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Postharvest Institute for Perishables

TRAINING COURSE ON PRESERVATION OF TROPICAL FRUITS AND VEGETABLES BY SOLAR DRYING WITH SUPPLEMENTAL HEAT

A Report to
The U.S. Agency for International Development
Manila, Philippines

and
Visayas State College of Agriculture
Baybay City, Leyte, Philippines

Presented by
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for the
Postharvest Institute for Perishables

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Training Course on

Preservation of Tropical Fruits and Vegetables by Solar Drying with Supplemental Heat

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Root Crop Research and Training Center
Republic of the Philippines

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TABLE OF CONTENTS

PAGE

I. Executive Summary.....1

II. Introduction.....3

III. Preparatory Work at the University of Idaho.....4

IV. In-Country Training.....5

Phase 1.....5
Phase 2.....5
Phase 3.....6
Phase 4.....7
Phase 5.....8

V. Summary and Conclusions.....9

APPENDIX A - List of Participants.....10

I. Executive Summary

The Philippine Root Crop Research and Training Center (PRCRTC) of Visayas State College of Agriculture (VISCA), Baybay, Leyte, Philippines requested assistance from the USAID Mission in Manila in developing a solar dryer suitable for use with tropical foods. By cable Manila 02589, the Mission requested that the Postharvest Institute for Perishables (PIP), University of Idaho, work jointly with VISCA in constructing and testing three dryer units for use in three rural communities. This would include training farmers in the construction, operation, and application of the dryers.

In response to this request, Mr. Kenneth D. Hoyt, appropriate techology specialist and Mrs. Marilyn A. Swanson, food and nutrition specialist, were designated resource personnel from the University of Idaho (UI) in collaboration with Dr. Louis Riesenberg and the Department of Agricultural Engineering at UI. A model solar dryer was constructed at the University with an added component of supplemental heat. The purpose of the latter was to utilize charcoal or other heat sources and permit use of the dryer during cloudy days of the rainy season.

The dryer was tested with a variety of food products and necessary modifications were made.

Hoyt and Swanson implemented a training course with appropriate training manuals on solar drying and food processing of tropical crops, and facilitated field work in collaboration with PRCRTC and VISCA from June 29, 1983 to August 27, 1983.

The in-country program was accomplished in five major phases. Fifteen Filipino participants from VISCA were selected to learn solar drying principles and applications. The first phase, one week, involved evaluating existing solar dryers, the availability of supplemental heat, and foods to dry.

In the second phase, three weeks, the Filipino participants received training on the fundamentals of drying foods, which included food selection, preparation, storage, and use of dried foods. Also taught were solar dryer construction and operation with various heat collectors, drying chambers, and supplemental heat sources. Finally, the training participants constructed two solar dryers and dried a variety of tropical crops.

During the third phase, one week, the participants tested and modified the dryers, and constructed a third one from indigenous materials. A handbook on solar dryer construction and food preservation was prepared in English and the local Filipino dialect, Cebuano. The participants then planned a solar dryer training course for three rural Filipino villages on Leyte.

The next phase of the training program, two weeks, involved utilizing the trained Filipino personnel as training facilitators. Workshops were conducted in three rural villages where solar dryers with supplemental heat sources were constructed and tropical foods were dried by the local populace.

During the last week, the instructors evaluated the training course, the village workshops and assisted in the development of plans for continuation and utilization of the solar dryers. Tangent opportunities and growth for the program were outlined.

In summary, the training course was considered to be highly successful because the participants readily learned and applied the new technology. Also, the technology was appropriate for village levels and it was well accepted by the villagers.

Continued collaboration with VISCA and PRCRTC should be encouraged. The task of extending technology and education relies heavily on the participants as well as the actions of the learners. Although the purposes, organization and skills needed for extension and research vary, it is likely that the greatest progress will be made if research and extension are approached as a continuum rather than as separate activities.

