

Teaching Diversified Organic Crop Production Using the Community Supported Agriculture Farming System Model

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ABSTRACT

An organic garden operated as a community supported agriculture (CSA) venture on the New Mexico State University (NMSU) main campus was begun in January 2002. Students enroll in an organic vegetable production class during spring and fall semesters to help manage and work on the project. The CSA model of farming involves the sale of shares to members who receive weekly assortments of the farm's output. This is the first organic garden on the NMSU main campus, the first organic vegetable production class, and the first CSA venture in southern New Mexico. This article focuses on the main class activities, how the class has evolved, and future challenges. In particular, the article explores how the class operates within the context of a functioning organic CSA farm with teaching, research, and extension objectives that sometimes are in conflict.

Organic food sales have nearly tripled since 1997, growing 17 to 21% annually; fruits and vegetables accounted for 42% of organic food sales in 2003 (Organic Trade Assoc., 2004). In a recent national survey commissioned by the Whole Foods grocery chain, 68% of the survey respondents who shop for organic foods said they seek fresh produce (Anonymous, 2004). Between 1 and 5% of the top specialty crops in the USA—lettuce, carrots, apples, and grapes¹—were certified organic in 2001 (Greene and Kremen, 2003). Most states are experiencing growth in certified organic land area due to the market growth and federal rule changes that beginning in 2002 standardized the certification process in the USA. In New Mexico, 10,714 hectares were certified organic in 1997, which increased 60% to slightly more than 17,010 hectares in 2001 (Greene and Kremen, 2003).

Agronomic characteristics that make land suitable for vegetable production (warm winter temperatures; adequate water; and level, well-drained soils) also make land appealing for urbanization (Heimlich and Anderson, 2001). Urban development sets up two countervailing pressures on vegetable production: urbanization bids up the price of land and makes it attractive to farmers to sell to real estate developers, but population growth also increases demand for locally grown produce. Since vegetable production typically produces higher returns per acre than other crops, urbanization can have the effect of increasing vegetable production in urbanizing areas

¹ Lettuce, *Lactuca sativa* L.; carrot, *Daucus carota* L.; apple, *Malus sylvestris* Mill.; grape, *Vitis* sp.

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(Heimlich and Anderson, 2001). In New Mexico, urbanization has concentrated along the Rio Grande River corridor, home to the state's three largest cities: Albuquerque, Las Cruces, and Santa Fe. Small-hectare irrigated farms, as a percentage of irrigated farms in the state, have increased, especially in counties along the Rio Grande River corridor (Table 1).

Development of marketing and production alternatives in New Mexico, particularly for small farms, is an ongoing challenge as well as an opportunity. One option for small farms is organic vegetable production, given the optimistic growth in that market. Although the growth in certified organic land area in New Mexico might indicate a thriving organic production sector in the state, the majority of that land area is in pastureland, and the bulk of the organic vegetable production is in northern New Mexico, according to the New Mexico Organic Commodity Commission (NMOCC), the state agency that certifies the majority of certified organic land in the state (J. Quinn, NMOCC, personal communication, June 2003). In response to the increased interest in organic production and the need for small farm alternatives, particularly in southern New Mexico where New Mexico State University (NMSU) is located, faculty members in the NMSU College of Agriculture and Home Economics established an organic garden operated as a Community Supported Agriculture (CSA) venture on the main campus in January 2002.

The project, named Organic Agriculture Students Inspiring Sustainability (OASIS), has multiple and sometimes conflicting objectives: to provide students with a multi-disciplinary experiential educational opportunity, to investigate the feasibility of small-scale organic drip irrigated farming in the Chihuahuan Desert, to demonstrate the CSA model to the local community, to trial vegetable varieties, and to provide a site where faculty can conduct research or student laboratory exercises. Supported by a 3-year USDA Hispanic Serving Institutions (HSI) grant, this is the first organic garden on the NMSU main campus and the first organic vegetable production class. The farm and CSA operations are conducted with the help of students who enroll in the class during spring and fall semesters. A full-time farm manager also assists with CSA planning, farm work, and class management.

The CSA model of farming involves the sale of shares to members who receive weekly assortments of the farm's output. The objective to demonstrate the CSA model as a direct marketing option for small growers was conceived because direct marketing is more than casually important to organic and small producers. In a comparison of organic and conventional producers, "nearly half the surveyed organic growers, and the majority of small ones, market their vegetables directly to consumers..." (Fernandez-Cornejo et al., 1998).

