PD-AAZ-405

EVALUATION OF

ON-FARM GRAIN STORAGE PROJECT

(615-0190)

FINAL REPORT

Submitted to
Ministry of Agriculture and USAID/Kenya

by
Review Task Force

Nairobi, March 1989

ACKNOWLEDGEMENTS

The Task Force for on-farm grain storage is grateful for the cooperation and support by the many officers in Kenya who helped make the mission a success. The list includes senior officials of the Ministry of Agriculture headquarters and National Agricultural Laboratories in Nairobi as well as MOA officers in the provinces and districts visited, the offices of Provincial Director and District Agricultural Officer together with Chiefs and local leaders in western Kenya, officials of USAID and SIDA, officers and consultants for the On Farm Grain Storage Project and the Rural Stuctures Unit, administrators and faculty of Egerton University, and Principals and staff of the Agricultural Institutes at Bukura, Embu and Kilifi. Without the support of these people and the excellent cooperation from the farmers and businessmen contacted, this report would not have been possible.

MEMBERS OF THE TASK FORCE

Dr. Richard Phillips,	Task Force Leader, Agricultural Economist in Grain Storage, Kansas State University
Mr. D. Karobia,	Under Secretary, Development, Ministry of Agriculture
Mr. Kimondo Mutambuki,	Entomologist (Crop Storage Section), National Agricultural Laboratories
Mr. M. W. O. Makunda,	Senior Agricultural Officer, Extension and Training,Ministry of Agriculture
Mr. J. A. M. Nkanya,	Agricultural Engineer, Project Manager, On Farm Grain Storage Project
Mr. Charles North,	Associate Member of Task Force, Program Officer, United States Agency for International Development Mission to Kenya

TERMS OF REFERENCE

The Terms of Reference for the Task Force are defined in the attachments to the letter of transmittal of 27 January, 1989, by the Director of Agriculture to the Team Leader of the On Farm Grain Storage Project, reproduced below. This report presents findings and recommendations of the first phase of the assignment, evaluation of the existing on-farm grain storage project in western Kenya. The findings and recommendations of the second phase, the proposed national crop post-harvest management program, are reported in a separate document.

-IV-

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27 January 1989

Walter G. Heid,
DPRA Team Leader
On-Farm Grain Storage Project
P. O. Box 4669,
KISUMU

Dear Dr. Heid,

ON-FARM GRAIN STORAGE PROJECT USAID PROJECT NO. 615-0190

May I apologise for not having been able to reply to your earlier letters concerning the proposal for a Task Force to work out a National Grain Storage Management programme.

While agreeing entirely with the deliberations and recommendations made by the workshop in Kisumu, I would like to stress my own conviction that before embarking on the process of working out a National Programme we must be satisfied that the existing project has yielded benefits or otherwise to the farmers. It is only when the facts have been established about the usefulness of the project that we can undertake to replicate results to the other parts of the Republic.

I am therefore, suggesting that prior to the working out a National Grain Storage Programme, a Project Review Team of five people from both GOK and DPRA should be established to review the current On-Farm Grain Storage Project. The Review Team will report its findings within 30 days. Depending on the findings of the Review Team, a Task Force to look at the National Grain Storage Programme would be established.

For purposes of making Savings on time, I suggest that the Review Team which will be composed of the names listed below should start its work on Monday 13th February, with a view to submitting a final report by Monday 13th March, 1989.

Yours sincerely,

E. K. KANDIE
DIRECTOR OF AGRICULTURE:

RECEIVED
DPRA
C
SI

CC; Mac Farland,
Project Officer,
USAID

Provincial Director of Agriculture
Western

Provincial Director of Agriculture
Nyanza Province.

A TASK FORCE TO REVIEW THE ONGOING ON-FARM GRAIN STORAGE PROJECT

FIRST PHASE - REVIEW OF EXISTING PROJECT

Compose a Task force to review existing project to start from 13-2-88 on the following terms.

i. What has been achieved

ii. Is the approach the best one

iii. What has been the impact of the project in the area

iv. Are the structures acceptable, and have they been utilised by the farmers.

v. What is the cost/benefit analysis for the project

vi. Identify the beneficiaries of the project

vii. Identify the beneficial omponents of the project that could be expanded to other areas, and the non-beneficial components that should be dropped from the future project.

viii. Propose new adjustments for a future project and adjustments of existing components for a future National Programme

ix. Prepare a final report to the Government on the ongoing on-farm Grain Storage Project.

x. Such an operation as stated above takes not more than 21 days as specified in the standard World Bank Missions. One week will then be allowed for report writing. They should thus give their final report in 4 weeks.

SECOND PHASE - PROPOSE AND PREPARE A NATIONAL GRAIN STORAGE MANAGEMENT PROGRAMME

i. Depending on the findings of the Review of the current project the taskforce should prepare a project covering the whole country for those components assessed as successful in the existing project as specified in the T.O.R. for the submitted National Proposal.

ii. Timing

The second phase should start after the report for the first phase is finalised and discussed, around mid-March, to take another 4 weeks to complete and submit the Project Document to the Director of Agriculture.

iii. COMPOSITION

The same members can carry out the two phases, and the proposed composition is as follows:

COMPOSITION OF THE TASK FORCE FOR EVALUATION

1. D.P.R.A. - Dr. Richard Phillips - Team Leader - Economics and Grain Storage.
2. Mr. Moses Makunda (Agricultural Extension and Training).
3. Mr. Nkanya (To cover Grain Storage Engineering)
4. Mr. Karobia (To cover Administration matters)
5. Mr. Kibata - Senior Entomologist - NAL (To cover Entomology)

13 FEB

Executive Summary of Findings and Recommendations

Project Summary

The On Farm Grain Storage Project (OFGSP) is United States Agency for International Development (USAID) grant funded with Government of Kenya (GOK) participation through counterpart funds. The project has been active in Nyanza and Western Provinces since July 1983 through the Ministry of Agriculture (MOA) extension program of training and visit (T & V) under support by the USAID, and implemented by Development Planning and Research Associates (DPRA) of Manhattan, Kansas, USA. It will continue under current agreement through April of 1990.

Findings

The analyses made to date demonstrate economic feasibility of the improved post-harvest management programme as sound farm management for small farmers in western Kenya. Internal rates of return for the total management package are in the range of 24 to 34 per cent on total capital investment. Based on preliminary adoption rates, the programme is viable as a major thrust of agricultural extension in Nyanza and Western Provinces. The projected benefit-cost ratio at 15 percent annual discount rate to year 2001 is 1.22, with corresponding net present value of Kshs 152 million. Important nutritional and public health benefits through improved quality of maize for family consumption have not been measured so far, but are known to be significant, and could raise the internal rate of return to as much as 40 per cent.

The following summarize the major findings of the Task Force.

1. The On Farm Grain Storage Project has been effective in achieving the goals and performing the functions for which it was intended. Effective technological packages for reducing post-harvest losses of maize have been developed, tested and demonstrated to farmers in western Kenya.

2. The Ministry of Agriculture's capacity to transfer the post-harvest management technology at the frontline level with small farmers in the project area has been demonstrated.

3. The capacity of Kenya's agricultural educational institutions to teach grain post-harvest management has been enhanced.

4. The Grain Monitoring Unit (GMU) has been established with facilities to evaluate the quality of grain samples for damage by insects, moulds and rodents; however, at present GMU is not fully utilized and not fully staffed.

5. To date some 1,764 improved grain structures have been erected in the project area to demonstrate the value of the technology and make farmers in the impact districts aware of the potentials for reducing post-harvest losses of maize.

6. While awareness of the programme among farmers is high, much effort is required to move from awareness to general adoption.

7. Key components of the delivery mechanism found to be effective in carrying the message of improved post-harvest technology to farm families include (a) mini-clusters of neighbouring farmers, (b) the demonstration structures, (c) the sequence of farmer field days on specific post-harvest management practices, and (d) the package of reference materials, films and other teaching aids.

8. Major constraints limiting project performance include (a) lack of mobility of extension staff, (b) delays in filling key posts, (c) insufficient coordination between the involved divisions of MOA at the national level, (d) emphasis on structures rather than grain post-harvest management, and (e) location of the Grain Monitoring Unit.

9. Lessons to be learned by experience under the OFGSP in Nyanza and Western Provinces include adaptations of (a) structure design and utilization, (b) post-harvest management, (c) extension delivery mechanisms, (d) methods of financing structures, and (e) staff training and development.

10. Some of the early steps in programme utilization now have been accomplished, and can be built upon for project extension.

11. It is apparent that OFGSP is not included in activities of Provincial Project Monitoring and Evaluation Units in the involved provinces.

12. The intended BSc and MSc in-country course programme for up-grading of Technical Officers (TOs) was not conducted. Delayed implementation and uncertain implementation terms of OFGSP were cited as main causes of this failure.

13. The Task Force noted the existence of two operational offices for OFGSP, one in Kisumu managed by DPRA and the other in Maseno under MOA.

14. It was observed that a large number of casual workers is employed by DPRA.

15. As of December 31, 1988, 78.6 per cent of total budgeted grant funds under OFGSP has been disbursed.

Recommendations

1. The basic thrust of improved maize post-harvest management is worthy of expansion in the project area and in other areas where maize is the major staple food for the population. Possibilities of including other farm produce should be explored.

2. Within the project area in western Kenya, the programme needs to be moved from the demonstration stage to a transitional stage of cost-sharing of the structure improvements with adoptor farmers.

3. The key delivery components of the project (including mini-clusters, the technical field day series, refresher training of Technical Assistants (TAs) and TOs, information and awareness activities with chiefs, assistant chiefs and local leaders, well-prepared leaflets, films and video tapes) have been proven to be effective and should be included in any expansion program.

4. Additional demonstration cribs and improved raised baskets may not be necessary in the transition to cost sharing unless new prototypes are introduced or the project is expanded to new areas.

5. Most of the components of the staff training activities under the project (including academic training, extended short course training on grain post-harvest management, technical short courses, workshops, and curriculum development at training institutes and universities) should be included in any project expansion programme.

6. Donor-supported technical assistance should be extended to ensure success of an expanded OFGSP programme; however, foreign experts should be used only where gaps for specialized capability are identified and are not available locally.

7. Facilities, equipment and logistical support should be continued to ensure the mobility required for effective farmer contacts.

8. More emphasis should be placed on the total post-harvest management system to make an expanded OFGSP most effective.

9. Emphasis should be placed on utilizing existing agencies such as NAL, AIC and various research institutes in Kenya, for developing improved and new training and extension materials.

10. Linkages to related programmes and operations should be given more attention in planning a national programme than was true for OFGSP.

11. The Grain Monitoring Unit serves important supporting functions to OFGSP, and should be continued and fully supported.

12. In order to facilitate smooth transition of project administration from DPRA to MOA, the Provincial Director of Agriculture for Nyanza Province should provide office accommodation for the MOA Project Manager and the DPRA Team Leader as soon as possible.

Minutes of the Meeting on the Task Force Presentation of Findings and Recommendations for the On Farm Grain Storage Project

Present:

Ministry of Agriculture

Mr. M. O. Were	–	Chief Crop Development Division (Chairman)
Mr. G. Muchiri	–	Chief Agricultural Engineering Division
Mr. K. Mogoi	–	Head, Crop Protection Branch
Mrs. Sarah Injairu	–	Senior Agricultural Officer, Crop Protection Branch
Mr. J. K. Ngeno	–	Provincial Director, Western Province
Mr. H. Mwangi	–	Provincial Post Harvest and Storage Officer, Western Province
Mr. A. O. Okongo	–	Provincial Crop Officer

USAID

Mr. Cecil McFarland	–	Project Officer

DPRA

Dr. Donald Wissman	–	Chairman
Dr. Walter Heid	–	Team Leader OFGSP
Mr. Steve McCarthy	–	Provincial Extension Specialist, Western Province
Mr. Don Evans	–	Provincial Extension Specialist, Nyanza Province

MEMBERS OF THE TASK FORCE

Dr. Richard Phillips – Task Force Leader

Mr. M.W.O. Makunda

Mr. Kimondo Mutambuki

Mr. J. A. M. Nkanya

Mr. D. Karobia

Mr. Charles North

1. Introduction

After welcoming the invited members to the meeting, the chairman, Mr. Were, informed the meeting that the Director of Agriculture would not be present to receive the Task Force Report on the On Farm Grain Storage Project because he was making arrangements to travel abroad. On his behalf, Mr. Were was mandated to receive the report and make the necessary decisions.

The chairman proceeded to give the background leading to the formation of the Review team, then invited the Task Force leader Prof. Richard Phillips to present the findings and recommendations.

2. Presentation of the Report

On presenting the report, Prof. Phillips echoed the appreciation of Task Force members for the co-operation received by the team from the Ministry of Agriculture provincial staff, USAID, DPRA, ICIPE, Egerton University, SIDA, RSU and all those who were interviewed by the Task Force. He then proceeded to introduce the report on the basis of the summarized findings and recommendations and emphasized that the report was preliminary and that suggestions for any omitted information were welcome.

3. Reactions to the Presentation

After the presentation of the report, the chairman invited comments and questions from the meeting. The discussions generated considerable interest from the members after which a number of suggestions and amendments to the findings and recommendations were made, among them the following:

- On the main project report page 88 under components of On Farm Grain Storage Project which could be dropped, it was agreed that the need for offices and houses continued to be a priority and the text should indicate this clearly.

- In the introductory paragraph of the findings, the word "appear" on line five should be deleted and substituted by a more definitive statement.

- On the item 5 of the "findings" it was suggested that the word "adequate" numbers of demonstration units should be replaced with figures.

- On the Recommendation 1, it was agreed that other crops should be included in an expanded OFGSP.

- The second part of Recommendation 6 should be rephrased to read, "foreign experts should be used only where gaps for specialized capability are identified and are not available locally".

In addition, it was agreed that;

- A specific recommendation should be made for the location of headquarters of the OFGSP in Nyanza and Western Province.

- Under the "findings", a statement on the rate of disbursement of funds should be included.

- The names of the Task Force Team as well as the Terms of Reference should be included in the introduction of the report.

4. Conclusions

The Chairman concluded the meeting by thanking the Task Force members for the speed and quality of the findings and recommendations. He fully accepted the recommendations by the Task Force that the OFGSP should be expanded to a national level and with the amendments suggested by the meeting, directed the Task Force to proceed to the next phase of making recommendations for a national programme. The USAID representative observed that the USAID will be interested in considering the funding for a national project but cannot make a commitment until a possible national programme has been formulated and discussed.

The chairman welcomed this supportive gesture from the USAID and emphasized the need to consider such funding under "Grant Assistance" because of the difficulties in accommodating the project in the MOA budgetary ceiling.

Signed .....
For: Director of Agriculture.

Signed .....
Task Force Leader.

TASK FORCE ITINERARY

First Phase

16 - 18 February, 1989
Convene Task Force; briefing on assignment by Director of Agriculture and staff; organization for assignment.

19 - 22 February
Visited PDA's office and met with District Ministry of Agriculture (MOA) officials and farmers of Nyanza Province; visited Grain Monitoring Unit (GMU) in Maseno.

23 - 25 February
Visited PDA's office and met with District MOA officials and farmers in Western Province.

27 - 28 February
Met with MOA officials and farmers in Busia District; conferred with the Deputy Provincial Director, Nyanza Province; met with the Local Advisory Committee, On Farm Grain Storage Project (OFGSP).

1 - 2 March
Met with the Deputy Vice Chancellor for Research and Extension and interested faculty members of Egerton University; met with Project Manager and Team Leader of Rural Structures Unit (RSU).

3 - 4 March
Attended briefing meetings with officials of MOA, United States Agency for International Development (USAID), and Swedish International Development Authority (SIDA); worked on drafting of Task Force report.

6 March
Participated in briefing for Task Force by technical consultants to OFGSP, including Judith Mbula, F. T. Kariungi, Adrian Sharp and John Fox.

7 - 14 March
Prepared and submitted draft Task Force report, first phase.

16 March
Participated in Task Force briefing meeting with officials of MOA head quarters and western Kenya, USAID officials and OFGSP staff (see minutes).

17 - 18 March

Prepared revisions and additions to phase one Task Force report as indicated by the briefing meeting (see Minutes).

Second Phase

20 -23 March

Participated in meetings of the Task Force with Division Chiefs and Branch Heads of concerned Divisions of MOA, including Extension and Services, Man Power Training and Development, Crop Production, Agricultural Engineering and Budget and Finance.

24 - 27 March

Easter break.

28 - 29 March

Visited PDA's office and met with District MOA officials and RSU officials in Central and Eastern Provinces; conferred with Deputy Principal and concerned staff members of the Embu Agricultural Institute.

30 - 31 March

Visited PDA's office and met with District MOA officials and RSU officials in Coast Province; conferred with Principal and concerned staff members of the Kilifi Agricultural Institute.

1 - 2 April

Prepared outline of Task Force report for phase two.

3 April

Visited PDA's office and met with District MOA officials and RSU officials in Rift Valley Province; toured facilities and met with officials of the MOA Rural Technology Development Unit (and Center) (RTDU) at Nakuru.

4 - 6 April

Met with the Head of the MOA Crop Protection Branch and Director of the National Agricultural Laboratories (NAL); met with USAID officials; met with Project Manager and Team Leader of RSU.

7 - 14 April

Prepared Task Force draft report on the second phase, national crop post-harvest management programme; Task Force subcommittees consulted with interested and knowledgeable officials regarding various issues concerning the proposed national programme.

17 - 18 April

Prepared Task Force notes for briefing meeting on April 19.

19 April

Participated in Task Force briefing meeting with MOA, USAID and other interested officials regarding draft report on the second phase.

20 - 24 April

Completed Task Force final report on second phase, the proposed national crop post-harvest management programme.

ACRONYMS

AIC	Agriculture Information Centre
AO	Agricultural Officer
DAEO	Divisional Agricultural Extension Officer
DANIDA	Danish International Development Agency
DAO	District Agricultural Officer
DPHO	District Post Harvest Officer
DPRA	Development Planning and Research Associates
ECA	European Centre of Africa
FAO	Food and Agricultural Organization of United Nations
FES	Frontline Extension Staff
FTC	Farmers' Training Centre
FTDU	Field Trial and Demonstration Unit
FTS	Fortnightly training sessions
GMU	Grain Monitoring Unit
GOK	Government of Kenya
IBM	International Business Machines
ICIPE	International Centre of Insect Physiology and Ecology
KGCCU	Kenya Grain Growers Cooperative Union
LEO	Locational Extension Officers
MC	Moisture content
MOA	Ministry of Agriculture
NAL	National Agricultural Laboratories
NCPB	National Cereals and Produce Board
NEC	National Electronics Company
NPV	Net Present Value
OFGSP	On Farm Grain Storage Project

PDA	Provincial Director of Agriculture
PHO	Post Harvest Officer
PHSO	Post Harvest and Storage Officer
PPHSO	Provincial Post Harvest and Storage Officer
RSP	Rural Structures Program
RSU	Rural Structures Unit
SAO	Senior Agricultural Officer
SIDA	Swedish International Development Authority
SMS	Subject matter specialist
TA	Technical Assistant
TDRI	Tropical Development Research Institute (now Overseas Natural Resources Development Institute)
TO	Technical Officer
TV	Television
T & V	Training and Visits
USAID	United States Agency for International Development
VCR	Video cassette recorder

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I. NATURE AND PURPOSE OF PROJECT

A. Design and Scope of Project

The On-Farm Grain Storage Project (OFGSP) is United States Agency for International Development (USAID) grant funded with Government of Kenya (GOK) participation through counterpart funds based on the needs assessment and project paper dating back to 1980. The project has been active in Nyanza and Western Provinces since July 1983 through the Ministry of Agriculture (MOA) extension programme of training and visit (T & V) under support by the USAID, and implemented by Development Planning and Research Associates (DPRA) of Manhattan, Kansas, USA. It will continue under current agreement through April of 1990.

The stated project objective is to support the national policy of food self-sufficiency by reducing crop losses through improved harvesting, drying, storage and handling practices by small farmers. In support of this objective, the USAID funding provides "technical assistance, training, commodities and construction in order to increase the use of more effective on-farm grain drying and storage practices in Kenya by increasing the capacity of the MOA to conduct adaptive research, and field testing; by increasing MOA extension capacities; by increasing the capacity of agricultural education institutions to provide grain drying and storage training; and by creating a nationwide capacity to monitor and evaluate grain losses" (Section 2.1, Project Agreement).

B. Summary of Project Features

1. *MOA/DPRA Contract and Programme*

The major document implementing the Project Agreement is the MOA/DPRA Contract, the first of which was signed in July 1983 for a two-year period. It was renewed in June 1986 for an additional year through April 1987.

Then following the midterm evaluation and reassessment, the Project Agreement was revised and a new contract executed to extend the programme in its present form for three years through April 1990.

The major tasks designated for the contractor in the project documents are (1) developing field trials and demonstrations, (2) developing capacity of the Ministry of Agriculture to transfer technology associated with on-farm grain storage, (3) improving the capability of agricultural education institutions, (4) developing capability to evaluate losses, and (5) determining the level of financial assistance required by small farmers for implementing improved grain drying and storage technologies. The first two years of the project were devoted largely to developing field trials, training and working out of extension methodolgy. In the third year emphasis was on efforts to extend the project to farmers in the grain producing districts of Nyanza and Western Provinces. This latter emphasis has continued in the more recent years, with project extension efforts being routed through the district programme structure under the present decentralized guidelines for government programme implementation.

2. *Organization and Operation in the Ministry of Agriculture*

The OFGSP represents an integral part on the on-going agricultural extension programme of the MOA in Nyanza and Western Provinces. The project is administered at the headquarters by the Crop Production Division of MOA with liaison with other divisions and the National Agricultural Laboratories (NAL).

C. History of Operations to Date

Field activity under the OFGSP began in February 1984 with the arrival of the first DPRA team leader together with the stored grain biologist and two extension specialists. The early months were spent on securing project commodities and supplies, and in developing working relationships with MOA and other officers in the two provinces, with key government and USAID leaders in Nairobi, and with others knowledgeable about on-farm grain drying and stor-

age. Decision was made to concentrate on maize only, and the anthropological survey of the project area was designed accordingly. A programme was developed for testing and demonstrating improved grain storage for the coming harvest through two local cluster groups. In June 1984 the Grain Monitoring Unit was started and improved storage structures were built at the Field Testing and Demonstration Unit (FTDU) at Maseno. Following the relatively slow startup, the programme gained momentum in the later half of 1984, and by year end 54 demonstration structures were constructed and under test. These were located at FTDU in Maseno, on farms in the test cluster groups, one near Rongo in Nyanza Province and the other near Kakamega in Western Province, and at the Farmers' Training Centre (FTC) in Kisii. The MOA assigned nine post-harvest officers, six counterparts and five laboratory technicians to the project.

Early in the second project year analysis started for the first maize drying and storage trials, and additional trials were initiated. Early findings from the socio-anthropological survey were released, and the first group of 19 Post Harvest and Storage Officers (PHSOs) returned from training in Slough, England. Later in the year two MOA officers returned from short course training at Kansas State University, and the six nominees for M.S. Degree training were accepted by U. S. universities. The needed references, training equipment and materials were assembled and supplied to Egerton University, to the Institutes at Bukura and Embu, and to the FTCs in the project area. Exhibits were presented at ASK shows in Kisumu and Kakamega, and materials and plans were assembled for a major effort in field training and extension activities. The project had reached the threshhold of the next phase of application in Nyanza and Western Provinces.

The third year of project operation, calendar year 1986, represented a period of major effort toward implementation of extension programmes and training activities for improved post-harvest drying and storage of maize. Training programmes were offered for 236 Ministry technical officers (TOs) and for 565 technical assistants (TAs), as well as for 127 artisans interested in constructing the on-farm storage structures. Project orientation was provided to 190 Chiefs and

Assistant Chiefs in the two Provinces. Some 323 on-farm structures were constructed for demonstration and training units in the project area. A total of 7,245 farmers participated in field days to learn about the recommended post-harvest management for maize.

During this third year key DPRA project staff changes were made as the tours of duty for the first team leader and stored grain biologist came to an end. As the year ended, the project had reached another threshhold in the demonstration of improved on-farm maize drying and storage practices.

The same kinds of training and demonstration activities were continued into project year five (1987) in the two provinces of western Kenya, but that year was marked by major institutional and operational adjustments to overcome constraints encountered in prior years. A midterm project evaluation was made and executive analysis completed. After some delays in planning and contract negotiation activities, the project was extended for three more years, and the amended MOA/DPRA implementing contract signed on July 7, 1987.

The present DPRA team leader and extension specialists were employed and arrived in Kenya by early November, and used the remaining time to gear up for the year ahead. The field manual for extension personnel based on the socio-anthropological evaluation, **Socio-Cultural Practices Related to Grain Storage in Western Kenya** was released in December 1987. In the same month the six M.S. Degree participants returned from training in USA. Limited travel and operating funds restricted mobility of the MOA extension staff during the year, and virtually brought the collection of grain samples for analysis at the Grain Monitoring Unit at Maseno to a standstill. The lack of mobility made the project staff keenly aware of the need to supply vehicles, motorcycles and bicycles to extension personnel charged with carrying the post-harvest message to farmers in the two provinces.

The sixth year of project operation, calendar year 1988, established the soundness of the extension and training programme for improved post-harvest management of maize by small farmers in western Kenya. Effort was concen-

trated on reducing the constraints of staff shortages and immobility, and to refinements in structure design and utilization to meet the needs of demonstration farmers in the different districts of Nyanza and Western Provinces. Intensive short courses on grain storage and post-harvest management were held for technical officers at Duduville and at Egerton University. Teaching aids, portable generators and other supporting materials as well as vehicles, motorcycles and bicycles to support the project were procured. Key staff vacancies on the MOA side were filled with well-trained persons, including the Project Manager (one of the recently returned M.S. Degree trainees). Qualified Kenyan short-term consultants were identified and engaged to address questions of (1) adoption rates, (2) farm management concerns related to adoption of improved structures, (3) preparation of technical and extension handbooks, films and video tapes, (4) assessment of media and other publicity potentials, and (5) projected macro economic impacts of the project on national welfare.

The training of TOs, TAs, artisans and local leaders continued at an accelerated rate during 1988, as did the construction of demonstration structures, the conduct of farmer field days, exhibits and presentations at agricultural shows in the project area. Adopter farmers--neighbours who have copied improved structures and practices from demonstration farmers--came into evidence in increasing numbers. It became increasingly clear that the time had come to test a cost-sharing mechanism to replace the demonstration structures in those districts where sufficient visibility and farmer awareness had been reached.

The On-Farm Grain Storage Project has now entered its seventh year of project operation (1989). Project efforts in the field are focused on implementation of cost-sharing arrangements for improved structures with farmers in the impact area who have expressed interest. Field days and other extension activities are being conducted by MOA personnel under established T & V programmes with reduced direct assistance from DPRA experts. Mobility constraints are being removed by accelerated distribution of motorcycles and bicycles to the TOs and TAs in the districts where the programme operates. Artisan training continues,

and is being extended to Village Polytechnics and technical schools where carpentry training is offered. Publicity programmes are being accelerated, not only through press and radio, but also with chemical companies, input suppliers and other change agents in the two provinces.

As the field programme accelerates, the project has come to another threshhold in planning for the future. The present Task Force has been mounted to assess project achievements and develop recommendations for possible movement from regional effort to a national programme. Draft reports have been prepared by consultants on (1) measurement of maize loss reduction, (2) measurement of adoption rates, (3) benefit-cost analysis of improved structures for adopting farmers, (4) economic impact analysis, and (5) extension manuals on improved post-harvest management of maize for small farmers. Universities, training institutes, secondary schools and other education agencies are becoming increasingly active in training efforts to enhance post-harvest management of maize and other grains. The sister project by the Rural Structures Unit with SIDA support in Rift Valley, Central and Eastern Provinces has reached a comparable level of achievement. The stage has been set for development of a national programme to utilize the lessons learned and reap the projected benefits of enhanced food security in the years ahead.

D. Contract Budget and Expenditures to Date

The total budget under the MOA/DPRA Contract as amended and the cumulative annual expenditures by line item through 1988 are shown in Table 1.1. The budget values are given in units of 1000 U.S. Dollars. The percentages expended relate to the corresponding line item budget. For example, the salaries expended by the end of December 1984 of $224,300 represented 20.8 per cent of the total Contract budget for salaries of $1,077,000.

Table 1.1 Contract Budget and Expenditures by Year (US$)

Major Cost Element	Contract Budget (000)	Cumulative Amount Spent by December 31: 1984 (000)	1984 (%)	1985 (000)	1985 (%)	1986 (000)	1986 (%)	1987 (000)	1987 (%)	1988 (000)	1988 (%)
1. Salaries	1,077	224.3	20.8	448.0	41.6	590.7	54.8	736.1	68.3	890.3	82.7
2. Short-term Consultants	119	22.5	18.9	22.7	19.1	26.6	22.4	36.4	30.6	89.2	75.0
3. Local Hire	394	20.3	5.2	71.7	18.2	130.8	33.2	190.8	48.4	261.2	66.3
4. Fringe Benefits	473	102.2	21.6	192.8	40.8	252.8	53.4	322.1	68.1	390.4	82.5
5. Travel and Transport	608	99.5	16.4	197.9	32.5	276.4	45.5	383.0	63.0	507.2	83.4
6. Allowances	335	59.8	17.9	130.2	38.9	183.0	54.6	229.8	68.6	299.2	89.3
7. Other Direct Costs	314	67.6	21.5	91.4	29.1	137.2	43.7	183.6	58.5	253.3	80.7
8A. Equipment	518	47.2	9.1	119.7	23.1	210.0	40.5	229.5	44.3	258.3	49.9
8B. Materials & Supplies	688	56.1	8.2	106.[illegible]	15.4	197.1	28.7	368.8	53.6	633.4	92.1
8C. Vehicles	530	75.4	14.2	108.4	20.5	155.8	29.4	155.8	29.4	474.1	89.5
8D. Freight & Handling	35	9.8	27.7	12.7	35.9	19.3	54.5	20.5	57.9	22.7	64.1
9. Participant Training	686	0.0	0.0	112.7	16.4	222.6	32.4	314.6	45.9	519.4	75.7
10. Contingency	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11. DSA Insurance	30	4.6	15.3	5.2	17.3	5.5	18.3	9.2	30.7	13.1	43.7
12. Administration	488	71.5	14.7	145.7	29.9	216.8	44.4	286.2	58.6	415.4	85.1
13. Fixed Fee	405	54.5	13.5	111.2	27.5	165.5	40.9	218.4	53.9	316.7	78.2
TOTAL CONTRACT	**6,800**	**915.3**	**13.5**	**1,876.3**	**27.6**	**2,790.1**	**41.0**	**3,684.8**	**54.2**	**5,343.6**	**78.6**

1. *Contract Budget*

The largest line item in the Contract budget is 8. Commodities, representing $1,768,700, or about 26 per cent of the total Contract. This item is divided into four components in Table 1.1, namely, equipment, materials and supplies, vehicles, and freight and handling. The budget for each of the first three components exceeds $500,000.

