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U.S. Department of Agriculture AD-421 Progress Report U.S. Dept. of Agriculture, State Agricultural Experiment Stations and Other Institutions		Date (Month, Day, Year) 02/16/2009	
1. Accession	Agency Identification No.	5. Work Unit/Project No.	6. Status
0210964	2. CSREES 3. MONE	MONE-2007-02535 [Grant # 2007-38411-18609]	Progress
7. Title			
New Paradigm for Discovery-Based Learning: Implementing Bottom-up Development by Listening to Farmers' Needs and Using Participatory Process			
12. Investigator Name(s) (Last Name and Initials)			
Dunkel, F. V.; Montagne, C. A.			
20. Termination Date 09/14/2010		40. Period Covered (mo/da/year): 09/15/2007 to 09/14/2008	
Students Funded: 14		Faculty Hours Funded: 24	
41. Progress Report:			
<p>Village-level communications were initiated by 6 US institutions and each Malian mentor, collectively the Mali Agribusiness Entrepreneurial Incubator Center (Center). All villages shared with us their holistic goals as a community and described resources, production, knowledge they would contribute in our joint projects serving as learning sites for US/Malian students. Sites selected were: for Chief Dull Knife College (CDKC) and Montana State University, a Bambara farming village (Sanambele); for Virginia Tech (VT), a Bambara farming/commercial shea production village (Zantiebouougou); for University of California (UC)-Davis, a Bambara village area near Baguinda; for University of St. Thomas (UST), a Dogon farming village (Borko). Both Montana State, UST faculty/extern teams collaborated with VT in Zantiebouougou. UC-Riverside (UC-R) initiated their first Mali extern program and is coming to an agreement with a village and the Center on a village focus. A new US institution partner, University of Montana (UMT)-Missoula joined our program to focus on a Bozo-Fulani fishing/herding village (Dangeuri-Malike). The Center, itself, was publically launched in Mali Sept 2007 thanks to parallel funding of USAID-Higher Education for Development (HED). US faculty collaborated with Mali mentors and 2 villages for event. Ghanaian author/American University economics professor, Dr. George Ayittey was advisor/keynote speaker for event in Mali. Assisted by Bozeman chapter of Engineers Without Borders, the Montana State Lively Arts/Lectures, and this grant, we brought Ayittey to Bozeman to teach a master class and extend these concepts to the Montana community via Mali Night held at Museum of the Rockies (Smithsonian partner institution) attended by 220 community leaders. From the event, we created a video Africa Unchained for teaching distribution featuring Ayittey. Concepts of cultural/traditional wealth and material poverty were new courses introduced across the US, in undergraduate honors, core courses at Land Grant, and non-agricultural private universities as well as in graduate programs (MBA) at UST's School of Business as a result of this grant. Students/faculty connected across 4 institutions (Montana State, UST, UC-R, VT). Malians mentoring in university courses and grad/undergrad extern research made orders of magnitude improvements in project impact. A Malian plant pathologist and agricultural/hydraulic engineering professor each made 6 week visits to work with externs in US and aid faculty introducing subsistence farmer issues into classrooms. Parallel funding from USAID/HED, Montana State, extended Malian mentors' US visits. Other parallel funding from UST, Montana</p>			

State University Undergraduate Scholars Program, UMT extended fundamental concepts of this grant to additional externs. We accomplished this with 24 faculty hours funded Year 1 by this grant for Ayittey to teach, counsel, give public addresses, in Montana and Mali. Faculty provided 4,990 hours (29.7 months) as cost share contributions Year 1 at CDKC, Montana State, VT, UC Davis, UC-R, UST, University of Mali (Institute of Agriculture), the national agricultural research organization, UMT.

43. Publications

Abraham, J., and George, C. 2007. Full-building radiation shielding for climate control in desert regions. *International Journal of Sustainable Energy*. (Authors are UST mentors in Mechanical Engineering.) 26:167-177.

Antonucci, A. A. Giusti, F.V. Dunkel. 2008. Art to fight Malaria: Community awareness program initiated in Malian farm village. *Montana State University Undergraduate Scholars Conference Proceedings*. Published abstract and poster presentation, Bozeman MT. 12 April 2008.