Abbreviations: CSA, community supported agriculture; HSI, Hispanic Serving Institutions; NMOCC, New Mexico Organic Commodity Commission; NMSU, New Mexico State University; OASIS, Organic Agriculture Students Inspiring Sustainability; OSP, Organic Seed Partnership grant.

Table 1. Growth of small irrigated farms in Rio Grande River counties.

Location	Farms with ≤ 19.85 ha ≤ 3.65 ha				
	1974†	1978	1992	1997	1997
	— % of total irrigated farms —				
New Mexico State	34.2	39.7	50.2	51.2	24.8
Doña Ana County (home to Las Cruces and NMSU)	37.9	55.7	73.8	77.5	55.0
Bernalillo County (home to Albuquerque)	66.4	79.2	89.4	89.1	62.0
Santa Fe County	72.7	60.8	72.9	64.5	38.1
Valencia County (home to Albuquerque bedroom communities)	59.1	71.4	78.8	80.0	39.4

† Irrigated farms by size class were not available for this year. These farms include irrigated and nonirrigated farms (U.S. Dep. of Commerce, 1981; USDA, 1999).

In addition, organizing the project as a CSA makes it possible to reach out to the community, to receive feedback on product quality, and to organize the produce marketing in a way that is not burdensome to a class. The CSA also provides a vehicle for class discussions about the structure of agriculture, industrialization of the food system, and other topics. In addition, no CSAs had ever been initiated, at the time of the grant, in southern New Mexico or the El Paso area of west Texas.

Community Supported Agriculture arrived in the USA in the mid-1980s from Europe. However, a similar concept developed in the late 1960s in Japan, as *Teikei*, which means “partnership” or “cooperation”; another translation is “face to face” (Robyn Van En Center for CSA Resources, 2003; Main and Lawson, 1999). More than 1000 CSA farms are registered with the Robyn Van En Center for CSA Resources (2003).

The OASIS Project

In the 3 years since the first production season in 2002, the OASIS project has grown (using organic principles) 366 different cultivars of vegetables, flowers, and herbs, and grossed more than \$50,000 in income on less than half a hectare. Vegetable distribution to the members each year has been for 34 weeks, from early April to mid-November. Both full and half share vegetable memberships were sold in each year. In 2004, flower shares were sold separately.

In 2002–2003, one 0.26-hectare plot was used, which had space for 53 beds each 45.6 meters long, and 106.7 centimeters center to center. In 2004, a 0.04-hectare plot for herbs and flowers was added, and a temporary (for 1 year only) field of 0.162 hectare was used for summer cover crop trials and rotating fall vegetables out of the main field. Except for flowers, count and weight yields by variety have been carefully recorded. Distribution information is also collected to track the members’ weekly assortment. At the end of 2004, OASIS became eligible for organic certification (completing 3 years of production without use of prohibited materials). (See the OASIS website for more production details: <http://agecon.nmsu.edu/oasis>; verified 28 Dec. 2004).

The OASIS Class

Six semesters of the OASIS class have been offered as of fall 2004 by the authors of this article. The class has attracted students from agriculture and nonagriculture majors, even though it has not been required in any degree plan. The OASIS class is co-listed in the Department of Agronomy and Horti-

Table 2. OASIS class requirements.

Category	No.	Points	Total points	Weight in	Weight in
				final grade (non-honors)	final grade (honors)
	— % —				
Individual project report	1	100	100	30	25
Individual project oral presentation	1	100	100	15	15
Field work	30 hours		100	25	20
Article summaries	2	100	200	10	10
Group project field plan	1	100	100	20	20
Honors service learning work	10 hours		100		5
Honors service learning paper	1	100	100		5

culture (HORT) and in the Department of Agricultural Economics and Agricultural Business (AGE) and has no prerequisites. With different numbers in spring and fall, Organic Fall Vegetable Production (HORT/AGE 330) and Organic Spring Vegetable Production (HORT/AGE 331), students can take the class twice and see all three seasons in production (spring students participate in spring and summer planting and spring harvest; fall students get to harvest summer and fall crops). In fall 2004, the Honors College at NMSU adopted the class as a senior level class (HON 430); starting in spring 2005, all of the sections of the OASIS class become part of the General Education (G) program at NMSU. At NMSU, all students must take two G classes at the junior or senior level from two different colleges other than their home college.