The only other line items in the Contract budget which exceed $500,000 are 1. Salaries at $1,077,000, 5 Travel and Transport at $608,000 and 9. Participant Training at $686,000.

2. *Annual Expenditures*

Total annual expenditures under the Contract are shown on the last line of Table 1.1. At the end of 1984 cumulative expenditures totaled $ 915,300, or 13.5 per cent of budget. Cumulative year-end expenditures reached 27.6 per cent of budget in 1985, 41 per cent of budget in 1986, 54.2 per cent of budget in 1987 and 78.6 per cent of budget in 1988.

The pattern of expenditures by year for most of the line items parallels that of the combined project budget. Some 82.7 per cent of total salary budget had been expended by the end of 1988. The rate of expenditure for this item and the related items of fringe benefits and allowances exceeds that for the combined budget in all years.

By the end of 1988 the expenditures for materials and supplies had reached 92.1 per cent and that for vehicles 89.5 per cent of total budget. Expenditures for these items were modest in the first two years, but pickedup in the later years, especially during 1988. The rate of expenditure for equipment and for freight and handling continued to lag behind the general pattern; expenditures for this two items reached only 49.9 and 64.1 per cent of the respective budget figures by the end of 1988.

The rate of expenditure for local hire was low during 1984 and 1985, but picked up thereafter; local hire expenditures stood at 66.3 per cent of budget at the

end of 1988. Expenditures for participant training also started off slowly, but increased rapidly in 1987 and 1988; these expenditures reached 75.7 per cent of budget as of December 31, 1988.

The cumulative rates and expenditures by year for selected line items in the MOA/DPRA Contract are shown graphically in Figure 1.1. The rates are plotted for seven major items, Salaries, Local Hire, Travel and Transport, Equipment, Materials and Supplies, Vehicles and Participant Training. The differences among the line items in patterns of expenditure rates are clear from this chart. In general the disbursement rate of the project funds is satisfactory.

E. Findings of Prior Evaluations

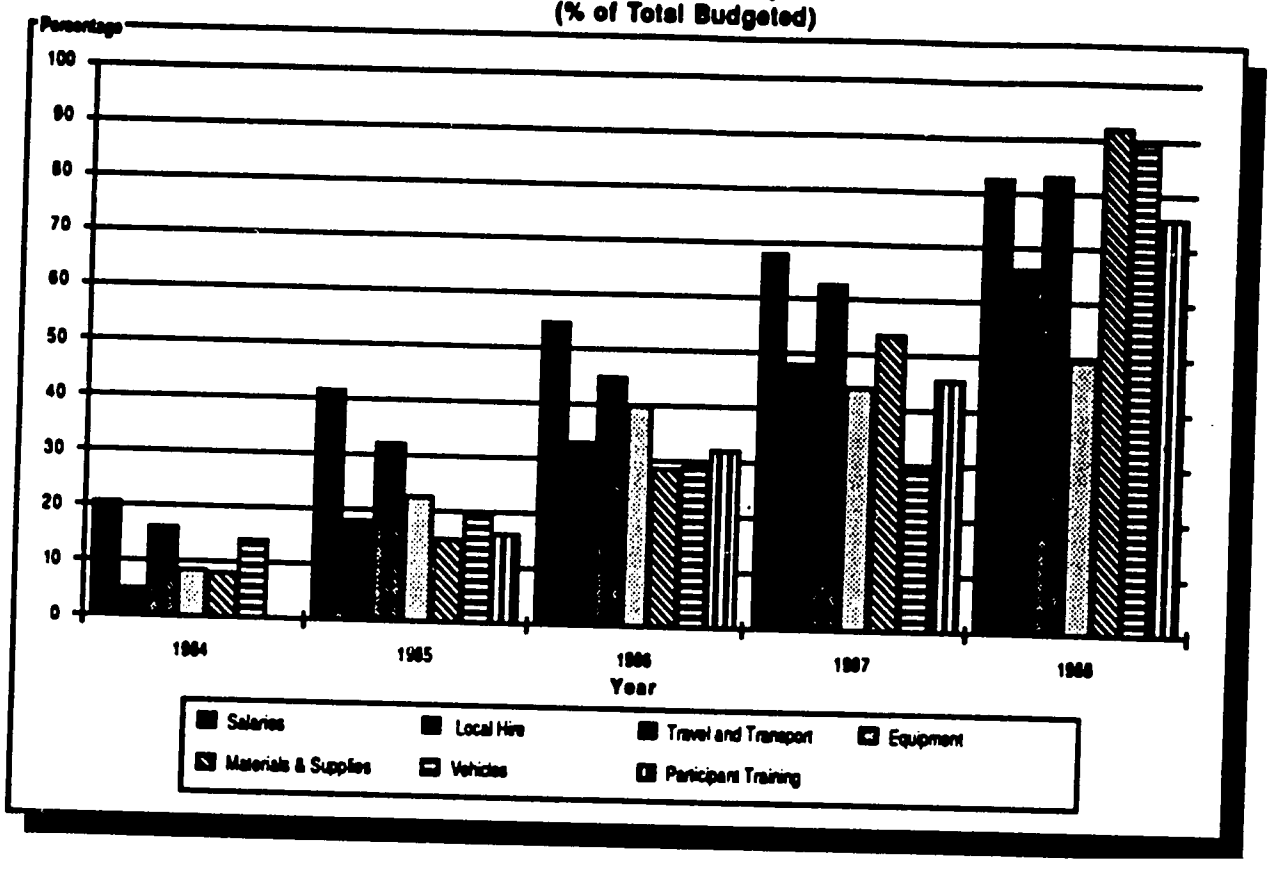
1. *Midterm Project Evaluation, March 1987*

An evaluation of the On-Farm Grain Storage Project was prepared for the Ministry of Agriculture and USAID in 1987 by an independent team led by Dr. David Thompson of Oklahoma State University. The opening paragraph of the Executive Summary of the team's evaluation report reads as follows:

"The On-Farm Grain Storage Project has created an awareness of post maturity losses in maize and demonstrated methods to reduce those loss levels. The increased awareness is evident among extension staff and farmers. An economic analysis of the proposed improved methods shows a very favourable economic return for farmers and, if the project is expanded, for the entire country. This analysis underestimated the return because it doesn't include credit for significant quality improvements. Assignment of an economic value to these is difficult" (Evaluation Report, Project 615-0190, March 1987).

Noting constraints encountered by the project, the evaluation recognizes that many decisions had to be made outside the project, resulting in frequent delays. The team recommended greater local control as partial solution.

Figure 1.1 Project Expenditures by Year (% of Total Budgeted)



At that time the team recommended that the project be extended for another year (1) to focus on transportation for the extension staff, more demonstration farms, providing kit grants, continuing staff training and strengthening the post-harvest extension programme, (2) to increase the drying/storage options with emphasis on local materials and alternatives to the RSU crib or raised baskets, (3) to start tests and information gathering necessary to expand the extension efforts to new areas or other crops, and (4) to complete the farm management component. The team suggested that the order for persons to accomplish these tasks be first, MOA extension specialists, second, in-country short-term consultants, and third, expatriate experts.

Regarding project performance the 1987 evaluation team concluded:

"The list of project accomplishments is impressive. It has created an awareness of post-harvest losses. The improved harvest and storage recommendations are recognized by farmers to improve grain quality and decrease labour requirements as well as reducing losses of grain weight. The training efforts have been well focused and successful. They generated motivation as well as imparting knowledge. The laboratory facility at Maseno can be a useful extension support facility." (Evaluation Report, Project 615-0190, March 1987).

Regarding a possible expanded project the report states:

"Grain (maize) losses appear to be high throughout the country. In most maize growing areas, improved post-harvest practices can be economically attractive. Opportunities may exist with other food crops but this is not clear from existing reports. Very high sorghum loss rates have been reported and questioned. Post-harvest bean losses are reportedly low, but the estimate did not include quality losses which can be very high due to hard-to-cook changes. Potato losses are probably high, but we are not aware of a comprehensive study." (Evaluation Report, Project 615-0190, March 1987).

2. *August 1988 Planning Workshop*

This planning workshop for the On-Farm Grain Storage Project was held in Kisumu August 2-4, 1988 to (1) review progress of OFGSP since its inception in 1984, (2) identify major issues affecting the project, and (3) make recommendations to the Ministry of Agriculture regarding its development, possible expansion and extension. Workshop participants included government officials as well as DPRA and MOA officers from Nyanza and Western Provinces; MOA, Ministry of Finance and USAID representatives from Nairobi; project consultants; university and training institute representatives; RSU representatives; and the president of DPRA from Manhattan, Kansas.

Conclusions of the workshop were directed to five specific areas, namely training, extension strategies, research, organization and management, and future activities. Regarding training the participants concluded that an expansion of training related to grain storage is needed at all levels including (1) universities, (2) colleges, (3) institutes, and (4) Farmers' Training Centres, and that "training of trainers" activities should be given priority by the OFGSP staff.

Regarding extension strategies the workshop concluded that the project activities are already well incorporated within the T & V system, but that there will be continuing need to ensure that all TAs receive orientation training on post-harvest management; likewise to ensure close links with the provincial administration, there should be a continuation of orientation courses for chiefs and assistant chiefs as well as awareness raising activities for administrative officers at all levels.

With respect to research the workshop concluded that studies should be continued on the most appropriate design of storage structures, paying particular attention to the feedback from farmers, and collaborating in design with RSU. The participants also urged expanded studies of grain quality by the Grain Monitoring Unit.

Regarding organization and management the workshop recommended formation of a steering committee for the two provinces consisting of the two

Provincial Directors of Agriculture (PDAs), the project manager, the team leader and suitable "co-opted" members. It should be noted that this recommendation was implemented immediately in the form of the Local Advisory Committee, as reported in Section II, below.

Finally, in regard to future activities the workshop recommended that an inter-Divisional committee be formed to consider ways of sustaining the project at the National level. It was further recommended that proposals for extending the project beyond 1990 should be drafted as early as possible to ensure timely and adequate administrative review.

II. PROJECT ORGANIZATION AND MANAGEMENT

A. Organization

As outlined in Section I, the On-Farm Grain Storage Project (OFGSP) is grant funded by the United States Agency for International Development (USAID) with Government of Kenya (GOK) participation through counterpart funding. The present project organizational structure was established in 1987 with signing of the amended Project Agreement and execution of the current contract between the Ministry of Agriculture (MOA) and DPRA for the execution of the project through April 1990. Components of the project organization include the Project Agreement between the governments of the United States of America (USA) and Kenya for USAID support, the organizational structure for project administration within the MOA, the operational structure for conduct of the project in Nyanza and Western Provinces, and the linkages to related projects and programmes in Kenya.

1. *Project Agreement*

The OFGSP was implemented in July 1983 under a larger existing Project Agreement between the USA Government and the Ministry of Finance on behalf of the GOK. The original Agreement provided for a total development loan of US$7.8 million to support the OFGSP through the MOA. The Agreement was amended in 1987 by converting the then unexpended portion of this amount to a grant and revising the budget to total of $6.8 million; and extending the project time frame to 1990.

2. *Administrative Organization in the Ministry of Agriculture*

As outlined in Section I the project is implemented by contract between the MOA and DPRA. Within the MOA the project is administered by the Crop Production Division directly by the Office of Chief of the Division, Mr. M. O. Were. On technical matters supporting project operations, the Project Manager and

Team Leader report to the head of the Crop Protection Branch of the Division, Mr. K. Mogoi. Coordination is maintained with other divisions of the Ministry, as well as with the National Agricultural Laboratories (NAL). The present MOA/DPRA Contract makes no provision for coordinating project extension activities with the MOA Office of Chief of Extension Service Division, and the Chief of Extension is not represented on the Joint Project Steering Committee.

The extension activities under the OFGSP in Nyanza and Western Provinces are carried out through the normal MOA extension organization for T & V in the districts and divisions where the project is active. However, at present the project is partially integrated into the T & V programs. The current delivery mechanism is discussed in Section IV, below.

The calendar achieved for posting of key positions under the On Farm Grain Storage Project by the MOA has been as follows:

August	1984	First MOA laboratory staff assigned to GMU
December	1984	Seven Post Harvest and Storage Officers posted
January	1985	Chief of MOA Crop Production Division designated as Officer in Charge for the project
October	1985	Project chemist posted to GMU (initially employed by DPRA until 1987, then absorbed by MOA)
January	1986	First Project Manager (and Officer in Charge GMU) posted to Maseno
April	1986	Storage Grain Biologist posted to GMU (but left later that year along with other staff)
March	1988	Present Project Manager posted to Maseno (who also serves as Officer in Charge of GMU)

3. *Current Structure in Nyanza and Western Provinces*

The Project Manager is administratively responsible to the Provincial Director of Agriculture (PDA) for Nyanza Province. Operationally the Project

Manager functions as counterpart to the DPRA Team Leader. The Project Manager is located in Maseno, while the Team Leader is located in Kisumu. The Provincial Post Harvest and Storage Officers in Nyanza and Western report to their respective PDAs. The DPRA extension specialists in the two provinces coordinate with their respective PPHSOs in a counterpart relationship, but report administratively to the team leader. The extension specialists are based at Kisumu and Kakamega, respectively.

The project organizational structure below the provincial level follows the standard district-division-location-sublocation governmental structure, and operates through the MOA structure of District Agricultural Officer (DAO), District Post Harvest Officer (DPHO), Technical Officers (TOs) and Technical Assistants (TAs). There are no direct DPRA counterparts below the provincial level.

Likewise there are no DPRA officials assigned to the Grain Monitoring Unit at Maseno. Nominally, the officer in charge of GMU reports to the Project Manager in Maseno, but the two positions currently are filled by the same person. The GMU is supported technically by the MOA with some collaboration with the National Agricultural Laboratory (NAL), but this linkage is relatively weak currently. Of the three key technical positions at GMU, only that of chemist is filled. The positions of stored grain insect biologist and of mycologist are vacant.

At present, extension personnel are not used to collect grain samples from the demonstration structures in the various districts of the project area. The laboratory technicians at GMU were recruited from the field staff and are expected to go to the field and collect the samples directly. This limits the number of samples that can be analyzed per day and per year. The GMU staff and MOA field officers alike feel that the linkage between extension and the Grain Monitoring Unit needs to be strengthened (see Section IX).

4. *Project Offices*

At the operational level, the Task Force observed the existence of two Project offices, one based in Kisumu in a Project house and managed by DPRA staff,

and the other at Maseno managed by the MOA staff associated with the Project. It was observed also that the DPRA Provincial Extension Officers have no offices at the PDA's office in the respective provinces.

The Task Force believes that the separation of the MOA and DPRA staffs has created difficulties in such areas as project administration, coordination, integration and transition. The Task Force recommends that the counterparts be housed together to ensure efficient project administration.

5. *Linkages to Related Projects and Programmes*

There are important operational linkages between OFGSP and related projects and programmes in Kenya, but most of these operate informally rather than through a formal organizational structure. The exception is the linkage between OFGSP and the Rural Structures (RSU), which has now been formalized in the form of the Joint Steering Committee for the two projects.

Close linkages to the RSU sponsored by SIDA have been maintained from the outset of OFGSP. Over the years much of the coordination achieved between the two projects has come from joint planning and frequent communication at the team leader level. Structure designs and plans by RSU were employed by OFGSP from the outset. Training materials and programmes for Agricultural Officers and Technical Officers have been developed and conducted jointly. Extension methods developed under OFGSP have been applied by RSU. From the beginning the team leader and project officer of RSU have participated in OFGSP conferences, and vice versa. This close operating linkage between the two projects continues, even though the project offices are separated by the distance between Nakuru and Maseno. The two together with the MOA Crop Protection Branch plan to participate in a workshop in Coastal Province on control of the greater grain borer.

The Joint Steering Committee was formed to formalize the linkages between OFGSP and RSU. However, the Committee has met only once, and has

not been very active in project matters. In the meantime the informal coordination and joint activity of the two projects continues.

Active linkages between OFGSP and International Centre of Insect Physiology and Ecology (ICIPE) have been developed, especially in Nyanza Province where OFGSP has supplied ICIPE with storage structures and training programmes as that project has moved into improved harvesting, drying and storage of maize.

Some operating linkages have been developed between OFGSP and both Kenya Grain Growers Cooperative Union (KGGCU) the National Cereals and Produce Board (NCPB) with respect to maize marketing and quality considerations, as well as in the use cf chemicals for insect control. It is expected that these linkages can be strengthened in the future.

Important linkages have been developed between the project and Kenya's training institutions all the way from the universities to local institutes and Farmers' Training Centres, and it is anticipated that these linkages will continue to grow stronger in the future. Programme support has been provided to the media, to rural schools, to women's groups and to other agencies and programmes which bear a relationship to the objectives of the project.

B. Functions and Operations of the Project Staff

The operations of the OFGSP for the MOA in Nyanza and Western Provinces are under the direction of the Project Manager who is based in Maseno. The DPRA counterpart to this position is the Team Leader.

At the operational level the Local Advisory Committee consisting of the Project Manager, the Team Leader, the two Provincial Directors of Agriculture, the two Provincial Post Harvest and Storage Officers (PPHSOs) and the two DPRA Extension Specialists serves to coordinate project operations at this level. The Extension Specialists are direct counterparts to the MOA Provincial Post Harvest and Storage Officers in each of the two provinces.

1. *Project Manager - Team Leader*

The Project Manager functions as the MOA senior Post Harvest and Storage Officer responsible for total project operations. Reporting directly to this position for programme functions is the officer in charge of the Grain Monitoring Unit. The Project Manager serves as direct counterpart for the Team Leader who acts as officer in charge of DPRA project operations for OFGSP in western Kenya. The persons filling these two positions coordinate project planning and direction on a daily basis.

Where the need exists, local hire to support DPRA operations is encouraged. However, there will be increasing pressure for the Ministry of Agriculture to utilize these existing personnel through re-deployment in any project expansion programme. It was noted that DPRA has employed large numbers of local personnel and MOA may not be in position to absorb them.

2. *Provincial Director of Agriculture - Local Advisory Committee*

The Provincial Directors of Agriculture are responsible for all MOA programme activities in their respective provinces; they report directly to the Director of Agriculture in Nairobi on programme functions and to the Provincial Commissioner on matters of provincial administration. For project operation of the OFGSP they coordinated the project activities with the Project Manager. The recently-established Local Advisory Committee serves to coordinate project planning and operation in the two provinces, as outlined above.

3. *Provincial Post Harvest and Storage Officers - Extension Specialists*

Reporting to their respective Provincial Director of Agriculture, the PPHSOs in the two provinces of western Kenya represent the senior MOA officers with primary responsibility for OFGSP programme execution at the provincial level. Those in these positions function in a direct counterpart relationship to the DPRA Extension Specialists in their respective provinces. As noted above, the PPHSOs and the Extension Specialists together with the PDAs and the Project

Manager and the Team Leader make up the Local Advisory Committee for the project.

4. *District Post Harvest Officers*

District Post Harvest Officers function for the Ministry of Agriculture extension programme in each of the districts of Nyanza and Western Provinces where OFGSP is active. Those filiing the positions are administratively responsible to the District Agricultural Officer, but depend upon their respective PPHSO (and the DPRA Extension Specialist) for technical programme guidance and support.

5. *Extension Field Staff*

Within each district where the project is active, the programme is carried out through the regular MOA extension structure, including Agricultural Officers, Technical Officers and Technical Assistants. The officers at each of these levels are expected to be provided adequate grain post-harvest management training and supporting programme materials by the project technical staff to carry out their respective functions effectively.

III. Field Testing and Demonstration Unit (FTDU)

This unit of On Farm Grain Storage Project (OFGSP) was charged with the responsibility of developing, testing and demonstration of technological packages which increase the use of more effective on-farm grain drying and storage practices in an attempt to reduce post-harvest loss and improve the welfare of small-scale farmers.

A. Technological Package Development

The initial two years of project implementation were used in identifying, developing and testing of various improved grain harvesting and storage methodologies and providing the evidence of their practicability.

These trials were conducted at the FTDU-Maseno. The development of technological packages was based on the 54 separate test units which were set up in 1984. These trials centred on structural design, location of structure, drying rates, chemical application, and various aspects of post-harvest storage management.

The Task Force noted that a continuous development and testing of the technological packages was stopped due to lack of staff and the movement of available resources to extension in an effort to deliver the already developed technological packages. The Task Force notes that a continuous programme of development and testing of technology provides the essential data and recommendations on the appropriateness of any package.

B. Field Testing Based on Cluster Approach

While the work on technology development was in a controlled environment at FTDU, these provisional recommendations were taken to the field in the form of farmer-user trials which were easily adopted in the Training and Visit Extension System.

The objectives of these farmer-user trials (cluster approach) were to:

- collect additional data on drying rates and storage losses in different agro-ecological zones.
- allow participating farmers to make comparisons of grain quality throughout the storage period.
- promote awareness of and a understanding for optional storage system for farmers.
- provide a teaching tool for field staff during fortnightly training sessions.
- evaluate the success of the clusters idea at a lower administrative level and in less concentrated formation.

The results of the clusters approach were:

- a spin-off effect where farmers outside the initial demonstration areas visited demonstration areas to seek and exchange information with participating farmers.
- some of the control farmers adopted the improved technological package before the end of the storage period.
- this approach offered farmers an opportunity to make comparisons on various aspects of post-harvest technology.

C. Demonstrations

After the success and experience with cluster approach the OFGSP put the third thrust into demonstration in all the seven districts in Nyanza and Western Provinces. The overall objective in this expanded demonstration was to create mass awareness. The project has succeeded in creating this awareness. Although the initial concept of demonstration was excellent from an extension point of view, the continued distribution of free demonstration packages to the farmers (until 1988) had a negative effect, as it created dependency by farmers in getting the post-harvest technology package from the project.

The OFGSP should be commended for having noticed this constraint before the end of contract period and the introduction of the cost-sharing programme . The concept of cost-sharing is receiving a fair degree of acceptance; however the Task Force feels such a programme should be allowed to continue for at least two more years before the farmers are left on their own.

D. Feedback and Evaluation

The OFGSP receives field reports from District Post Harvest Officers through their respective District Agricultural Officers. These reports are monthly, quarterly, bi-annual and yearly. They include summary of field activities, achievements and constraints to programme implementation.

The Task Force would like to encourage the OFGSP to develop its own plan of evaluation of activities, their effects and impacts. While the OFGSP has had the Grain Monitoring Unit (GMU) for evaluation of its activities, it has not been utilized to full potential due to inadequate staff, and in the past, limited operational budget and lack of mobility. The Task Force feels there is need to develop and test a plan for evaluating innovations and impacts of adoption that can be measured in the future.

E. Conclusion and Recommendations

The initial work by OFGSP through FTDU had very encouraging results. OFGSP extension packages are based on the result of these trials. This development and testing lasted only two years and the Task Force feels that development and testing of alternative technologies should have been continuous. However, the Task Force recognizes the difficulties that arose when expatriate technicians left without local staff replacement. While the data on post-harvest losses are controversial, there is need to build up enough data over a period to ensure sound recommendations.

Full staffing of the FTDU should be initiated with proper identification of development and testing areas. Local resources should be tapped in this devel-

opment and testing, hence the need to collaborate with other research institutions.

The project should be able to develop a plan of monitoring the rate of adoption of various post-harvest technologies in an effort to keep track of their effects and impacts.

IV. DELIVERY MECHANISM

A. The Approach

The major thrust of the On Farm Grain Storage Project (OFGSP) was to change small holder farmers' post-harvest grain management practices. Information on the prevailing practices among the target group had to be gathered. The farmers' activities in the preparation for maize harvest – actual harvesting time and process, the drying process, storage practices including the losses – were observed in detail and documented[1]. Using this information the project mobilized the farmers through a group approach. The objective of this approach was to encourage farmers to share ideas on their traditional grain storage management as compared to improved on-farm grain storage management. In this way the farmers were able to learn from each other and encourage each other to put into practice what they learned.

As much information as possible was made available to the groups by practical examples which compared traditional practices with improved practices, emphasizing the effects on the quality and quantity of grain at the end of the storage periods. Reading materials were made available to those who could read. Emphasis was put not only on the structures suitable for storage but more so on the management of those structures and the grain – before harvesting, during harvesting and drying, and during storage.

The technical information was organized through specialized group meetings variously referred to as Crop Commodity Groups at the district level and Crop Production Professional Group Meetings at the provincial level. In most cases the OFGSP professional group functions independently of the Crop Commodity Groups. Technical subject matter focused on: (1) preharvest activities, (2) physiological maturity harvesting, (3) structure and drying, (4) shelling and

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1 Maize Conservation on the Farm: Proceedings of a Seminar at Kisumu, Kenya, 21-23 January 1986, DPRA - MOALD - USAID.

treatment, and (5) safe storage of produce. Preparation for delivery of this information was done by the post-harvest and storage subject matter specialists making pre-workshop lesson plans. The lessons were delivered with practical demonstrations during monthly workshops to the Divisional Agricultural Extension Officers (DAEOs) and Locational Extension Officers (LEOs). Thereafter the same material and demonstrations were given to the Frontline Extension Staff (FES) during the fortnightly training sessions. The FESs are the ones who actually deliver the technical messages and demonstrate to the farmers during their visit with the contact farmers and follower farmers and during contact group meetings.

B. Staffing Pattern

There are three levels of staffing in the implementation of the OFGSP. The Provincial and District levels were staffed by Agricultural or Technical Officers who were specifically trained and oriented in Post Harvest Crop Management. The Frontline Extension Staff (FES) level is composed of three sub-levels of non-specialized extension workers. The Divisional and the Locational levels are staffed by Agricultural Officers or Technical Officers trained in general agriculture. The officers at these levels are responsible for supervision of the sub-locational or area extension officers. The DAEOs are the ones who conduct the fortnightly training sessions with the help of the District Post Harvest and Officers (DPHO). The sub-locational or area extension staff are certificate holders trained in general agriculture in any of the Institutes of Agriculture. They are the extension workers who are in direct contact with the farmers. Their role is not only to provide technical messages but also to demonstrate to the farmers practically how they can be applied in farmers' individual situations[2].

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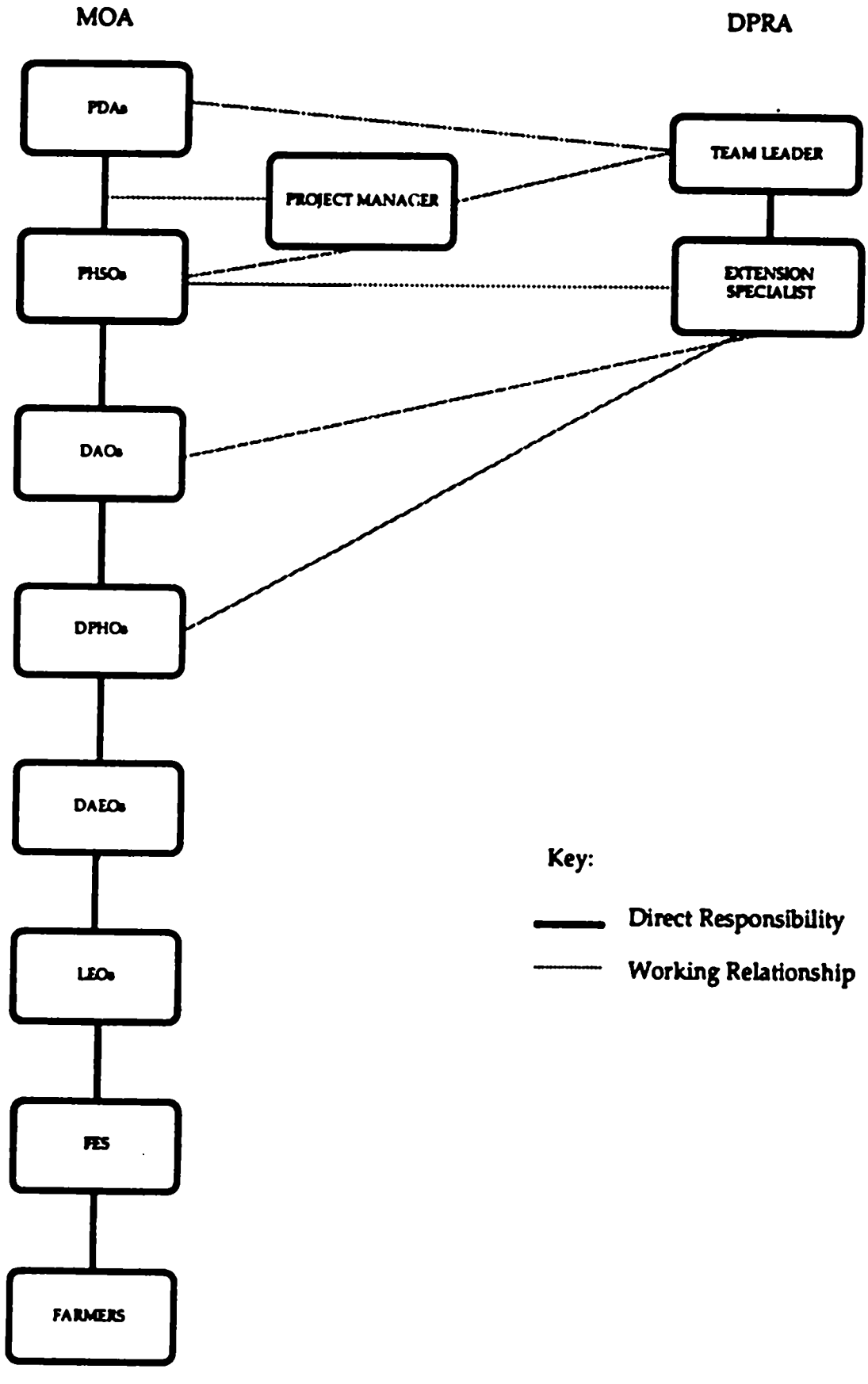
2 Source: District Agricultural Officers in the Project Area.

Figure 4.1 OFGSP ORGANISATIONAL CHART IN PROJECT AREA



The major role of the Provincial Post Harvest and Storage Officers (PPHSOs) is supervision of the district staff training and field extension activities. The roles of the DPHO are: (1) to conduct the actual staff training during the monthly workshops, (2) to provide technical backstopping for training during the Fortnightly Training Sessions; and (3) to supervise and follow up on the actual implementation of the project in the field. The DPHOs are responsible for the initial recruitment by FES of farmer cooperators in the siting of the storage structure demonstrations. They also coordinate the whole demonstration activity.

C. Demonstration Structures

The group approach used in the extension activities of the OFGSP is based on mini-clusters. The mini-clusters were composed of four cooperating farmers on whose farms the improved structures were located. In addition, other farmers cooperated as a control group. The control farmers used their normal unimproved storage structures and managed their grain traditionally for comparison purposes.

