Geographic Information System (GIS) and Remote Sensing (RS): Undergraduate Academic Curriculum and Precollege Training Program

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ABSTRACT

Geographic Information System (GIS), Global Positioning System (GPS) and Remote Sensing (RS) are important tools in the emerging agricultural revolution called precision agricultural or site-specific management. GIS and GPS are inherently linked technologies. Together, they form a powerful tool to measure, map, monitor, and model resources and environmental data for both scientific and commercial applications. Many students and faculty of agricultural colleges from minority institutions have little experience with these new technologies. This paper summarizes how GIS, GPS, and Remote Sensing instruction was incorporated into the existing agriculture/natural science curriculums at the Land-Grant Institutions, Virginia State University (VSU), Delaware State University (DSU), Southern University (SU), and Historically Black Colleges and Universities (HBCUs) such as Elizabeth City State University (ECSU) and Bethune-Cookman University (BCU). The curricular materials were developed through a series of faculty development workshops at VSU, ECSU, and DSU. These workshops were coordinated by the Principal Investigator (Shobha Sriharan, senior author of this presentation) of the USDA Capacity Building Teaching Grant. The USDA collaborators, James Everitt and Reginald Fletcher provided training in the use of ArcGIS, GPS and remote sensing techniques. In addition, a summer faculty workshop was hosted at the Remote Sensing Laboratory of the Integrated Farming and Natural Resources Research, Weslaco, Texas, for exposing the faculty members to the applications of GIS and RS in agricultural fields. These activities led to the faculty development, curricula design, and offering of 3-credit courses (AGRI 280 Geographic Information System and AGRI 290 Introduction to Remote Sensing) at VSU and students preparing their independent projects by using GIS and presenting at the professional meetings. Further, the faculty members at all participating institutions gained valuable research experiences at NASA’s Space Centers (Stennis, Goddard, and Langley). VSU conducted summer programs to create awareness of GIS among the precollege audiences (high school teachers and students) in Southside Virginia.

Key Words: Teaching GIS, GPS, and remote sensing at HBCUs, curricula design, faculty development
INTRODUCTION

One of the most rapidly developing technologies in the agricultural sciences is site-specific management or precision agriculture, natural resources management, agricultural economics, and environmental management. Advanced computer systems that use geographic information system (GIS) and global positioning system (GPS) software, remote sensing (RS), and information analysis are changing the way natural resource managers and agricultural producers conduct business. There is a demand for personnel broadly trained in the agricultural and natural resource management applications of GPS/GIS technology. The emphasis has been on training as compared to education. Education seeks to enable students to understand basic concepts, principles and theories while training strives to make the trainee proficient in using the functions of a particular tool, for example, a specific GIS software system. It is important to include instruction on the basics and applications of GIS, GPS, and Remote Sensing through the General Education Curriculum to the freshmen and sophomores. Though many institutions are offering GIS instruction through the schools of agriculture and liberal arts and sciences, very few HBCUs have taken steps to include GIS instruction in their academic programs. Therefore, Virginia State University (VSU) initiated activities with funding from the USDA Capacity Building Grant on GIS. The grant activities included faculty development in the use of softwares, ArcGIS for GIS, and ERDAS for remote sensing. In addition, the faculty members were trained in the use of GPS equipment. The selection of course contents and textbooks are very important for offering instruction on basics of the ArcGIS and its applications in agricultural and natural sciences. This presentation provides an overview of how GPS/GIS instruction was incorporated into the existing curriculums of the Department of Agriculture and Human Ecology at Virginia State University, and its collaborators, DSU and ECSU.

GENERAL PROCEDURES

The faculty members teaching agricultural, earth, environmental, and engineering courses at the minority institutions, VSU, DSU, SU, ECSU, and BCU took the leadership in developing the curricular materials for introducing courses on GIS and Remote Sensing (RE). Our approach included development of the lesson plans on the basics of GIS/GPS and RE instructional elements within the required lower division GE (General Education) courses at all the participating institutions. The GIS/GPS and RE instruction falls within the Technology Matrix of GE Curriculum at VSU. A series of faculty development workshops were conducted for training faculty members in the use of ArcGIS, GPS and RE techniques at VSU, DSU, and ECSU. Approximately fourteen (14) faculty members from the collaborating institutions (VSU, DSU, and ECSU) and cooperating institutions (SU and BCU) were trained during the project period (2005-2007). The workshop presenters were Dr. James Everitt and Dr. Reginald Fletcher of the USDA ARS Remote Technology Laboratory, Weslaco, Texas, and academia teaching GIS courses at Virginia Tech, HBCUs (Morgan State University and Alabama A & M University). The workshops included discussions on designing course materials according to the background of the Land-Grant Institutions (VSU, DSU, and SU) and HBCUs (ECSU and BCU). At VSU, a course, AGRI 280 Principles of Geographic System (GIS) which included theory and intensive hands-
on exercises was developed by the faculty members, Dr. Shobha Sriharan, Dr. G. Jagannadham (Agriculture), Dr. N. Ghariban, and Dr. E. Sheybani (Engineering). These faculty members received guidance from Ms. Belinda Barnard (GIS Data Analyst, USDA NRCS Water Quality Team). This course was submitted to VSU’s GE Curriculum Committee. The course was approved for offering in fall, 2005. The course was widely publicized via e-mail, brochures, and flyers among the students and faculty advisors on VSU campus.