The class content covered by the instructors includes organic regulations, the history of CSAs, evaluating profitability of CSAs in general and OASIS in particular, the difference between cool and warm season crops, harvest and planting procedures, post-harvest requirements, and biological control of vegetable diseases. Guest speakers, who are also part of the regular class structure, have addressed regional beneficial insect control and beneficial insect identification, tillage methods, cover crop and green manure research in the state, use of wind breaks for soil conservation, soil test interpretations and comparisons with tissue tests, biointensive agriculture methods, and organic weed control options.

Another feature of the class is optional field trips to the annual state organic farming conference in the spring and in the fall to a local diversified organic vegetable, fruit, and flower farm. We have also encouraged visitors to the farm, and have hosted visits from local elementary school classes, extension agents from west Texas, Master Gardeners, participants in NMOCC-sponsored organic transition workshops, the New Mexico Food and Agriculture Policy Council, and faculty from an agroecology program in Torreón, Coahuila, Mexico.

Since the class goal is to provide an experiential educational opportunity, class attendance is essential. More than three unexcused absences lowers the student’s semester grade by one letter. The class requirements include field work, an individual project, a group project, and two article summaries and discussions (Table 2). Honors students are required to engage in service learning activities with agencies that address local hunger concerns and write a short paper about it. The work requirements, individual project, and group project are examined in more detail.

Work Requirements

The OASIS class requires 30 hours of work, about 2 hours per week in a 15-week semester. Much of this is direct field

work such as planting, harvesting, and weeding. In the fall semester, harvest is taking place already when the semester begins, so students can easily begin their work hours helping with harvest and distribution each Wednesday. However, in the spring, harvest does not begin until early April, leaving weeks in January through March without much field work to do except some planting and transplant preparation. Non-field work activities have included managing the membership drive, designing the membership brochure, managing the Earth Day booth, selecting summer varieties, and creating an OASIS scrapbook.

Individual Creative Projects

The individual project assignment requires students to prepare a written and oral report regarding some aspect of organic or CSA farming. The project must be a creative effort; no strictly library papers are accepted. The creative component requirement developed after the first semester's experience with "term papers"; many appeared to have been downloaded from the internet the night before they were due. Some examples of individual student projects have included an analysis of beneficial insects at the farm, a comparison of the cost of our "basket" of groceries with what is in local stores, an OASIS member satisfaction survey, testing composted cotton (*Gossypium hirsutum* L.) trash as a planting medium, and testing cover crops in onions (*Allium cepa* L.) to control thrips. A former art teacher in the class painted two lovely flower and vegetable canvasses for the class and distribution room.

Group Projects

In the group project, students prepare a field plan, which involves making two key decisions: (i) number of pounds or units, and (ii) number of weeks to give members each crop. Using seed catalog recommendations and OASIS historical yield data and plant spacing information, students must estimate field space needed and seed quantities and costs. The students must also lay out the field such that the crops farthest from the irrigation manifold come out first, so that the drip lines can be gradually cut back as successive crops are harvested. After the groups turn in their farm plan, the class meets to make the final decisions together.

The teams are formed by the instructors to ensure that no team is without a student who has taken the class before, and that no team is without a horticulture major, if possible. Additional considerations that could be useful in team formation is assessment of students' work and class schedules to ensure a common block of time is available for meetings outside of class (Felder and Brent, 2003). Teams formed by instructors perform better than student-selected teams (Felder and Brent, 2003).

The group project is a form of cooperative learning, an instructional method that has been investigated in more than 900 research studies that compared cooperative learning to competitive and individualist learning efforts (Johnson et al., 2000). Cooperative learning, which involves students working together on structured learning tasks, is a subset of collaborative learning, which is a subset of active learning (Felder and Brent, 2003).

To be classified as cooperative learning, five criteria must be met: positive interdependence, individual accountability,

face-to-face interaction, appropriate use of interpersonal skills, and regular self-assessment of group functioning (Johnson et al., 1998). To date, the OASIS group project involves all these criteria except *regular* group self-assessment, which means the groups self-assess at least one time midsemester (preferably two to three times) in addition to the final assessment (Felder and Brent, 2003).