The lack of affordable appropriate technology has led to the deterioration and loss of perishable crops. Efforts directed towards such technology as cottage industries, charcoal making, utilization of indigenous materials to construct additional food dryers, and packaging and storage of dried foods will greatly enhance the availability of food stuffs and reduce the postharvest loss of perishable crops.

II. Introduction

The Visayas State College of Agriculture (VISCA) started as a provincial agricultural school in 1924 and evolved into a national agricultural school in 1935 when it was then popularly known as the Baybay National Agricultural School, or BNAS. In 1960 it became the Visayas Agricultural College, and finally, it was converted into the Visayas State College of Agriculture. VISCA has emerged as the premier agricultural college in the region under the innovative leadership of President F.A. Bernardo. It occupies a 1,053 hectare campus extending from the shore of the Camotes Sea in the west to the peak of Mr. Pangasugan in the east. VISCA's curricular offerings are many, ranging from graduate degree programs to undergraduate, including Agriculture, Agricultural Development Education, Home Economics, Agribusiness, Forestry, Animal Science, Experimental Statistics, Agricultural Engineering and two, two-year non-degree technician programs.

VISCA requested through USAID/Manila that the Postharvest Institute for Perishables provide the services of specialists in agricultural education/ agricultural mechanization, and food and nutrition from the University of Idaho to work jointly with VISCA in the construction of three food dryer units for rural communities. The major emphasis of this program was to train local participants who would then train farmers in the construction, operation, and applications of the food dryer. In response to this request, Mr. Kenneth D. Hoyt, appropriate technology specialist and Mrs. Marilyn A. Swanson, food and nutrition specialist, spent the period of June 29 to August 27, 1983, at VISCA. Their preparatory work at the University of Idaho was done in collaboration with Dr. Louis Riesenberg and the Department of Agricultural Engineering.

III. Preparatory Work at the University of Idaho

For thousands of years, people have dried foods to preserve them. However, in hot, humid climates, especially during monsoon seasons, the use of passive solar drying of foods is inadequate. From a review of the literature, it was determined that adequate food drying could be accomplished by solar food dryers if supplemental heat was used when solar energy was inadequate for proper drying. As a result, a prototype solar dryer with a supplemental heat source was developed and tested by the Department of Agricultural Engineering at the University of Idaho.

A solar dryer was constructed to design specifications, paying particular attention to heat and airflow requirements in relation to ambient temperatures and relative humdity. The prototype dryer included a fire chamber that provided supplemental heat from a variety of renewable energy sources, e.g. coconut husks, charcoal, wood or other types of fuel.

A variety of tropical and non-tropical foods were dried and tested during inclement weather to identify appropriate pretreatment methodologies and efficiency of the prototype solar dryer. Necessary modifications to the prototype dryer were made and selection of food and dryer parameters for drying trials were established.

Drying procedures specific to fruits and vegetables as well as other food commodities were initiated, and as a result of the drying trials, a training manual was designed as a convenient reference guide for the course participants and workshop facilitators. The manual included a class schedule, course outline, expanded course outline, reference materials on solar drying, supplemental heat sources, and food preservation techniques and practices, as well as a bibliography.

IV. In-Country Training

The training course was presented by the team to eight men and seven women representing disciplines in agricultural engineering, home science, food science, and rural extension. The course was taught in five distinct phases, each phase relying on a teaching methodology that involved consistent interaction with the participants, along with discussions rather than lectures. Visual aids, demonstrations and hands-on experiences were used extensively to provide the necessary training and expertise in solar dryer construction, operation, food preparation, actual drying procedures, storage of dried foods, rehydration and utilization of the foods.

