

CRIS AD-421 Research Report – Year 3

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New Paradigm for Discovery-Based Learning: Implementing Bottom-up Development by Listening to Farmers' Needs and Using Participatory Process

Investigators: Dunkel, F. V., Montagne, C. A.

Students Funded: 20

Faculty Hours Funded: 0

Termination Date: 09/14/2011

Reporting period: 09/15/2009 to 09/14/2010

Progress Report:

Most substantial result was Dancing Across the Gap, a 56-minute broadcast quality film, 14 chapters, trailer, showing how cross-cultural communication/cultural exchange inspires culture preservation. In film, 3 MT Cheyenne women travel to Mali, live in village of Sanambebe. The Cheyenne experience how traditional knowledge/cultural ways-of-knowing are essential to addressing contemporary issues. The film will air 18, 22 November on Montana PBS. Courses developed or modified, result of HEC grant during Year 3: MSU PSPP 465R: Poverty (action research); UST SOCI 498: Mali Development; UST FREN 492: Intro to Malian civilization; UST ENGR 480, Senior Design Clinic I; UST ACCT 714, (graduate) accounting in developing economy; UCR Honors 012: Global Awareness/Engagement. Student evaluations were high for most parameters of these courses. U MT-Missoula published research linking MSU Mali extern program with water quality/disease issues in Niger River inland delta. MSU, UCR, Mali agricultural university (IPR/IFRA) were partners. Service-learning/community-based research continued in 5 Malian villages and Northern Cheyenne Reservation (NCR), Lame Deer, MT, with teaching/learning programs at 7 US universities and tribal college, Chief Dull Knife College (CDKC) on the NCR. NCR is a new action research site where 26 MSU undergrads/1 grad student used the holistic process. Linkages between language revival, subsistence agriculture, wellbriety were explored. In Sanambebe, undergrads/grad students (20 MSU, 4 CDKC, 1 UCR) collaborated with villagers/ village school on issues of nutrition (kwashiorkor), malaria, cultural identity preservation, women farmers' economic stability. Cheyenne began storytelling sessions, prepare 2 books illustrated by Sanambebe children. Village-produced neem leaf slurry, successful vs mosquito larvae, was verified at UCR. No childhood deaths from malaria for 2nd year. Village handicraft enterprise now is official women's cooperative, workshop, micro-loan system, website (in progress). In Borko, Mali, Gen-1 seed potatoes planted, harvested, stored. Village

will expand farmer numbers, include women, plants seed that become Gen-2. National Agricultural Research Organization (IER) and IPR/IFRA are collaborating on certifying Gen-1 for disease-free status. 25 students/faculty at UST, UC-Davis (UCD), VTech (VT), MSU collaborated with farmers. Zantiebouyou/Dio-Gare, Mali, shea butter quality analysis kit developed by MSU chemistry undergrad Mali extern, underwent UST shelf life analysis. Plan developed with Mali ABC to revising directions/marketing. Product diversification, production issues addressed by villages with UST, VT faculty/students, and NGO Shea Yeleen. Dunkel/Rothschild provided 9-hr UCD workshop on holistic approach to village-based seed potato production. Fort Belknap MT Tribal College became collaborator in shea expansive collaboration. Mali ABC leader, B. Tamboura, awarded Borlaug Fellowship. Campus faculty/student awards received at MSU, VT, UCR for project work. All was accomplished by 11,880 hours contributed by US faculty, 4,160 hours contributed by 6 Mali faculty/scientist mentors, in US classrooms, e-mail, villages.

Publications:

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Williams, A.L., S.J. Halvorsen, S.H. Ba, and F.V. Dunkel. 2010. Water quality and water borne disease along the Niger River, Mali: A study of local knowledge and response. *Health and Place*. 16: In press.

Dunkel, F.V., S.T. Jaronski, C.W. Sedlak, S.U. Meiler, and K.D. Veo. 2010. Effects of steam-distilled shoot extract of *Tagetes minuta* (Asterales: Asteraceae) and entomopathogenic fungi on larval *Tetanops myopaeformis*. *Environmental Entomology*. 39:979-988.