The only group self-assessment we organize involves giving each student points worth 25% of the group project grade for distribution to group members. They could divide up the points evenly or give a greater share to students who worked harder. However, this system of point distribution could be refined. According to Felder and Brent (2003), cooperative learning is enhanced if each member of a group is given a specific role in the group, and their performance in that role is one of the criteria for self-assessment. Roles that can be assigned include coordinator, recorder, checker, and group process monitor (Felder and Brent, 2003). To date, we have not instituted role assignments, but may consider doing so.

Conflicts Arising from Multiple Goals

The goals of the OASIS project, as indicated in the introduction, are educational, research, and demonstration. However, there are tradeoffs associated with trying to meet all of the goals. Conflicts arising from pursuit of multiple goals have affected conduct of the class.

For example, seed selection is influenced by all objectives and impacts the class. Students participate in selecting cultivars, and every semester they get excited about the options. However, after each growing season, the additional experience with cultivars means we know more about cultivar performance, and this restricts the freedom of students. Reducing the number of cultivars would simplify field management, but the desire to try new cultivars for research and demonstration purposes remains. In addition, the need to publish field results from the project means we should identify cultivars to repeat across seasons, an effort we are beginning to initiate. Since we want to reduce production costs as much as possible we tend to order seeds in bulk quantities when possible, which means we frequently have enough seeds for multiple seasons, which reduces choice. In addition, in fall 2004 OASIS received a piece of Cornell University's Organic Seed Partnership grant (OSP), whose objectives include having regional hubs of universities with organic land grow organic crops. Participation in the OSP will influence cultivar selection. Each semester, cultivar selection is a little more challenging.

Curly top virus in the tomatoes (*Lycopersicon esculentum* Mill.) created a case of research/demonstration goals in conflict with CSA management/profitability goals. Loss of tomatoes to curly top virus spread by the beet leafhopper (*Circulifer tenellus*) was heavy in 2002–2003 due to the weather in those years. No effective organic control methods exist for leafhopper control. Once a plant is infected with the virus, it needs to be removed from the field so it does not serve as a source of virus for transmission by leafhoppers to other plants. In 2003, OASIS lost 271 of 294 tomato plants. Different cultivars were used in replantings, since on short notice we had to buy commercially available transplants (a CSA cannot *not* have tomatoes). In 2003, the great diversity of tomatoes made it impossible to keep track of yields by cultivar. So CSA members got slicer, cherry, or paste-type tomatoes, but cultivars yield in-

formation was not kept, like in other crops. The students learned from this particular situation the tradeoffs associated with managing a project as a functioning CSA and managing a project for research purposes, and the financial impacts of the virus.

Demonstration, education, and research goals come in conflict when it comes to demonstrating “profitability.” Visitors touring OASIS hear we are “demonstrating” the CSA concept, which is often interpreted to mean we are demonstrating CSA profitability. However, the project spends money and receives subsidies in ways a strictly commercial enterprise would not. Seed costs to trial all the varieties exceed what a commercial farm would withstand; soil and leaf tests for educational and research purposes also may be excessive. Electricity to run the cooler room is provided by the university. Labor hours probably surpass what is likely in a commercial venture because students working for class credit do not necessarily maximize their productive output. With only about a quarter of a hectare in production, the salary and benefits of a full-time assistant can never be fully covered. The assistant helps not only with the farming, but also with class management, which makes it difficult to isolate the potential commercial returns from OASIS. The students learn about all of these financial complexities in an exercise in class in which they are asked to prepare an income statement for OASIS as a commercial enterprise.

Since visitors often insist we estimate how much land would be needed to “make a living” from a CSA venture, we have had to answer that successful farming depends on many factors such as how high the living has to be, source and cost of water, farmer talent, and other factors. In CSA farming, how much labor could be provided by a core group and pick-your-own also enters the equation. In our field trip to a small organic farm, the farmers tell the students they “make a living” because they have no kids, owe no money, own all their equipment, buy everything used, fix everything broken, manufacture their own parts, sell value-added products, and keep meticulous records. Both the OASIS project and the field trip help students understand the unique circumstances that make it possible for small farms to thrive where others may fail.

A conflict between demonstration and project management goals occurs because of irrigation choices. The OASIS project uses buried drip lines because it makes irrigation manageable in a diversified vegetable garden and that is the system available on the university farm. A statewide drought in New Mexico makes demonstration of drip irrigation more relevant than ever, and reinforces to students and the community that organic horticultural production using drip irrigation is feasible. However, in Doña Ana County, where OASIS is located, few farmers have converted to drip irrigation. Farmers using surface water but interested in trying a CSA format might feel the OASIS model is not workable under furrow irrigation.