The extension objectives of the mini-cluster approach are:

- To provide facilities for training of field staff in different drying and storage management systems and their evaluations.
- To use the facilities once a method has been proved successful, for the training of extension staff, and farmers, and as demonstrations as part of extension program to disseminate improved maize drying and storage practices[4].

The farmers on whose farms the improved structures were located were given technical information on all the recommended post-harvest grain management practices. These practices included: (1) preharvest hygiene, (2) harvesting at physiological maturity, (3) drying, (4) shelling and treatment; and (5) storage monitoring and management. The control farmers were told what the pro-

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4 Executive Report: On Farm Grain Storage Project, April 30, 1987

ject was all about and what their role was. Their participation was completely voluntary. Their major activity in the project was storage monitoring.

During field days mini-clusters made it easy for the extension agent to gather all the cooperating farmers and their neighbours at each demonstration structure site for a demonstration of the recommended grain management practices. Besides being used for teaching during field days, the demonstration structures were conspicuous to the neighbouring communities. Out of curiosity other farmers learned more about the purposes of the structures. In many cases neighbours shared ideas with the cooperating farmers and thereafter sought advice from the extension officers or simply copied the structure on their farms.

In spite of the large numbers of demonstration drying and storage structures throughout the project area the Task Force notes with serious concern the low adoption rates for the storage structure reported. Shortage of staff, inadequate frontline staff mobility, shortage of artisans and cost of the storage structure were cited as major constraints to widespread adoption. Where adopted, the structures served as drying structures but not as storage structures due to fear of theft and exposure. The following table shows the demonstration structures as at the end of December, 1988[5].

Table 4.1 Demonstration Structures

	No. of Demonstrations by Province		
Type of Structure	Western[(a)]	Nyanza	Total
Cribs	315	569	884
Raised Baskets	422	364	791

(a) Provincial number estimated

5 Source: DPRA: OFGSP Team Leader

It was reported that adoption of shelling, dusting and storing of maize in gunny bags was more widespread than adoption of the structures. This, however, was difficult to confirm.

D. Field Days

1. *Agricultural Field Days*

Whole farm approach field days were conducted featuring post-harvest activities as an important component of the management of a farm. Because the most important theme of the multipurpose field days was economic returns from the farm, savings through proper post-harvest grain management was portrayed as a major factor contributing to improved farm economic performance. Agriculture field days normally involve local leaders who use them to emphasize government policies relating to food security and comment on current issues.

2. *Publicity Field Days*

The DAEOs, LEOs and FES have used field days extensively to create awareness about the project among the farming community. Publicity field days mostly have preceded recruitment of cooperating farmers. They have also been used to advertise major OFGSP events. Publicity field days are conducted by the DAEO, DPHO or LEO alone. Sometimes a chief's baraza served a similar function.

3. *Functional Field Days*

The OFGSP emphasizes five main areas of post-harvest grain management: (1)pre-harvest hygiene, (2) physiological maturity harvesting, (3) storage and drying structures, (4) shelling and treatment, and (5) safe storage of produce. For each one or a combination of these aspects of grain management the DPHOs and FESs conduct a functional field day focusing on the main practices of that particular grain management area. Where possible result demonstrations,

method demonstrations and comparisons are used to make the messages more understandable.

The following table shows the numbers of field days and participants achieved by the end of December, 1988[5].

Table 4.2 Field Day Achievements of OFGSP by 31.12.88

Province	No. of Field Days	No. of Participants
Western[(a)]	328	29,463[(b)]
Nyanza[(a)]	279	14,510
Total	607	43,973

(a) Provincial number estimated
(b) Included some school children

The Task Force was of the opinion that field days are a cost effective group approach to extension.

E. Training of Implementing Agents

The Task Force noted with satisfaction the efforts the OFGSP project staff put into the training of local leaders, artisans and demonstration farmers. This activity has enhanced the publicity and effectiveness of the project. The table below shows the training achieved by 31st December, 1988[5].

5 Source: DPRA: OFGSP Team Leader

Table 4.3 Implementing Agents Training Achieved by 31.12.88

Target Group	Number Trained in country		
	Western[a]	Nyanza[a]	Total
Chiefs/Assistant Chiefs & Local Leaders	164	317	481
Artisans	356	471	827
Cooperating Farmers	834	1105	1939
Adult Educators	None	182	182

(a) Province number estimates.

There was clear evidence of awareness of OFGSP among local leaders especially in Kakamega and Bungoma Districts. This achievement is commendable as it provides a fertile ground for enhanced adoption.

In order to facilitate farmer training programmes, OFGSP provides training aids and equipment to the Farmers' Training Centres in the project area. The Farmers' Training Centres at Bungoma, Busia, Homa Bay, Kisii, Maseno and Siaya each were supplied with equipment as listed in Section VIII.

F. Participant Visits by Field Staff

It was reported that immediately after a field day the FES make follow-up visits to individual interested farmers. The objective of the follow-up visits is to provide advice and guidance on the grain management practices demonstrated during the field day. This process is reported to have been hampered in many instances by limited mobility. The staff to farmer ratios in the project area were

reported to be 1:850 on the average. In some cases the FES had to cover long distances.

G. General Awareness

OFGSP staff actively participate in all the provincial and district agricultural shows in the project area. This affords the project widespread publicity as evidenced by press coverage since 1984. For example, the following report appeared in the Kenya Times of July 28, 1988:

> "DPRA's On-Farm Grain Storage Project ... aims at reducing Kenya's known losses of maize and other stored farm commodities ... It is sponsored by the Government of Kenya ... there are many projects in the field especially in South Nyanza, Kisii, Kakamega, Bungoma ... Siaya, Busia and Kisumu are not left out ... this year alone 600 new structures have been erected".

It is also reported that there have been radio programmes featuring OFGSP activities. Whenever major school and community activities occur, the OFGSP staff participates.

V. Design of Storage Structures

The use of natural ventilation for drying is understood by farmers. Therefore, modest improvements to an existing system should have a better chance of acceptance than major innovations. The main problem with traditional methods is that they are suitable for drying maize once the moisture content (MC) has been reduced to below 20% by pre-harvest drying in the field. This can lead to unacceptable pre-harvest losses and a build up of insect infestation.

A. Design of Crib and Improved Basket

Early attempts to improve the performance of traditional structures was carried out by Nigerian Stored Products Research Institute (FAO, 1980). This provided a better ventilation than some of the traditional ventilation structures.

In order to practice early harvest a drying structure is required. The conclusions noted below refer to trial results carried out by the On Farm Grain Storage Project (OFGSP) for drying and storage cribs and improved woven basket granaries[1].

- The mean drying rate of 0.16%, 0.15% and 0.17% moisture drop per day was observed for 1.5m, 1.75m and 2.0m diameter improved woven basket granaries respectively.
- The maize harvested at maturity (30% MC) can be dried to safe storage moisture content (13%) within 53 to 67 days, depending upon weather conditions.
- The 1.5m wide crib had the best drying performance; however, the round improved woven basket had similar characteristics provided the diameter was within 1-2 meters.

[1]Maize Conservation on the Farm: Proceedings of the Seminar at Kisumu, Kenya. 21-23 January, 1986, DPRA -MOALD-USAID.

B. Drying on Trays

The development and testing of tray drying was designed in particular for very small-scale farmers. The drying rate in the trays was compared for shelled and unshelled maize. The conclusions from trial results are:

- The average drying rate for shelled maize was observed to be 40% faster than unshelled maize. However, it was noted that it was very difficult to shell maize at high moisture content.
- The mean drying rate for unshelled maize was 0.93% moisture drop per day; however, the average drying rate for shelled maize was 1.31% per day.
- The average daily moisture content drop was 1.79% for 15.2cm (6") maize depth. For 22.9cm (9") depth layer, the drying rate was noted to be 1.18%.
- The maize dried from about 30% MC to 14% MC in less than 2 weeks (range was 4 to 16 days).
- The drying rate decreased by approximately 50% for uncovered tray and exposed to rainfall compared to the one with rain protection. The rate of rainfall precipitation during the period was not indicated. Further trials are recommended to provide reliable data and recommendation on the requirements for protecting the grains.
- The daily drying rate for a tray with three sides closed under the drier floor, and open side towards the prevailing wind direction was 60% higher than the open trays. While it was noted that construction of platform driers with closed sides was difficult, it appears to offer a desirable feature due to this increase in daily drying rate.

C. In-House Storage

Storage of shelled and bagged maize in warehouses has indicated that effective insect control can be achieved by admixing insecticide dust with the grain.

Work carried out by Rural Structures Programme over a 300 day period has shown that application of insecticides does not eliminate insect attack, but offers an effective control in shelled grain stored in bags as compared to untreated dehusked maize stored on cobs.

The OFGSP evaluated the performance of baglets in the house and the conclusion was:

- Control method of insect infestation seems to be applying insecticidal dust to early harvest at about twice the dosage rate recommended for storage in different structures.

D. Design Aspects of the Structures

The OFGSP has stressed the need for high standards required in construction of these structures compared to the existing structures in many farms. The structures constructed have performed the objectives for which they were designed. There was no major engineering shortcoming observed; however the problems experienced are noted below:

- The ends of the beams carrying the floor load were noted to deteriorate with time. These ends need to be covered or alternative designs be selected.
- The design of the crib and the improved baskets is based on the idea of replacing various items (materials) in case of deterioration, or breakage; however, there was expression of the need to have long poles from the ground to the roof as they provided stronger structure. Such designs should be developed and be tested before promoting them.
- The nails are becoming increasingly scarce and expensive, and there is need for alternative designs which reduce the requirements for these items.

- There were reported cases of crib tilt and this was attributed to weak foundations in black cotton soils. There is need to recommend concrete around the poles for less stable soils.

E. Alternative Design Package

The OFGSP has focused mainly on the crib and improved lantana basket and the post-harvest technology management package which accompanies them. The Task Force agrees with such strict recommendations as they ensure that the potential risk of technical failure are reduced. However, there might be other structures or simple solutions which when developed, tested and promoted will complement the existing package.

During the years of operation of OFGSP, the Task Force feels that the project has gained extensive experience to put extra thrust in developing and testing of alternative engineering designs. The interesting options to look into are:

1. *Large Drying Platform*

The OFGSP developed and tested simple drying trays for very small farmers, and the performance of these trays was excellent and it appears the most efficient and important alternative. The unit is easy to construct and inexpensive. The Task Force is convinced that the larger platform is a feasible alternative for these farmers who cannot invest in cribs.

2. *Bulk Storage in Smeared Lantana Baskets*

OFGSP evaluated the storage of shelled maize in dung smeared lantana baskets and found out that the grains were in satisfactory condition after 32 weeks of storage. A combination of drying trays and smeared lantana baskets may produce a very interesting combination of storage management. The important advantage with solid wall storage unit is the likely potential for long-term storage and food security.

VI. POST-PRODUCTION MANAGEMENT SYSTEM

When the grains are fully grown and ready for harvest, they become susceptible to damage by birds , insects, wild animals, fungi, bacteria, weather, livestock, and theft, individually or in combination. Since the introduction and acceptance of hybrid maize varieties, the farmers have observed gradual increase of insects and mould in their grains in the fields just before harvest.

Due to high post-harvest losses (up to 25%)[1] and the problems related to reaching safe moisture content at the farm level, the OFGSP developed several post-harvest management packages to support the application of the farm storage structures. These were easily incorporated in the National Extension (T&V) Programme.

A. Preparing Storage Structure

The OFGSP thrust in this area has been to encourage the farmers to renovate, repair or construct new storage structures, as improved structures provide the basis for early harvesting and other essential management components. The technical message has been to remove the previous harvest, clean the store thoroughly, and spray the store.

B. Timing and Carrying Out Harvest

The need for early harvest has been an essential component of post-harvest management in order to reduce field losses. In order to harvest early the farmers should be able to identify the stage of physiological maturity (30% MC). This stage is identified by development of a black layer at the base of the grains. By carrying out early harvest, losses which would have occurred in the field of nearly 10% [2]

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1 Evaluation of the Rural Structures Programme in Kenya 1988

2 Maize Conservation on the Farm. Proceeding of a Seminar at Kisumu, Kenya. January 21-23, 1986.

can be reduced. This practice can only succeed if the farmers have drying structures.

The traditional approach to harvesting has been to harvest the whole field in one step operation, however, an interesting alternative is to have step by step harvesting as the crop reaches maturity. This approach has not been tried by OFGSP, but the Task Force feels there is need to develop a package related to this aspect.

C. Drying and Storage of Maize on Cobs

The maize from the field is loaded to the store on cobs. While in the store, depending on climatic conditions, it has been observed to take 45 to 60 days to reach safe storage moisture content (13%). The Task Force during field visits found that the farmers appreciate the drying performance of the structures being marketed. Due to high moisture content of the grains, in the early harvested grains the application of chemicals is not recommended due to rapid breakdown of these storage chemicals.

While it is difficult to have uniform distribution of storage chemicals on maize cobs, the Task Force found out that some farmers applied storage chemicals to the maize cobs in the store. The Task Force encouraged the OFGSP to develop and test various methods and aspects of chemical application to maize on cobs and in shelled form to facilitate efficient and uniform application.

D. Shelling and Treatment

One of the aspects of post-harvest management which the Task Force noted has been widely accepted was shelling and treatment. This may be attributed to the fact that farmers will adopt those technologies which show quick returns, and less expensive technological and capital inputs.

It was noted that the hand shellers the OFGSP was advocating within their message were expensive to the farmers. There was need to develop and test

much cheaper technologies for shelling and treatment applicable in the rural farm communities.

The current evaluations by the Grain Monitoring Unit (August to December 1988) show that grain loss due to insect damage had the most significant influence in the total loss, followed by moulds. The loss due to insect damage accounts for over 6% of the total grain loss in the store while mould and other damage contributed approximately 4% of the total loss.

E. On-Farm Storage

When the Task Force visited a number of farms in the project area, one observation noted was that the structures being demonstrated for both drying and storage of maize, were performing only half of that function, i.e. they were used widely for drying rather than storage. The reasons expressed by most farmers were social-economic. It was noted that after harvest and drying, followed by shelling and treatment, the grains were stored mainly in the farmers' house.

The Task Force recommends that the OFGSP look at various levels of storage management in the house in order to prepare a comprehensive package in this respect.

F. Conclusions and Recommendations

The Task Force members noted with appreciation the work carried out by OFGSP in development of post-production management packages which have demonstrated the potential to reduce post-harvest losses.

The recommendation for future direction of this project could include:-

- Development and testing of various aspects of chemical application.
- In-house storage appears to be here to stay and there is need to develop appropriate storage management aspects.
- Other traditional storage management practices need to be identified, tested and improved for a wider audience.

VII. STAFF TRAINING

The OFGSP has provided both off-shore and in-country in-service training in order to increase the MOA extension capacity for transferring technology. To ensure long-term effectiveness the project also provided equipment and material support to agricultural education institutions so that the institutions can provide grain drying and storage training to future extension workers.

To facilitate in-country staff training, training aids and equipment have been supplied to the Farmers' Training Centres for use during professional group meetings, monthly workshops and the fortnightly training sessions of the national extension (Training and Visits) programme. The full list of the aids and equipment is given in Section VIII.

The Task Force noted an apparent deficiency among the Technical Officers and Agricultural Officers in project management and development. This deficiency could be corrected by further training in this area.

A. Pre-Service Training

OFGSP provided short-term training for two instructors each from Bukura and Embu Institutes of Agriculture on the principles and practices for grain storage on small farms. As a result Post Harvest Grain Storage Management has been expanded in the curriculum of Bukura Institute of Agriculture. There was also a commendable outreach programme at Bukura Institute of Agriculture which provides the trainees with first-hand experience of grain storage in the farmers' situation. Egerton University has expressed interest in modifying the undergraduate curriculum to cater for Post Harvest Grain Storage Management including an outreach programme.

The project also has supplied training aids and equipment to the Agricultural Institutions and Egerton University to facilitate pre-service training (see Section VIII).

B. Technical Assistants

The TAs in the project area have undergone intensive training in Post Harvest Grain Management and Extension Methodologies during residential training at the Farmers' Training Centres. In addition the TAs continue to receive follow-up information at appropriate times during the fortnightly training sessions (FTS's) of the national extension programme. The numbers of TAs trained are estimated to be 598 from Nyanza and 522 from Western.

Two manuals have been drafted for training and use by the TAs:

1. Techniques of Proper Grain Storage for Small-Scale Farms.
2. Extension Communication Manual for Frontline Agricultural Extension Methods.

A video film for training the TAs on how to raise an existing basket is in preparation.

The objective of the Technical Assistant training programme is to prepare the TAs for their key role in:

1. The delivery of technological messages on post-harvest grain management,
2. Selection of cooperating farmers for demonstrations, and
3. Organizing field days.

C. Technical Officers

The objective of the Technical Officers' (TOs) training is to provide the TOs with technological information and extension skills for effective transmission to the TAs during fortnightly training sessions and to the farmers during field days. Emphasis is laid on all aspects of grain storage and management, and extension methodologies.

1. *Short-Term Off-Shore Training*

In preparation for project implementation the TOs who had been identified for DPHO and instructor positions attended a nine week intensive course on the Principles and Practices for Grain Storage at Slough, England. The officers are reported to have been highly motivated by this course programme. This has enabled them to participate in the training of other TOs and the TAs during monthly workshops and FTS.

2. *In-Country Short-Term Training*

Intensive training programmes have been provided by OFGSP to TOs for 1 to 2 weeks within the districts, and 10 weeks at Egerton University. Emphasis is laid on grain drying and storage principles, and extension methodologies in both programmes. In addition, the course programme at Egerton University includes economic aspects of on-farm grain storage practices and practical storage structure construction. These programmes have equipped TOs with the technologies and skills needed for conducting effective field days and monthly workshops.

Table 7.1 TOs Trained as of 31.12.88

Type of Training	Number of TOs trained by OFGSP			
	Western	Nyanza	Other Institutions	Total
Short Term Off-shore	7	5	7	19[b]
Short Term In-country	268[a]	151[a]	None	419
TOTAL	275	156	7	438

(a) Provincial number estimated
(b) Includes 6 AOs

The courses offered to the TOs not only motivated them for improved job performance but they also raised TOs' expectations for promotion. Repeated appeals were made to the Task Force for promotional training. There are quite a few deserving cases for Bachelor of Science up-grading courses.

3. *Monthly Workshops*

There has been a continuous programme of monthly workshops conducted by the national extension (T & V) programme in the project area. All the Divisional Agricultural Extension Officers (DAEOs), Locational Extension Officers (LEOs) and other divisional subject matter specialists (SMS) attended the monthly workshops. The main emphasis during the monthly workshops is reported to be on the definition of impact points with some practicals on post-harvest crop management.

4. *In-country Bachelor of Science (B.Sc.) and Master of Science (M.Sc.) Degree Training*

The intended B.Sc. and M.Sc. course programmes for up-grading AOs and TOs were not conducted. Delayed implementation and uncertain implementation terms of OFGSP were cited as the main causes of this failure.

D. Senior Staff Training

Agricultural Officers, Crop Protection Officers, Provincial Directors of Agriculture and Principals of agricultural institutes attended short-term and long-term course programmes. These courses have prepared them for supervisory and administrative roles in the implementation of the OFGSP.

1. *Grain Storage and Marketing Short Course*

Five senior officers attended the course at Kansas State University, Manhattan, Kansas.

Table 7.2 Short Course Training

Target Group	No. Who Attended
Headquarters Staff	1
Provincial Directors of Agriculture	2
Principals of Institutes	2

Another short course programme has been proposed for eight senior officers including two PDAs, two PHOs, the Project Manager, a SAO from the Crop Protection Branch, the Principal at Embu and a Lecturer from Egerton University. The Task Force was informed that although the training will be of definite benefit to OFGSP, the funds to be used were a part of those originally planned for long-term professional and academic course programmes for TOs and AOs, as noted above.

2. *Master of Science Course*

Five Agricultural Officers and one Research Officer attended two-year Master of Science course programmes in the USA. The objective of the training was to prepare them for counterpart key positions in the OFGSP.

Table 7.3 Master of Science Training Achieved

Course Programme	No. Trained
M.Sc. Microbiology	1
M.Sc. Agricultural Economics	1
M.Sc. Agricultural Engineering	1
M.Sc. Agricultural and Extension Education	3
Total	6

The Task Force learned that the OFGSP has not benefited directly from the training of four of the U.S. Masters degree trainees. It was reported that they have been deployed in other positions in the Ministry of Agriculture outside the project area.

VIII. LOGISTICAL SUPPORT AND PROPERTIES

A. Support Purpose

The project started in early 1984 with no support capacity. In the ensuing months of the first year support for both MOA and project administration was secured by the project staff. This support, which has continued throughout the first five (5) years of the project, directed to strengthen the GOK capacity in three categories: technical capacity, extension-education capacity and mobility.

The amended budget, amendment No. 2, 1 May 1987, indicates a total authorized project expenditure of US $1,796,000 for commodities. Although no detailed breakdown of the amended budget is available at the project headquarters, the original budget breakdown for Major Cost Element VIII called for the following:

Project Household Furniture and Appliances	US$ 92,000
Laboratory Equipment for Phase I	207,000
Laboratory Supplies, Educational Materials, etc.	252,000
Maize Procurement	63,000
Cribs, Platforms & Kit Grants	530,000
Vehicles	374,000
Freight and Handling	198,000
Total	**US $ 1,716,000**

As of 31 January 1989 the cumulative project expenditures for various commodities totaled:[1]

Commodities-Equipment	US $ 276,665
Commodities-Materials and Supplies	666,114
Commodities-Vehicles	474,099

[1] No accounting by district has been kept during the project thus far. However, should the project be extended and more emphasis placed on a District focus, then a record of expenditures by district should be kept.

Commodities-Freight and Handling	22,663
Total	**US $ 1,439,541**

This, of course, leaves about US$ 356,000 to use for all commodity purchases during the last year of the present contract. Most of the amount is expected to be used for the purchase of materials under the cost-sharing structure construction program. Lesser amounts are planned for procurement of video equipment and educational supplies.

B. Transport Facilities

As of 31 January 1989 the MOA has been provided 16 vehicles by the project. A history of these purchases and the project's four-wheel vehicles follows:

1. *Four-Wheel Vehicles*

The project's original fleet of vehicles included one Peugeot 505 Station Wagon, four Land Rovers, one lorry and one matatu.

In 1985 seven Suzuki S.J. 410 Sierras were provided for the District Post Harvest Officers and two similar type vehicles for the Provincial Post Harvest Officers.

Later, in 1986 a Peugeot 504 Station Wagon was procured for the Head, Crop Protection Branch. Also in September 1986 a Honda Accord replaced the project's Peugeot Station Wagon.

In 1987, tenders were announced for six Suzukis to supplement the project-provided fleets of the districts. These vehicles were distributed in early 1988. At the same time four replacement vehicles were obtained for the project, two Isuzu Troopers, one Hiace Toyota Van and one Hilux Toyota double cab pickup. (The latter did not arrive until April 1989).

The new project vehicles were replacements for the four old Land Rovers which had reached 100,000 kms of use. The Land Rovers, in turn, were sent for reconditioning at a total cost of less than the expenditure for one new Land Rover. Work on the two is complete. The remaining two should be on the road

again by April 30, 1989. These four vehicles will be assigned as follows: one to Maseno GMU; one to Bukura's farmer outreach program; one to Nyanza Province; and one to Western Province. No other vehicle purchases or major overhauls are expected through April 1990.

The project's experience with providing this type of mobility has been reasonably good. Each has been GK plated and is the responsibility of the Ministry for maintenance. Fifteen of the 16 vehicles provided are still in operation. However, the project's experience with regard to benefit from the deployment of these vehicles has been less than satisfactory. Too often these vehicles, although clearly intended and painted with the project logo, have been commandeered for non-project uses at both the province and district levels.

2. *Motorcycles*

In late 1987 and early 1988 the MOA received 78 motorcycles through the project. These motorcycles, procured after a long series of red tape delays, provided total mobility of post-harvest officers down through the division level.

Without doubt these motorcycles, along with the 768 bicycles also provided by the project, will greatly increase the efficiency of the extension officers and subject matter specialists to whom they are assigned. The MOA extension officers who will ride these motorcycles were each given driver and vehicle maintenance training by the project. Nevertheless, the project staff has concern for drivers' safety and foresees substantial recurrent MOA maintenance costs. The appropriateness of this activity should be carefully evaluated before it is copied in other provinces.

3. *Bicycles*

In early 1989, 768 unassembled bicycles were received by the project. These will be distributed to MOA frontline extension workers as soon as assembled. These bicycles should give all TAs in the two provinces, presently without bicycles, mobility to conduct their fortnightly T & V visits with much greater efficiency. This activity should also be closely evaluated and in all probability should

be encouraged in other provinces, because with a cycle, a TA's efficiency should increase about 200% over the alternative of walking to the farms.

C. Construction Materials

As of 1 March 1989, 1764 demonstration units had been constructed. Most of them were erected on selected demonstration farms (in clusters) as a part of the project's tie-in with the extension T & V system and field day activity. Some, however, were constructed in key locations to attract attention, like FTCs, polytechnics, agricultural institutes and Egerton University, and agricultural shows.

According to Voucher No. 62, as of 31 January 1989 a total of US $364,770.59 had been spent for Cribs and Platforms - Kit Grants. This, of course, far understates the total cost associated with the distribution of the demonstration units. Specifically not taken into account in this cost is the labour and transport associated with procurement, preparation, delivery, artisan training and followup.

The cost-sharing programme, started in 1989, will continue the project's activity of providing and delivering kits to farmers. However, the cost will be reduced by the farmer's contribution. With more advanced planning this cost-share programme (with donor assistance) can be decentralized and performed largely from district points. Timing is of critical importance as all planned structures each year should be in place prior to harvest time.

Locks and chains were distributed as a part of about 250 demonstration kits during 1988. These were systematically distributed in densely and more sparsely popuiated areas. A follow-up survey will be conducted in mid-1989 to determine the value of this minimal security effort in reducing theft.

D. Extension-Demonstration Field Packs

The project staff found that quite frequently the MOA staff, in charge of conducting farmer field days, did not have access to the equipment needed for their demonstrations. Therefore, beginning in 1988 146 field packs were purchased, equipped and distributed. Each pack contained one panga, one slasher,

one tube Actellic (1%), one tube Malathion (2%), 500 gms. of Green Circle Malathion 25% wetable powder, one canvas ground sheet (2m), one shovel and two hand shellers.

These packs can be transported like a back pack on motorcycles or tossed into the back of a four-wheel vehicle like a box.

E. Laboratory Equipment

In it's first five years, the project supplied over US $300,000 worth of teaching aids to all FTCs in western Kenya and laboratory equipment to Egerton University and the three institutes of agriculture.

1. *Maseno Equipment*

The project fully equipped the Grain Monitoring Unit to evaluate grain losses. The laboratory has the capacity, in terms of equipment, to analyze samples for aflatoxins and other mycotoxins, rodent contamination, to grade samples, to identify insects, as well as to process and interpret results.

Basically the GMU is equipped to serve as a modern grain quality control laboratory. A summary of major items supplied by the project follows:

- Office equipment for scientists, i.e. desks, files photocopy machines, typewriters.
- Computer, i.e. IBM, NEC printer, numerous programmes and manuals.
- Laboratory equipment, such as auto-maize counter, electric balance, microscopes, pressure cooker, freezer, Kjeldal apparatus, complete chemical lab, dark room equipment and platform scales.
- Grounds maintenance and crib construction equipment — a large component of tools.

The complete list of laboratory equipment and reference materials provided for the Grain Monitoring Unit at Maseno is included in Appendix F of this report.

2. *Education Institutions*

During the period of 1986-88, the project provided numerous pieces of equipment to Egerton University and Bukura, Embu and Kilifi Institutes of Agriculture.

A list of the major items include: Dec-O-gram balance, Dail-O-gram balance, Sling psycrometer, Mason's hygrometer, several Dickey-John moisture testers, Isotemp oven, magnifiers, black lights, grain test weight scales, hand lenses, tallys and shellers. The list of equipment supplied to Egerton and to the institutes is shown in Section VIII-K, below.

Followup contact with these institutions suggests that some need both assistance in setting up usable laboratories and training in the use of this equipment. The exception is Embu Institute of Agriculture, at which a totally functional grain quality laboratory is in operation.

F. Extension-Education Aids to FTCs

Each FTC in western Kenya has been supplied with equipment for use in training farmers, and others.

Some of the major items provided to these training centres include: mimeograph machines, 16-mm movie projectors, 35-mm slide projectors, overhead projectors, portable projector screens, flip charts, 35-mm cameras and portable generators. The latter proved very useful, giving the FTCs significantly greater farmer outreach capability.

The project plans to provide each FTC with a TV and VCR in 1989 for the purpose of presentation of training videos. This equipment will not only allow these centres to show training videos made by the project, but the purchase of this equipment is also in cooperation with AIC's Train the Trainers Package - a

plan to deliver communication skills and information to field extension workers throughout Kenya.

Experience gained by the project shows that the recipients of both laboratory and extension–education equipment and supplies appreciated it and take reasonably good care of it. The extension–education equipment is used for many programmes besides grain storage. Thus, it benefits the MOA's entire extension delivery programme. The list of equipment and training aids supplied to the FTCs in western Kenya is shown in Section VIII–K below.

G. Microcomputers

The project uses three computers, one at Maseno, one at the project's Kisumu headquarters and one at Kakamega. All are IBM compatible PCs.

An evaluation of the use of these systems suggests that (1) the computer at the project's headquarters is used full time, (b) the computer at Maseno should be linked to NAL or another appropriate centre in order to obtain biometric assistance and thus fuller use; and (c) the computer at Kakamega should be moved to another location if the project is expanded in order to gain greater use of the equipment.

H. Reference Material and Training Film

1. *Reference Materials*

Since training is a major component of the project, many reference materials have been purchased and distributed to educational institutions, to the Maseno Laboratory and to students attending short-courses. For the latter, the project's cooperation with the Rural Structures Unit has resulted in receipt and distribution of a number of FAO publications on the subject of post-harvest management.

The basic set of reference books supplied to both institutions and students (TOs) includes:

Post Harvest Grain Loss Assessment Methods

Drying Cereal Grains

Food Storage Manual

Grain Storage (Fungi)

The Storage of Tropical Agricultural Products

Insects and Arachnids of Tropical Stored Products

Small Grain Storage

Volume I

Volume II

Volume III

The educational institutions have received several copies of each for stocking their libraries. In addition the Maseno library received approximately 50 reference books and manuals on many grain storage related subjects (see Appendix F).

2. *Training Film and Videos*

The project purchased and distributed enough copies of the 16-mm Grain Storage film so that each FTC, each educational institution, AIC, RSU and Maseno Laboratory have one or more copies in both English and Kiswahili.

Two training videos near completion will be distributed similarly. These are "How to Conduct Model Field Days" and "How to Raise an Existing Traditional Basket".