PHASE I - Planning for the Training Course

Even though an efficient and effective prototype solar dryer with supplemental heat had previously been constructed at the University of Idaho, it was necessary to ensure the prototype dryer would operate as designed within the microclimate in which the course was being conducted in the Philippines. Further, the availability of building materials and tropical crops for drying needed to be verified. Last, in order to have a basis of commonality from which to work, existing solar dryers and sources of potential supplemental heat required evaluation. These requirements were met during the first phase of the training through a cooperative effort on the part of the participants. They determined the types of construction materials available and sources of procurement, identified crops suitable for drying and discussed previous research done with existing solar dryers at VISCA. Based upon conclusions drawn from the discussions, final plans were made on the class outline, foods were obtained, and the necessary construction materials procured.

PHASE II - VISCA Training Course

This phase of the course covered a period of three weeks. During that time there were discussions concerning solar dryer design, heat sources, solar collection, cabinet construction, air flow and relative humidity. Also, demonstrations and performances were utilized to teach the participants the necessary procedures for selecting, preparing,

drying, storing, rehydrating, and utilization of the dried foods. During the process of the phase of training, the participants were divided into two teams, with each team consisting of an agricultural engineer, home science specialist, food science specialist and a rural extension agent. Each team constructed a solar dryer modeled after the University of Idaho prototype using building materials that were obtained locally. Additionally, both groups prepared foods and tested drying procedures with their dryers using charcoal as a supplemental heat source.

During the construction and testing of the solar dryers, it was determined that three disparities existed:

1. The cost of the materials for the construction of the solar dryer was prohibitive to the rural farmer.
2. The construction and use of the supplemental heat burner was too time consuming and labor intensive to be readily adapted by the rural people.
3. The location of the supplemental heat source in the solar dryer was crucial and temperature regulation was difficult, at best.

Through collaboration with the participants and testing, these disparities were rectified. Local indigenous materials such as split bamboo, rice hulls and stones were substituted for high cost construction materials. A clay pot was adapted for burning charcoal that was produced locally from previously unused coconut husks and shells. The supplemental heat source was placed below the primary air inlet of the solar collector.

PHASE III - Dryer Testing/Modification and Community Planning

A third food dryer was constructed using the modifications developed for the first two. A variety of food items were dried in all three, then a manual, "Solar Dryer Construction and Food Processing of Tropical Crops," was written in both English and the local dialect, Cebuano. Upon completion of these tasks and their proven success, the fifteen participants were divided into three equal groups. Each group contained a rural extension specialist as a leader. Each of the three groups was charged with the task of developing a specific extension/outreach program that would be implemented during the fourth phase (community training) of the program.

The essential components of transferring the newly learned technology to the rural families were thoroughly discussed. Clearly defined goals were established while maintaining a clientele-centered approach. The teams took on the role of problem solving with a determination to provide enhancement and acceptance of the project within the assigned communities. By leading the participants, a system of teaching-extension methodology was adapted. Each of the teams presented group instruction, on-site demonstrations and illustrated the advantage of adopting the recommended practice of drying foods, in their respective villages or communities.

The participants talked with the family members as much as possible to learn their values, attitudes and perceived problems. They paid special attention to factors such as age, size of family, their capital position, the success of previous experiences and the extent of their motivation for change. An inventory of the situation including quantity, quality and condition of home and land, equipment, supplies, other production inputs and of satisfactory markets were noted. Upon completion of this planning, Phase IV of the training was implemented.

PHASE IV - Community Training Course/Extension Outreach

Three rural communities were chosen to receive training in solar dryer construction and food drying. Each of the three communities reponded positively to the assigned team participants and the program outlined for their village. Each of the three teams of five participants, under the guidance of the PIP team, provided the three assigned communities with instruction on solar dryer construction and operation as well as food preparation and drying procedures. The inhabitants of each community, under the guidance of their assigned team, constructed one solar dryer with a supplemental heat source. The community clientele tested between nine and thirteen native tropical foods, and initiated plans for utilizing dryers on a larger scale.