Bennett, R.J. 2007. *New Paradigm for Discovery-Based Learning: Launching of the Mali Agribusiness Network*. Visit Report Sept 25 to 29, 2007 Dean, School of Engineering Univer. of St. Thomas.
<http://www.montana.edu/mali/pdfs/2007|pct|20Trip|pct|20Report|pct|20Bennett|pct|20ed|pct|20Sidy.pdf>

Bennett, R.J. 2007. Capacity building in Mali:3-years, 23-students, 8-faculty working in solidarity. National Institute of Engineering (ENI). Bamako, Mali. Part of Mali Agri-Business Center Kickoff events, Sept 25-28, 2009. [Invited]

Boswell, E. 2008. Bug buffet returns Friday, Feb. 29 at Montana State University: Dunkel's students invite the community to appreciate other cultures'important protein sources. www.montana.edu/cpa/news/nview.php

Dunkel, F.V. and L. Eddington. 2007. *Anthology of the issues of insects and human societies*. 355 pp, in press (electronic).

Dunkel, F.V., R.E. Digs. 2008. www.montana.edu/mali website revised with New Paradigm Challenge Grant section.

Dunkel, F.V. 2007. *For Mali Night 2007: Summary of Externs and Secondary School Teachers Research*. 17 min.

Dunkel, F.V., M. Broughton, D. Sands, R. Biglefthand, K. Coulibaly, A. Kante. 2007. Environmental and genetic impacts on quality. NC-213 Management of Grain Quality and Security in World Markets. Technical Reports from Participating Stations. Pp. 11- 15.

Dunkel, F.V. 2007. *Discovery-Based Research Opportunities: Collaborative Research Support Programs (CRSPs)*. USDA Cooperative States Research, Education, and Extension Service Higher Education Challenge Grant Program. Final Report. 19 pp.

Dunkel, F.V. 2007. *Suggestions for future USAID graduate training programs for sub-Saharan Africans : The single-country model*. Final report for Higher Education for Development. 5pp.

Dunkel, F.V. 2007. *Linking biotechnology / Bioengineering with Mali-based Agribusiness: Strengthening Food and Water Quality for Health, Safety, and Exports*. Final Qualitative Partnership Report for Higher Education for Development. Partnership Period: 30 June 2004 through 30 September 2007. 23 pp.

Dunkel, F.V. 2007. *Linking biotechnology / Bioengineering with Mali-based Agribusiness: Strengthening Food and Water Quality for Health, Safety, and Exports*. Final Quantitative Partnership Report for Higher Education for Development. Partnership Period: 30 June 2004 through 30 September 2007. 15 pp.

Dunkel, F.V. 2007. After two years, Malians depart to Launch the Mali Agribusiness Network, an Entrepreneurial Incubator. *Plant Science Says*. 10(8):3.5 pp.

Dunkel, F.V. 2007. Second helpings, anyone?: Adding termites to your Thanksgiving leftovers. *Big Sky Weekly*, Big Sky Montana. 23 November 2007.

Dunkel, F.V. 2007. *Natural Product Toxicology: Participatory, holistic approaches*. University of California-Riverside, Department of Entomology, Riverside California [invited]. December 13, 2007.