Kon, T., M.R. Rojas, I.K. Abdourhamane, and R.L. Gilbertson. 2009. The roles and interactions of begomoviruses and satellite DNAs associated with okra leaf curl disease in Mali, West Africa. *J. Gen. Virol.* 90: 1001-1013.

Chen, L.-F., M.R. Rojas, T. Kon, K.T. Gamby, B. Xoconostle-Cazares, and R.L. Gilbertson. 2009. A severe symptom phenotype in tomato in Mali is caused by a reassortant between a novel recombinant begomovirus (Tomato yellow leaf curl Mali virus) and a betasatellite. *Mol. Plant Pathol.* 10: 415-430.

Williams, A.L. 2009. Water quality and waterborne disease along the Niger River, Mali: A study of local knowledge and response. Professional paper presented in partial fulfillment of the requirements for M.S. in Geography, University of Montana-Missoula. 56 pp.

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Chapman, R., B. Mernin, M. Oien-Rochat, N. Peterson, N. Shannon. 2010. Comprehensive experimental, analytical, numerical investigation of seed potato storage in Borko, Mali. Univer. of St. Thomas, St. Paul MN. Final report. School of Engineering, 12 May 2010. 52 pp Appendix 110 pp.(faculty mentor: C.George).<http://www.montana.edu/mali/pdfs/GeorgeFinalReportMay2010coverthrupage19.pdf>, <http://www.montana.edu/mali/pdfs/GeorgeFinalReportMay2010pages20thrupage39.pdf>,<http://www.montana.edu/mali/pdfs/GeorgeFinalReportMay2010pages40thru52.pdf>.

George, C.M., R. Chapman, B. Mernin, M. Oien-Rochat, N. Peterson, and N. Shannon. 2010. Experimental Investigation of village-based seed potato storage in Borko, Mali. Trip report and meeting notes <http://www.montana.edu/mali/docsaspdfs/GeorgeTripReportJan2010.pdf>

Alston, B., J. Pavek, S. Smith-Cunnien, A. Shams. 2010. Preliminary Sociological Assessment of the Village-Based Seed Potato Project in Borko, Mali. <http://www.montana.edu/mali/docsaspdfs/finalReportToMaliAgribusinessCenterJan2010PublicVersion.pdf>

Fell, R. and D. Mullins. 2009. The Quiet Revolution within an Entomology Department: Virginia Tech. Symposium presentation at Entomological Society of America annual meetings, 15 Dec 2009, Indianapolis IN.

Dunkel, F. 2009. Setting the stage: What is the Quiet Revolution? Symposium presentation at Entomological Society of America annual meetings, 15 Dec 2009, Indianapolis IN.

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Chaikin, E., R. Littlebear, and F. Dunkel. 2009. Dancing Across the Gap: Scientific knowledge and cultural wealth. Symposium presentation at Entomological Society of America annual meetings, 15 Dec 2009, Indianapolis IN.

Dunkel, F.V. 2010. Learning from Sanambebe: Role of Food Insects in Village Nutritional Health. Presentation given for Conference on World Hunger: the potential of Edible Insects, Clemson University, 24 April 10. Alabama.
<http://www.montana.edu/mali/pptsaspdfs/worldHungerDunkelSanambebepresentationsmallpdfvs n.pdf>

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Products:

Main products this year: 56-minute film aired twice on Montana PBS and multiple other sites, syllabi for 14 courses at 3 US universities, updated website www.montana.edu/mali, 20 externships at 5 partner institutions, 9-hour workshop for UC-Davis faculty/students. Most important product is new, essential awareness of students learned by role-playing how to: think in others' roles, climb out of ethno-centric thinking, appreciate other cultures on equal basis. Students acknowledge other-than-Western development, understand what happens when one does not learn to speak one's native tongue. These lessons; whether aggie, engineer, linguist, historian, artist, molecular biologist, geneticist; are crucial to learn as our societies try to learn to live sustainably. Students know the importance, flock to these courses, and give them high evaluations. 473 Montana St. Univ. (MSU) students were exposed to these concepts, 120 in poverty, health, agriculture courses with curricula developed in this project (40 in Plant Sciences/Plant Path; 40 in Liberal Studies, Honors Seminars, Political Science; 40 in Land Resources/Environmental Sciences). Mali/its agricultural issues were used in all French course levels (298 students) and Insects and Human Societies (35 students). With similar syllabus, 20 students took UC-Riverside (UCR) poverty honors seminar. 38 African students completed similar curriculum at Mali national agricultural university (IPR/IFRA). Univ. St. Thomas, St. Paul MN (UST) developed/taught 4 courses. SOCI 498: Mali Development used development theories/policies related to Africa, analytical/practical skills for social impact assessment to build on initial request by Mali national ag research organization (IER)/previous teams' work. Students assessed sustainability of seed potato project (pilot site, Borko, Mali) for IER, IPR/IFRA, Mali Agribusiness Center. ENGR 480, Senior Design Clinic I, capstone applied engineering principles to real problems, promoting UST's mission to produce ethical, entrepreneurial engineers with difference-making skills, passion, and courage. Students developed sustainable technology with subsistence farmers holistically. ACCT 714 applied business/accounting to village-based seed

potato industry. Students studied International Financial Reporting Standards/Not-for-profit accounting to understand concepts while living in Mali, developing intercultural skills with people of different cultural/educational backgrounds, different languages. FREN 492: Introduction to Malian Civilization used Malian history/culture readings: Mariko's, Le ciel d'hivernage; Ba's Introduction a la civilisaiton Malienne; Mali news on TV5 Monde learning current events/Malian French pronunciation. French team gave presentation at Mali Night event, translated seed potato sociology survey questions, language facilitation/cultural connection for other teams. Twenty student externs were chosen from courses at 5 US higher education institutions. They completed extensive community-based research/service learning experiences in their Malian villages-of-focus and US institutions. Some collaborated in the field with students from IPR/IFRA.

Outcomes:

Mentor visits of one member of the Mali Agri-Business Center (A. Camara, also is a tenured scientist at national agricultural research organization of Mali (IER) was made to US to work with MSU and CDKC students and faculty, particularly PSPP 465R. Camara also updated his meristem culturing, ELISA, and other microbiology procedures related to propagation and certification of disease-free seed potatoes. Another member of the mentor team (Mali Agri-Business Center) entered the Ph.D. program in Environmental Engineering (specifically water issues) at UC-Riverside, completed his prelims, and continued to mentor students on campus and electronically on other campuses (U of MT and MT State University). Samples of virus-infected plants were collected and tested by UC-Davis students and faculty. Virus infections were confirmed in numerous crops including cassava, okra, peppers, and sweet potato. This information is important for seed potato production in Mali and for other horticultural crop production. Publishable research was completed at UC-R with Mali student extern (K. Luong), Dr. Beckage, Dr. Dunkel. Luong, now a M.S. student at MSU with Dunkel determined effective dosages to managing *Anopheles gambiae* by village with village-produced *Azadirachta indica*. Senior design students in Engineering at UST developed a design to store seed potatoes safely in the village. Design was based on improvement of traditional cooling apparatus, the zeer pot. Design used 2 zeer-pot constructions inside existing village building and could be built with local materials/expertise and have minimal power requirements. The next step will be in-field tests in US. The importance of this UST work is 4 non-agricultural disciplines collaborated at a non-agricultural school learned importance of agricultural production, marketing, storage, accounting. Students/faculty practiced transdisciplinary thinking, discovered interconnectedness within the agricultural, community-based system of each non-agriculture-based disciplines, experienced how this approach addressed community-based goals effectively. Many awards received by faculty, students, departments, including: MSU President's Service Learning Award to Dr. Ada Giusti and Women's Association of Sanambebe, Mali; MSU College of Letters & Science Outstanding Teaching Award, 2010 to Dr. Giusti; MSU Anna K. Fridley Phi Beta Kappa Distinguished Teaching Award 2010 to Dr. Giusti; Virginia Tech's Exemplary Department award in developing and sustaining innovative/effective approaches fostering International Awareness/Education to Dept of Entomology due in part to program initiated by Dr. Don Mullins/Dr. Rick Fell in our USDA-HEC project. http://www.montana.edu/mali/pdfs/UED_9_15_10.pdf; UC-Riverside 2 externs received Civic Engagement Awards (one undergrad/one grad student); UC-Riverside extern was