PHASE V - Evaluation

Upon completion of the first four phases of the training program, an in-depth evaluation was conducted by the PIP team and the VISCA participants. During the practical application of the course, the class participants provided imeptus and new ideas which were used to expedite the course. The use of coconut husk and shell charcoal, which increased the heating time of the solar dyrer, and the construction of an oven to use in conjunction with the solar dryer were very well accepted at the village level. The new foods introduced, including balimbing, balimbing prunes, camia prunes, candied papaya, coconut macaroons baked in the solar oven, and papaya candy as well as fried cassava and fruit leathers, were well accepted. The village participants of the course were still using the dryers one week after completion of the course, and the community clientele were making plans to increase the use and scope of the dryers.

V. Summary and Conclusion

It is believed that the training was well received by the participants and the villagers in the Philippines. The success of this program can be attributed to many factors, the most salient of which are: pre-preparation by personnel of the University of Idaho; team work, and the opportunity of individuals from different disciplines to cooperate jointly at VISCA; the team leaders' attempt to coordinate existing expertise and consider the social structures. Participants contributed immeasurably to the success of the program because they were offered the opportunity to solve problems and collaborate in the planning of the dryer and the implementation of the village extension/outreach program.

The village extension/outreach program was successful because of the efforts of all participants. The personnel from VISCA established clearly defined goals and provided effective village instruction along with continuous supervision. The village participants themselves worked together. They planned and constructed their own food dryer as well as made successful decisions on which foods to dry. Last, the workshop participants and village participants formulated and initiated efforts to develop cottage industries whereby the dried foods could be sold in the open market.

A survey was made of the existing dietary status of women in the villages and their acceptance of dried products. The survey revealed a strong acceptance for dried food, identified a willing potential for use of the solar dryer and suggested a need for enhancement of nutritional patterns in rural Filipinos.

A follow-up study should be conducted to evaluate the changes the solar dryer has made in preventing loss of perishable crops. Additionally, other courses in appropriate technology and extension/outreach should be conducted. Some appropriate technologies befitting the area surrounding VISCA are: development of a satisfactory means to produce charcoal; a short course in home canning procedures; short course in rural health and the development of an economic infrastructure.

Continued collaboration with VISCA and PRCRTC should be encouraged in the areas of research and extension.

APPENDIX A
List of Participants in the
"Solar Drying and Processing of Tropical Crops"
Training Course

	NAME	AGENCY	ADDRESS
1.	Eunice I. Beray	Department of Home Science	VISCA, Baybay, Leyte
2.	Marilou C. Canoy	Ministry of Agriculture Region VII, Cebu City	Crops, Livestock, Processing Utilization Unit, Arellano, Cebu City
3.	Lemuel M. Diamante	Department of Agricultural Chemistry & Food Science	VISCA, Baybay, Leyte
4.	Christopher V. Estrada	Romualdez Experiment Station Babatngon, Leyte	Bagong-Silang, Babatngon, Leyte
5.	Edna E. Forio	Philippine Root Crop Research & Training Center	VISCA, Baybay, Leyte
6.	Edilberto A. Hinay	Regional Coconut Research Center	VISCA, Baybay, Leyte
7.	Fe P. Jazon	Center for Social Research in Small Farmer Development	VISCA, Baybay, Leyte
8.	Anilfa L. Labayan	Center for Social Research in Small Farmer Development	VISCA, Baybay, Leyte
9.	Alan B. Loreto	Philippine Root Crop Research & Training Center	VISCA, Baybay, Leyte
10.	Ramon R. Orias	Philippine Root Crop Research & Training Center	VISCA, Baybay, Leyte
11.	Francisco A. Pajares, Jr.	Ministry of Agriculture Region VIII	EDS, Barugo, Leyte
12.	Ricardo B. Peteros	Center for Social Research in Small Farmer Development	VISCA, Baybay, Leyte
13.	Elizabeth O. Polotan	Awihaw Watershed Project	San Francisco, Camotes, Cebu
14.	Manuel T. Siona	Ministry of Agriculture Region VIII	St. Bernard, Southern Leyte
15.	Jocelyn T. Urgello	Department of Home Science	VISCA, Baybay, Leyte