- Dunkel, F.V. 2008. Free distribution of bednets to fight malaria. Annual Formal Public Debate: Contemporary Issues in Science. Montana State University. April 2008. 60 minute video.
- Dunkel, F.V., L. Eddington, and D.H. Bachelor. 2008. Anthology of the Issues of Insects and Human Societies. 159pp. (electronic)
- Dunkel, F.V. 2008. Action research links MSU with Mali. Ag Excellence 2008. MSU College of Ag and MAES. p. 16.
- Dunkel, F.V. 2008. Integrated, Village-Level, Malaria management. In Mali. Poster presented at national meeting of USDA SERD and NACTA meetings, Provo, UT.
- Dunkel, F.V. 2008. Discovery-Based Research Opportunities: Facilitating Farmer-to-Farmer Teaching and Learning. USDA Cooperative States Research, Education, and Extension Service Higher Education Challenge Grant Program. Final Report of Productivity, Dissemination, Future Initiatives, and Impact of MONE-2004-02778. 6pp.
- Dunkel, F.V., M. Giroux, Keriba Coulibaly, J. Campbell, L. Eddington, A. Kante, D. Sands. 2008. Environmental and genetic impacts on quality. 2007 NC-213 Management of Grain Quality and Security in World Markets. Technical Reports from Participating Stations. Pp. 1- 8. Addendum.
- Dunkel, F.V. 2008. Brock Road Elementary School: Across Continents. Spotsylvania Extra, The Free Lance-Star, Fredericksburg, Virginia, 10 June 2008 p. 4.
- Dunkel, F.V. 2008. Rural poverty and traditional ecological knowledge. Montana State University lecture series on the Sociology of Globalization. Bozeman MT. 26 March 2008. [Invited]
- Dunkel, F.V. 2008. Interdisciplinary, Multi-institutional, Vertically Integrated International Action Research. MSU Symposium on Innovative Concepts of International Education. 6 Sept 2008. MSU Bozeman. [Invited]
- Dunkel, F.V. 2008. Impact of Action Research in the New Paradigm for Discovery-Based Learning: Implementing Bottom-up development by listening to farmers' needs while engaging them in Participatory, Holistic Thinking. Presentation at national meeting of USDA / SERD Project Directors, Provo, UT. 10 June 08. [Invited]
- Dunkel, F.V. 2008. Montana Externship Program in Mali (West Africa). Poster presentation national meeting of USDA SERD and NACTA meetings, Provo, UT. 13 June 2008.
- Dunkel, F.V. 2008. Discovery-Based Undergraduate Learning: Village-based Integrated Malaria Management in West Africa. Poster presentation national meeting of USDA SERD and NACTA meetings, Provo, UT. 11 June 2008.
- Dunkel, F.V. 2008. First Decade of Montana's Mali Extern Program in Discover-Based Learning at Challenging International Sites. Annual Meeting Entomological Society of America. Poster presentation Pacific Northwest Mixer. 17 Nov 2008.
- Fraser, S. 2008 Bug bites. Current Science. 94:pp. 10-11. www.weeklyreader.com
- George, C. and A. Shams. 2007. The Challenge of Including Customer Satisfaction Into the Assessment Criteria of Overseas Service-Learning Projects. International Journal of Service Learning in Engineering. 2: 64-75.
- Jelenchick, J. and F.V. Dunkel. 2008. The village of Sanambebe, Mali. Part I Village Castes. video 40 min.
- Jelenchick, J. and F.V. Dunkel. 2008. The village of Sanambebe, Mali. Part II Women's Work. video 40 min.
- Kante, Assa. 2007. Rural woman's perceptions of the diffusion of technological innovations that increase quality shea butter production in Mali. Thesis M.S. Ag and Tech Ed., Montana State University. 111 pp.
- KTVM TV. 2008. Bug buffet: Dunkel and her students serve the community a taste of other culture's protein. KTVM TV News at Six. Bozeman MT. 29 February 2008. 3 minutes dvd.

- Lehman, A.D., F.V. Dunkel, R.A. Klein, S. Ouattara, D. Diallo, K.T. Gamby, and M. N=Diaye. 2007. Insect management products from Malian traditional medicine: Establishing systematic criteria for their identification. *Journal of Ethnopharmacology*. 110:235-249.
- Mends, E.J., F.V. Dunkel, M. White, M. Jerome, R.A. Klein. 2008. Exploration of traditional anti-malarial medicinal plants of Mali: Effectiveness in experimental (in vitro) trials. Montana State University Undergraduate Scholars Conference Proceedings. Published abstract and poster presented at the MSU Undergraduate Scholars' Conference, Bozeman MT. April 12, 2008.
- Mends, E., M. Matzick,, K. Meyer, and A. Antonucci, A. Giusti, F.V. Dunkel. 2008. Response to Request for Recommendations on Locally Eradicating Malaria from a Bambara Farming village in Mali. Symposium, Museum of the Rockies. 24 April 2008. dvd 1 hour.
- Meyers, K., M. Mazick, A. Giusti, F.V. Dunkel. 2008. Handicraft enterprise of Women's Association of Sanambele: Part of integrated malaria management in Malian village. Montana State University Undergraduate Scholars Conference Proceedings. Published abstract and poster presented at the MSU Undergraduate Scholars' Conference, Bozeman MT. April 12, 2008.
- Nejame, S. 2008. Man Bites Insect: The case for entomophagy (based on interview of F. Dunkel). *New York Times*. 10 February 2008.
- Person, D. 2008. Montana to Mali: New classroom approach links students with real life problems. *Bozeman Daily Chronicle*. pp. C1-2. 9 Nov 2008.
- Sedlak, C., A. Erlandson, D. Howard, B. Furey, F.V. Dunkel. 2008. Response to Request for Recommendations on Integrated Management of Malaria in a Bambara Farming village in Mali. Symposium Part I, 1 May 2008. 120 min dvd.
- Tamboura, B., A. Thera, K. B. Sidy, K. Coulibaly, A. Berthe, A. Camara, A. Kante, K. Gamby, F.V. Dunkel. 2007. Launching of the Mali Agribusiness Network: An Entrepreneurial Incubator. 3-day workshop presentation. 25-27 September 2007. Bamako, Mali. 4 hour video.
- Thera, Aissata. 2008. Bacterial wilt management: Prerequisite for a potato seed certification program in Mali. M.S. thesis in Plant Pathology, Montana State University. 128 pp.
- Woolbaugh, W. and F.V. Dunkel. 2008. Real Science: A USDA CSREES Secondary Education Challenge Grant Program 2005 to 2008. video 29 min.
- Zhou, Y.-C., Noussourou, M., Kon, T., Rojas, M. R., Jiang, H., Chen, L.-F., Gamby, K., Foster, R., and Gilbertson, R. L. 2008. Evidence for local evolution of tomato-infecting begomovirus species in West Africa: characterization of tomato leaf curl Mali virus and tomato yellow leaf crumple virus from Mali. *Arch. Virol*. 153:693-706.