3. *Training Leaflets and Posters*

Thousands of leaflets and posters have been distributed by the project at farmer field days, at agricultural shows, to school children and other groups.

The four basic leaflets used by the project since 1985 are:

General Storage and Drying Structures

When to Harvest

Pre-Storage Hygiene

Shelling and Treatment

These leaflets are printed in three languages: English, Kiswahili and Luo.

A new leaflet, "How to Raise an Existing Traditional Basket", should be printed before 30 April 1989. Before the current project contract ends each of the original four leaflets should be reviewed, revised and reprinted.

In the early years of the project, when the emphasis was on field testing and demonstration trials, a technical project poster entitled "Storage Pests of Maize and Beans", was published. While the pictures on this poster are meaningful, the printed description is too technical for most farmers to understand.

A new poster, entitled "Save More Maize" will be received from the printers by 30 April 1989. This poster shows six steps to improved grain storage management using only a few simple descriptive words under each picture. These educational posters are being printed in English and Kiswahili and will be distributed widely to farmers, school children and other groups.

4. *Extension Manuals*

In an effort to increase the efficiency of the frontline extension TAs and to supplement the project's re-training effort, two field manuals were planned in 1988. Drafts of both of these manuals have been completed. One is very near publication.

One manual is designed for TAs to use when delivering technical grain storage management information to farmers. This manual contains about 20-25 chapters. The subjects cover the full range of post-harvest technology. For each subject, the technical material presented in this manual has been translated into simple "layman's" language.

The other manual assembles practical extension communications methods for the purpose of helping TAs improve their delivery efficiency. These two manuals should have application to the TAs total assignment.

I. Office, Laboratory and Staff Housing

The donor, USAID, provided structures for the Maseno GMU and housing for contractor's support staff. During the first years of the project, when the major emphasis was on field testing and development of an appropriate technology, the project's office was in the laboratory. In 1987, when the project's major emphasis changed to the extension phase, the office relocated to a vacant project house in Kisumu and the laboratory was officially handed over to the MOA.

This move accomplished two things: (1) it gave the project's demonstration kit distribution effort (which necessitated major materials procurement activity) greater efficiency in terms of access to suppliers and a more centralized distribution centre, and (2) it freed the laboratory to serve the purpose for which it was designed. Had the laboratory been fully staffed as originally intended under the contract and as recommended by the 1987 Project Evaluation Team, it would have been fully utilized by MOA staff. The laboratory is well-designed for its purpose with a spacious, well-lighted grain quality analysis room, sample storage space, biological and chemical laboratories, library and conference space and enough office space for both laboratory scientists and administrative staff.

The grounds provide adequate space for conducting applied and basic research projects.

Five of the six project houses are located in Kisumu; one is in Kakamega. The Kakamega house is occupied by the DPRA extension grain storage specialist (Western Province). The five Kisumu houses were utilized as follows as of 31 January 1989:

- DPRA Team Leader residence
- MOA Project Manager residence
- DPRA Extension Grain Storage Specialist (Nyanza Province) residence
- On Farm Grain Storage Project Offices

- Storage house - conference centre (houses all training materials, gunny bag store, etc.)

In addition, the Kisumu compound has adequate space for a demonstration kit (and now cost-sharing kit) construction area and for vehicle parking.

The facilities constructed by USAID have proven to be generally adequate for the project's needs to date. If, however, the cost-share program should be extended beyond 1989-90 and a stronger district focus is pursued, then additional facilities are recommended. These include worksheds for the seven FTCs in western Kenya as recommended in the original contract (ref.p. A-7 and p. B-2-7).

These structures were not needed until 1989 at the beginning of the cost-sharing program. Uncertainty about project life prevented their construction. (Cost estimates for sheds and fenced security areas were made by project staff). It is recommended that these facilities be constructed if the project and the cost-sharing program continues beyond 30 April 1990.

J. Summary

The logistical support provided by the On-Farm Grain Storage Project appears to be well-planned and reasonably well in place. There are instances where (1) technical assistance is needed to make more of the rather expensive and intricate laboratory equipment operational and (2) MOA staffing is needed to fully utilize this equipment, i.e., Maseno GMU.

As can be expected, when involving costly structures and equipment, a certain amount of maintenance is necessary. As long as the project is active in Kenya, provision for periodic inspection and repair should be built into work plans and the project's budget.

The logistic support provided in the project area, including vehicles and housing, appears to be well planned and not in excess of needs to conduct the grain storage management project. Should the project be expanded to a national programme support similar to that provided in Nyanza and Western Provinces should be extended to other provinces.

K. List of Equipment and Materials Supplied

1. Institutes of Agriculture

Equipment

Quantity	Item
3	Mimeograph
3	Overhead Projector
3	Slide Projector
3	35MM Projector
3	Dec-O-gram balance
3	Dial-O-gram balance
3	Foot Scoop for balance
3	Sling Psychrometer
3	Cover for Dial-O-gram
3	Mason's Hygrometer
4	Dial Thermometer-10°-100°C
4	Dial Thermometer-10°-150°C
20	Dissecting forceps
4	Desiccator W/plate
10	Dickey-John Moisture testers
3	Portable Generator
3	Microscopes
6	5" curved solid eye needles
3	Isotemp laboratory oven (230V-50HZ)
3	Dip shaft Hygrometer
3	Black light (220-240V)
3	Black light replacement filter
3	Black light replacement bulbs
8	Protective spectacles
2	Hand grinder
8	Base magnifier
8	Flip up magnifier
3	Testing hopper
2	35mm movie projector Bell & Howell
6	Film reels (3 English and 3 Swahili)
2	Flip Charts
3	Grain test weight w/scale
20	Hand lens
14	Hand tally

3	Sets of grain sieves w/bottom pan
8	6" Grain bag trier
4	18" Grain bag trier
4	30" Grain bag trier
40	Hand maize shellers
4	Black beauty maize sheller
2	Sample splitter
3	Thermometer for hygrometer

Reference Material

36	Post-Harvest Grain Loss Assessment Methods
29	Drying Cereal Grains
3	Food Storage Manual
32	Grain Storage (Fungi)
30	The Storage of Tropical Agricultural Products
29	Insects and Arachnids of Tropical Stored Products
35	Small Farm Storage Volume I Volume II Volume III
28	Social Anthropological Survey of Small Scale Farming in Western Kenya
21	Maize Conservation on the Farm
14	International Plant Quarantine Treatment Manual
14	Rodent Control in Agriculture

2. Egerton University

Equipment

Quantity	Item
2	Dec-O-gram balance
2	Dial-O-gram balance
2	Foot Scoop for balance
2	Sling psychrometer
2	Cover for Dial-O-gram
3	Dial Thermometer - 10° - 100°C
3	Dial Thermometer - 10° - 150°C
12	Dissecting forceps
3	Desiccator W/plate
1	RH Temp Recorder 24 hr. 0° - 100°F
1	Balance, students w/notched beam

4	5" curved solid eye needles
1	Isotemp Laboratory Oven (230V - 50HZ)
1	Dip Shift Hygrometer
1	Black Light (220 - 240V)
1	Black Light replacement filter
2	Black Light replacement bulbs
6	Protective Spectacles
1	Hand grinder
6	Base magnifier
6	Flip up magnifier
1	Testing hopper
1	Grain test weight w/scale
10	Hand lens
10	Hand tally
2	Set of grain sieves w/bottom pan
4	6" Grain bag trier
3	18" Grain bag trier
3	30" Grain bag trier
24	Hand maize shellers
3	Black beauty maize sheller
1	Sample splitter
3	Microscopes
1	Generator
1	Moisture Meter
1	Grain Counter
1	Grain Probe thermometer

Reference Materials

10	Post Harvest Grain Loss Assessment
10	Drying Cereal Grains
5	Food Storage Manual
10	Grain Storage Fungi
10	The Storage of Tropical Agricultural Products
5	Insects and Arachnids of Tropical Stored Products
10	Small Farm Grain Storage
	Volume I
	Volume II
	Volume III

3. Farmers' Training Centres

Quantity	Item	
7	Movie Projectors - Bell & Howell Model 2692A Serial No. 5126052	
7	Overhead Projectors - Concord Model -91-224T	
7	Duplicating machines	S/No. 85F7578
7	Dickey-John moisture meters	S/No. 41108
7	Slide Projectors	S/No. 0470
7	35-mm Cameras	S/No. 1628618
14	Flip charts	
7	Portable Generators Nissan Model GL 650 and Honda EX 650	
14	Film reels (English and Swahili)	

IX. GRAIN MONITORING UNIT

A. Nature and Purpose

The Grain Monitoring Unit (GMU) is situated at Maseno in what used to be the headquarters of the On Farm Grain Storage Project. It's activities were and still remain laboratory based, focusing on assessment of grain quality with the main emphasis or priority area being on maize grains which comprise the staple food of the country. Its operation started in August 1984 with initial field trials concentrated at the Maseno complex. For its effective operation the GMU has two main laboratories, namely, biology and chemistry laboratories with back-up ancilliary units such as computer room and a dark room (for aflotoxin analysis).

The main objective of GMU is to investigate ways and means of reducing post-harvest losses through the innovation and improvement of the existing technology in crop storage system. The following are the main areas to be tackled by the unit:

1. To investigate the drying rate of post-harvest maize in newly innovated, existing and improved structures.
2. To investigate losses accruing from late harvesting as compared to early harvesting.
3. To investigate the effectiveness of various insecticidal dust and sprays on the grains and structure, respectively.
4. To investigate the level of fungal infection (moulds) on poorly stored maize.
5. To investigate the most effective method of maize sun drying.
6. To monitor and evaluate progress toward reduction of post-harvest losses of farmers' grain in the impact area.

The main purpose of carrying out these investigations in the field though initially based at the Maseno complex was to bring awareness to farmers on disadvantages of failing to heed some storage practices through quantifiable data.

The trials were also a means of reflecting to the farmers and frontline staff what was really happening in their own farms and how they could identify with these problems which were locally based. This practice has been found quite effective for answering some of the questions affecting the farmers directly rather than quoting cases happening elsewhere which may have no immediate bearing on the target group.

A good example that can be quoted from these trials was on post maturity losses where the losses were calculated in monetary terms of the failure by the farmers to harvest early and avoid excessive field damage. This has a direct bearing during the recommendation of storage structures to complement other principles of storage management. Another area of importance that featured prominently was on the use of dusts where actellic (Pirmiphos methyl) was investigated and found quite effective at the recommended rate as a grain protectant. Farmers whose grains had traces of aflotoxin higher than the accepted limits were also advised accordingly; fortunately these cases were fairly few.

The idea of extending drying platforms to the field was unfortunately left out although results from trials were encouraging.

In February 1987, the GMU was turned over to the MOA for continued operation.

B. Organization, Equipment and Staffing

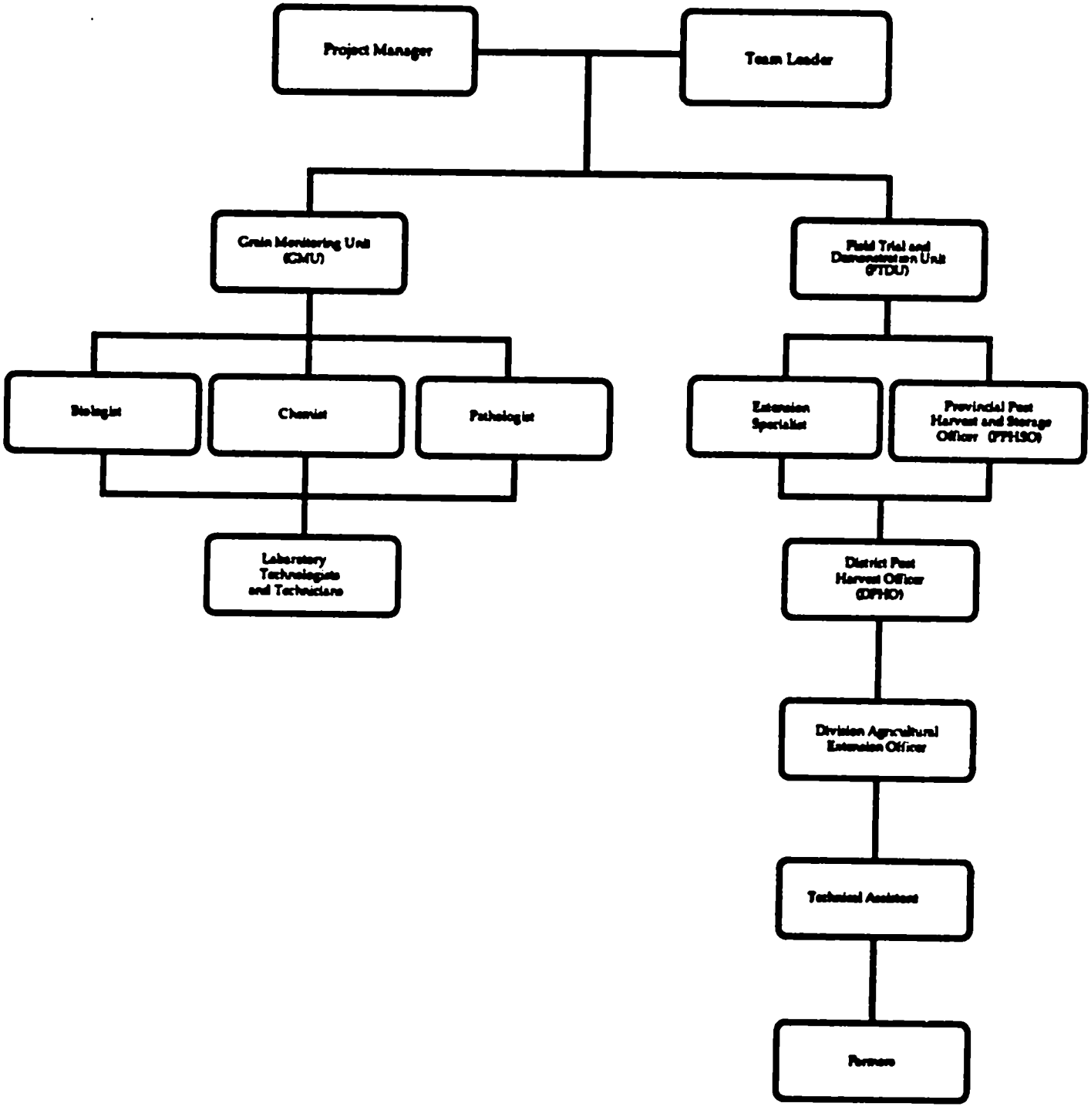
1. *Organizational Structure*

1. The current organizational structure of the Grain Monitoring Unit within the On Farm Grain Storage Project is shown in Figure 9-1. As pointed out elsewhere, the position of officer in charge of GMU currently is filled by the same person functioning as Project Manager of OFGSP.

2. *Equipment*

Biology Laboratory - Dickey John, Protimeters, Doles, Tally counters, Logam magnifiers, Desks, Electric balance, Olivetti Logas 48 calculator.

Figure 9.1 OFGSP Organizational Structure



Chemistry Laboratory- Fisher Scientific Beam balance, Kjedal Apparatus, Digestion unit, Refrigerator, Freezer, Fisher Thermix stirring hot plate, Waring blenders, Volumetric Flasks, Measuring Cylinders, and other glass-wares.

Dark room Spectroline UV Lamp.

Additional video equipment is still needed to properly equip the Maseno Laboratory's conference room. The complete list of laboratory equipment and reference materials at Maseno is shown in Appendix F of the report.

3. *Staffing*

The initial staffing in 1984 consisted of the following positions:

Post	No.
Grain Storage Engineer	1
Storage Grain Biologist	1
Chemist	1
Laboratory Supervisor	1
Laboratory Technicians	10
Computer Operator	1

After GMU was handed over to MOA in 1987 the staff to date includes four laboratory technicians, one chemist and one laboratory technician cum computer operator[1].

C. Achievements

1. The GMU identified a practical technology package based on the two-year trial (1984-1985) on the improvement of cultural storage practices to facilitate

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1 Executive Report, On Farm Grain Storage. April 30 1987.

reduction of on-farm grain storage losses. To reduce these losses the trials came up with the following recommendations:[2]

a. Grow maize with good husk cover.

b. Plant grains at a time which will result in harvesting during an expected dry period.

c. Maintain grain store in good repair.

d. Perform hygiene in both the store and surrounding area.

e. Spray store with appropriate insecticide.

f. Harvest grain as early as possible to reduce field damage and theft.

g. Drying granary should be located at a well-ventilated site and should be rain proof, rodent proof, theft resistant and easy to clean.

h. Treat the grain thoroughly with correct rate of recommended insecticidal dusts.

i. Rodent control; if rat guards are absent use anti-coagulant poisons, traps and cats.

2. Local farmers no longer have a problem of marketing their produce through the Central Storage System; i.e., National Cereal and Produce Board (NCPB) as before due to high moisture content of the grains.

3. The GMU programme has facilitated adoption of structures through the evolvement of measurable data.

4. As a result of collaborative effort with extension staff, farmer awareness of grains treatment and other storage practices has increased.

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2 Maize Conservation on the Farm. Proceedings of Seminar in Kisumu, Kenya. 21-23, January, 1986. DPRA, MOALD, USAID.

D. Constraints

1. *Lack of Key Staff:*

Since 1987 the laboratory has had no grain biologists to run the unit. The qualified laboratory supervisor (technologist) who was assisting the biologist has also left, leaving only a few staff (the rest were transferred laterally within the Ministry) who have acquired their laboratory experience on the job. They have had no training through established institutions in this professional area, inducing certain limitations during their operations particularly on insect identification and laboratory procedures.

2. *Lack of Coordination between GMU and FTDU*

Since 1987 there has been lack of proper coordination between the GMU and Field Testing and Demonstrations Unit (FTDU) to facilitate well-integrated operations between the laboratory and the field on the assessment of grain quality and effective grain sampling. This was voiced explicitly by the extension staff saying that their samples were not collected and delivered to the laboratories as had been done before 1987. The absence of a biologist played a role in this failure. Another area attributed to this failure was lack of transport since the technicians had to rely on funds from the PDA's office which were oftentimes unavailable except during the 1988/89 financial year when the unit was allocated its own budget.

3. *Lack of Training*

Training is very essential if required quality and quantity of output from the unit will be forthcoming. This would also motivate the staff during the execution of their assigned duties.

4. *Lack of Housing*

This area was overlooked during preparation of the project. Housing facilities at the Maseno Centre even for renting are lacking thereby forcing the staff to commute to and from Kisumu Town. All the staff vehemently voiced their con-

cern over this issue. The Task Force recommends provision of housing at the site.

5. *Lack of Nutritional Analysis*

No nutritional tests are being carried out though facilities are available to determine nitrogen content and thus infer protein content.

6. *Lack of Follow-Up Analysis*

Results from sample analysis are being stored in the computer pending further analysis to determine grain quality. This information is of technical importance to the extension workers when meeting farmers on post-harvest related matters. Efforts need to be made to summarize and disseminate the results to the extension staff in the project area.

E. Suggestions for the Future

1. *Staff Development*

Adequate staffing and training at the GMU should be the first priority in view of demonstrating to the farmers the extent of grain losses using available data tested in their fields. The requirements so far are the following cadres of staff:

1. Entomologist
2. Pathologist or mycologist
3. Laboratory technologist (specializing in Entomology or Pathology at the National Polytechnics).
4. Technicians (could be trained on the job as long as 1-3 of the above mentioned cadres of the staff are available. Short-term courses would also be essential before they could embark on the laboratory technologist training at the polytechnic).

2. *Added Functions*.

Another role that has hitherto been raised and was raised during the evaluation tour was on exploring the possible expansion of the laboratory to serve other needs such as soil testing and formulation analysis for the western Kenya region. However, before implementation of such efforts, a thorough study of the institutions having these facilities is required to understand the operation and constraints of such work. It would be unfortunate to venture into an area hurriedly with resultant failure due to unforeseen circumstances. It has been learned that certain institutions have been supplied with equipment which has been unserviceable due to lack of agents, thereby hindering any progress in the functioning of these units. Nevertheless, this area should be explored further and if found viable could go a long way in benefiting the farmers at large in the western Kenya region.

X. OPERATIONAL LINKAGES

A. National Agricultural Laboratories

Substantial collaboration between the National Agriculture Laboratories (NAL) and the OFGSP occurred during the initial stages of the project. The biologists within the project wanted information on all fields carried out at NAL Section for background information before embarking on the project trials. The NAL staff was also invited to contribute during the Maize Conservation On Farm seminar at Kisumu in January 1986. The project also assisted in the training of one staff member at TDRI.

B. Rural Structures Unit

RSU started its operations as far back as 1978 with headquarters situated in Nakuru. From then up to 1983 the sponsorship of this unit was executed through FAO. Since about 1983/84 the unit has been sponsored directly by SIDA. During its initial operations the thrust of the unit focused specifically on the crib for on-farm maize drying, water tanks and animal housing structures. When the On Farm Grain Storage Project (OFGSP) started its trial activity, it borrowed the RSU crib structure and compared it with the existing storage structures in the operational areas to determine the differences in their drying rates. This was the beginning of cooperation between the two projects. RSU was also invited to contribute project findings during the 1986 OFGSP workshop. Later collaboration included training of TOs at Duduville, Egerton University and artisans at Farmers' Training Centres (FTCs). Operations of RSU started in Rift Valley Province covering all districts except Uasin Gishu and Turkana. They later expanded to Central Province covering 5 districts, Eastern (3 districts) and Coast covering only Taita Taveta District in collaboration with DANIDA. While RSU has been active in many districts, the degree of saturation is less than in the districts in western Kenya where OFGSP has operated. RSU's approach in the last two years started

focusing not only on the RSU crib but on the whole package of grain storage mechanism involving management practices after harvest.

C. Chemical Companies

The main area of collaboration with the chemical firms has revolved on packaging of the recommended insecticidal dust for admixing with the shelled grain and sprays on the store fabric. The packaging of the dust in large quantities has led to unscrupulous stockists selling other inert white powdery dusts to unsuspecting farmers. The chemical companies have therefore been urged to pack the dusts in smaller packs besides the 400 gram puffer pack. This enables the farmers to purchase only the required dusts and also eliminates any tampering by stockists. They have also been requested to stock these dusts in smaller centres for easy accessibility by the farmers.

D. Agricultural Training Institutes - Embu and Bukura

The project provided training in Slough, England for two staff members at each institution. It also supplied these two institutions with audio-visual and laboratory equipment, books and training aids to be used by lecturers and students during their training at their institution. Significant progress is noted in terms of inclusion of grain storage technology within curricula and the establishment of grain quality laboratories.

E. Universities

The project has assisted the faculties of Engineering and Agricultural Extension at Egerton University with equipment and books. However, the task force was informed that some of the expected equipment has not yet been received at the engineering faculty. It is hoped the university will incorporate grain storage technology within its four-year curricula to enable graduating students to acquire knowledge in this important area. Similar contacts have been made with University of Nairobi but cooperation has been limited to date.

F. Farmers' Training Centres (FTCs)

Grain storage management training has been incorporated into the curricula of FTCs located at Bungoma, Busia, Homa Bay, Kisii, Maseno, Bukura and Siaya where audio visual aids and films are shown during training of TAs and farmers.

G. International Centre of Insect Physiology and Ecology (ICIPE)

ICIPE in collaboration with ECA is conducting trials in Oyugis Division of South Nyanza District on preharvest losses through resistant varieties, cultural and biological practices particularly on stalk borer. In early 1989 OFGSP collaborated with ICIPE in the construction of 50 storage cribs with OFGSP supplying the materials for construction and ICIPE/ECA funding the construction. The TAs in this area are also involved in imparting knowledge to the farmers in grain storage management practices, and further collaboration is expected.

H. Ministry Programmes

The project, in order to accomplish its intended goals, is effectively using the existing National Extension Programme and post-harvest officers at the provincial and district levels. Another area of collaboration which could be utilized during the delivery of this information is through the Crop Commodity Groups at the district level or Crop Production Professional Group meetings at the provincial level. Unfortunately, the task force found most post-harvest officers at the district level operating independently. However, these are two groups which could be effectively utilized by the project in carrying out extension work with farmers.

XI. ESTIMATION OF PROJECT IMPACTS

A. Estimation on Grain Losses

In the absence of analysis from GMU, the Task Force has had to rely on early field experiments, studies by other projects and qualitative surveys to determine the magnitude and causes of grain loss. Despite the variety of sources and methods, there is general agreement on the loss rates using traditional storage methods and using the improved management package.

ICIPE has estimated that 17% to 31% of maize grown by small-scale farmers is lost after physiological maturity (Seshu Reddy and Lucas Ngode of ECA/ICIPE Pilot Project, personal communication, 30 January 1989). In his analysis of farm management in the project area, Kariungi used a loss rate of 25% based on Peter Giles Post-Maturity Losses in the Field, Maize Conservation on the Farm, proceedings at Kisumu, January 12-13, 1986. In Judith Mbula's 1988 survey of demonstration and adopter farmers in western Kenya, the farmers reported pre-adoption losses averaging 23.6%. The evaluation of the RSU project also estimated pre-adoption losses at 23.6%.

Various surveys and field experiments (DPRA 1980, Giles 1986, Mbula 1988, and RSU 1988) have estimated that full implementation of the improved post-harvest management package will reduce grain losses to 4-5%. The full package is often not implemented, so the lower loss rates are frequently not realized. In South Nyanza, for example, the DPHO monitored five farmers in three sub-locations who had received raised baskets. Their average loss rate dropped from 35% in 1984 to 18% in 1988. While the results do indicate significant improvement, the five farmers are still far from attaining the targeted level.

In field tests by Giles, early harvesting of maize was found to reduce insect infestation by 50% as well as reducing losses due to birds, rodents, livestock, moulds, mycotoxins, weathering and grain germination. Giles also estimated

that up to 10% of the value of the potential harvest can be saved through early harvesting.

In another study by Giles, losses under three different management systems — improved traditional granaries, drying and storage cribs and traditional granaries — were compared over a 32 week period. In the improved granaries and cribs, the recommended package was implemented including early-harvesting. The traditional granaries were managed under the traditional system. Giles found that dusted shelled and bagged maize stored in cribs and raised baskets had 37 - 67% fewer insects than unfumigated maize stored in traditional granaries. Weekly dry weight loss was 63% to 70.8% lower in the improved granaries and cribs. He estimated that if a weight loss of 3.4% was prevented the cost of the Actellic would be covered. The percentages of discoloured grains and dust were reduced to negligible levels under the improved systems. (Giles, Maize Conservation on the Farm proceedings at Kisumu January 12-13, 1986)

B. Adoption Rates

Estimates of adoption and dispersion rates of the full management package, including structures, are not available. To gauge the extent to which farmers have adopted the package, it is necessary to examine each of the package components. As expected, low cost components with high returns have higher adoption rates than more expensive components with lower returns.

For example, cleaning storage units is a low-cost grain management practice. In Mbula's 1988 survey, storage hygiene was the most frequently reported activity among adopter farmers (59.3%) and farmers from the random sample (24.3%). Among demonstration farmers it was the third most frequently reported activity (68.1%).

Dusting shelled grain is another low-cost activity (less than Kshs 2 per 90 kg of maize). Farmers can readily observe the absence of pests and the better quality of the maize. Of the components that Mbula's 1988 survey covered, dusting shelled grain had the second highest adoption rate among adopter farmers

(52.5%) and farmers in the random sample (24.3%). Some 53.2% of demonstration farmers reported dusting their maize. Post-harvest officers interviewed by the Task Force confirmed that maize dusting is widespread. In one district, officials estimated that 50% of the farmers were using pesticides on their grain. While this may be an unrealistically high level, it illustrates the general perception of high chemical use.

To date the project has built 1764 demonstration structures. Extrapolating conservatively from data provided by district officials, roughly 220 structures were built by farmers without project support. Combined these 1984 structures represent a .25% dispersion level. Considering that this is the most expensive and complex component of the management system and that the project has only been distributing them for three years, this low level of dispersion is not unreasonably low.

(Note: From her 1988 survey of 173 randomly selected farmers in western Kenya, Mbula found that 9% reported having raised an existing structure or built a new one. For the two provinces this is equivalent to 71,632 structures. Mbula has clarified her results by noting that the 9% includes any structures that emulate, intentionally or not, any aspect of the demonstration units. For example, a raised structure that is too large for adequate ventilation would be included). The Task Force still feels that 9% is an overestimate.

Nonetheless, several factors have contributed to keeping the dispersion rate low. For example, as with the marketing of any complex and expensive product, frequent re-enforcement and a high level of personal contact are required to stimulate adoption of the new structures. The late arrival of bicycles and motorcycles to the project restricted the mobility of PHOs and TAs and thus, retarded the rate of dispersion. (This also applies to the rest of the management package and may explain why Mbula found so few demonstration farmers dusting shelled maize.) The lack of mobility was the constraint most frequently cited by post-harvest officers. During her study, Mbula found that many demonstration farmers had not been visited by a TA during the post-harvest period.

The adoption of structures was also slowed by the extended distribution of demonstration structures. Many potential adopters put off building their own in the expectation of receiving a free one from the project. Now that the project is moving to cost sharing, several districts reported that demand for structures (as high as 400 units per district) exceeds the project's ability to build them. Not surprisingly, the increased demand coincides with complaints from farmers about their share of the cost.

Table 11.1 Level of Adoption

Component	Percent Adoption (random sample)[1]	Cost
Harvesting at physiological maturity	18.5%	Labour only, but requires adequate storage capacity
Practice storage hygiene	24.3%	Low Cost
Installed rat guards	1.7%	Kshs 106
Dried maize to lower moisture level	13.9%	
With crib:		Kshs 620 to 2786 (includes rat guards)
Without crib:		Low monetary cost, high labour cost
Dusted shelled maize	24.3%	Kshs 15 for 400 gm of 1% Actellic.50 gms per 90 kg of maize are required.
Raised an existing or built a new structure.	2.5%[2]	Kshs 620 to 2786

1 Mbula, Judith, 1988 survey
2 Task Force estimate

C. Rate of Return Analysis

The economic viability of three technology packages – improved two section crib, improved raised basket, and traditional raised basket – was analyzed by the Task Force. All three packages, with IRRs between 24% and 34%, were found to be economically viable. Benefit-cost ratios based on opportunity cost of capital of 15% ranged from 1.401 for the improved raised basket to 1.827 for the traditional raised basket.

The analysis was based on Kariungi's 1989 farm management study in western Kenya ("Small-scale Farm Finance and Structure Loan Feasibility, Western Kenya"). Cash flows were projected quarterly over twenty years. The life of the structures was projected at 10 years for the two-section crib and 15 years for the two baskets. The primary modification to Kariungi's analysis was the exclusion of depreciation from annual capital costs. The annual capital costs for the two baskets are still somewhat overstated as they included the cost of rethatching the roof, a procedure that normally occurs every 18 to 24 months.

