cluded students involved in the New Product Development course, was able to use the machine to produce and market mini doughnuts on campus. The food company involved continued development on this project and did a test market during the summer of 1986.

Conclusion

Comments from representatives from the companies as well as faculty involved in the mock company were extremely positive and documented with letters to that affect. Several benefits of this teaching approach can be identified. Students work with and are exposed to industry people. Their creative abilities are challenged. The students develop interpersonal skills needed in team situations. UMW faculty is made more aware of the nature of the food industry and technology program as well as its students.

Evidence of the success of this method of teaching has been demonstrated on the University of Minnesota Technical College, Waseca campus in the demeanor of students at formal activities and in their appearance at professional meetings. Two of the students who have taken the class are employed by The Pillsbury Company in its Research and Development Center in Minneapolis. Comments from their supervisors have been very positive, indicating that these students were well prepared for their role in industry.

Results of a Skills Inventory for Production Agriculture in Developing Countries

David A. Munn

Abstract

This paper presents findings of a survey of international agencies and organizations assessing the importance of certain basic and applied skills in four broad categories of production agriculture. Since thousands of U.S. and non U.S. citizens are trained to become future participants in international agriculture, this survey attempts to assess the relative importance of skills in plant production (agronomy/horticulture), animal production, agricultural mechanics and engineering, and general educational skills. Survey results support the idea that U.S. scale and technology is not completely appropriate for the training of international agriculturalists. Smaller machinery, smaller animal enterprise units, crop planning, pest identification and control were among the most important skills. Solving practical math problems and effective oral and written communication skills were ranked very important by the respondents. Given an opportunity to list up to three languages important to their agency's work, the respondents' most cited languages were French, Spanish and English.

Introduction

The United States in this century has become a leading nation at training participants in international agriculture. This role has evolved from initially sending U.S. trained agriculturalists to developing countries and trying (sometimes unsuccessfully) to transfer or adopt U.S. technology or the U.S. agricultural systems to the local circumstances. This was followed by training scientists from developing countries in U.S. institutions and doing research in host countries or a network of international research institutes to develop appropriate technology and solve local problems. In this country, the training and employment of international agriculturalists has been a unique mix of U.S. government agencies like USAID, Peace Corps, educational institutions (especially the Land Grant and 1890 universities), and religious and other charities and foundations. Most recently, private consulting firms have offered the expertise of specialists in agriculture to foreign nations, universities and firms.

The Ohio State University/Agricultural Technical Institute, has begun to assume a participatory role in the training of both U.S. citizens and non U.S. citizens for international agricultural assignments. As a two-year technical college, our courses and curricula are a mixture of theory and application with "hands on" oriented laboratory activities in most technical courses. Many advisors to farmers in developing countries are trained at the sub-baccalaureate level (Brams, 1978). The presence of farm enterprises or "enterprise laboratories" at our campus (Garrison, 1986) makes real participation by students in the production of crops and livestock feasible. While the "extension" type farm advisor may be called upon to do many functions including civic skills and community development (Kouzekanani and Barrick, 1984), this paper represents an assessment of production agriculture skills as evaluated by U.S. based government programs, church charities, private foundations, and international research organizations involved in food assistance and production in developing countries. In order to assess those skills, a survey was done to discover an answer to the question: Are separate international or tropical agriculture courses and programs needed by individuals seeking training at the technical college level so that they may be participants in international agriculture? According to Sedlock (1984), most host countries prefer Peace Corp volunteers with specific training in skills in certain

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aspects of agriculture important to the host country. Certainly, training programs for international agriculture participants must keep in mind the problems and perspectives of small scale farmers (Rhoades, 1984). Having prepared this survey to improve existing courses or create new ones for prospective international agriculture participants, it seemed reasonable to share the results with colleagues.

Methods

A survey instrument was developed with questions in four broad categories: Agronomy and Horticulture (17 questions); Animal Production (11 questions); Agricultural Mechanics and Engineering (8 questions) and General Skills (5 questions). The survey was mailed to 67 agencies, groups, foundations, and research institutes. It included as obvious choices, USAID and Peace Corps, many U.S. church relief or mission outreach agencies, the major international research centers like IRRI, CIMMYT, etc. and a number of private foundations and agencies doing overseas food assistance and agricultural mission work.

Respondents to the survey were asked to answer each question which focused on a skill or practice or cluster of related skills and practices by circling numbered responses from 1 to 4 where 1 = Very Important; 2 = Important; 3 = Moderately Important; and 4 = Not Important. Respondents had the freedom to not answer individual questions or whole sections of the survey if they did not work in or feel comfortable assessing a major area covered by the survey instrument. There were 20 returned surveys from a mailing list of 67 agencies, and only a few questions were answered by all 20 respondents. Although the respondents numbered less than a third, the data received was still useful. The number of people who responded to a particular question can be quickly ascertained by adding the number of responses under each of the four possible response codes (1, 2, 3, 4). The individual questions are reproduced in Tables 1-4 which present the findings in four broad categories. A weighted "index number" was calculated for each response as follows index number = [(1) (No. of responses code 1) + (2) (No. of responses code 2) + (3) (No. of responses code 3) + (4) (No. of responses code 4(] divided by the total number of responses to the question.

The index number is simply a weighted average response taking into account the relative importance of that skill or cluster of skills and practices. Keep in mind that respondents who did not feel comfortable evaluating an area where they did not work could and often did simply skip that question preferring not to make a judgment if it was outside the area of personal or agency experience. Finally, respondents were asked to list three languages important to their agency's work in developing countries.

Results and Discussion

The index number provides a weighted importance for each question skills and practices cluster. A low number indicating a high order of importance and a high number indicating a low degree of importance. It must be remembered that this is a very limited survey of agricultural practitioners and the respondents were not just agronomists, animal scientists, engineers, or any single homeogeneous group. Having stated the precautions, I will highlight the outcome of the four major categories in the survey instrument.