Products

During Year 1 Montana State extern teams completed 4 research / creative undergrad projects: 1) Determine in vitro effectiveness of the main traditional plants used for malaria in Sanambele, a Bambara farming village (Eva Mends, Biomed undergrad; Dr. Michael White, professor Veterinary and Molecular Biology; Dr. Florence Dunkel, professor of Entomology [nat. prod. toxicology], Plant Sciences and Plant Pathology; Dr. Ada Giusti, professor French Language / Literature; Mali mentor Abdoulaye Camara, IPM scientist national agricultural research organization [IER]) ; 2) Launch through art, a malaria community awareness project with 7th, 8th, 9th graders in Sanambele's village school (Alonzo Antonucci, Art/French major undergrad; A. Giusti; F. Dunkel; A. Camara); 3) Develop marketing plan for Handicraft Enterprise to improve malaria management resources of Women's Association of Sanambele (Kelsey Meyer, Megan Mazick, French/Business undergrads; A. Giusti; F. Dunkel; A. Camara); and 4) Facilitate use of colorimetric kits and other means of determining quality in shea butter production by women's cooperative in Bambara village of Zantiebougou (Katy Hansen, undergrad in industrial engineering and economics; Chris Sedlak, Chemistry undergrad; Dunkel; Mali mentor Belco Tamboura, professor of Small Enterprise, national agriculture university [IPR/IFRA]). The first graduate student project was initiated by Montana State in collaboration with University of MT. This project was to determine perceptions of water quality in 4 Fulani/Bozo villages of inland Niger Delta prior to assisting community install slow sand filtration for water

purification (Ashley Williams, cultural geography grad student; Dr. Sarah Halvorson, professor geography, University of MT; Dunkel; Mali mentor Sidy Ba, professor hydraulic engineering IPR/IFRA). CDKC extern (Gloria Zerber, undergrad in general science) and Montana State extern (Jaime Jelenchick, grad student in Natural History Filmmaking) initiated film segments to illustrate traditional values in film Voyage of Discovery: Dancing Across the Gap. Funded under the previous Challenge Grant, UST externs, Joe Caruso and Robert Schultzenberg (mechanical engineering undergrads) and their professor Dr. Camille George, mechanical engineering made measurements / calculations in the Dogon village of Borko to prepare for seed potato production villagers plan to initiate with the Mali Agribusiness Center and UST students/faculty in Year 2 of the current grant. Details of all extern projects are available in Appendix to annual report and on website www.montana.edu/mali. Other products in this reporting period, publications, presentations, videos, are listed elsewhere in this report.

Outcomes

We held 50 weekly phone conferences with US faculty, Malian mentors, and Malian students in Year 1. We discussed / developed measurements of uptake / adoption rates to assist villagers in evaluating progress toward their own holistic goals. We used pc-based Skype technology for voice and video conferencing to connect with each other (faculty) and with students within the US and between US and Mali. Malian students involved Year 1 were all from the national agricultural university of Mali (IPR/IFRA). In Year 1 we initiated a program and extern at an entirely new, non-agriculture oriented university, the University of Montana (UMT). As a result of the cultural geography team at UMT (Halvorson and extern A. Williams), the environmental engineering project of a professor and his students at IPR/IFRA understand village concepts of water quality and village perceptions of disease transmission via water. Consequently the Malian engineering team has a possibility of successfully introducing a slow sand filtration model they designed. While the UCR Education Abroad Program focuses on placing students in classrooms around the world, there were no international research training programs for undergrads until this year the Mali extern program was put in place at UCR. Moreover, prior to the UCR Honors 012 proposal, no courses were previously offered on campus or approved to be offered linking grad / undergrad level global health, agriculture, and economic development. Likewise, no courses linking health, agriculture, and poverty in action research were offered at Montana State until our course (PSPP 465R) in this program was initiated this year. The first French capstone course in literature to focus on an African country's literature (MLF 450R) was offered at Montana State in Year 1. As a result of this project's faculty visits to Mali in Year 1, UST faculty developed action research courses linking M.B.A. students with shea butter production cooperative in the Malian village of Zantieboubou and development of a village-based seed potato production system for Mali beginning with the Dogon village of Borko. Other UST faculty linked French students with MBA students and sociology students to use their French language skills to work with the village potato project and the Mali Agribusiness strategic planning process. Montana State students saw their answers to village questions on malaria management result in a decrease of annual young child deaths from malaria