Another conflict between CSA management and educational goals occurred when students used OASIS transplants in experiments, and again when OASIS field crops were included in an experiment. The greenhouse experiments interfered with timely transplanting and the field study affected harvest and yields. Future greenhouse studies need transplants grown specifically for research, and field studies that could interfere with harvest need their own space.

Class Changes

Some of the changes in the class have been made due to student feedback and others resulted from instructor decisions. For example, changing the term paper to a creative component was an instructor decision. The introduction of class discussions and article summaries on controversial topics such as the role of genetically modified foods in sustainable agriculture was based in part on the need to comply with General Education guidelines, but also on student desire to spend less class time in the field and more time in structured learning activities.

The student-initiated request to use less class time in the field was easy to implement because the classroom and the garden are across the street from each other. However, students had to be hired during the semesters as a result (summer field work requires significant hired student labor). The additional class time has made it possible to allocate two class periods for the groups to work on their farm plan, with the instructors available to answer questions. In addition, the farm planning forms for the group project are explained in detail, which involves significant class time. In the first year, monitored class time for group work was not scheduled and little explanation of the forms was provided.

Another student request was more formal instruction in harvest and planting procedures. Students in the first semester were all horticulture majors, mostly seniors, and needed little guidance. However, in the second semester many students felt adrift and not sure at what stage to harvest certain crops, how deep to plant seeds, or how to ensure uniform in-row plant spacing.

Now, students receive a planting guide covering in-row spacing, order of plants in the row when multiple varieties are to be planted, whether to stagger, how deep to plant seeds, and number of rows. Planting procedures for transplants and direct seeding are demonstrated. At harvest now, harvesting instructions are explained whenever new crops are to be harvested. Students initial a harvest list for each variety they harvest and fill out variety name slips for each bag of produce filled. Data logging procedures for weights and counts by variety are also explained.

Challenges for the Future

Besides prioritizing among conflicting goals, future challenges associated with operating the class include development of an outcomes assessment since exams are not given. In addition, the University of California at Santa Cruz Farm and Garden Apprenticeship teaching manual is being reviewed to select appropriate sections to use in the class, and from which outcomes assessments can be created.

The project also needs more field space for rotating with cover crops and to accommodate student research projects. Spring crops are planted in January and harvest continues to Thanksgiving, making rotation difficult. If the project had its own small tractor, cover cropping between summer and the subsequent spring crops might be possible; however, reliance on the farm crew to do field work means that such operations cannot be done in a timely manner. In addition, the field crew tractors are too big to effectively prepare small sections of the field. The small plot acquired in 2004, being used for herbs and flowers and over wintering garlic (*Allium sativum* L.) and

leeks (*Allium ampeloprasum* L.), is inadequate for rotational purposes or student research projects. Lack of land also hampers efforts to propose research grants that require certified organic land.

An additional challenge has been managing the production data from the garden. About 150 varieties are grown each year, and for each variety each season and year data are kept on yield, in-row spacing, bed feet, number of rows, seed cost, seed quantity, seed source, planting dates, and harvest dates. Two database classes on campus have adopted the OASIS database as a project. Current student efforts are to make it possible for visitors to the internet site to make queries of production information by cultivar. This dynamic query capability will eliminate the need for OASIS staff to update production reports on the website.

One of the most important unresolved issues is the need to institutionalize the farm manager's salary. Although the HSI grant ended in 2004, the OSP grant will help cover the farm manager's salary for a few more years. The accumulated revenues from the subsidized years of production and the partial salary support from the OSP will eventually be overtaken by project expenses, and then salary support will be needed for the project to continue. Whether soft money options continue to be available or whether the university, the college, or other donors will support the project is uncertain.

SUMMARY AND CONCLUSIONS

Establishment of the organic CSA farm, OASIS, on the NMSU campus has been enthusiastically received by the local community. Possibilities for regional crop diversification are being discovered in the project as varieties are tested, planting dates experimented with, and disease, insect, and fertility problems are encountered. Students are learning about organic production challenges and getting hands-on and collaborative experience planning and operating an organic CSA farm. Student learning activities include a group CSA farm planning project, an individual creative project, field work hours, guest lectures, field trips, and article discussions. The class has evolved in response to student input and instructor discussions.

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