve specific course learning outcomes that map to similar program learning outcomes for both Crop Science and SFSB Sustainable Crop Production programs. These outcomes are being assessed in both above mentioned courses every year regardless of program assessment calendars. This effort (specifically Charlie Watt's stipend support) is partially funded by a USDA - MDA Specialty Crop Block Grant 20SC02611 "Plant Nutrition and Soil Fertility Management for High Tunnels", where we regard MSU undergraduate students as stakeholders and include them in the stated objective of creating enhanced communication between researchers and stakeholders regarding reasonably quantities of organic soil amendments.

Combined and condensed program learning outcomes common to both programs used for assessment in this course sequence are shown below, with outcomes in **bold** all mapping to the course outcomes and specific assessment assignment outlined later in this report. Notation of CS or SFBS below corresponds to Crop Science and Sustainable Food and Bioenergy Systems programs respectively.

1. Students will effectively communicate (public speaking, slide design etc.) (both programs)
2. **Students will be capable of critical thinking (CS) or systems (SFBS) thinking**
3. **Students will design effective cropping systems (CS) or be able to grow food (SFBS)**
4. **Students will be able to "lead the public discourse on agriculture" (CS) or "Demonstrate Agency, make choices and advocate a position" (SFBS).**

5. Students will be able to financially assess cropping systems (CS).
6. **Students will have a body of knowledge related to Sustainability (SFBS).**

Course learning outcomes for AGSC 356 relevant to this assessment are that students will be able to

- Calculate application rates for soil amendments, including fertilizer, manure, compost, crop residue, and lime, to meet plant nutrition needs in agronomic, horticultural, rangeland, forestry, and residential settings weighing economic and environmental considerations.
- Apply knowledge of plant nutrition and soil fertility to real-world management scenarios in horticultural, agronomic, and rangeland settings.
- Assess the environmental impact of soil fertility management decisions.

Course learning outcomes for AGSC 428 that are relevant to this assessment include:

- Demonstrate understanding of practical and theoretical aspects of soil management in cropping systems, with special regard to cover crops, soil nitrogen cycling, and soil carbon storage.
- Demonstrate basic competence in scientific literacy to critically evaluate and synthesize different sources of information including research data.

In this report data sources include description of an active learning module in AGSC 356 in Fall 2018, related midterm and final exam questions in AGSC 428 in Spring 2019, and outcomes from a revised active learning activity in AGSC 356 in Fall 2019.

b. What are your threshold values for which you demonstrate student achievement?

Both SFBS and Crop Science assessment plans have thresholds based on grades in course assignments. Crop Science has a grade threshold of 70%, corresponding to a minimum passing grade, with program-wide minimum mean score of 75% and no more than 10% of students scoring below 70%. The most recent SFBS Plan does not include collecting data from these courses but has thresholds of 80% of students achieving a grade of B or better on systems thinking plans in other courses. I (Mac Burgess) believe SFBS programs housed in the College of Agriculture should include more assessment in upper division agriculture classes, so this data is presented here above and beyond SFBS program assessments prepared by other units. Data collected here are not available on a program-specific basis since student major information was not collected or associated with student responses to assessment projects and questions.

2. What Was Done

a) Was the completed assessment consistent with the plan provided? YES______ NO_x__
If no, please explain why the plan was altered.

We are not able to agree upon performance thresholds for this process. Frustration with the entire process seems to be a common theme among faculty.

In this report, two different programs with only slightly differing learning outcomes but different performance thresholds are assessed for one specific critical topic addressed in a sequence of courses with the goal of eventually documenting success of a change in teaching practices.

Each year in AGSC 356 students complete an in-class worksheet as a group project where they compute quantities of manure required to meet the nitrogen requirement of various crops. Students are given a manure analysis report from a commercial laboratory specifying N,P, and K content of actual bed pack dairy manure in units of lb of each nutrient per ton of manure, the common unit of measurement used in commercial farming practice. Students are then shown a series a photos detailing calibration of a manure spreader to 25 tons per acre, a typical manure application rate resulting in "just a sprinkling" of manure, with the ground not being completely covered by manure. Students are asked to compute the amount of N, P, and K of this quantity of this specific manure, and to compare that to crop nutrient needs which they are expected to compute from provided national average crop yields and crop nutrient removal rates from an online crop nutrient removal calculator. Finally, students are asked to compute cumulative contributions to soil organic matter from the carbon contained in this manure and estimate how many years of manure application would be required to achieve a specific measurable change in soil organic matter content. Students are given the opportunity to work on these calculations in a group, and then are walked through the calculations by the instructor. The focus is ultimately on the final take-home point, that manure cannot be used to provide optimum crop nitrogen requirements without overapplying both phosphorus and potassium. It is hoped that students gain appreciation for both quantitative and visual measures of typical manure application rates. Further we hope to cultivate an appreciation that manure and composted manure products vary widely in nutrient content, so quantitative analysis of the composition of soil amendments is necessary for both environmental and economic optimization. Application rates suggested by commercial suppliers of composted manure range from excessive to sometimes absurd, as do claims in some circles about the potential effect of cover cropping and manure application on accumulation of soil organic matter. Students need to be able to navigate this confusing landscape confidently.