Alternative	Two-Section Crib	Improved R. Basket	Traditional R. Basket
Base Case:	34.165%	24.775%	34.028%
With Cost Sharing:			
1) Material Hired	59.907%	41.195%	66.404%
2) Material Supplied	157.179%	68.899%	84.851%

If failure to follow recommended management practices resulted in a 15.5% savings instead of the projected 20.5% savings, the IRRs for the three packages would be:

	13.182%	5.029%	13.513%

The projected cash flow for each of the three alternatives is shown in Appendix A, Appendix B and Appendix C, respectively.

D. Overall Impacts Towards National Goals

An additional kind of measure used to evaluate economic potential for an expanded programme of improved grain post-harvest management is to relate projected national benefits to projected total public costs for extension programmes, training and related functions, including the costs to donor agencies for support of the programme. The recent paper by F. T. Kariungi entitled **National Economic Savings through Adoption of Improved Storage Grain Structures and Storage Management**, prepared for the On-Farm Grain Storage Project on February 20, 1989 represents an effort in this direction.

1. *Benefits Contributing to National Goals*

What are the kinds of benefits from adoption of an improved grain post-harvest management system that contribute to Kenyan national goals? Mr. Kariungi has identified several of them. The most obvious is the value of the maize saved by reduction of the amount lost to insects, moulds, rodents and other pests. Additional benefits come as result of early harvesting under the improved system. Cattle can be grazed on the maize stalks to increase the production of milk and meat. The second crop of maize can be planted at the beginning of the rains, bringing about increased domestic production of staple food for the nation's families. Finally, the improved post-harvest system results in maize quality improvements that enhance the nutrition and health of the population. The food value is increased, contamination due to insects and rodents is reduced and possible poisons such as aflotoxins are eliminated.

The extent of benefit from these sources to the nation depends upon (1) how much improvement accrues to each farmer who adopts the programme and (2) the rate of adoption of the improved system by farmers once they have been exposed to it. Research results relating to the first of these is discussed in part A and the second is discussed in part B of this section. Projections of benefits for western Kenya based on quantitative loss reduction alone are presented in Section A of Appendix D. The adoption rates were projected based on Judith Mbula's

estimate for 1984. Another set of projected benefits are presented in Section A of Appendix E under a "worst possible" scenario with adoption rates only 60 per cent are those projected.

2. *Total Social Costs for the Programme*

Following Kariungi's work, the Task Force developed estimates of total costs for an expanded grain post-harvest programme in western Kenya as summarized in Section B of Appendices D and E. These costs include MOA extension and training costs for the programme, the costs for the USAID donor support, annualized investment costs and maintenance costs for structures by adopting farmers, and chemicals and related costs to farmers adopting this practice.

3. *Benefit-Cost and Net Present Value*

Based of projected benefits towards national goals and projected social costs through year 2001, the benefit-cost ratio discounted at 15 per cent per annum for the expanded programme in western Kenya years is 1.223 as shown in Section C of Appendix D. The corresponding projected net present value (NPV) is about Kshs 152 million.

If the adoption for shelling and treating maize and for early harvesting and drying were to lag seriously behind those projected, the benefits would be reduced substantially. In the scenario tested with the adoption rates taken at only 60 per cent of those projected, the benefit-cost ratio is 1.03 and the corresponding NPV is about Kshs 14.5 million (Appendix E; Section C).

XII. Major Constraints and Limitations Affecting Project Performance

In terms of the goals and targets of the OFGSP as stated on project documents (see Section I), project performance has been up to expectations, and is making the intended favourable impacts in Nyanza and Western Provinces. However, several constraints have been identified which have somewhat limited performance and delayed achievement dates beyond those targeted. If constraints can be reduced or eliminated in future grain post-harvest management programmes, then the achievements that can be expected will be enhanced.

Key constraints adversely affecting performance of OFGSP identified by the Task Force are listed below in the general order of most restrictive first.

A. Limitations of Equipment and Budget for Travel by Extension Workers

The lack of equipment and budget for travel funds has restricted MOA extension personnel in the frequency and timing of contacts with farmers. Limitations usually are most severe during the June-July period pending release of fiscal year funds at a time which is crucial for effective results in terms of saving crop losses. Project officials have been aware of this problem, and have used flexibility available to them to route grant funds to field workers where possible. After much delay in securing the necessary approvals and clearances, the full component of project motorcycles and a bicycles at last is available, and will help alleviate the problem. However, travel and other operating funds must be available to AOs, TOs and TAs if they are to be effective in making full use of these vehicles to visit contact farmers on schedule.

B. Delays in Fielding Key MOA Project Posts

As indicated in Section II A, the delays in posting qualified persons to counterpart and other key MOA project positions particularly in the early years has meant delays in the transference of project functions from DPRA staff to the MOA staff. Such delays restrain project performance more than simple time table delays. When the expatriate staff have to intervene directly, local people tend to become dependent upon them, and associate the new post-harvest technology with their presence physically. This tends to cause a back sliding of project performance when the expatriate is no longer on the scene.

C. Problems in Filling Expatriate Posts

Problems in filling expatriate posts during the early years of project operation caused some delay in project achievements. As contractor, DPRA was given Notice to Proceed in August of 1984. The first expatriate staff, the grain storage engineer and team leader, the stored grain biologist, the extension specialist in non-formal education and one provincial extension specialist arrived in western Kenya in February, 1984[1] . The social anthropologist started at the same time. The second provincial extension specialist was added in July 1984. The first provincial extension specialist resigned in April of 1985 and was replaced in June, 1985.

Most of the time from Febraury through June of 1984 was used to secure project commodities, to develop working relationships with USAID, with MOA officers in Nairobi and in Western and Nyanza Provinces, and with other persons knowledgeable about on-farm grain storage, and to conduct other "start-up" activities.

Delays in project achievements also arose in 1986-87 because of project extension and contract negotiations, which were finally completed on July 7, 1987. The new DPRA team leader and second provincial extension specialist were brought on board in November of 1987.

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1 **Executive Report.** On-Farm Grain Storage Project, DPRA, October, 1987.

D. Lack of Effective Coordination with the MOA Extension Division

The Task Force believes that a fourth constraint somewhat limiting potential project performance has been the lack of effective coordination with the National Extension (T & V) Programme through the office of Chief of the Extension and Service Division of MOA (see Section IIB). While the OFGSP has been carried out through the T & V mechanism at the division levels and below, both the project and the T & V could have benefited from the experiences of the other if more direct coordination had been achieved at the MOA Division level, as discussed in Section IV.

E. Emphasis on Structures Rather than Grain Post-Harvest Management

The Task Force believes that another constraint limiting potential performance of OFGSP has been the emphasis on structures rather than on the grain post-harvest management, particularly during the first three years of project operations. The engineering aspects were given emphasis at the expense of farm management, socio-anthropological and nutritional aspects, with heavy focus on two on-farm prototype structures, the "FAO crib" and the raised baskets, both of which were taken directly from the RSU designs. As the OFGSP later demonstrated, the major benefits to farmers and the nation accrue through reduced loss achieved by improved post-harvest management practice, the on-farm storage and drying structures being just one component part. Furthermore, as those directly involved with OFGSP have come to realize, farmers in the different districts face varying conditions so that alternative structure designs and alternative modifications of existing structures often are more feasible than those serving as the "centre piece" of the On-Farm Grain Storage Project in western Kenya. Even this title for the project tends to emphasis grain storage and structures only, rather than the grain post-harvest management system for small farmers in Kenya.

F. Location of Project Offices

As noted in Section II, the separation of the MOA project office and the DPRA project office has represented an additional constraint on project achievements. The problem was caused in part by the shifts of the DPRA office from Maseno to Kisumu midway through the project life and in part because no office space has been available for the two offices at the Nyanza Province headquarters. The Task Force recommends that effort be made to provide such space as soon as possible.

G. Location of the Grain Monitoring Unit

Perhaps the least significant, but still valid constraint limiting potential project performance in the eyes of the Task Force is the location of the Grain Monitoring Unit in Maseno. The location is not at the cross roads of economic activity in the area and does not have the amenities to attract and keep capable technical staff for the analytical testing. According to some estimates the costs of collecting and transporting the grain sample from the various divisions in the two provinces may be as much as double the cost to a central location on the highway network such as Kisumu or Kakamega. The location is even more disadvantageous if one were thinking of a national grain post-harvest management programme to be served by the GMU.

XIII. CONCLUSIONS AND RECOMMENDATIONS

A. Summary of Conclusions

The On Farm Grain Storage Project has been effective in achieving the goals and performing the functions for which it was intended. Effective technological packages for reducing post-harvest losses of maize have been developed, tested and demonstrated to farmers in western Kenya. The Ministry of Agriculture's capacity to transfer the post-harvest management technology at the frontline level with small farmers in the project area has been demonstrated. The capacity of Kenya's agricultural educational institutions to teach grain post-harvest management has been enhanced. The Grain Monitoring Unit has been established with capability to evaluate the quality of grain samples for damage by insects, moulds, rodents and other pests. Adequate numbers of improved grain structures have been erected in the project area to demonstrate the value of the technology and make farmers in the impact districts aware of the potentials for reducing post-harvest losses of maize.

The analyses made to date indicate the economic feasibility of the improved post-harvest management programme as sound farm management for small farmers in western Kenya, with internal rates of return for the total management package in the range of 24 to 34 per cent on total capital investment. Based on preliminary adoption rates, the programme is viable as a major thrust of agricultural extension in Nyanza and Western Provinces. The projected benefit-cost ratio based on 15 per cent annual discount rate to year 2001 is 1.22 at projected adoption rates and 1.03 if adoption rates are only 60 per cent of those projected. Important nutritional and public health benefits through improved quality of maize for family consumption have not been measured so far, but are known to be significant, and could raise the internal rate of return to as much as 40 per cent.

While major strides have been achieved in staff training at all levels, in increased training capability of Kenyan educational institutions, as well as in training of artisans, local leaders and others, the project has not yet reached the stage where no more donor technical assistance is needed. On the contrary, the project has demonstrated the economic and social viability of the programme, but has not passed the innovator and very early adopter stage of the diffusion process. Even where the programme has been in operation for five years, no more than one per cent of potential farm families has adopted the full technological package. Awareness is much higher--perhaps as much as 50 per cent--but much effort is required to move from awareness to adoption on a major scale. A well-planned donor support programme to help capitalize on what has been accomplished to date and move forward on the adoption curve over the next ten years or so could be very productive indeed.

Lessons are to be learned by experience under the OFGSP in Nyanza and Western Provinces to date on what to avoid as well as what needs to be done to maximize the benefits to target farm families and to the nation. Major constraints limiting project performance are outlined in Section XII; every effort should be made to minimize the negative impacts of such constraints in any planning for project extension in western Kenya or nationally. Likewise, some of the early steps in programme institutionalization have now been accomplished, and need not be repeated for project extension, at least not to the same degree. Other kinds of steps may be needed to move on forward.

Key components of the delivery mechanism found to be effective in carrying the message of improved post-harvest technology to farm families involve modifications of the T & V system of the national extension programme. Central components in that mechanism are the mini-clusters of neighbouring farmers, the demonstration structures, the series of farmer field days on specific post-harvest management practices timed to the right season, and the package of reference materials, films and other teaching aids.

B. Beneficial Components of OFGSP which Are Worthy of Expansion

The success of the project so far and the indicated rates of return to adopting farm families and to the nation clearly show that the basic thrust of improved maize post-harvest management is worthy of expansion in the project area and in other areas where maize is the major staple food for the population. Within the project area in western Kenya, the programme needs to be moved from the demonstration stage to a transitional stage of cost-sharing of the structure improvements with adaptor farmers. The first stage cost sharing which has been initiated seems to be appealing to farmers, but it is still too early to know what modifications may be needed to ensure the full success of a cost sharing transition.

The key delivery components of the project, including mini-clusters, the technical field day series, refresher training of TAs and TOs, information and awareness activities with chiefs, assistant chiefs and local leaders, well-prepared leaflets, films, video tapes, etc., have been proven to be effective and definitely should be included in any expansion program. Demonstration structures will be needed if additional prototypes are to be introduced. No additional demonstration cribs nor improved raised baskets for full transition to the cost sharing stage are recommended unless new prototypes are introduced or the project is extended to new areas. Offering of any more free demonstration structures in these areas could delay the acceptance of the cost sharing programme.

The Task Force is of the belief that most of the components of the staff training activities under the project, including academic training, extended short course training on grain post-harvest management, technical short courses, workshops, curriculum development at universities, colleges and training institutes, all should be considered for components worthy of inclusion in any project expansion programme. While there are trained people at all levels in Kenya, their numbers are insufficient to meet the needs of grain post-harvest management expertise under an expanded program even in western Kenya to say nothing of a possible national programme.

The Task Force believes that donor-supported technical assistance should be extended to ensure success of an expanded OFGSP programme; however, the ratio of foreign experts to Kenyan officers can be reduced as the project moves forward, and the functions of foreign technical assistants are limited to those requiring special expertise which is not available locally. An increasing part of the assistance can be shifted from extension methodology to technical and economic components of field development and testing of components of improved grain post-harvest and marketing systems for Kenyan farmers.

A final component worthy of inclusion in any expansion of grain post-harvest management is the facilities and equipment support. With the major component of the MOA extension programme committed for staff salaries (some 85 per cent, and increasing), outside support will be needed to ensure the mobility required for effective farmer contacts. The same goes for training aids, manuals and related materials.

C. Components of OFGSP Which Could Be Dropped in an Expanded Programme

The Task Force did not identify major components of the On Farm Grain Storage Project which could be dropped without adversely affecting the potential success of an expanded programme. However, several kinds of administrative streamlining were identified, and some subcomponents of the existing programme could be dropped in a well-structured expansion effort.

Less emphasis on grain storage structures and more emphasis on post-harvest management than has been true under OFGSP would make an expanded programme more effective. Such re-emphasis would reduce the relative expenditures needed for construction materials, carpenter training, etc. and increase the budget needed for computers, analytical programmes, financial worksheets, etc.

Another shift in emphasis under an expanded programme can be toward less effort on the development of new teaching and extension materials on post-

harvest management, and toward more effort on improving available materials such as those available from NAL, AIC and various research institutes and agencies in Kenya.

D. Needed Adjustments for a Future National Programme

The Task Force anticipates that several adjustments in components of the OFGSP will be needed for application in a future national programme on grain post-harvest management. The nature of the adjustments will depend in part on the parameters selected for the national programme. For example, the OFGSP is targeted to the small farmer who uses much of his maize crop to feed the family. Larger farmers may need a different set of management practices; likewise the very small farmers may need no structure at all, but could be assisted by management practices suitable to their conditions. On another dimension, the OFGSP concentrates on maize as the dominant food crop in Kenya. If the national programme were to target sorghum, millet, beans and other food staples as well, the emphasis would need to be somewhat different. If it were also to target potatoes and other perishable food crops it could be quite different. These kinds of parameters will need to be determined before the relative emphasis on demonstration structures, on engineering versus post-harvest management, etc., can be resolved.

Linkages to related programmes and operations should be given more attention in planning a national programme than was true for OFGSP. Issues to be addressed might include such things as (1) how to build more effective linkages between research and extension units and activities, (2) how to enhance appropriate supporting curriculum development at universities, institutes, secondary schools, polytechnic institutes and other training agencies, (3) how to achieve more effective coordination between technical divisions and the extension division of MOA in programme design, planning and execution, (4) how to structure a national programme in terms of national versus regional staffing patterns, (5) how to overcome recurring June-July budget limitations when field

activities crucial to project success come during this period, and (6) how to objectively assess the most effective mix of engineers, social scientists, farm management specialists, biologists, mycologists, extension methods specialists, etc., to carry out the programme.

Appendix A

Rate of Return Analysis for Two-Section Crib

Listing of Projected Quarterly Cash Flow

Calculation of Internal Rate of Return for Base Case

Calculation of Internal Rate of Return for Alternative 1, cost-sharing with most materials purchased and construction labour hired.

Calculation of Internal Rate of Return for Alternative 2, cost sharing with mostly local materials and no hired construction labour

Calculation of Internal Rate of Return for Alternative 3, reduction of loss savings from 20.5 percent to 15.5 percent.

LISTING OF FACTORS CONCERNING THIS RUN:

Unit of Measure for Output Is KShs

Number of Times Discounted per Year = 4.00

"Sunken Investment" Option IS NOT Being Used

Benefit-Costs Computed at Annual Discount Rates of:

.15000 .20000 .25000 .30000 .35000 .40000

A LISTING OF THE DATA

20.00 4.00 1 1 6 1 3 2 0 .110000

Two-Section Crib

Period No.	Qtr.	Invest	Wrk Cap	Savings	Shelling &Harvest	Pre-Store Hygiene	Insect.	Labour	Maint. Cost	Gunny Bags				
0	1	2885.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	2	0.	0.	0.	250.	0.	60.	25.	86.	149.	0.	0.	0.	0.
2	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
3	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
5	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
6	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
7	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
9	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
10	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
11	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
13	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
14	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
15	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
17	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
18	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
19	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
21	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
22	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
23	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
25	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
26	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
27	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
29	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
30	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.

31	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
33	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
34	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
35	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
37	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
38	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
39	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
40	1	2885.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
41	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
42	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
43	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
45	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
46	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
47	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
49	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
50	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
51	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
53	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
54	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
55	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
57	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
58	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
59	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
61	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
62	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
63	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
65	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
66	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
67	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
68	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
69	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
70	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
71	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
72	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
73	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
74	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
75	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
76	1	0.	0.	0.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
77	2	0.	0.	0.	250.	25.	60.	25.	86.	149.	0.	0.	0.	0.
78	3	0.	0.	1691.	0.	0.	0.	0.	86.	0.	0.	0.	0.	0.
79	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

INVESTMENT FEASIBILITY ANALYSIS

Two-Section Crib

INTERNAL RETURN ON TOTAL CAPITAL 34.165 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Present Value Net Revenue
0	1	2885.	0.	2885.	0.	0.	0.	1.0000	2885.	0.
1	2	0.	0.	0.	0.	570.	-570.	.9292	0.	-529.
2	3	0.	0.	0.	1691.	86.	1606.	.8633	0.	1386.
3	4	0.	0.	0.	0.	0.	0.	.8022	0.	0.
4	1	0.	0.	0.	0.	86.	-86.	.7453	0.	-64.
5	2	0.	0.	0.	0.	595.	-595.	.6925	0.	-412.
6	3	0.	0.	0.	1691.	86.	1606.	.6435	0.	1033.
7	4	0.	0.	0.	0.	0.	0.	.5979	0.	0.
8	1	0.	0.	0.	0.	86.	-86.	.5555	0.	-48.
9	2	0.	0.	0.	0.	595.	-595.	.5162	0.	-307.
10	3	0.	0.	0.	1691.	86.	1606.	.4796	0.	770.
11	4	0.	0.	0.	0.	0.	0.	.4456	0.	0.
12	1	0.	0.	0.	0.	86.	-86.	.4141	0.	-35.
13	2	0.	0.	0.	0.	595.	-595.	.3847	0.	-229.
14	3	0.	0.	0.	1691.	86.	1606.	.3575	0.	574.
15	4	0.	0.	0.	0.	0.	0.	.3322	0.	0.
16	1	0.	0.	0.	0.	86.	-86.	.3086	0.	-26.
17	2	0.	0.	0.	0.	595.	-595.	.2868	0.	-171.
18	3	0.	0.	0.	1691.	86.	1606.	.2665	0.	428.
19	4	0.	0.	0.	0.	0.	0.	.2476	0.	0.
20	1	0.	0.	0.	0.	86.	-86.	.2300	0.	-20.
21	2	0.	0.	0.	0.	595.	-595.	.2137	0.	-127.
22	3	0.	0.	0.	1691.	86.	1606.	.1986	0.	319.
23	4	0.	0.	0.	0.	0.	0.	.1845	0.	0.
24	1	0.	0.	0.	0.	86.	-86.	.1715	0.	-15.
25	2	0.	0.	0.	0.	595.	-595.	.1593	0.	-95.
26	3	0.	0.	0.	1691.	86.	1606.	.1480	0.	238.
27	4	0.	0.	0.	0.	0.	0.	.1375	0.	0.
28	1	0.	0.	0.	0.	86.	-86.	.1278	0.	-11.
29	2	0.	0.	0.	0.	595.	-595.	.1187	0.	-71.
30	3	0.	0.	0.	1691.	86.	1606.	.1103	0.	177.
31	4	0.	0.	0.	0.	0.	0.	.1025	0.	0.
32	1	0.	0.	0.	0.	86.	-86.	.0953	0.	-8.
33	2	0.	0.	0.	0.	595.	-595.	.0885	0.	-53.
34	3	0.	0.	0.	1691.	86.	1606.	.0822	0.	132.
35	4	0.	0.	0.	0.	0.	0.	.0764	0.	0.
36	1	0.	0.	0.	0.	86.	-86.	.0710	0.	-6.
37	2	0.	0.	0.	0.	595.	-595.	.0660	0.	-39.
38	3	0.	0.	0.	1691.	86.	1606.	.0613	0.	98.
39	4	0.	0.	0.	0.	0.	0.	.0570	0.	0.
40	1	2885.	0.	2885.	0.	86.	-86.	.0529	153.	-5.
41	2	0.	0.	0.	0.	595.	-595.	.0492	0.	-29.
42	3	0.	0.	0.	1691.	86.	1606.	.0457	0.	73.

43	4	0.	0.	0.	0.	0.	0.	.0424	0.	0.
44	1	0.	0.	0.	0.	86.	-86.	.0394	0.	-3.
45	2	0.	0.	0.	0.	595.	-595.	.0366	0.	-22.
46	3	0.	0.	0.	1691.	86.	1606.	.0341	0.	55.
47	4	0.	0.	0.	0.	0.	0.	.0316	0.	0.
48	1	0.	0.	0.	0.	86.	-86.	.0294	0.	-3.
49	2	0.	0.	0.	0.	595.	-595.	.0273	0.	-16.
50	3	0.	0.	0.	1691.	86.	1606.	.0254	0.	41.
51	4	0.	0.	0.	0.	0.	0.	.0236	0.	0.
52	1	0.	0.	0.	0.	86.	-86.	.0219	0.	-2.
53	2	0.	0.	0.	0.	595.	-595.	.0204	0.	-12.
54	3	0.	0.	0.	1691.	86.	1606.	.0189	0.	30.
55	4	0.	0.	0.	0.	0.	0.	.0176	0.	0.
56	1	0.	0.	0.	0.	86.	-86.	.0163	0.	-1.
57	2	0.	0.	0.	0.	595.	-595.	.0152	0.	-9.
58	3	0.	0.	0.	1691.	86.	1606.	.0141	0.	23.
59	4	0.	0.	0.	0.	0.	0.	.0131	0.	0.
60	1	0.	0.	0.	0.	86.	-86.	.0122	0.	-1.
61	2	0.	0.	0.	0.	595.	-595.	.0113	0.	-7.
62	3	0.	0.	0.	1691.	86.	1606.	.0105	0.	17.
63	4	0.	0.	0.	0.	0.	0.	.0098	0.	0.
64	1	0.	0.	0.	0.	86.	-86.	.0091	0.	-1.
65	2	0.	0.	0.	0.	595.	-595.	.0084	0.	-5.
66	3	0.	0.	0.	1691.	86.	1606.	.0078	0.	13.
67	4	0.	0.	0.	0.	0.	0.	.0073	0.	0.
68	1	0.	0.	0.	0.	86.	-86.	.0068	0.	-1.
69	2	0.	0.	0.	0.	595.	-595.	.0063	0.	-4.
70	3	0.	0.	0.	1691.	86.	1606.	.0058	0.	9.
71	4	0.	0.	0.	0.	0.	0.	.0054	0.	0.
72	1	0.	0.	0.	0.	86.	-86.	.0050	0.	0.
73	2	0.	0.	0.	0.	595.	-595.	.0047	0.	-3.
74	3	0.	0.	0.	1691.	86.	1606.	.0044	0.	7.
75	4	0.	0.	0.	0.	0.	0.	.0040	0.	0.
76	1	0.	0.	0.	0.	86.	-86.	.0038	0.	0.
77	2	0.	0.	0.	0.	595.	-595.	.0035	0.	-2.
78	3	0.	0.	0.	1691.	86.	1606.	.0032	0.	5.
79	4	0.	0.	0.	0.	0.	0.	.0030	0.	0.
TOTAL		5770.	0.	5770.	33825.	15210.	18615.		3038.	3038.

Interest Per cent	Benefit/Cost Ratio	Revenue	Present Value In Kshs Outlay	Balance
15.000	1.705	6137.	3598.	2538.
20.000	1.448	4853.	3351.	1502.
25.000	1.253	4004.	3195.	809.
30.000	1.102	3409.	3094.	315.
35.000	.982	2973.	3028.	-55.
40.000	.885	2642.	2985.	-343.

**Excluding depreciation, interest, and income tax
ALTERNATIVE: Base Case

INVESTMENT FEASIBILITY ANALYSIS

Two-Section Crib

INTERNAL RETURN ON TOTAL CAPITAL 13.182 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Net Revenue
0	1	2885.	0.	2885.	0.	0.	0.	1.0000	2885.	0.
1	2	0.	0.	0.	0.	570.	-570.	.9695	0.	-552.
2	3	0.	0.	0.	1279.	86.	1193.	.9400	0.	1121.
3	4	0.	0.	0.	0.	0.	0.	.9113	0.	0.
4	1	0.	0.	0.	0.	86.	-86.	.8835	0.	-76.
5	2	0.	0.	0.	0.	595.	-595.	.8566	0.	-509.
6	3	0.	0.	0.	1279.	86.	1193.	.8305	0.	991.
7	4	0.	0.	0.	0.	0.	0.	.8052	0.	0.
8	1	0.	0.	0.	0.	86.	-86.	.7806	0.	-67.
9	2	0.	0.	0.	0.	595.	-595.	.7568	0.	-450.
10	3	0.	0.	0.	1279.	86.	1193.	.7338	0.	875.
11	4	0.	0.	0.	0.	0.	0.	.7114	0.	0.
12	1	0.	0.	0.	0.	86.	-86.	.6897	0.	-59.
13	2	0.	0.	0.	0.	595.	-595.	.6687	0.	-398.
14	3	0.	0.	0.	1279.	86.	1193.	.6483	0.	773.
15	4	0.	0.	0.	0.	0.	0.	.6285	0.	0.
16	1	0.	0.	0.	0.	86.	-86.	.6094	0.	-52.
17	2	0.	0.	0.	0.	595.	-595.	.5908	0.	-351.
18	3	0.	0.	0.	1279.	86.	1193.	.5728	0.	683.
19	4	0.	0.	0.	0.	0.	0.	.5553	0.	0.
20	1	0.	0.	0.	0.	86.	-86.	.5384	0.	-46.
21	2	0.	0.	0.	0.	595.	-595.	.5220	0.	-310.
22	3	0.	0.	0.	1279.	86.	1193.	.5061	0.	604.
23	4	0.	0.	0.	0.	0.	0.	.4907	0.	0.
24	1	0.	0.	0.	0.	86.	-86.	.4757	0.	-41.
25	2	0.	0.	0.	0.	595.	-595.	.4612	0.	-274.
26	3	0.	0.	0.	1279.	86.	1193.	.4471	0.	533.
27	4	0.	0.	0.	0.	0.	0.	.4335	0.	0.
28	1	0.	0.	0.	0.	86.	-86.	.4203	0.	-36.
29	2	0.	0.	0.	0.	595.	-595.	.4075	0.	-242.
30	3	0.	0.	0.	1279.	86.	1193.	.3951	0.	471.
31	4	0.	0.	0.	0.	0.	0.	.3830	0.	0.
32	1	0.	0.	0.	0.	86.	-86.	.3713	0.	-32.
33	2	0.	0.	0.	0.	595.	-595.	.3600	0.	-214.
34	3	0.	0.	0.	1279.	86.	1193.	.3491	0.	416.
35	4	0.	0.	0.	0.	0.	0.	.3384	0.	0.
36	1	0.	0.	0.	0.	86.	-86.	.3281	0.	-28.
37	2	0.	0.	0.	0.	595.	-595.	.3181	0.	-189.
38	3	0.	0.	0.	1279.	86.	1193.	.3084	0.	368.
39	4	0.	0.	0.	0.	0.	0.	.2990	0.	0.
40	1	2885.	0.	2885.	0.	86.	-86.	.2899	836.	-25.

41	2	0.	0.	0.	0.	595.	-595.	.2811	0.	-167.
42	3	0.	0.	0.	1279.	86.	1193.	.2725	0.	325.
43	4	0.	0.	0.	0.	0.	0.	.2642	0.	0.
44	1	0.	0.	0.	0.	86.	-86.	.2561	0.	-22.
45	2	0.	0.	0.	0.	595.	-595.	.2483	0.	-148.
46	3	0.	0.	0.	1279.	86.	1193.	.2407	0.	287.
47	4	0.	0.	0.	0.	0.	0.	.2334	0.	0.
48	1	0.	0.	0.	0.	86.	-86.	.2263	0.	-19.
49	2	0.	0.	0.	0.	595.	-595.	.2194	0.	-130.
50	3	0.	0.	0.	1279.	86.	1193.	.2127	0.	254.
51	4	0.	0.	0.	0.	0.	0.	.2062	0.	0.
52	1	0.	0.	0.	0.	86.	-86.	.1999	0.	-17.
53	2	0.	0.	0.	0.	595.	-595.	.1938	0.	-115.
54	3	0.	0.	0.	1279.	86.	1193.	.1879	0.	224.
55	4	0.	0.	0.	0.	0.	0.	.1822	0.	0.
56	1	0.	0.	0.	0.	86.	-86.	.1767	0.	-15.
57	2	0.	0.	0.	0.	595.	-595.	.1713	0.	-102.
58	3	0.	0.	0.	1279.	86.	1193.	.1660	0.	198.
59	4	0.	0.	0.	0.	0.	0.	.1610	0.	0.
60	1	0.	0.	0.	0.	86.	-86.	.1561	0.	-13.
61	2	0.	0.	0.	0.	595.	-595	.1513	0.	-90.
62	3	0.	0.	0.	1279.	86.	11[illegible]	.1467	0.	175.
63	4	0.	0.	0.	0.	0.	0.	.1422	0.	0.
64	1	0.	0.	0.	0.	86.	-86.	.1379	0.	-12.
65	2	0.	0.	0.	0.	595.	-595.	.1337	0.	-80.
66	3	0.	0.	0.	1279.	86.	1193.	.1296	0.	155.
67	4	0.	0.	0.	0.	0.	0.	.1257	0.	0.
68	1	0.	0.	0.	0.	86.	-86.	.1218	0.	-10.
69	2	0.	0.	0.	0.	595.	-595.	.1181	0.	-70.
70	3	0.	0.	0.	1279.	86.	1193.	.1145	0.	137.
71	4	0.	0.	0.	0.	0.	0.	.1110	0.	0.
72	1	0.	0.	0.	0.	86.	-86.	.1076	0.	-9.
73	2	0.	0.	0.	0.	595.	-595.	.1044	0.	-62.
74	3	0.	0.	0.	1279.	86.	1193.	.1012	0.	121.
75	4	0.	0.	0.	0.	0.	0.	.0981	0.	0.
76	1	0.	0.	0.	0.	86.	-86.	.0951	0.	-8.
77	2	0.	0.	0.	0.	595.	-595.	.0922	0.	-55.
78	3	0.	0.	0.	1279.	86.	1193.	.0894	0.	107.
79	4	0.	0.	0.	0.	0.	0.	.0867	0.	0.
TOTAL		5770.	0.	5770.	25575.	15210.	10365.		3721.	3721.