In the area of Agronomy and Horticulture (Table 1), crop pest identification and making crop rotations appropriate for the in-country situation were among the most important skills. In this area those skills given the lowest importance ratings were apiculture skills complimentary to crop production and, surprisingly, pesticide sprayer calibration which received 2.5 on the 1 to 4 scale used. Most areas covered by questions or agronomic and horticultural practices fell in the range of 1.6 to 2.0.

In the area of Animal Production (Table 2), routine management skills such as castration, dehorning, giving innoculations, and feeding were regarded as most important. Knowledge of artificial insemination practices was only moderately important. Animal species and their management were also cited for their importance to the respondents. Most important were cattle, poultry and goats followed by sheep and swine with horses rated much less important. In the area of milk production, there was a clear preference for small labor intensive units as contrasted

Table 1. Skills in Agronomy and Horticulture*

	Response Code**				Index
	1	2	3	4	No.
Crop variety selection based on variety trial	18	3	0	0	1.9
Sampling soils for testing	6	7	6	0	2.0
Performing routine soil test pH, lime need, P, K, S, micronutrients	5	8	6	0	2.1
Soil test interpretation and fertilizer-lime recommendation	2	10	6	1	2.3
Insect pest identification	6	10	3	0	1.8
Crop disease identification	6	12	2	0	1.8
Weed pest identification	3	9	6	0	2.2
Pesticide sprayer calibration	4	3	9	2	2.5
Mixing and application of pesticides	6	5	7	1	2.2
Make pesticide recommendations on the basis of pests identified	4	8	4	1	2.1
Design drainage and irrigations systems	9	6	2	2	1.8
Install drainage and irrigation systems	7	6	4	2	2.1
Diagnose soil salinity - sodicity by field evaluations and laboratory tests	4	7	4	3	2.3
Recommend crop rotations or sequences appropriate for climate, capital and national needs	4	5	0	0	1.6
Propagation - printing - fertilization of tree fruits	6	7	5	0	1.9
Managing beehives for honey production	5	5	6	2	2.3
Maintaining bee colonies to maximize crop pollination	4	4	7	3	2.5

* Numbers in the table are frequency of response followed by the weighted index number.

** 1 = Very Important; 2 = Important; 3 = Moderately Important; 4 = Not Important

Table 2. Skills in Animal Production*

	Response Code**				Index
	1	2	3	4	No.
Routine management skills: castration, dehorning, give innoculations, feeding	8	5	4	1	1.9
Prepare balanced rations from handbook values and/or laboratory data on feedstuffs	4	8	5	1	2.2
Collect semen and impregnate female animals correctly to artifically inseminate poultry, cattle, sheep and swine	2	3	6	8	3.1
Knowledge of management practices by animal species. Response by subcategories.					
Cattle	11	7	1	1	1.6
Sheep	4	8	5	2	2.3
Goats	8	8	2	1	1.8
Swine	8	6	4	2	2.0
Horses	1	0	9	9	3.4
Poultry	11	6	1	2	1.7
Milk production practices:					
Large commercial herds 50-100 or more	0	3	7	8	2.8
Small units-labor intensive	11	6	1	2	1.7

* Numbers in the table are frequency of response followed by the weighted index number.

** 1 = Very Important; 2 = Important; 3 = Moderately Important; 4 = Not Important

Table 3. Skills in Agricultural Mechanics and Engineering*

	Response Code**				Index
	1	2	3	4	No.
Large machinery operation - large tractors, combines, balers, etc.	0	2	5	12	3.5
Small machinery operations - small tractors, small seeders, drills	6	3	7	2	2.3
Small unit equipment such as rototillers, stationary threshers, chainsaws	5	8	7	0	2.1
Small engine repair and maintenance	9	8	3	0	1.7
Large machinery repair and maintenance	1	2	8	7	3.2
Install grain and other materials handling equipment	2	4	7	6	2.9
Maintain grain and other materials handling equipment	2	4	6	6	2.9
Elementary surveying	3	7	6	2	2.4

* Numbers in the table are frequency of response followed by the weighted index number.

** 1 = Very Important; 2 = Important; 3 = Moderately Important; 4 = Not Important

Table 4. General Skills*

	Response Code**				Index
	1	2	3	4	No.
Solve practical math problems	10	4	2	0	1.5
Prepare written and oral reports	11	4	3	0	1.6
Use microcomputer software	4	4	7	4	2.6
Program in one or more computer languages	1	4	5	9	3.2
Speak and write effectively in a language other than English	11	3	3	1	1.7

* Numbers in the table are frequency of response followed by the weighted index number.

** 1 = Very Important; 2 = Important; 3 = Moderately Important; 4 = Not Important

with equipment and practices associated with large dairy herds of 50-100 or more animals.

In the area of Agricultural Mechanics and Engineering (Table 3), small engine repair and maintenance was rated most important of the skills listed. Correlating with this preference large machinery operation and repair were least important. While small machinery operations and maintenance were rated important, other skills were marked as only moderately important. The respondents' emphasis seemed to indicate the expected need for people trained to use equipment appropriate for the circumstances of developing countries.

In the area of General Skills (Table 4), solving practical math problems and effective written and oral communication skills were ranked with the greatest importance. Also rated important was the ability to use another language in addition to English. Using appropriate computer software was rated more important than the ability to write computer programs in Basic, Fortran, etc. The survey concluded by asking respondents to list in a fill-in format the three languages most important to the mission of their agency or groups' work in international agriculture. The three most mentioned languages were French (17), Spanish (13) and English (6). Many other languages were listed, but none more than twice. Clearly, language skills are vital to international agriculturists.

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