Dissemination Activities

We disseminated our fundamental approach underlying this grant in 4 main ways. with the simultaneous teaching of concepts in discussion/action research courses on 4 US campuses (MSU, UC-R, UST, VT). In September 2007, the Mali mentor network, an Agribusiness Incubator Center was launched publically with the national agricultural research organization of Mali (IER) the University of Mali (both the institutes of engineering [ENI] and agriculture [IPR/IFRA]) and in two of villages (Sanambele and Zantiebougou) with which our externs and in-US students interact. National radio and TV covered this event. In April, hundreds of Montanas joined with faculty and students for a celebration reception to hear the externs present their Mali village work and to hear African economist Dr. Ayittey share his views of the strength of the African village. In July, faculty met via phone / video conference to launch writing of a book detailing the Quiet Revolution that is emerging in our university action research courses and related projects in secondary schools. By September 2008, simultaneous teaching of poverty concepts in discussion/action research courses was occurring on 4 US campuses (MSU, UC-R, UST, VT). During the year, Montana State and CDKC faculty held 3 face-to-face meetings, one with students. They also held several video conferences with CDKC faculty and students, primarily to plan for and then later to evaluate the first set of filming for the PBS film Voyage of Discovery: Dancing across the Gap. A CDKC faculty member and Northern Cheyenne elder has begun the planning process for a course on traditional ecological knowledge and concepts of sharing. This course is targeted for tribal colleges (also for use in the other US partners action research courses.

Future Initiatives

Activities planned for year 2 and 3 are currently on schedule and underway. Beyond the funding period, we are working toward a Memorandum of Understanding between Montana State and IPR/IFRA that would make possible the exchange of undergraduate and graduate students. UST is working with the Center to enable them to register as an entity with the Malian government and we have proposed to USAID a planning process that would result in a strategic plan linking the national agricultural research organization with IPR/IFRA and with our 6 US partner universities. At the village level, we are hoping the school of Sanambele will remain connected to the US rural schools and the village of Sanambele as well as the other villages of Borko, Zantiebougou will be able to grow sustainably their new enterprises in a way that supports their own holistic goals as a community. We sincerely hope that the integrated, local malaria management which this project initiated

with the farmers of Sanambele will be sustained. Student leaders of Engineers for a Sustainable World are considering village sites in Mali (the farming village of Borko and the fishing/herding village of Dangeuri Malike) for possible world project sites.

Impacts

After only one year, 3 partner institutions now offer action research courses crossing colleges linking health, agriculture and poverty issues, both concepts and solutions. At Montana State a University Research Core course proposal (Health, Poverty, Agriculture) was accepted for offering every semester in Plant Sciences/Plant Pathology. Seventy-three percent were premed students with bachelor degrees, others were business, French, art, horticulture majors. All worked together with Mali farm community whose holistic goal was to locally eradicate malaria. UST School of Business offered 2 semesters of action research/project mgt course (70 MBA students). Students gained skills interacting with West African business/agricultural sphere via Malian mentors addressing holistic goals of a remote Malian village, one course focus was shea butter, other course focus, seed potatoes. UCR, with little on-going cross-college collaborative teaching/research, brought together faculty/students from 3 colleges and Education Abroad program. UCR offered 1 semester of Global Health/Agriculture. UCR developed international training opportunities (their own Mali extern program) for students in biology, neuroscience, entomology, psychology, global studies, economics, linguistics. The Mali extern program, conceived 10 yrs ago at Montana State University, added a grad student component and assisted in creating an amazing mentor team, the Mali Agribusiness Entrepreneurial Incubator Center, 6 Malian agricultural scientists, professors, and engineer, making possible for first time, solo externships

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