Interest Per Cent	Ratio	Benefit/cost Revenue	Present value in KShs Outlay	Balance
15.000	.936	3368.	3598.	-230.
20.000	.792	2653.	3351.	-698.
25.000	.682	2180.	3195.	-1015.
30.000	.598	1850.	3094.	-1245.
35.000	.531	1607.	3028.	-1421.
40.000	.477	1423.	2985.	-1562.

**Excluding depreciation, interest, and income tax

ALTERNATIVE:

Alternative 1: Loss savings reduced from 20.5 to 15.5 per cent

INVESTMENT FEASIBILITY ANALYSIS

Two-Section Crib

INTERNAL RETURN ON TOTAL CAPITAL 59.907 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs.) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Present Value Net Revenue
0	1	2000.	0.	2000.	0.	0.	0.	1.0000	2000.	0.
1	2	0.	0.	0.	0.	543.	-543.	.8893	0.	-483.
2	3	0.	0.	0.	1691.	59.	1632.	.7908	0.	1290.
3	4	0.	0.	0.	0.	0.	0.	.7032	0.	0.
4	1	0.	0.	0.	0.	59.	-59.	.6254	0.	-37.
5	2	0.	0.	0.	0.	568.	-568.	.5561	0.	-316.
6	3	0.	0.	0.	1691.	59.	1632.	.4945	0.	807.
7	4	0.	0.	0.	0.	0.	0.	.4398	0.	0.
8	1	0.	0.	0.	0.	59.	-59.	.3911	0.	-23.
9	2	0.	0.	0.	0.	568.	-568.	.3478	0.	-198.
10	3	0.	0.	0.	1691.	59.	1632.	.3093	0.	505.
11	4	0.	0.	0.	0.	0.	0.	.2750	0.	0.
12	1	0.	0.	0.	0.	59.	-59.	.2446	0.	-15.
13	2	0.	0.	0.	0.	568.	-568.	.2175	0.	-124.
14	3	0.	0.	0.	1691.	59.	1632.	.1934	0.	316.
15	4	0.	0.	0.	0.	0.	0.	.1720	0.	0.
16	1	0.	0.	0.	0.	59.	-59.	.1529	0.	-9.
17	2	0.	0.	0.	0.	568.	-568.	.1360	0.	-77.
18	3	0.	0.	0.	1691.	59.	1632.	.1209	0.	197.
19	4	0.	0.	0.	0.	0.	0.	.1076	0.	0.
20	1	0.	0.	0.	0.	59.	-59.	.0956	0.	-6.
21	2	0.	0.	0.	0.	568.	-568.	.0851	0.	-48.
22	3	0.	0.	0.	1691.	59.	1632.	.0756	0.	123.
23	4	0.	0.	0.	0.	0.	0.	.0673	0.	0.
24	1	0.	0.	0.	0.	59.	-59.	.0598	0.	-4.
25	2	0.	0.	0.	0.	568.	-568.	.0532	0.	-30.
26	3	0.	0.	0.	1691.	59.	1632.	.0473	0.	77.
27	4	0.	0.	0.	0.	0.	0.	.0421	0.	0.
28	1	0.	0.	0.	0.	59.	-59.	.0374	0.	-2.
29	2	0.	0.	0.	0.	568.	-568.	.0333	0.	19.
30	3	0.	0.	0.	1691.	59.	1632.	.0296	0.	48.
31	4	0.	0.	0.	0.	0.	0.	.0263	0.	0.
32	1	0.	0.	0.	0.	59.	-59.	.0234	0.	-1.
33	2	0.	0.	0.	0.	568.	-568.	.0208	0.	-12.
34	3	0.	0.	0.	1691.	59.	1632.	.0185	0.	30.
35	4	0.	0.	0.	0.	0.	0.	.0164	0.	0.
36	1	0.	0.	0.	0.	59.	-59.	.0146	0.	-1.
37	2	0.	0.	0.	0.	568.	-568.	.0130	0.	-7.
38	3	0.	0.	0.	1691.	59.	1632.	.0116	0.	19.
39	4	0.	0.	0.	0.	0.	0.	.0103	0.	0.
40	1	2000.	0.	2000.	0.	59.	-59.	.0091	18.	-1.
41	2	0.	0.	0.	0.	568.	-568.	.0081	0.	-5.
42	3	0.	0.	0.	1691.	59.	1632.	.0072	0.	12.

43	4	0.	0.	0.	0.	0.	0.	.0064	0.	0.
44	1	0.	0.	0.	0.	59.	-59.	.0057	0.	0.
45	2	0.	0.	0.	0.	568.	-568.	.0051	0.	-3.
46	3	0.	0.	0.	1691.	59.	1632.	.0045	0.	7.
47	4	0.	0.	0.	0.	0.	0.	.0040	0.	0.
48	1	0.	0.	0.	0.	59.	-59.	.0036	0.	0.
49	2	0.	0.	0.	0.	568.	-568.	.0032	0.	-2.
50	3	0.	0.	0.	1691.	59.	1632.	.0028	0.	5.
51	4	0.	0.	0.	0.	0.	0.	.0025	0.	0.
52	1	0.	0.	0.	0.	59.	-59.	.0022	0.	0.
53	2	0.	0.	0.	0.	568.	-568.	.0020	0.	-1.
54	3	0.	0.	0.	1691.	59.	1632.	.0018	0.	3.
55	4	0.	0.	0.	0.	0.	0.	.0016	0.	0.
56	1	0.	0.	0.	0.	59.	-59.	.0014	0.	0.
57	2	0.	0.	0.	0.	568.	-568.	.0012	0.	-1.
58	3	0.	0.	0.	1691.	59.	1632.	.0011	0.	2.
59	4	0.	0.	0.	0.	0.	0.	.0010	0.	0.
60	1	0.	0.	0.	0.	59.	-59.	.0009	0.	0.
61	2	0.	0.	0.	0.	568.	-568.	.0008	0.	0.
62	3	0.	0.	0.	1691.	59.	1632.	.0007	0.	1.
63	4	0.	0.	0.	0.	0.	0.	.0006	0.	0.
64	1	0.	0.	0.	0.	59.	-59.	.0005	0.	0.
65	2	0.	0.	0.	0.	568.	-568.	.0005	0.	0.
66	3	0.	0.	0.	1691.	59.	1632.	.0004	0.	1.
67	4	0.	0.	0.	0.	0.	0.	.0004	0.	0.
68	1	0.	0.	0.	0.	59.	-59.	.0003	0.	0.
69	2	0.	0.	0.	0.	568.	-568.	.0003	0.	0.
70	3	0.	0.	0.	1691.	59.	1632.	.0003	0.	0.
71	4	0.	0.	0.	0.	0.	0.	.0002	0.	0.
72	1	0.	0.	0.	0.	59.	-59.	.0002	0.	0.
73	2	0.	0.	0.	0.	568.	-568.	.0002	0.	0.
74	3	0.	0.	0.	1691.	59.	1632.	.0002	0.	0.
75	4	0.	0.	0.	0.	0.	0.	.0002	0.	0.
76	1	0.	0.	0.	0.	59.	-59.	.0001	0.	0.
77	2	0.	0.	0.	0.	568.	-568.	.0001	0.	0.
78	3	0.	0.	0.	1691.	59.	1632.	.0001	0.	0.
79	4	0.	0.	0.	0.	0.	0.	.0001	0.	0.
TOTAL		4000.	0.	4000.	33825.	13660.	20165.		2018.	2018.

Interest Per Cent	Benefit/cost Ratio	Revenue	Present value in KShs Outlay	Balance
15.000	2.669	6659.	2494.	4164.
20.000	2.268	5268.	2323.	2945.
25.000	1.962	4346.	2215.	2132.
30.000	1.726	3702.	2145.	1556.
35.000	1.538	3229.	2099.	1130.
40.000	1.387	2869.	2069.	800.

**Excluding depreciation, interest, and income tax
Alternative 2: Some materials purchased, labour hired
Cost construction drops from 1365 to 1000

INVESTMENT FEASIBILITY ANALYSIS

Two-Section Crib

INTERNAL RETURN ON TOTAL CAPITAL 157.179 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Present Value Net Revenue
0	1	1000.	0.	1000.	0.	0.	0.	1.0000	1000.	0.
1	2	0.	0.	0.	0.	514.	-514.	.7897	0.	-406.
2	3	0.	0.	0.	1691.	30.	1662.	.6236	0.	1036.
3	4	0.	0.	0.	0.	0.	0.	.4924	0.	0.
4	1	0.	0.	0.	0.	30.	-30.	.3888	0.	-12.
5	2	0.	0.	0.	0.	539.	-539.	.3070	0.	-165.
6	3	0.	0.	0.	1691.	30.	1662.	.2425	0.	403.
7	4	0.	0.	0.	0.	0.	0.	.1915	0.	0.
8	1	0.	0.	0.	0.	30.	-30.	.1512	0.	-4.
9	2	0.	0.	0.	0.	539.	-539.	.1194	0.	-64.
10	3	0.	0.	0.	1691.	30.	1662.	.0943	0.	157.
11	4	0.	0.	0.	0.	0.	0.	.0744	0.	0.
12	1	0.	0.	0.	0.	30.	-30.	.0588	0.	-2.
13	2	0.	0.	0.	0.	539.	-539.	.0464	0.	-25.
14	3	0.	0.	0.	1691.	30.	1662.	.0367	0.	61.
15	4	0.	0.	0.	0.	0.	0.	.0289	0.	0.
16	1	0.	0.	0.	0.	30.	-30.	.0229	0.	-1.
17	2	0.	0.	0.	0.	539.	-539.	.0181	0.	-10.
18	3	0.	0.	0.	1691.	30.	1662.	.0143	0.	24.
19	4	0.	0.	0.	0.	0.	0.	.0113	0.	0.
20	1	0.	0.	0.	0.	30.	-30.	.0089	0.	0.
21	2	0.	0.	0.	0.	539.	-539.	.0070	0.	-4.
22	3	0.	0.	0.	1691.	30.	1662.	.0055	0.	9.
23	4	0.	0.	0.	0.	0.	0.	.0044	0.	0.
24	1	0.	0.	0.	0.	30.	-30.	.0035	0.	0.
25	2	0.	0.	0.	0.	539.	-539.	.0027	0.	-1.
26	3	0.	0.	0.	1691.	30.	1662.	.0022	0.	4.
27	4	0.	0.	0.	0.	0.	0.	.0017	0.	0.
28	1	0.	0.	0.	0.	30.	-30.	.0013	0.	0.
29	2	0.	0.	0.	0.	539.	-539.	.0011	0.	-1.
30	3	0.	0.	0.	1691.	30.	1662.	.0008	0.	1.
31	4	0.	0.	0.	0.	0.	0.	.0007	0.	0.
32	1	0.	0.	0.	0.	30.	-30.	.0005	0.	0.
33	2	0.	0.	0.	0.	539.	-539.	.0004	0.	0.
34	3	0.	0.	0.	1691.	30.	1662.	.0003	0.	1.
35	4	0.	0.	0.	0.	0.	0.	.0003	0.	0.
36	1	0.	0.	0.	0.	30.	-30.	.0002	0.	0.
37	2	0.	0.	0.	0.	539.	-539.	.0002	0.	0.
38	3	0.	0.	0.	1691.	30.	1662.	.0001	0.	0.
39	4	0.	0.	0.	0.	0.	0.	.0001	0.	0.
40	1	1000.	0.	1000.	0.	30.	-30.	.0001	0.	0.
41	2	0.	0.	0.	0.	539.	-539.	.0001	0.	0.
42	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.

43	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
44	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
45	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
46	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
47	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
48	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
49	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
50	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
51	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
52	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
53	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
54	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
55	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
56	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
57	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
58	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
59	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
60	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
61	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
62	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
63	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
64	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
65	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
66	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
67	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
68	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
69	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
70	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
71	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
72	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
73	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
74	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
75	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
76	1	0.	0.	0.	0.	30.	-30.	.0000	0.	0.
77	2	0.	0.	0.	0.	539.	-539.	.0000	0.	0.
78	3	0.	0.	0.	1691.	30.	1662.	.0000	0.	0.
79	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
TOTAL		2000.	0.	2000.	33825.	11907.	21918.		1000.	1000.

Interest Per Cent	Benefit/cost Ratio	Revenue	Present Value in KShs Outlay	Balance
15.000	5.812	7248.	1247.	6001.
20.000	4.938	5736.	1162.	4574.
25.000	4.275	4734.	1107.	3626.
30.000	3.759	4032.	1073.	2960.
35.000	3.351	3518.	1050.	2468.
40.000	3.022	3127.	1035.	2092.

**Excluding depreciation, interest, and income tax
Alternative 3: Most materials obtained locally: excludes labour
Construction cost drops from 1365 to 700

Appendix B

Rate of Return Analysis for Improved Raised Basket

Listing of Projected Quarterly Cash Flow

Calculation of Internal Rate of Return for Base Case

Calculation of Internal Rate of Return for Alternative 1, cost-sharing with most materials purchased and construction labour hired.

Calculation of Internal Rate of Return for Alternative 2, cost sharing with mostly local materials and no hired construction labour.

Calculation of Internal Rate of Return for Alternative 3, reduction of loss savings from 20.5 percent to 15.5 percent.

LISTING OF FACTORS CONCERNING THIS RUN:

Unit of Measure for Output Is KShs

Number of Times Discounted per Year = 4.00

"Sunken Investment" Option IS NOT Being Used

Benefit-Costs Computed at Annual Discount Rates of:

.15000 .20000 .25000 .30000 .35000 .40000

A LISTING OF THE DATA

20.00 4.00 1 1 6 1 3 2 0 .110000

Improved Raised Basket

Period No.	Qtr.	Invest	Wrk Cap	Savings	Shelling &Harvest	Pre-Store Hygiene	Insect.	Labour	Maint. Cost	Gunny Bags				
0	1	1365.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	2	0.	0.	0.	100.	0.	24.	10.	45.	60.	0.	0.	0.	0.
2	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
3	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
5	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
6	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
7	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
9	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
10	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
11	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
13	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
14	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
15	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
17	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
18	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
19	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
21	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
22	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
23	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
25	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
26	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
27	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
29	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
30	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.

31	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
33	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
34	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
35	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
37	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
38	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
39	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
40	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
41	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
42	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
43	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
45	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
46	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
47	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
49	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
50	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
51	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
53	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
54	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
55	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
57	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
58	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
59	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	1	1365.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
61	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
62	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
63	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
65	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
66	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
67	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
68	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
69	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
70	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
71	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
72	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
73	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
74	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
75	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
76	1	0.	0.	0.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
77	2	0.	0.	0.	100.	25.	24.	10.	45.	60.	0.	0.	0.	0.
78	3	0.	0.	677.	0.	0.	0.	0.	45.	0.	0.	0.	0.	0.
79	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

INVESTMENT FEASIBILITY ANALYSIS

Improved Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 24.775 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Present Value Net Revenue
0	1	1365.	0.	1365.	0.	0.	0.	1.0000	1365.	0.
1	2	0.	0.	0.	0.	239.	-239.	.9462	0.	-226.
2	3	0.	0.	0.	677.	45.	631.	.8952	0.	565.
3	4	0.	0.	0.	0.	0.	0.	.8470	0.	0.
4	1	0.	0.	0.	0.	45.	-45.	.8014	0.	-36.
5	2	0.	0.	0.	0.	264.	-264.	.7583	0.	-200.
6	3	0.	0.	0.	677.	45.	631.	.7175	0.	453.
7	4	0.	0.	0.	0.	0.	0.	.6789	0.	0.
8	1	0.	0.	0.	0.	45.	-45.	.6423	0.	-29.
9	2	0.	0.	0.	0.	264.	-264.	.6077	0.	-160.
10	3	0.	0.	0.	677.	45.	631.	.5750	0.	363.
11	4	0.	0.	0.	0.	0.	0.	.5441	0.	0.
12	1	0.	0.	0.	0.	45.	-45.	.5148	0.	-23.
13	2	0.	0.	0.	0.	264.	-264.	.4871	0.	-129.
14	3	0.	0.	0.	677.	45.	631.	.4608	0.	291.
15	4	0.	0.	0.	0.	0.	0.	.4360	0.	0.
16	1	0.	0.	0.	0.	45.	-45.	.4126	0.	-19.
17	2	0.	0.	0.	0.	264.	-264.	.3903	0.	-103.
18	3	0.	0.	0.	677.	45.	631.	.3693	0.	233.
19	4	0.	0.	0.	0.	0.	0.	.3495	0.	0.
20	1	0.	0.	0.	0.	45.	-45.	.3306	0.	-15.
21	2	0.	0.	0.	0.	264.	-264.	.3128	0.	-83.
22	3	0.	0.	0.	677.	45.	631.	.2960	0.	187.
23	4	0.	0.	0.	0.	0.	0.	.2801	0.	0.
24	1	0.	0.	0.	0.	45.	-45.	.2650	0.	-12.
25	2	0.	0.	0.	0.	264.	-264.	.2507	0.	-66.
26	3	0.	0.	0.	677.	45.	631.	.2372	0.	150.
27	4	0.	0.	0.	0.	0.	0.	.2245	0.	0.
28	1	0.	0.	0.	0.	45.	-45.	.2124	0.	-10.
29	2	0.	0.	0.	0.	264.	-264.	.2009	0.	-53.
30	3	0.	0.	0.	677.	45.	631.	.1901	0.	120.
31	4	0.	0.	0.	0.	0.	0.	.1799	0.	0.
32	1	0.	0.	0.	0.	45.	-45.	.1702	0.	-8.
33	2	0.	0.	0.	0.	264.	-264.	.1610	0.	-43.
34	3	0.	0.	0.	677.	45.	631.	.1524	0.	96.
35	4	0.	0.	0.	0.	0.	0.	.1442	0.	0.
36	1	0.	0.	0.	0.	45.	-45.	.1364	0.	-6.
37	2	0.	0.	0.	0.	264.	-264.	.1291	0.	-34.
38	3	0.	0.	0.	677.	45.	631.	.1221	0.	77.
39	4	0.	0.	0.	0.	0.	0.	.1155	0.	0.
40	1	0.	0.	0.	0.	45.	-45.	.1093	0.	-5.
41	2	0.	0.	0.	0.	264.	-264.	.1034	0.	-27.
42	3	0.	0.	0.	677.	45.	631.	.0979	0.	62.

43	4	0.	0.	0.	0.	0.	0.	.0926	0.	0.
44	1	0.	0.	0.	0.	45.	-45.	.0876	0.	-4.
45	2	0.	0.	0.	0.	264.	-264.	.0829	0.	-22.
46	3	0.	0.	0.	677.	45.	631.	.0784	0.	50.
47	4	0.	0.	0.	0.	0.	0.	.0742	0.	0.
48	1	0.	0.	0.	0.	45.	-45.	.0702	0.	-3.
49	2	0.	0.	0.	0.	264.	-264.	.0664	0.	-18.
50	3	0.	0.	0.	677.	45.	631.	.0629	0.	40.
51	4	0.	0.	0.	0.	0.	0.	.0595	0.	0.
52	1	0.	0.	0.	0.	45.	-45.	.0563	0.	-3.
53	2	0.	0.	0.	0.	264.	-264.	.0532	0.	-14.
54	3	0.	0.	0.	677.	45.	631.	.0504	0.	32.
55	4	0.	0.	0.	0.	0.	0.	.0477	0.	0.
56	1	0.	0.	0.	0.	45.	-45.	.0451	0.	-2.
57	2	0.	0.	0.	0.	264.	-264.	.0427	0.	-11.
58	3	0.	0.	0.	677.	45.	631.	.0404	0.	25.
59	4	0.	0.	0.	0.	0.	0.	.0382	0.	0.
60	1	1365.	0.	1365.	0.	45.	-45.	.0361	49.	-2.
61	2	0.	0.	0.	0.	264.	-264.	.0342	0.	-9.
62	3	0.	0.	0.	677.	45.	631.	.0324	0.	20.
63	4	0.	0.	0.	0.	0.	0.	.0306	0.	0.
64	1	0.	0.	0.	0.	45.	-45.	.0290	0.	-1.
65	2	0.	0.	0.	0.	264.	-264.	.0274	0.	-7.
66	3	0.	0.	0.	677.	45.	631.	.0259	0.	16.
67	4	0.	0.	0.	0.	0.	0.	.0245	0.	0.
68	1	0.	0.	0.	0.	45.	-45.	.0232	0.	-1.
69	2	0.	0.	0.	0.	264.	-264.	.0220	0.	-6.
70	3	0.	0.	0.	677.	45.	631.	.0208	0.	13.
71	4	0.	0.	0.	0.	0.	0.	.0197	0.	0.
72	1	0.	0.	0.	0.	45.	-45.	.0186	0.	-1.
73	2	0.	0.	0.	0.	264.	-264.	.0176	0.	-5.
74	3	0.	0.	0.	677.	45.	631.	.0167	0.	11.
75	4	0.	0.	0.	0.	0.	0.	.0158	0.	0.
76	1	0.	0.	0.	0.	45.	-45.	.0149	0.	-1.
77	2	0.	0.	0.	0.	264.	-264.	.0141	0.	-4.
78	3	0.	0.	0.	677.	45.	631.	.0133	0.	8.
79	4	0.	0.	0.	0.	0.	0.	.0126	0.	0.
TOTAL		2730.	0.	2730.	13530.	7013.	6517.		1414.	1414.

Interest Per cent	Benefit/Cost Ratio	Present Value In Kshs Revenue	Outlay	Balance
15.000	1.401	2148.	1533.	615.
20.000	1.169	1700.	1454.	246.
25.000	.993	1403.	1413.	-10.
30.000	.859	1196.	1392.	-196.
35.000	.756	1043.	1380.	-337.
40.000	.675	928.	1374.	-446.

**Excluding depreciation, interest, and income tax
ALTERNATIVE: Base Case

INVESTMENT FEASIBILITY ANALYSIS

Improved Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 5.029 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Net Revenue
0	1	1365.	0.	1365.	0.	0.	0.	1.0000	1365.	0.
1	2	0.	0.	0.	0.	239.	-239.	.9878	0.	-236.
2	3	0.	0.	0.	511.	45.	466.	.9758	0.	455.
3	4	0.	0.	0.	0.	0.	0.	.9639	0.	0.
4	1	0.	0.	0.	0.	45.	-45.	.9521	0.	-43.
5	2	0.	0.	0.	0.	264.	-264.	.9405	0.	-248.
6	3	0.	0.	0.	511.	45.	466.	.9290	0.	433.
7	4	0.	0.	0.	0.	0.	0.	.9177	0.	0.
8	1	0.	0.	0.	0.	45.	-45.	.9065	0.	-41.
9	2	0.	0.	0.	0.	264.	-264.	.8955	0.	-236.
10	3	0.	0.	0.	511.	45.	466.	.8846	0.	413.
11	4	0.	0.	0.	0.	0.	0.	.8738	0.	0.
12	1	0.	0.	0.	0.	45.	-45.	.8631	0.	-39.
13	2	0.	0.	0.	0.	264.	-264.	.8526	0.	-225.
14	3	0.	0.	0.	511.	45.	466.	.8422	0.	393.
15	4	0.	0.	0.	0.	0.	0.	.8319	0.	0.
16	1	0.	0.	0.	0.	45.	-45.	.8218	0.	-37.
17	2	0.	0.	0.	0.	264.	-264.	.8118	0.	-214.
18	3	0.	0.	0.	511.	45.	466.	.8019	0.	374.
19	4	0.	0.	0.	0.	0.	0.	.7921	0.	0.
20	1	0.	0.	0.	0.	45.	-45.	.7825	0.	-35.
21	2	0.	0.	0.	0.	264.	-264.	.7729	0.	-204.
22	3	0.	0.	0.	511.	45.	466.	.7635	0.	356.
23	4	0.	0.	0.	0.	0.	0.	.7542	0.	0.
24	1	0.	0.	0.	0.	45.	-45.	.7450	0.	-34.
25	2	0.	0.	0.	0.	264.	-264.	.7359	0.	-194.
26	3	0.	0.	0.	511.	45.	466.	.7269	0.	339.
27	4	0.	0.	0.	0.	0.	0.	.7181	0.	0.
28	1	0.	0.	0.	0.	45.	-45.	.7093	0.	-32.
29	2	0.	0.	0.	0.	264.	-264.	.7007	0.	-185.
30	3	0.	0.	0.	511.	45.	466.	.6921	0.	323.
31	4	0.	0.	0.	0.	0.	0.	.6837	0.	0.
32	1	0.	0.	0.	0.	45.	-45.	.6754	0.	-30.
33	2	0.	0.	0.	0.	264.	-264.	.6671	0.	-176.
34	3	0.	0.	0.	511.	45.	466.	.6590	0.	307.
35	4	0.	0.	0.	0.	0.	0.	.6510	0.	0.
36	1	0.	0.	0.	0.	45.	-45.	.6430	0.	-29.
37	2	0.	0.	0.	0.	264.	-264.	.6352	0.	-168.
38	3	0.	0.	0.	511.	45.	466.	.6274	0.	293.
39	4	0.	0.	0.	0.	0.	0.	.6198	0.	0.
40	1	0.	0.	0.	0.	45.	-45.	.6122	0.	-28.

41	2	0.	0.	0.	0.	264.	-264.	.6046	0.	-160.
42	3	0.	0.	0.	511.	45.	466.	.5974	0.	279.
43	4	0.	0.	0.	0.	0.	0.	.5901	0.	0.
44	1	0.	0.	0.	0.	45.	-45.	.5829	0.	-26.
45	2	0.	0.	0.	0.	264.	-264.	.5758	0.	-152.
46	3	0.	0.	0.	511.	45.	466.	.5688	0.	265.
47	4	0.	0.	0.	0.	0.	0.	.5619	0.	0.
48	1	0.	0.	0.	0.	45.	-45.	.5550	0.	-25.
49	2	0.	0.	0.	0.	264.	-264.	.5482	0.	-145.
50	3	0.	0.	0.	511.	45.	466.	.5416	0.	253.
51	4	0.	0.	0.	0.	0.	0.	.5350	0.	0.
52	1	0.	0.	0.	0.	45.	-45.	.5284	0.	-24.
53	2	0.	0.	0.	0.	264.	-264.	.5220	0.	-138.
54	3	0.	0.	0.	511.	45.	466.	.5156	0.	241.
55	4	0.	0.	0.	0.	0.	0.	.5093	0.	0.
56	1	0.	0.	0.	0.	45.	-45.	.5031	0.	-23.
57	2	0.	0.	0.	0.	264.	-264.	.4970	0.	-131.
58	3	0.	0.	0.	511.	45.	466.	.4909	0.	229.
59	4	0.	0.	0.	0.	0.	0.	.4850	0.	0.
60	1	1365.	0.	1365.	0.	45.	-45.	.4790	654.	-22.
61	2	0.	0.	0.	0.	264.	-264	.4732	0.	-125.
62	3	0.	0.	0.	511.	45.	466.	.4674	0.	218.
63	4	0.	0.	0.	0.	0.	0.	.4617	0.	0.
64	1	0.	0.	0.	0.	45.	-45.	.4561	0.	-21.
65	2	0.	0.	0.	0.	264.	-264.	.4506	0.	-119.
66	3	0.	0.	0.	511.	45.	466.	.4451	0.	208.
67	4	0.	0.	0.	0.	0.	0.	.4396	0.	0.
68	1	0.	0.	0.	0.	45.	-45.	.4343	0.	-20.
69	2	0.	0.	0.	0.	264.	-264.	.4290	0.	-113.
70	3	0.	0.	0.	511.	45.	466.	.4237	0.	198.
71	4	0.	0.	0.	0.	0.	0.	.4186	0.	0.
72	1	0.	0.	0.	0.	45.	-45.	.4135	0.	-19.
73	2	0.	0.	0.	0.	264.	-264.	.4084	0.	-108.
74	3	0.	0.	0.	511.	45.	466.	.4035	0.	188.
75	4	0.	0.	0.	0.	0.	0.	.3985	0.	0.
76	1	0.	0.	0.	0.	45.	-45.	.3937	0.	-18.
77	2	0.	0.	0.	0.	264.	-264.	.3889	0.	-103.
78	3	0.	0.	0.	511.	45.	466.	.3841	0.	179.
79	4	0.	0.	0.	0.	0.	0.	.3795	0.	0.
TOTAL		2730.	0.	2730.	10230.	7013.	3217.		2019.	2019.

Interest Per Cent	Ratio	Benefit/cost Revenue	Present value in KShs Outlay	Balance
15.000.	679	1041.	1533.	-492.
20.000.	564	820.	1454.	-634.
25.000.	477	674.	1413.	-739.
30.000.	411	572.	1392.	-820.
35.000.	360	497.	1380.	-883.
40.000.	320	440.	1374.	-934.