commencement speaker for 2010 graduation ceremony College of Natural/Agricultural Sciences; First solo Mali Extern received Boren Fellowship, Katy Hansen MSU.

Dissemination Activities:

2,340 persons attended 14 Community Service Events managed by students/faculty collaborating on this Challenge Grant. These events included: Bozeman MT Spring and Fall International Children's Festival (Mali mask making, sale of handicrafts by Sanambele Women's Assoc.), May/Sep 2010; Montana State University (MSU) new President's Inaugural, Sept 2010; Edible Insects luncheon, MSU, Feb 2010; MSU International Food Festival, Mali booth, Feb 2010; MSU Contemporary Issues in Science debate - Food Insects in the MSU Salad Bar, Apr 2010; Mali Night, U St Thomas (UST), St Paul, MN, Fall 2009, Spring 2010; Mali/N. Cheyenne Night (drumming, dancing, presentations, project film Dancing Across the Gap), Bozeman, Feb 2010; Mali Luncheon, Chief Dull Knife College (CDKC), Lame Deer MT, Sep 2009; Mali Night, N. Cheyenne Reservation, Lame Deer, Apr 2010; Thesis defense, U of MT-Missoula, Nov 2009; Sanambele village handicraft sale, Bozeman HS, May 2010; Sanambele village handicraft sale, Engineers Without Borders benefit event, Feb 2010; Bozeman Africa Bazaar event, Apr 2010. Dancing Across the Gap project film was viewed by 730 prior to its showing on Montana PBS: viewings included Bozeman, Feb 2010; Mali, Mar 2010; N. Cheyenne Reservation, Apr 2010; NIFA, Washington, DC, May 2010. Film is used by Smithsonian Native American Museum for staff training since Mar 2010. Film used in Dr. Dunkel's Health, Poverty, Agriculture (PSPP 465R) University Core course and all of Dr. Giusti's MSU French courses (ca. 340 students per year). Film being evaluated for classroom use by 15 US universities, including Cornell, Ohio St, U New Mexico, U Wyoming, UST. Planning underway for Dancing Across the Gap Week organized by CDKC involving students, faculty, Reservation residents, MSU students (Nov 2010). A trilogy of peer-refereed articles submitted to NACTA Journal summarizes new pedagogical model developed/tested with this grant. Case study of one of five long-term projects underway in our program is featured in the trilogy: shea butter production, diversification, quality management, marketing by Malian village women. Two symposia at professional meetings in North America were organized/presented by faculty from 5 partner schools: First, at Entomological Society of America (ESA) national meetings on the Quiet Revolution: New Pedagogical Model supported by USDA HEC. Presentations were made by professors of French, Mechanical Engineering (ME), the NY film producer, 3 entomologists, Dec 2009, Indianapolis; second at American Assoc. of Teachers of French round table on agriculture-based service learning in francophone countries with an Expansive Collaboration Model. Presentations made by 2 professors of French, professor of Entomology, ME, Sociology, a HS French teacher, all from this HEC and companion SEC project, Jul 2010, Philadelphia. Keynote address and symposium presentation made by project PI F. Dunkel at World Hunger Conference on Food Insects explored importance of edible insects in Mali, especially with respect to kwashiorkor, Apr 2010. A program symposium, Entomophagy, Edible Insects Revisited, organized by F. Dunkel, was funded by ESA, for presentation 15 Dec 2010.