2. How Data Were Collected

a) How were data collected? (Please include method of collection and sample size).

As a follow-up to the specific expected outcomes related to this assignment described above, students in AGSC 428 - Spring 2019, many of whom would have taken AGSC 356 Fall 2018, were given an assessment question on the mid-term exam where they were asked to evaluate common claims made by proponents of regenerative agriculture regarding potential increases in soil organic matter resulting from use of cover crops. This analysis is analogous to the soil carbon portion of the manure assignment in AGSC 428. In Spring of 2019, only 3 of 28 students were able to correctly answer this quiz question on the midterm exam. We found this result alarming, and presented it, in detail, in a poster presentation at the 2019 meeting of the North American Colleges and Teachers of Agriculture. At this meeting we received valuable feedback on how to better present this question, but widespread agreement that it is a reasonable expection regarding an important topic. In his role as teaching assistant, Charlie Watt followed up with a review of approaches to this problem in AGSC 428. When given a simplified version of the same question on the Final Exam, 7 of 28 students were able to compute the correct answer, though 14 earned partial credit by demonstrating correct reasoning but making math errors.

b) Explain the assessment process, and who participated in the analysis of the data.

Only Perry Miller and Charlie Watt were involved with assessment, Though Mac Burgess, Tony Harshorn, and various participants at the NACTA meeting in Twin Falls, ID provided input. This is a straight-forward math problem requiring students to be able to:

- Recall the weight of an acre furrow slice of soil (2 million lbs).
- Compute a percentage of a weight.
- Recognize reasonable quantities of agricultural production.
- Use critical thinking skills.

Determining whether this answer is correct requires no subjective judgment. Determining where students are getting lost and what to do about it is an ongoing effort.

4. What Was Learned

Based on the analysis of the data, and compared to the threshold values provided, what was learned from the assessment?

We conclude that Undergraduate Students in SFBS Sustainable Crop Production and Crop Science Programs need more practice with application of simple mathematical concepts to quantities of agricultural inputs, more practice visualizing quantities of inputs both on the ground and in units of measure common to commerce.

5. How We Responded

a) Describe how "What Was Learned" was communicated to the department, or program faculty. Was there a forum for faculty to provide feedback and recommendations?

These results were shared at a national meeting for Agriculture Teaching and discussed at length among faculty teaching related and prerequisite courses.

b) Based on the faculty responses, will there any curricular or assessment changes (such as plans for measurable improvements, or realignment of learning outcomes)?
YES__x____ NO_______

If yes, when will these changes be implemented?

In Fall of 2019, immediately following the above described assessment in AGSC 428, a new cohort of students was taking AGSC 356. We completed an intervention where students had an additional "hands-on" component to the manure project described previously. Charlie had students fill flat wood boxes with quantities of a commercially available composted manure product consistent with product instructions targeting home gardeners, compute the equivalent application rate in tons per acre, compute the associated inputs of plant macronutrients, and compute corresponding contributions to soil organic matter. On the Final Exam in AGSC 356 in Fall 2019 we included two multiple choice questions to gauge students take-home points from the activity.

On the Fall 2019 AGSC 356 Final Exam, 85% of students correctly identified overapplication of P & K as likely results of using Manure at a rate to meet crop N needs.

However, only 59% of students correctly identified (in a multiple choice question) 25 tons per acre as a typical manure application rate that is not particularly visually impressive. Remaining students were persuaded by distractor responses that this amount of manure would be 2-4” deep, or that it is “totally absurd”. 2-4” deep manure application is totally absurd for crop production, but it does not correspond to 25 tons per acre. We need more repetition of this worthwhile activity, ideally outdoors.

A follow-up with this Cohort’s performance on the related cover crop question in AGSC 428 for spring semester 2020 was thwarted by the COVID-19 pandemic.

Please include which outcome is targeted, and how changes will be measured for improvement. If other criteria is used to recommend program changes (such as exit surveys, or employer satisfaction surveys) please explain how the responses are driving department, or program decisions.

c) When will the changes be next assessed?

Assessment and improvement of this assignment will continue annually until performance meets thresholds or a higher priority is identified.

Closing the Loop

a) Based on assessment from previous years, can you demonstrate program level changes that have led to outcome improvements?

As part of a commitment to continuous improvement, we continue to make changes to the specific assignment described here in AGSC 356 in Fall 2020. Additionally, a simplified version of the same manure application rate project was presented to SFBS 296 practicum students in Summer 2020 as part of integrated research and teaching efforts by Mac Burgess and Charlie Watt.

Submit report to programassessment@montana.edu