**Excluding depreciation, interest, and income tax

ALTERNATIVE:

Alternative 1: Loss savings reduced from 20.5 to 15.5 per cent

INVESTMENT FEASIBILITY ANALYSIS

Improved Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 41.195 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs.) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Present Value Net Revenue
0	1	1000.	0.	1000.	0.	0.	0.	1.0000	1000.	0.
1	2	0.	0.	0.	0.	227.	-227.	.9174	0.	-208.
2	3	0.	0.	0.	677.	33.	644.	.8416	0.	542.
3	4	0.	0.	0.	0.	0.	0.	.7720	0.	0.
4	1	0.	0.	0.	0.	33.	-33.	.7082	0.	-23.
5	2	0.	0.	0.	0.	252.	-252.	.6497	0.	-164.
6	3	0.	0.	0.	677.	33.	644.	.5960	0.	384.
7	4	0.	0.	0.	0.	0.	0.	.5468	0.	0.
8	1	0.	0.	0.	0.	33.	-33.	.5016	0.	-17.
9	2	0.	0.	0.	0.	252.	-252.	.4602	0.	-116.
10	3	0.	0.	0.	677.	33.	644.	.4221	0.	272.
11	4	0.	0.	0.	0.	0.	0.	.3873	0.	0.
12	1	0.	0.	0.	0.	33.	-33.	.3553	0.	-12.
13	2	0.	0.	0.	0.	252.	-252.	.3259	0.	-82.
14	3	0.	0.	0.	677.	33.	644.	.2990	0.	192.
15	4	0.	0.	0.	0.	0.	0.	.2743	0.	0.
16	1	0.	0.	0.	0.	33.	-33.	.2516	0.	-8.
17	2	0.	0.	0.	0.	252.	-252.	.2308	0.	-58.
18	3	0.	0.	0.	677.	33.	644.	.2117	0.	136.
19	4	0.	0.	0.	0.	0.	0.	.1942	0.	0.
20	1	0.	0.	0.	0.	33.	-33.	.1782	0.	-6.
21	2	0.	0.	0.	0.	252.	-252.	.1635	0.	-41.
22	3	0.	0.	0.	677.	33.	644.	.1500	0.	97.
23	4	0.	0.	0.	0.	0.	0.	.1376	0.	0.
24	1	0.	0.	0.	0.	33.	-33.	.1262	0.	-4.
25	2	0.	0.	0.	0.	252.	-252.	.1158	0.	-29.
26	3	0.	0.	0.	677.	33.	644.	.1062	0.	68.
27	4	0.	0.	0.	0.	0.	0.	.0974	0.	0.
28	1	0.	0.	0.	0.	33.	-33.	.0894	0.	-3.
29	2	0.	0.	0.	0.	252.	-252.	.0820	0.	-21.
30	3	0.	0.	0.	677.	33.	644.	.0752	0.	48.
31	4	0.	0.	0.	0.	0.	0.	.0690	0.	0.
32	1	0.	0.	0.	0.	33.	-33.	.0633	0.	-2.
33	2	0.	0.	0.	0.	252.	-252.	.0581	0.	-15.
34	3	0.	0.	0.	677.	33.	644.	.0533	0.	34.
35	4	0.	0.	0.	0.	0.	0.	.0489	0.	0.
36	1	0.	0.	0.	0.	33.	-33.	.0448	0.	-1.
37	2	0.	0.	0.	0.	252.	-252.	.0411	0.	-10.
38	3	0.	0.	0.	677.	33.	644.	.0377	0.	24.
39	4	0.	0.	0.	0.	0.	0.	.0346	0.	0.
40	1	0.	0.	0.	0.	33.	-33.	.0318	0.	-1.
41	2	0.	0.	0.	0.	252.	-252.	.0291	0.	-7.
42	3	0.	0.	0.	677.	33.	644.	.0267	0.	17.

43	4	0.	0.	0.	0.	0.	0.	.0245	0.	0.
44	1	0.	0.	0.	0.	33.	-33.	.0225	0.	-1.
45	2	0.	0.	0.	0.	252.	-252.	.0206	0.	-5.
46	3	0.	0.	0.	677.	33.	644.	.0189	0.	12.
47	4	0.	0.	0.	0.	0.	0.	.0174	0.	0.
48	1	0.	0.	0.	0.	33.	-33.	.0159	0.	-1.
49	2	0.	0.	0.	0.	252.	-252.	.0146	0.	-4.
50	3	0.	0.	0.	677.	33.	644.	.0134	0.	9.
51	4	0.	0.	0.	0.	0.	0.	.0123	0.	0.
52	1	0.	0.	0.	0.	33.	-33.	.0113	0.	0.
53	2	0.	0.	0.	0.	252.	-252.	.0103	0.	-3.
54	3	0.	0.	0.	677.	33.	644.	.0095	0.	6.
55	4	0.	0.	0.	0.	0.	0.	.0087	0.	0.
56	1	0.	0.	0.	0.	33.	-33.	.0080	0.	0.
57	2	0.	0.	0.	0.	252.	-252.	.0073	0.	-2.
58	3	0.	0.	0.	677.	33.	644.	.0067	0.	4.
59	4	0.	0.	0.	0.	0.	0.	.0062	0.	0.
60	1	1000.	0.	1000.	0.	33.	-33.	.0057	6.	0.
61	2	0.	0.	0.	0.	252.	-252.	.0052	0.	-1.
62	3	0.	0.	0.	677.	33.	644.	.0048	0.	3.
63	4	0.	0.	0.	0.	0.	0.	.0044	0.	0.
64	1	0.	0.	0.	0.	33.	-33.	.0040	0.	0.
65	2	0.	0.	0.	0.	252.	-252.	.0037	0.	-1.
66	3	0.	0.	0.	677.	33.	644.	.0034	0.	2.
67	4	0.	0.	0.	0.	0.	0.	.0031	0.	0.
68	1	0.	0.	0.	0.	33.	-33.	.0028	0.	0.
69	2	0.	0.	0.	0.	252.	-252.	.0026	0.	-1.
70	3	0.	0.	0.	677.	33.	644.	.0024	0.	2.
71	4	0.	0.	0.	0.	0.	0.	.0022	0.	0.
72	1	0.	0.	0.	0.	33.	-33.	.0020	0.	0.
73	2	0.	0.	0.	0.	252.	-252.	.0018	0.	0.
74	3	0.	0.	0.	677.	33.	644.	.0017	0.	1.
75	4	0.	0.	0.	0.	0.	0.	.0016	0.	0.
76	1	0.	0.	0.	0.	33.	-33.	.0014	0.	0.
77	2	0.	0.	0.	0.	252.	-252.	.0013	0.	0.
78	3	0.	0.	0.	677.	33.	644.	.0012	0.	1.
79	4	0.	0.	0.	0.	0.	0.	.0011	0.	0.
TOTAL		2000.	0.	2000.	13530.	6302.	7228.		1006.	1006.

Interest Per Cent	Benefit/cost Ratio	Present value in KShs Revenue	Outlay	Balance
15.000	2.126	2387.	1123.	1264.
20.000	1.775	1890.	1065.	825.
25.000	1.507	1560.	1035.	525.
30.000	1.304	1330.	1020.	310.
35.000	1.148	1161.	1011.	150.
40.000	1.025	1032.	1006.	26.

**Excluding depreciation, interest, and income tax
Alternative 2: Some materials purchased, labour hired
Cost construction drops from 1365 to 1000

INVESTMENT FEASIBILITY ANALYSIS

Improved Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 68.899 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Net Revenue	Present Value Factor	Present Value Total Investment	Present Value Net Revenue
0.	1.	700.	0.	700.	0.	0.	0.	1.0000	700.	0
1.	2.	0.	0.	0.	0.	217.	-217.	.8772	0.	-190.
2.	3.	0.	0.	0.	677.	23.	653.	.7695	0.	50.3
3.	4.	0.	0.	0.	0.	0.	0.	.6750	0.	0.
4.	1	0.	0.	0.	0.	23.	-23.	.5921	0.	-14.
5.	2.	0.	0.	0.	0.	242.	-242.	.5194	0.	-126
6.	3.	0.	0.	0.	677.	23.	653.	.4556	0.	298
7.	4.	0.	0.	0.	0.	0.	0.	.3996	0.	0
8.	1.	0.	0.	0.	0.	23.	-23.	.3505	0.	-8
9.	2.	0.	0.	0.	0.	242.	-242.	.3075	0.	-74
10.	3.	0.	0.	0.	677.	23.	653.	.2697	0.	176
11.	4.	0.	0.	0.	0.	0.	0.	.2366	0.	0
12.	1.	0.	0.	0.	0.	23.	-23.	.2075	0.	-5
13.	2.	0.	0.	0.	0.	242.	-242.	.1821	0.	-44
14.	3.	0.	0.	0.	677.	23.	653.	.1597	0.	104
15.	4.	0.	0.	0.	0.	0.	0.	.1401	0.	0
16.	1.	0.	0.	0.	0.	23.	-23.	.1229	0.	-3
17.	2.	0.	0.	0.	0.	242.	-242.	.1078	0.	-26
18.	3.	0.	0.	0.	677.	23.	653.	.0946	0.	62
19.	4.	0.	0.	0.	0.	0.	0.	.0829	0.	0
20.	1.	0.	0.	0.	0.	23.	-23.	.0728	0.	-2
21.	2.	0.	0.	0.	0.	242.	-242.	.0638	0.	-15
22.	3.	0.	0.	0.	677.	23.	653.	.0560	0.	37
23.	4.	0.	0.	0.	0.	0.	0.	.0491	0.	0
24.	1.	0.	0.	0.	0.	23.	-23.	.0431	0.	-1
25.	2.	0.	0.	0.	0.	242.	-242.	.0378	0.	-9
26.	3.	0.	0.	0.	677.	23.	653.	.0331	0.	22
27.	4.	0.	0.	0.	0.	0.	0.	.0291	0.	0
28.	1.	0.	0.	0.	0.	23.	-23.	.0255	0.	-1
29.	2.	0.	0.	0.	0.	242.	-242.	.0224	0.	-5
30.	3.	0.	0.	0.	677.	23.	653.	.0196	0.	13
31.	4.	0.	0.	0.	0.	0.	0.	.0172	0.	0
32.	1.	0.	0.	0.	0.	23.	-23.	.0151	0.	0
33.	2.	0.	0.	0.	0.	242.	-242.	.0132	0.	-3
34.	3.	0.	0.	0.	677.	23.	653.	.0116	0.	8
35.	4.	0.	0.	0.	0.	0.	0.	.0102	0.	0
36.	1.	0.	0.	0.	0.	23.	-23.	.0089	0.	0
37.	2.	0.	0.	0.	0.	242.	-242.	.0078	0.	-2
38.	3.	0.	0.	0.	677.	23.	653.	.0069	0.	4
39.	4.	0.	0.	0.	0.	0.	0.	.0060	0.	0
40.	1.	0.	0.	0.	0.	23.	-23.	.0053	0.	0
41.	2.	0.	0.	0.	0.	242.	-242.	.0046	0.	-1
42.	3.	0.	0.	0.	677.	23.	653.	.0041	0.	3

43.	4.	0.	0.	0.	0.	0.	0.	.0036	0.	0
44.	1.	0.	0.	0.	0.	23.	-23.	.0031	0.	0
45.	2.	0.	0.	0.	0.	242.	-242.	.0027	0.	-1
46.	3.	0.	0.	0.	677.	23.	653.	.0024	0.	2
47.	4.	0.	0.	0.	0.	0.	0.	.0021	0.	0
48.	1.	0.	0.	0.	0.	23.	-23.	.0019	0.	0
49.	2.	0.	0.	0.	0.	242.	-242.	.0016	0.	0
50.	3.	0.	0.	0.	677.	23.	653.	.0014	0.	1
51.	4.	0.	0.	0.	0.	0.	0.	.0013	0.	0
52.	1.	0.	0.	0.	0.	23.	-23.	.0011	0.	0
53.	2.	0.	0.	0.	0.	242.	-242.	.0010	0.	0
54.	3.	0.	0.	0.	677.	23.	653.	.0008	0.	1
55.	4.	0.	0.	0.	0.	0.	0.	.0007	0.	0
56.	1.	0.	0.	0.	0.	23.	-23.	.0007	0.	0
57.	2.	0.	0.	0.	0.	242.	-242.	.0006	0.	0
58.	3.	0.	0.	0.	677.	23.	653.	.0005	0.	0
59.	4.	0.	0.	0.	0.	0.	0.	.0004	0.	0
60.	1.	700.	0.	700.	0.	23.	-23.	.0004	0.	0
61.	2.	0.	0.	0.	0.	242.	-242.	.0003	0.	0
62.	3.	0.	0.	0.	677.	23.	653.	.0003	0.	0
63.	4.	0.	0.	0.	0.	0.	0.	.0003	0.	0
64.	1.	0.	0.	0.	0.	23.	-23.	.0002	0.	0
65.	2.	0.	0.	0.	0.	242.	-242.	.0002	0.	0
66.	3.	0.	0.	0.	677.	23.	653.	.0002	0.	0
67.	4.	0.	0.	0.	0.	0.	0.	.0002	0.	0
68.	1.	0.	0.	0.	0.	23.	-23.	.0001	0.	0
69.	2.	0.	0.	0.	0.	242.	-242.	.0001	0.	0
70.	3.	0.	0.	0.	677.	23.	653	.0001	0.	0
71.	4.	0.	0.	0.	0.	0.	0.	.0001	0.	0
72.	1.	0.	0.	0.	0.	23.	-23.	.0001	0.	0
73.	2.	0.	0.	0.	0.	242.	-242.	.0001	0.	0
74.	3.	0.	0.	0.	677.	23.	653.	.0001	0.	0
75.	4.	0.	0.	0.	0.	0.	0.	.0001	0.	0
76.	1.	0.	0.	0.	0.	23.	-23.	.0000	0.	0
77.	2.	0.	0.	0.	0.	242.	-242.	.0000	0.	0
78.	3.	0.	0.	0.	677.	23.	653.	.0000	0.	0
79.	4.	0.	0.	0.	0.	0.	0.	.0000	0.	0
TOTAL		1400.	0.	1400.	13530.	5718.	7812.		700.	700.

Interest Per Cent	Benefit/cost Ratio	Present Value in KShs Revenue	Outlay	Balance
15.000	3.287	2584.	786.	1798.
20.000	2.744	2046.	745.	1300.
25.000	2.331	1689.	725.	965.
30.000	2.018	1440.	714.	726.
35.000	1.776	1257.	708.	549.
40.000	1.587	1118.	704.	413.

**Excluding depreciation, interest, and income tax
Alternative 3: Most materials obtained locally: excludes labour
Construction cost drops from 1365 to 700

Appendix C

Rate of Return Analysis for Traditional Raised Basket

Listing of projected quarterly cash flow

Calculation of Internal Rate of Return for Base Case

Calculation of Internal Rate of Return for Alternative 1, cost-sharing with most materials purchased and construction labour hired.

Calculation of Internal Rate of Return for Alternative 2, cost sharing with mostly local materials and no hired construction labour

Calculation of Internal Rate of Return for Alternative 3, reduction of loss savings from 20.5 percent to 15.5 percent.

LISTING OF FACTORS CONCERNING THIS RUN:

Unit of Measure for Output Is KShs

Number of Times Discounted per Year = 4.00

"Sunken Investment" Option IS NOT Being Used

Benefit-Costs Computed at Annual Discount Rates of:

.15000 .20000 .25000 .30000 .35000 .40000

A LISTING OF THE DATA

20.004.00 11 1 6 1 3 2 0 .110000

Traditional Raised Basket

Period No.	Qtr.	Invest	Wrk Cap	Savings	& Harvest	Shelling Hygiene	Pre-Store Insect.	Labour	Maint. Cost	Gunny Bags				
0	1	1115.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
2	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
3	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
5	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
6	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
7	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
9	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
10	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
11	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
13	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
14	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
15	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
17	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
18	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
19	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
21	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
22	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
23	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
25	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
26	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
27	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
29	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
30	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
31	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.

33	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
34	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
35	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
37	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
38	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
39	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
40	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
41	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
42	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
43	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
45	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
46	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
47	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
49	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
50	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
51	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
53	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
54	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
55	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
57	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
58	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
59	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	1	1115.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
61	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
62	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
63	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
65	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
66	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
67	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
68	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
69	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
70	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
71	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
72	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
73	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
74	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
75	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
76	1	0.	0.	0.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
77	2	0.	0.	0.	100.	25.	24.	10.	37.	60.	0.	0.	0.	0.
78	3	0.	0.	677.	0.	0.	0.	0.	37.	0.	0.	0.	0.	0.
79	4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

INVESTMENT FEASIBILITY ANALYSIS

Traditional Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 34.028 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Present Net Revenue	Value Factor	Present Value Total Investment	Net Revenue
0	1	1115.	0.	1115.	0.	0.	0.	1.0000	1115.	0.
1	2	0.	0.	0.	0.	256.	-256.	.9294	0.	-238.
2	3	0.	0.	0.	677.	37.	640.	.8638	0.	553.
3	4	0.	0.	0.	0.	0.	0.	.8028	0.	0.
4	1	0.	0.	0.	0.	37.	-37.	.7461	0.	-27.
5	2	0.	0.	0.	0.	256.	-256.	.6934	0.	-177.
6	3	0.	0.	0.	677.	37.	640.	.6445	0.	412.
7	4	0.	0.	0.	0.	0.	0.	.5990	0.	0.
8	1	0.	0.	0.	0.	37.	-37.	.5567	0.	-20.
9	2	0.	0.	0.	0.	256.	-256.	.5174	0.	-132.
10	3	0.	0.	0.	677.	37.	640.	.4809	0.	308.
11	4	0.	0.	0.	0.	0.	0.	.4469	0.	0.
12	1	0.	0.	0.	0.37.	-37.		.4154	0.	-15.
13	2	0.	0.	0.	0.	256.	-256.	.3860	0.	-99.
14	3	0.	0.	0.	677.	37.	640.	.3588	0.	230.
15	4	0.	0.	0.	0.	0.	0.	.3334	0.	0.
16	1	0.	0.	0.	0.	37.	-37.	.3099	0.	-11.
17	2	0.	0.	0.	0.	256.	-256.	.2880	0.	-74.
18	3	0.	0.	0.	677.	37.	640.	.2677	0.	171.
19	4	0.	0.	0.	0.	0.	0.	.2488	0.	0.
20	1	0.	0.	0.	0.	37.	-37.	.2312	0.	-9.
21	2	0.	0.	0.	0.	256.	-256.	.2149	0.	-55.
22	3	0.	0.	0.	677.	37.	640.	.1997	0.	128.
23	4	0.	0.	0.	0.	0.	0.	.1856	0.	0.
24	1	0.	0.	0.	0.	37.	-37.	.1725	0.	-6.
25	2	0.	0.	0.	0.	256.	-256.	.1603	0.	-41.
26	3	0.	0.	0.	677.	37.	640.	.1490	0.	95.
27	4	0.	0.	0.	0.	0.	0	.1385	0.	0.
28	1	0.	0.	0.	0.	37.	-37.	.1287	0.	-5.
29	2	0.	0.	0.	0.	256.	-256.	.1196	0.	-31.
30	3	0.	0.	0.	677.	37.	640.	.1112	0.	71.
31	4	0.	0.	0.	0.	0.	0.	.1033	0.	0.
32	1	0.	0.	0.	0.	37.	-37.	.0960	0.	-4.
33	2	0.	0.	0.	0.	256.	-256.	.0893	0.	-23.
34	3	0.	0.	0.	677.	37.	640.	.0830	0.	53.
35	4	0.	0.	0.	0.	0.	0.	.0771	0.	0.
36	1	0.	0.	0.	0.	37.	-37.	.0717	0.	-3.
37	2	0.	0.	0.	0.	256.	-256.	.0666	0.	-17.
38	3	0.	0.	0.	677.	37.	640.	.0619	0.	40.
39	4	0.	0.	0.	0.	0.	0.	.0575	0.	0.
40	1	0.	0.	0.	0.	37.	-37.	.0535	0.	-2.
41	2	0.	0.	0.	0.	256.	-256.	.0497	0.	-13.
42	3	0.	0.	0.	677.	37.	640.	.0462	0.	30.

43	4	0.	0.	0.	0.	0.	0.	.0429	0.	0.
[illegible]	[illegible]	0.	0.	0.	0.	37.	-37.	.0399	0.	-1.
45	2	0.	0.	0.	0.	256.	-256.	.0371	0.	-9.
46	3	0.	0.	0.	677.	37.	640.	.0345	0.	22.
47	4	0.	0.	0.	0.	0.	0.	.0320	0.	0.
48	1	0.	0.	0.	0.	37.	-37.	.0298	0.	-1.
49	2	0.	0.	0.	0.	256.	-256.	.0277	0.	-7.
50	3	0.	0.	0.	677.	37.	640.	.0257	0.	6.
51	4	0.	0.	0.	0.	0.	0.	.0239	0.	0.
52	1	0.	0.	0.	0.	37.	-37.	.0222	0.	-1.
53	2	0.	0.	0.	0.	256.	-256.	.0206	0.	-5.
54	3	0.	0.	0.	677.	37.	640.	.0192	0.	2.
55	4	0.	0.	0.	0.	0.	0.	.0178	0.	0.
56	1	0.	0.	0.	0.	37.	-37.	.0166	0.	-1.
57	2	0.	0.	0.	0.	256.	-256.	.0154	0.	-4.
58	3	0.	0.	0.	677.	37.	640.	.0143.	0.	9.
59	4	0.	0.	0.	0.	0.	0.	.0133	0.	0.
60	1	1115.	0.	1115.	0.	37.	-37.	.0124	14.	0.
61	2	0.	0.	0.	0.	256.	-256.	.0115	0.	-3.
62	3	0.	0.	0.	677.	37.	640.	.0107	0.	7.
63	4	0.	0.	0.	0.	0.	0.	.0099	0.	0.
64	1	0.	0.	0.	0.	37.	-37.	.0092	0.	0.
65	2	0.	0.	0.	0.	256.	-256.	.0086	0.	-2.
66	3	0.	0.	0.	677.	37.	640.	.0080	0.	5.
67	4	0.	0.	0.	0.	0.	0.	.0074	0.	0.
68	1	0.	0.	0.	0.	37.	-37.	.0069	0.	0.
69	2	0.	0.	0.	0.	256.	-256.	.0064	0.	-2.
70	3	0.	0.	0.	677.	37.	640.	.0059	0.	4.
71	4	0.	0.	0.	0.	0.	0.	.0055	0.	0.
72	1	0.	0.	0.	0.	37.	-37.	.0051	0.	0.
73	2	0.	0.	0.	0.	256.	-256.	.0048	0.	-1.
74	3	0.	0.	0.	677.	37.	640.	.0044	0.	3.
75	4	0.	0.	0.	0.	0.	0.	.0041	0.	0.
76	1	0.	0.	0.	0.	37.	-37.	.0038	0.	0.
77	2	0.	0.	0.	0.	256.	-256.	.0036	0.	-1.
78	3	0.	0.	0.	677.	37.	640.	.0033	0.	2.
79	4	0.	0.	0.	0.	0.	0.	.0031	0.	0.
TOTAL		2230.	0.	2230.	13530.	6551.	6979.		1129.	1129.

Interest Per Cent	Benefit/Cost Ratio	Present Value In KShs Revenue	Outlay	Balance
15.000	1.827	2288.	1252.	1036.
20.000	1.521	1806.	1187.	619.
25.000	1.288	1487.	1154.	333.
30.000	1.112	1264.	1137.	127.
35.000	.976	1101.	1127.	-27.
40.000	.870	976.	1122.	-146.

**Excluding depreciation, interest, and income tax

ALTERNATIVE: Base Case

INVESTMENT FEASIBILITY ANALYSIS

Traditional Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 13.513 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Present Net Revenue	Value Factor	Present Value Total Investment	Net Revenue
0	1	1115.	0.	1115.	0.	0.	0.	1.0000	1115.	0.
1	2	0.	0.	0.	0.	256.	-256.	.9688	0.	-248.
2	3	0.	0.	0.	511.	37.	475.	.9386	0.	446.
3	4	0.	0.	0.	0.	0.	0.	.9093	0.	0.
4	1	0.	0.	0.	0.	37.	-37.	.8810	0.	-32.
5	2	0.	0.	0.	0.	256.	-256.	.8535	0.	-218.
6	3	0.	0.	0.	511.	37.	475.	.8269	0.	393.
7	4	0.	0.	0.	0.	0.	0.	.8011	0.	0.
8	1	0.	0.	0.	0.	37.	-37.	.7761	0.	-29.
9	2	0.	0.	0.	0.	256.	-256.	.7519	0.	-192.
10	3	0.	0.	0.	511.	37.	475.	.7284	0.	346.
11	4	0.	0.	0.	0.	0.	0.	.7057	0.	0.
12	1	0.	0.	0.	0.	37.	-37.	.6837	0.	-25.
13	2	0.	0.	0.	0.	256.	-256.	.6624	0.	-169.
14	3	0.	0.	0.	511.	37.	475.	.6417	0.	305.
15	4	0.	0.	0.	0.	0.	0.	.6217	0.	0.
16	1	0.	0.	0.	0.	37.	-37.	.6023	0.	-22.
17	2	0.	0.	0.	0.	256.	-256.	.5835	0.	-149.
18	3	0.	0.	0.	511.	37.	475.	.5653	0.	268.
19	4	0.	0.	0.	0.	0.	0.	.5477	0.	0.
20	1	0.	0.	0.	0.	37.	-37.	.5306	0.	-20.
21	2	0.	0.	0.	0.	256.	-256.	.5140	0.	-131.
22	3	0.	0.	0.	511.	37.	475.	.4980	0.	236.
23	4	0.	0.	0.	0.	0.	0.	.4825	0.	0.
24	1	0.	0.	0.	0.	37.	-37.	.4674	0.	-17.
25	2	0.	0.	0.	0.	256.	-256.	.4528	0.	-116.
26	3	0.	0.	0.	511.	37.	475.	.4387	0.	208.
27	4	0.	0.	0.	0.	0.	0.	.4250	0.	0.
28	1	0.	0.	0.	0.	37.	-37.	.4118	0.	-15.
29	2	0.	0.	0.	0.	256.	-256.	.3989	0.	-102.
30	3	0.	0.	0.	511.	37.	475.	.3865	0.	183.
31	4	0.	0.	0.	0.	0.	0.	.3744	0.	0.
32	1	0.	0.	0.	0.	37.	-37.	.3628	0.	-13.
33	2	0.	0.	0.	0.	256.	-256.	.3514	0.	-90.
34	3	0.	0.	0.	511.	37.	475.	.3405	0.	162.
35	4	0.	0.	0.	0.	0.	0.	.3299	0.	0.
36	1	0.	0.	0.	0.	37.	-37.	.3196	0.	-12.
37	2	0.	0.	0.	0.	256.	-256.	.3096	0.	-79.
38	3	0.	0.	0.	511.	37.	475.	.3000	0.	142.

39	4	0.	0.	0.	0.	0.	0.	.2906	0.	0.
40	1	0.	0.	0.	0.	37.	-37.	.2815	0.	-10.
41	2	0.	0.	0.	0.	256.	-256.	.2727	0.	-70.
42	3	0.	0.	0.	511.	37.	475.	.2642	0.	125.
43	4	0.	0.	0.	0.	0.	0.	.2560	0.	0.
44	1	0.	0.	0.	0.	37.	-37.	.2480	0.	-9.
45	2	0.	0.	0.	0.	256.	-256.	.2403	0.	-61.
46	3	0.	0.	0.	511.	37.	475.	.2328	0.	111.
47	4	0.	0.	0.	0.	0.	0.	.2255	0.	0.
48	1	0.	0.	0.	0.	37.	-37.	.2185	0.	-8.
49	2	0.	0.	0.	0.	256.	-256.	.2117	0.	-54.
50	3	0.	0.	0.	511.	37.	475.	.2051	0.	97.
51	4	0.	0.	0.	0.	0.	0.	.1987	0.	0.
52	1	0.	0.	0.	0.	37.	-37.	.1925	0.	-7.
53	2	0.	0.	0.	0.	256.	-256.	.1865	0.	-48.
54	3	0.	0.	0.	511.	37.	475.	.1807	0.	86.
55	4	0.	0.	0.	0.	0.	0.	.1750	0.	0.
56	1	0.	0.	0.	0.	37.	-37.	.1696	0.	-6.
57	2	0.	0.	0.	0.	256.	-256.	.1643	0.	-42.
58	3	0.	0.	0.	511.	37.	475.	.1592	0.	76.
59	4	0.	0.	0.	0.	0.	0.	.1542	0.	0.
60	1	1115.	0.	1115.	0.	37.	-37.	.1494	167.	-5.
61	2	0.	0.	0.	0.	256.	-256.	.1447	0.	-37.
62	3	0.	0.	0.	511.	37.	475.	.1402	0.	67.
63	4	0.	0.	0.	0.	0.	0.	.1358	0.	0.
64	1	0.	0.	0.	0.	37.	-37.	.1316	0.	-5.
65	2	0.	0.	0.	0.	256.	-256.	.1275	0.	-33.
66	3	0.	0.	0.	511.	37.	475.	.1235	0.	59.
67	4	0.	0.	0.	0.	0.	0.	.1197	0.	0.
68	1	0.	0.	0.	0.	37.	-37.	.1159	0.	-4.
69	2	0.	0.	0.	0.	256.	-256.	.1123	0.	-29.
70	3	0.	0.	0.	511	37.	475.	.1088	0.	52.
71	4	0.	0.	0.	0.	0.	0.	.1054	0.	0.
72	1	0.	0.	0.	0.	37.	-37.	.1021	0.	-4.
73	2	0.	0.	0.	0.	256.	-256.	.0989	0.	-25.
74	3	0.	0.	0.	511	37.	475.	.0959	0.	46.
75	4	0.	0.	0.	0.	0.	0.	.0929	0.	0.
76	1	0.	0.	0.	0.	37.	-37.	.0900	0.	-3.
77	2	0.	0.	0.	0.	256.	-256.	.0872	0.	-22.
78	3	0.	0.	0.	511	37.	475.	.0844	0.	40.
79	4	0.	0.	0.	0.	0.	0.	.0818	0.	0.
TOTAL		2230.	0.	2230.	10230.	6551.	3679.		1282.	1282.

Interest Per Cent	Benefit/Cost Ratio	Present Value In KShs Revenue	Outlay	Balance
15.000	.943	1180.	1252.	-72.
20.000	.780	926.	1187.	-261.
25.000	.657	758.	1154.	-396.
30.000	.563	640.	1137.	-497.
35.000	.492	554.	1127.	-573.
40.000	.435	489.	1122.	-634.