Future Initiatives:

We will develop our workshop process electronically with webinars, skype, twitter, blogs, and face book in order to disseminate this approach to discovery-based learning in other parts of our partner universities and at other institutions of higher education. This will also provide a venue for our 129 former externs who, of all our students, went through the most extensive

transformation to share reflections and network about how they are expressing this new outlook in their career and life goals/values. We will share with other faculty in person/electronically concepts of the Expansive Collaboration (EC) Model we developed as a product of this grant. This Model fits well with the requirements of and provides a useful venue for service learning/community-based research.. The EC-Model includes: action research based on the holistic process; appreciation of cultural diversity; and other specific skills for working with communities as part of a collective teaching and learning unit. We will seek additional media to share these concepts and skills. CDKC will explore relationships between Cheyenne language revival and development of place-based, culture-based subsistence agriculture/gardening. This way of supplying one's food not only supplies nutrients, but becomes a healthy form of exercise, at the same time it fosters a strong connection to the Earth and its seasonality. With this renewed physical/spiritual health, traditional, subsistence agriculture can reinforce cultural identity/contribute to a healthy Northern Cheyenne community. Fundamental to this process is revival of the Cheyenne language. MSU students will continue their discussions on with Northern Cheyenne. UC-Davis team will continue characterizing viruses associated with samples collected and use information to develop integrated pest management (IPM) packages for table potato/ tomato in Mali. UC-Davis, VTech, MSU will explore linking to sustainable food systems on campus using the holistic process. will explore linking their extern program with their relatively new sustainable food systems majors. UCR, IPR/IFRA, Montana State University will continue sustainably without external funding to offer courses they developed. At MSU due to overflow of students wanting to register for course each semester, Dunkel will open additional sections assisted by team faculty (Montagne, Giusti, Lawson). Thanks to Mali mentors we will continue providing many hours for in-classroom students and in-Mali for extern students: UST will use our experiential approach grounded in concepts such as the holistic process, intercultural competency, valuing traditional ways of knowing to continue their service-learning in Ghana/France. 5 faculty (entomology, engineering, sociology, French) will contribute to a book accepted for publication on service-learning in francophone countries. We will collate all evaluation results from all partners of all assessment instruments that we have used: the Intercultural Development Inventory, a global awareness survey, student evaluations of instruction, reflective logs of students. These quantitative measures will be part of final project report.

Impacts:

MSU students/faculty collaborated in research with Sanambebe, a Malian subsistence farming village of 1,200. Together, they discovered neem-based, village-made IGR works for malaria mosquito control. The Women's Association, advised by MSU students/faculty, produces saleable handicrafts (funds mosquito abatement sustainably), is now an official Malian cooperative. MSU Mali Extern (student) program became self-sustaining. Venue (University Extended Studies Program) exists for entire extern experience. Our project uses the Intercultural Development Inventory (IDI) assessment tool. MSU funded training of a project faculty to pilot the IDI to assess all MSU student diversity training. MSU, UST, UC-Davis, IPR/IFRA students/faculty, via years of collaborative research and using the holistic process, helped Borko, Mali, produce first crop of seed potatoes. The village had sociology, plant pathology, management, engineering assistance. Farmer response was enthusiastic. US students: a major, life-changing experience. Longitudinal analysis of 1 of 4 Expansive Collaborations in current project revealed 16,745 US/Malians were impacted by work with shea of students, faculty,

scientists, NGOs. UST students/faculty developed on-campus partnerships focused on transdisciplinary thinking. This approach more effectively addresses community-based goals when linked with US/Malian agricultural faculty from other institutions. Dr. Jane Saly, UST Accounting Dept Chair, responded, 'This project has changed me and the way I teach, exposure to another culture made me more aware of potential issues,'