Advance Faculty Development:
As a result of enthusiasm generated due to the interactions among the faculty members and GIS professionals, the faculty members from the collaborating institutions (VSU, DSU, SU, ECSU, and BCU) participated in the Summer Faculty Fellowship Programs at NASA’s Space Centers and SPACE Programs sponsored by the National Science Foundation at the University of California, Santa Barbara (UCSB).

Undergraduate Student Development:
The activities on undergraduate student development at VSU are described here. However, similar approach was made by DSU, SU, ECSU, and NCU. The undergraduates enrolled in AGRI 280 (at VSU) were trained in making independent projects on the application of ArcGIS according to their academic disciplines. The students made projects in the areas of animal, environmental, soil, and social sciences as part of their requirements for the course, AGRI 280. The students whose presentations were ranked meritorious were provided opportunities to make their presentations at the workshops and conferences such as USDA GIS Day in Washington, D.C. (2006), HBCU Undergraduate Research Day at the University of Maryland at Eastern shore (2007), Annual Meetings of National Institute of Science and Beta Kappa Chi (2007 and 2008).

Pre-college Program for GIS Awareness:
With funding from the USDA Capacity Building Teaching Grant, VSU conducted summer programs in 2006 and 2007 for promoting GIS awareness among high schools through two approaches:

(i) Teacher Preparation through the course, CNES 599 Applications of GIS and GPS in Environmental Science. Each summer (2006-2007) approximately ten (10) high school science teachers from Southside Virginia (Dinwiddie, Petersburg, Prince George, Matoaca, and Colonial Heights) participated in this course. The teachers were trained by Dr. Sriharan and invited GIS professionals from Virginia Tech (Dr. Anurag Misra) and Morgan State University (Dr. Chenlui Fan), and USDA collaborators (Dr. Everitt and Dr. Fletcher). The teachers prepared their independent projects as part of their course requirements, and presented at the closing day of summer program.

(ii) Hands-on Experiences on GIS and GPS to High School Students. Juniors and seniors from the above mentioned high schools were offered hands-on experiences on the basics of ArcGIS and use of GPS, in summers of 2006-2007. In each summer program, approximately fifteen (15) students were trained. The training was provided by Dr. Sriharan, Dr. Ghariban, Dr. Jagannadham, (VSU), and GIS educators from VSU, Morgan State University (Dr. Fan), Virginia Tech (Dr. Misra), and Tennessee State University (Dr. David Pagdett), USDA Collaborators (Dr. Fletcher and Dr. Everitt), and USDA NRCS (Ms. Belinda Bernard).

Community Outreach Activities: VSU hosted a workshop, “Alert, Evacuate, and Shelter” sponsored by the USDA and
National Geographic Society, under the directions of Dr. Thomas Tate (USDA) and Dr. Carol Wabash (University of Nevada). Through this workshop, training was offered on the use of GPS for mapping the alternate routes to evacuate the community members from the disaster areas. The workshop participants were from the 4-H organizations, high schools (students and teachers), and community organizations in North Carolina, and South Carolina and University of Nevada.

RESULTS

The activities on faculty development, curricular design, student development of the undergraduates and precollege audiences led to the enhancement of GIS education at the minority institutions (VSU, ECSU, DSU, SU, and BCU). The faculty development led to development of courses on GIS and RS through the team efforts of the faculty members teaching courses on agricultural, earth, environmental, and social sciences, and engineering. The faculty development workshops provided a forum for discussions among the faculty members and GIS professionals from the Federal agencies (e.g. USDA and NASA) and academic institutions (Virginia Tech, Tennessee State University, and Morgan State University). This led to enhanced interest among the faculty members to participate in research programs on GIS which is reflected through the participation in NASA and NSF sponsored-programs of the following faculty members: S. Sriharan (VSU), Lionel Lyles and Wendi Zhang (SU), and Valentina David (BCU) at NASA Stennis Space Center, Mississippi; Anuradha Dujari (DSU) at the NASA Space Centers (Langley and Goddard).

The offerings of these courses (e.g. AGRI 280 Principles of GIS and AGRI-290 Introduction to Remote Sensing) contributed to the undergraduate students presentations of their independent project at the professional meetings on GIS (e.g. National Institute of Science/Beta Kappa Chi, Undergraduate Research at HBCU Institutions at the University of Maryland, USDA GIS Day). The precollege awareness among the high school audiences resulted in the preparation of high school teachers (20) through the course on GIS (CNED 599) and hands-on experiences on GPS to seniors and juniors (35) in Southside Virginia.

At VSU, Dr. Nasser Ghariban, Associate Professor of Manufacturing Engineering, demonstrated that Golf Cart can be used for farm use by equipping it with GPS and laptop (see picture below). In response to the USDA goal in tagging all farm animals, the Golf cart can be taken to the farm to track the movements of animals tagged with RFID. The research is in progress to check the feasibility of GPS technology for tracking of animal movements on the farm.