**Excluding depreciation, interest, and income tax
Alternative 1: Loss savings reduced from 20.5 to 15.5 per cent

INVESTMENT FEASIBILITY ANALYSIS

Traditional Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 66.404 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Present Net Revenue	Value Factor	Present Value Total Investment	Net Revenue
0	1	700	0.	700.	0.	0.	0.	1.0000	700.	0.
1	2	0.	0.	0.	0.	242.	-242.	.8805	0.	-213.
2	3	0.	0.	0.	677.	23.	653.	.7752	0.	507.
3	4	0.	0.	0.	0.	0.	0.	.6825	0.	0.
4	1	0.	0.	0.	0.	23.	-23.	.6009	0.	-14.
5	2	0.	0.	0.	0.	242.	-242.	.5291	0.	-128.
6	3	0.	0.	0.	677.	23.	653.	.4659	0.	304.
7	4	0.	0.	0.	0.	0.	0.	.4102	0.	0.
8	1	0.	0.	0.	0.	23.	-23.	.3611	0.	-8.
9	2	0.	0.	0.	0.	242.	-242.	.3180	0.	-77.
10	3	0.	0.	0.	677.	23.	653.	.2800	0.	183.
11	4	0.	0.	0.	0.	0.	0.	.2465	0.	0.
12	1	0.	0.	0.	0.	23.	-23.	.2170	0.	-5.
13	2	0.	0.	0.	0.	242.	-242.	.1911	0.	-46.
14	3	0.	0.	0.	677.	23.	653.	.1682	0.	110.
15	4	0.	0.	0.	0.	0.	0.	.1481	0.	0.
16	1	0.	0.	0.	0.	23.	-23.	.1304	0.	-3.
17	2	0.	0.	0.	0.	242.	-242.	.1148	0.	-28.
18	3	0.	0.	0.	677.	23.	653.	.1011	0.	66.
19	4	0.	0.	0.	0.	0.	0.	.0890	0.	0.
20	1	0.	0.	0.	0.	23.	-23.	.0784	0.	-2.
21	2	0.	0.	0.	0.	242.	-242.	.0690	0.	-17.
22	3	0.	0.	0.	677.	23.	653.	.0608	0.	40.
23	4	0.	0.	0.	0.	0.	0.	.0535	0.	0.
24	1	0.	0.	0.	0.	23.	-23.	.0471	0.	-1.
25	2	0.	0.	0.	0.	242.	-242.	.0415	0.	-10.
26	3	0.	0.	0.	677.	23.	653.	.0365	0.	24.
27	4	0.	0.	0.	0.	0.	0.	.0321	0.	0.
28	1	0.	0.	0.	0.	23.	-23.	.0283	0.	-1.
29	2	0.	0.	0.	0.	242.	-242.	.0249	0.	-6.
30	3	0.	0.	0.	677.	23.	653.	.0219	0.	14.
31	4	0.	0.	0.	0.	0.	0.	.0193	0.	0.
32	1	0.	0.	0.	0.	23.	-23.	.0170	0.	0.
33	2	0.	0.	0.	0.	242.	-242.	.0150	0.	-4.
34	3	0.	0.	0.	677.	23.	653.	.0132	0.	9.
35	4	0.	0.	0.	0.	0.	0.	.0116	0.	0.
36	1	0.	0.	0.	0.	23.	-23.	.0102	0.	0.
37	2	0.	0.	0.	0.	242.	-242.	.0090	0.	-2.
38	3	0.	0.	0.	677.	23.	653.	.0079	0.	5.
39	4	0.	0.	0.	0.	0.	0.	.0070	0.	0.
40	1	0.	0.	0.	0.	23.	-23.	.0061	0.	0.
41	2	0.	0.	0.	0.	242.	-242.	.0054	0.	-1.
42	3	0.	0.	0.	677.	23.	653.	.0048	0.	3.

43	4	0.	0	0.	0.	0.	0	.0042	0.	0.
44	1	0.	0.	0.	0.	23.	-23.	.0037	0.	0.
45	2	0.	0.	0.	0.	242.	-242.	.0033	0.	-1.
46	3	0.	0.	0.	677.	23.	653.	.0029	0.	2.
47	4	0.	0.	0.	0.	0.	0.	.0025	0.	0.
48	1	0.	0.	0.	0.	23.	-23.	.0022	0.	0.
49	2	0.	0.	0.	0.	242.	-242.	.0020	0.	0.
50	3	0.	0.	0.	677.	23.	653.	.0017	0.	1.
51	4	0.	0.	0.	0.	0.	0.	.0015	0.	0.
52	1	0.	0.	0.	0.	23.	-23.	.0013	0.	0.
53	2	0.	0.	0.	0.	242.	-242.	.0012	0.	0.
54	3	0.	0.	0.	677.	23.	653.	.0010	0.	1.
55	4	0.	0.	0.	0.	0.	0.	.0009	0.	0.
56	1	0.	0.	0.	0.	23.	-23.	.0008	0.	0.
57	2	0.	0.	0.	0.	242.	-242.	.0007	0.	0.
58	3	0.	0.	0.	677.	23.	653.	.0006	0.	0.
59	4	0.	0.	0.	0.	0.	0.	.0005	0.	0.
60	1	70	0.	700.	0.	23.	-23.	.0005	0.	0.
61	2	0.	0.	0.	0.	242.	-242.	.0004	0.	0.
62	3	0.	0.	0.	677.	23.	653.	.0004	0.	0.
63	4	0.	0.	0.	0.	0.	0.	.0003	0.	0.
64	1	0.	0.	0.	0.	23.	-23.	.0003	0.	0.
65	2	0.	0.	0.	0.	242.	-242.	.0003	0.	0.
66	3	0.	0.	0.	677.	23.	653.	.0002	0.	0.
67	4	0.	0.	0.	0.	0.	0.	.0002	0.	0.
68	1	0.	0.	0.	0.	23.	-23.	.0002	0.	0.
69	2	0.	0.	0.	0.	242.	-242.	.0002	0.	0.
70	3	0.	0.	0.	677.	23.	653.	.0001	0.	0.
71	4	0.	0.	0.	0.	0.	0.	.0001	0.	0.
72	1	0.	0.	0.	0.	23.	-23.	.0001	0.	0.
73	2	0.	0.	0.	0.	242.	-242.	.0001	0.	0.
74	3	0.	0.	0.	677.	23.	653.	.0001	0.	0.
75	4	0.	0.	0.	0.	0.	0.	.0001	0.	0.
76	1	0.	0.	0.	0.	23.	-23.	.0001	0.	0.
77	2	0.	0.	0.	0.	242.	-242.	.0001	0.	0.
78	3	0.	0.	0.	677.	23.	653.	.0000	0.	0.
79	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
TOTAL		1400.	0.	1400.	13530.	5743.	7787.		700.	700.

Interest Per Cent	Benefit/Cost Ratio	Present Value In KShs Revenue	Outlay	Balance
15.000	3.257	2560.	786.	1774.
20.000	2.712	2022.	745.	1276.
25.000	2.299	1666.	725.	941.
30.000	1.985	1416.	714.	703.
35.000	1.743	1234.	708.	526.
40.000	1.554	1095.	704.	390.

**Excluding depreciation, interest, and income tax

Alternative 2: Some materials purchased, labour hired
Cost construction drops from 1115 to 700

INVESTMENT FEASIBILITY ANALYSIS

Tradtional Raised Basket

INTERNAL RETURN ON TOTAL CAPITAL 84.851 PERCENT

Period No	Ident.	Investment (KShs) Facilities	Working Capital	Total	Operating (KShs) Total Revenue	Operating Expenses**	Present Net Revenue	Value Factor	Present Value Total Investment	Net Revenue
0	1	585.	0.	585.	0.	0.	0.	1.0000	585.	0.
1	2	0.	0.	0.	0.	238.	-238.	.8576	0.	-204.
2	3	0.	0.	0.	677.	19.	657.	.7355	0.	483.
3	4	0.	0.	0.	0.	0.	0.	.6308	0.	0.
4	1	0.	0.	0.	0.	19.	-19.	.5410	0.	-10.
5	2	0.	0.	0.	0.	238.	-238.	.4640	0.	-111.
6	3	0.	0.	0.	677.	19.	657.	.3979	0.	261.
7	4	0.	0.	0.	0.	0.	0.	.3412	0.	0.
8	1	0.	0.	0.	0.	19.	-19.	.2927	0.	-6.
9	2	0.	0.	0.	0.	238.	-238.	.2510	0.	-60.
10	3	0.	0.	0.	677.	19.	657.	.2153	0.	141.
11	4	0.	0.	0.	0.	0.	0.	.1846	0.	0.
12	1	0.	0.	0.	0.	19.	-19.	.1583	0.	-3.
13	2	0.	0.	0.	0.	238.	-238.	.1358	0.	-32.
14	3	0.	0.	0.	677.	19.	657.	.1164	0.	77.
15	4	0.	0.	0.	0.	0.	0.	.0999	0.	0.
16	1	0.	0.	0.	0.	19.	-19.	.0856	0.	-2.
17	2	0.	0.	0.	0.	238.	-238.	.0735	0.	-18.
18	3	0.	0.	0.	677.	19.	657.	.0630	0.	41.
19	4	0.	0.	0.	0.	0.	0.	.0540	0.	0.
20	1	0.	0.	0.	0.	19.	-19.	.0463	0.	-1.
21	2	0.	0.	0.	0.	238.	-238.	.0397	0.	-9.
22	3	0.	0.	0.	677.	19.	657.	.0341	0.	22.
23	4	0.	0.	0.	0.	0.	0.	.0292	0.	0.
24	1	0.	0.	0.	0.	19.	-19.	.0251	0.	0.
25	2	0.	0.	0.	0.	238.	-238.	.0215	0.	-5.
26	3	0.	0.	0.	677.	19.	657.	.0184	0.	12.
27	4	0.	0.	0.	0.	0.	0.	.0158	0.	0.
28	1	0.	0.	0.	0.	19.	-19.	.0136	0.	0.
29	2	0.	0.	0.	0.	238.	-238.	.0116	0.	-3.
30	3	0.	0.	0.	677.	19.	657.	.0100	0.	7.
31	4	0.	0.	0.	0.	0.	0.	.0086	0.	0.
32	1	0.	0.	0.	0.	19.	-19.	.0073	0.	0.
33	2	0.	0.	0.	0.	238.	-238.	.0063	0.	-1.
34	3	0.	0.	0.	677.	19.	657.	.0054	0.	4.
35	4	0.	0.	0.	0.	0.	0.	.0046	0.	0.
36	1	0.	0.	0.	0.	19.	-19.	.0040	0.	0.
37	2	0.	0.	0.	0.	238.	-238.	.0034	0.	-1.
38	3	0.	0.	0.	677.	19.	657.	.0029	0.	2.
39	4	0.	0.	0.	0.	0.	0.	.0025	0.	0.
40	1	0.	0.	0.	0.	19.	-19.	.0021	0.	0.
41	2	0.	0.	0.	0.	238.	-238.	.0018	0.	0.
42	3	0.	0.	0.	677.	19.	657.	.0016	0.	1.

43	4	0.	0.	0.	0.	0.	0.	.0014	0.	0.
44	1	0.	0.	0.	0.	19.	-19.	.0012	0.	0.
45	2	0.	0.	0.	0.	238.	-238.	.0010	0.	0.
46	3	0.	0.	0.	677.	19.	657.	.0009	0.	1.
47	4	0.	0.	0.	0.	0.	0.	.0007	0.	0.
48	1	0.	0.	0.	0.	19.	-19.	.0006	0.	0.
49	2	0.	0.	0.	0.	238.	-238.	.0005	0.	0.
50	3	0.	0.	0.	677.	19.	657.	.0005	0.	0.
51	4	0.	0.	0.	0.	0.	0.	.0004	0.	0.
52	1	0.	0.	0.	0.	19.	-19.	.0003	0.	0.
53	2	0.	0.	0.	0.	238.	-238.	.0003	0.	0.
54	3	0.	0.	0.	677.	19.	657.	.0002	0.	0.
55	4	0.	0.	0.	0.	0.	0.	.0002	0.	0.
56	1	0.	0.	0.	0.	19.	-19.	.0002	0.	0.
57	2	0.	0.	0.	0.	238.	-238.	.0002	0.	0.
58	3	0.	0.	0.	677.	19.	657.	.0001	0.	0.
59	4	0.	0.	0.	0.	0.	0.	.0001	0.	0.
60	1	585.	0.	585.	0.	19.	-19.	.0001	0.	0.
61	2	0.	0.	0.	0.	238.	-238.	.0001	0.	0.
62	3	0.	0.	0.	677.	19.	657.	.0001	0.	0.
63	4	0.	0.	0.	0.	0.	0.	.0001	0.	0.
64	1	0.	0.	0.	0.	19.	-19.	.0001	0.	0.
65	2	0.	0.	0.	0.	238.	-238.	.0000	0.	0.
66	3	0.	0.	0.	677.	19.	657.	.0000	0.	0.
67	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
68	1	0.	0.	0.	0.	19.	-19.	.0000	0.	0.
69	2	0.	0.	0.	0.	238.	-238.	.0000	0.	0.
70	3	0.	0.	0.	677.	19.	657.	.0000	0.	0.
71	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
72	1	0.	0.	0.	0.	19.	-19.	.0000	0.	0.
73	2	0.	0.	0.	0.	238.	-238.	.0000	0.	0.
74	3	0.	0.	0.	677.	19.	657.	.0000	0.	0.
75	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
76	1	0.	0.	0.	0.	19.	-19.	.0000	0.	0.
77	2	0.	0.	0.	0.	238.	-238.	.0000	0.	0.
78	3	0.	0.	0.	677.	19.	657.	.0000	0.	0.
79	4	0.	0.	0.	0.	0.	0.	.0000	0.	0.
TOTAL		1170.	0.	.1170.	13530.	5519.	8011.		585.	585.

Interest Per Cent	Benefit/Cost Ratio	Present Value In KShs Revenue	Outlay	Balance
15.000	4.012	2635.	657.	1978.
20.000	3.342	2082.	623.	1459.
25.000	2.832	1715.	606.	1110.
30.000	2.446	1459.	596.	862.
35.000	2.148	1271.	591.	679.
40.000	1.915	1128.	589.	539.

**Excluding depreciation, interest, and income tax

Alternative 3: Most materials obtained locally, excludes labour
Construction cost drops from 1115 to 585

Appendix D

Preliminary Benefit-Cost Analysis of Expanded Programme Western Kenya

Scenario 1. High Adoption of Improved Storage Structures and Treatment Practices

A. Estimated Benefits

B. Projected Costs

C. Benefit/cost at 15% discount

Cost-Benefit Analysis of Storage Structure and Management, Western Kenya

A. Estimated Benefits

Scenario #1: High Adoption of Improved Storage Structure and Treatment Practices

Year	Maize Production MT 000	Adoption Rate Structure %	Adoption Rate Treatment %	Maximum Reduced Losses MT 000	Maize Saved Improved Structure	Maize Saved Improved Treatment	Value of Maize Saved Imp. Stru. Kshs 000	Value of Maize Saved Management Kshs 000	Total Benefits Kshs 000
1984	467.00	0.001%	10.0%	95.74	0.000	4.20	1	13,870	13,871
1985	479.00	0.004%	11.0%	98.20	0.002	4.74	7	15,649	15,656
1986	491.00	0.022%	12.0%	100.66	0.013	5.30	42	17,499	17,541
1987	491.00	0.093%	15.0%	100.66	0.053	6.63	173	21,874	22,048
1988	510.64	0.305%	20.0%	104.68	0.179	9.19	591	30,332	30,923
1989	531.07	0.816%	25.0%	108.87	0.499	11.95	1,645	39,432	41,077
1990	552.31	1.849%	30.0%	113.22	1.174	14.91	3,875	49,211	53,086
1991	574.40	3.643%	34.0%	117.75	2.407	17.58	7,942	58,003	65,945
1992	597.38	6.398%	38.0%	122.46	4.395	20.43	14,505	67,420	81,925
1993	621.27	10.210%	42.0%	127.36	7.295	23.48	24,072	77,497	101,570
1994	646.12	15.048%	47.0%	132.46	11.182	27.33	36,899	90,192	127,091
1995	671.97	20.764%	52.0%	137.75	16.046	31.45	52,951	103,779	156,730
1996	698.85	27.125%	57.0%	143.26	21.800	35.85	71,939	118,308	190,247
1997	726.80	33.861%	61.0%	148.99	28.302	39.90	93,396	131,674	225,070
1998	755.87	40.705%	65.0%	154.95	35.383	44.22	116,764	145,921	262,686
1999	786.11	47.425%	69.0%	161.15	42.874	48.82	141,483	161,097	302,580
2000	817.55	53.838%	84.0%	167.60	50.618	61.81	167,038	203,963	371,001
2001	850.25	59.814%	90.0%	174.30	58.486	68.87	193,003	227,273	420,275
TOTAL	11,268.58			2,310.06	280.705	476.66	926,327	1,572,993	2,499,320

Total # of Households: 795920

Source: Karuingi, F.T. National Economic Savings through Adoption of Improved Storage Grain Structure and Storage Management. Draft prepared for On-Farm Grain Storage Project. February, 20,1989.

1. Projected maize production based on annual rates of increase of 4 percent.

2. Base year for structures adoption rate (1984) taken from Judith Mbula's adoption of Post-Harvest Technological Package in western Kenya, August 3, 1988. Annual exponential increase in adoption assumed to be 0.83 through 2001.

3. Treatment adoption rate taken directly from the source document (which is based in part on Mbula's paper, cited above).

4. Maximum loss reduction for adopters taken at 25% minus 4.5%, or 20.5%.

5. Maize saved through improved structures and early harvesting taken at 11.5%.

6. Maize saved through shelling and treatment taken at 9%.

7. Values of maize saved based on market value of KShs. 330.00 per 100 kg. of sound dry maize.

Cost-Benefit Analysis of Storage Structure and Management, Western Kenya

B. Projected Costs

Scenario #1: High Adoption of Improved Storage Structure and Treatment Practices

Year	GOK Costs Kshs 000	USAID Kshs 000	Cum. Stru. Invest Kshs 000	Incremental Invest. Kshs 000	Annualized Incr.Invest Kshs 000	Annual Maint. Costs (000)	Harvesting & Chems. (000)	Total Costs Kshs 000
1984	5,000	25,600	7	7	1	1	10,665	41,267
1985	5,500	18,000	57	50	4	6	11,732	35,243
1986	8,500	19,656	317	261	22	36	12,798	41,013
1987	17,000	16,074	1,325	1,008	86	150	15,998	49,308
1988	17,561	28,710	4,340	3,015	256	493	21,331	68,351
1989	18,300	21,996	11,618	7,279	619	1,319	26,663	68,897
1990	18,300	9,000	26,310	14,691	1,249	2,987	31,996	63,532
1991	18,400	9,000	51,850	25,540	2,171	5,887	36,262	71,720
1992	18,600	9,000	91,052	39,202	3,332	10,338	40,528	81,798
1993	18,900	9,000	145,298	54,246	4,611	16,496	44,794	93,802
1994	19,100	9,000	214,154	68,856	5,853	24,314	50,127	108,394
1995	19,300	9,000	295,497	81,343	6,914	33,549	55,460	124,223
1996	19,500	9,000	386,020	90,523	7,694	43,827	60,792	140,813
1997	19,700	9,000	481,877	95,857	8,148	54,710	65,059	156,616
1998	20,000	9,000	579,279	97,401	8,279	65,768	69,325	172,372
1999	20,200	9,000	674,912	95,633	8,129	76,626	73,591	187,545
2000	20,500	9,000	766,170	91,258	7,757	86,987	89,589	213,833
2001	20,700	4,500	851,217	85,047	7,229	96,643	95,988	225,060
TOTAL	305,061	233,536				520,136	812,698	1,943,785

Source: Karuingi, F. T. op.cit.

1. GOK costs taken directly from the source, Table 1. The costs include personnel cost of the staff involved in grain post-harvest extension, transport, accommodation and training.
2. USAID costs taken directly from the source, Table 1 through 1989; thereafter these costs taken at KShs. 9 million through year 2000 and at KShs. 4.5 million in 2001.
3. Cumulative structure investment based on total number of farm households times adoption times the average capital cost per structure. The latter weighted equally by crib (KShs. 2,885), improved raised basket (KShs.1,365) and traditional raised basket (KShs. 1,115).
4. Incremental investment is cumulative investment current year minus cumulative investment the previous year.
5. Annualized incremental investment is incremental investment divided by average useful life. The calculation is [(2,885.10 + 1,365.15 + 1,115.15)/3 = 151.3; 151.3/1,788 - 0.085.
6. Annual maintenance cost is KShs. 203 times structures adoption rate times total farm households.
   Thus value is the weighted average for the three types of structures [(288 + 136 + 115)/3] + 25 = 203. The KShs 25 is for prestorage hygiene.
7. Harvesting and chemicals cost is KShs 134 times treatment adoption rate times total farm households.
8. Total costs represent the sum of GOK costs, USAID costs, annualized incremental investment, annual maintenance cost and harvesting and chemicals costs.

Cost-Benefit Analysis of Storage Structure and Management, Western Kenya

C. Benefit/Cost at 15% Discount

Scenario #2: Low Adoption of Improved Structure and Treatment Practices

Year	Discount Factor	Discounted Incremental Costs Kshs 000	Discounted Incremental Benefits Kshs 000	
1984				
1985				
1986				
1987				
1988				
1989	1.000	68,897	41,077	
1990	0.870	55,245	46,161	
1991	0.756	54,230	49,864	
1992	0.658	53,784	53,867	
1993	0.572	53,631	58,073	
1994	0.497	53,891	63,187	
1995	0.432	53,705	67,759	
1996	0.376	52,937	71,521	
1997	0.327	51,198	73,576	
1998	0.284	48,999	74,672	
1999	0.247	46,358	74,793	
2000	0.215	45,962	79,744	
2001	0.187	42,065	78,552	
TOTAL		680,903	832,845	

Benefit-Cost	1.223
NPV	151,942

1. Discount factor is the annual discount factor at 15 percent per annum with 1989 as base year.
2. Benefit/costs equals total value of discounted benefit divided by total value of discounted cost.
3. Net present value (NPV) equals total value of discounted benefit minus total value of discounted costs.

Appendix E

Preliminary Benefit Cost Analysis of Expanded Programme Western Kenya

Scenario 2. Low Adoption of Improved Storage Structures and Treatment Practices

A. Estimated Benefits

B. Projected Costs

C. Benefit/cost at 15% discount

Cost-Benefit Analysis of Storage Structure and Management, Western Kenya

A. Estimated Benefits

Scenario #2: Low Adoption of Improved Storage Structure and Treatment Practices

Year	Maize Production MT 000	Adoption Rate Structure %	Adoption Rate Treatment %	Maximum Reduced Losses MT 000	Maize Saved Improved Structure	Maize Saved Improved Treatment	Value of Maize Saved Imp. Stru. Kshs 000	Value of Maize Saved Management Kshs 000	Total Benefits Kshs 000
1984	467.00	0.001%	6.0%	95.74	0.001	2.52	2	8,322	8,324
1985	479.00	0.004%	6.6%	98.20	0.002	2.85	7	9,389	9,397
1986	491.00	0.013%	7.2%	100.66	0.008	3.18	25	10,500	10,524
1987	491.00	0.056%	9.0%	100.66	0.032	3.98	104	13,124	13,229
1988	510.64	0.183%	12.0%	104.68	0.107	5.51	355	18,199	18,554
1989	531.07	0.490%	15.0%	108.87	0.299	7.17	987	23,659	24,646
1990	552.31	1.109%	18.0%	113.22	0.705	8.95	2,325	29,526	31,851
1991	574.40	2.186%	20.4%	117.75	1.444	10.55	4,765	34,802	39,567
1992	597.38	3.839%	22.8%	122.46	2.637	12.26	8,703	40,452	49,155
1993	621.27	6.126%	25.2%	127.36	4.377	14.09	14,443	46,498	60,942
1994	646.12	9.029%	28.2%	132.46	6.709	16.40	22,140	54,115	76,255
1995	671.97	12.459%	31.2%	137.75	9.628	18.87	31,771	62,267	94,038
1996	698.85	16.275%	34.2%	143.26	13.080	21.51	43,164	70,985	114,148
1997	726.80	20.317%	36.6%	148.99	16.981	23.94	56,037	79,005	135,042
1998	755.87	24.423%	39.0%	154.95	21.230	26.53	70,059	87,553	157,611
1999	786.11	28.455%	41.4%	161.15	25.724	29.29	84,890	96,658	181,548
2000	817.55	32.303%	50.4%	167.60	30.371	37.08	100,223	122,378	222,600
2001	850.25	35.888%	54.0%	174.30	35.091	41.32	115,802	136,364	252,165
TOTAL	**11,268.58**			**2,310.06**	**168.424**	**286.00**	**555,800**	**943,796**	**1,499,596**

Total # of Households: 795,920

1. See Appendix D, A. Estimated Benefits

2. Low adoption rates taken to be 60 percent of the corresponding high rates.

3. Calculations identical to those followed for the high rate case.

Cost-Benefit Analysis of Storage Structure and Management, Western Kenya

B. Projected Costs

Scenario #2: Low Adoption of Improved Storage Structure and Treatment Practices

Year	GOK Costs Kshs 000	USAID Kshs 000	Cum. Stru. Invest Kshs 000	Incremental Invest. Kshs 000	Annualized Incr.Invest Kshs 000	Annual Maint. Costs (000)	Harvesting & Chems. (000)	Total Costs Kshs 000
1984	5,000	25,600	14	14	1	2	6,399	37,002
1985	5,500	18,000	57	43	4	6	7,039	30,549
1986	8,500	19,656	190	133	11	22	7,679	35,868
1987	17,000	16,074	795	605	51	90	9,599	42,814
1988	17,561	28,710	2,604	1,809	154	296	12,798	59,519
1989	18,300	21,996	6,971	4,367	371	791	15,998	57,457
1990	18,300	9,000	15,786	8,815	749	1,792	19,198	49,039
1991	18,400	9,000	31,110	15,324	1,303	3,532	21,757	53,992
1992	18,600	9,000	54,631	23,521	1,999	6,203	24,317	60,119
1993	18,900	9,000	87,179	32,548	2,767	9,898	26,877	67,441
1994	19,100	9,000	128,493	41,314	3,512	14,588	30,076	76,276
1995	19,300	9,000	177,298	48,806	4,148	20,130	33,276	85,854
1996	19,500	9,000	231,612	54,314	4,617	26,296	36,475	95,888
1997	19,700	9,000	289,126	57,514	4,889	32,826	39,035	105,450
1998	20,000	9,000	347,567	58,441	4,967	39,461	41,595	115,023
1999	20,200	9,000	404,947	57,380	4,877	45,976	44,154	124,207
2000	20,500	9,000	459,702	54,755	4,654	52,192	53,753	140,100
2001	20,700	4,500	510,730	51,028	4,337	57,986	57,593	145,116
TOTAL	**305,061**	**233,536**				**312,086**	**487,619**	**1,381,713**

1. See Appendix D, B. Estimated Costs.

2. Low adoption rates taken to be 60 percent of the corresponding high rates.

3. Calculations identical to those followed for the high rate case.

Cost-Benefit Analysis of Storage Structure and Management, Western Kenya

C. Benefit/Costs at 15% Discount

Scenario #2: Low Adoption of Improved Structure and Treatment Practices

Year	Discount Factor	Discounted Incremental Costs Kshs 000	Discounted Incremental Benefits Kshs 000	
1984				
1985				
1986				
1987				
1988				
1989	1.000	57,457	24,646	
1990	0.870	42,643	27,697	
1991	0.756	40,826	29,918	
1992	0.658	39,529	32,320	
1993	0.572	38,560	34,844	
1994	0.497	37,923	37,912	
1995	0.432	37,117	40,655	
1996	0.376	36,048	42,913	
1997	0.327	34,472	44,145	
1998	0.284	32,697	44,803	
1999	0.247	30,702	44,876	
2000	0.215	30,113	47,846	
2001	0.187	27,123	47,131	
TOTAL		485,209	499,707	

Benefit/Cost: 1.030
NPV: 14,499

1. Discount factor is the annual discount factor at 15 percent per annum with 1989 as base year.

2. Benefit/cost equals total value of discounted benefit divided by total value of discounted cost.

3. Net present value (NPV) equals total value of discounted benefit minus total value of discounted costs.

Appendix F

Inventory of Materials and Equipment, GMU.

ON—FARM GRAIN STORAGE PROJECT
P O BOX 208 MASENO KENYA
Telephone: Maseno 161

11 February 1987

I, J.M.O. Sewe accept the temporary custody, for the Ministry of Agriculture, of the On-Farm Grain Storage Project facilities, known as the "Maseno Laboratory" with the equipment as per inventory lists.

Consumable supplies to operate the office and laboratory will be adequately provided until the facilities are fully signed over to MOA.

A small staff, to keep the grounds properly maintained, to assist in the operation of the office and laboratory and a driver will be temporarily posted to the Maseno Laboratory by the On-Farm Grain Storage Project.

One vehicle KWC 495 will be assigned by the Project to operate from Maseno.

Funds, to temporarily operate the facility prudently, are being provided by the Project. The expenditure of the funds will be receipted.

In due time this Maseno Laboratory will be signed over to the Ministry of Agriculture. This facility will then be funded by the Ministry of Agriculture.

J.M.O. Sewe

Project Manager/Custodian for
Ministry of Agriculture

Fred W. Lenz

Team Leader & Extension Specialist
On-Farm Grain Storage Project

"On-Farm Grain Storage" Project

Maseno Facility

Inventory

I Administrative Offices

Project manager's Offices

two drawer file cabinets - 1
cupboard - 1
office Desk with side drawers - 1
office table with side drawer - 1

Chief Administrative Office

cupboard: 1 with stationery and 1 with library - 2
telephone stool 1

Computer room I

manual typewriter (Olympia) - 1
two-drawer cabinets - 2
office desk with 2 drawers - 1

Reception Area

large table - 1
photocopy machine (owned by Mimeograph Supplies in Kisumu) - 1
IBM electric typewriter (type 670X) - 1

Kitchen

cupboard - 1
square table - 1
duplicating machine - 1 (Gestetner)
letter tray - 1
first aid box - 1
gas cylinder - 1
burner cooker plate - 1

II *Grain Monitoring Unit (GMU)*

Stored Grain Biologist's Office

file cabinet with 3-drawers - 1
cupboard - 1
microscope - 1
protimeter - 1
sets of 7m intercom - 3
min. & max thermometers - 1
office desk with side drawers - 1
drawing set machine - 1

Biology Laboratory

Moisture testers
- Dickey John - 4
- Protimeters - 2
- Doles - 2

Fisher scientific microscope (Stereomaster) - 1
model SPT - ITH - serial no. 7000
Tally counters - 8
Logan magnifiers - 4
desk with 3 side drawers - 1
electric balance - 1
Olivetti Logas 48 calculator - 1

Dark Room

Spectroline UV lamp (Model 8-100x/F) - 1
pressure cooker - 1
table - 1
alcohol burner - 1
desiccator - 1
four- drawer cabinet - 1
Ohaus balance - 3

Chemistry Laboratory

Fisher Scientific beam balance - model 220R serial R0003238
Kjeldal apparatus for protein analysis
digestion unit- 1 distillation unit - 1
refrigerator/freezer - model TBI5-scc serial no. AR 484608
Fisher Thermix stirring hot plate - model 6101 serial no. 103
Sanyo blender with 2 blender jars - 1
Waring blenders (model 13BL75) with 6 blender jars - 2
wall clock - 1

volumetric flasks
- 1000 ml - 1
- 500 ml - 2
- 250 ml - 2
- 100 ml - 2

measuring cylinders
- 1000 ml - 1
- 100 ml - 23
- 24 ml - 24

measuring jars
- 2000 ml (plastic) - 1

Kjeldal flasks
- 800 ml - 1

Kjeldal bulbs

separating funnels
- 500 ml - 2
- 125 ml - 2

graduated pipettes
- 25 ml - 2
- 10 ml - 5
- 2 ml - 2
- 1 ml - 1
- 0.1 ml - 8

non-graduated pipettes
- 50 ml - 2
- 10 ml - 3

burettes
- 50 ml - 2
- 25 ml - 1
- 10 ml - 2

droppers
- pipette fillers - 3
- watch glasses - 3
- hoses and clamps
- tripod stands .- 2
- asbestos mats
- tongs
- test tubes
- culture tubes

funnels
- glass - 3
- plastic - 3

conical flasks
- 1000 ml - 2
- 500 ml - 4
- 250 ml - 8
- 125 ml - 7

filtration flasks
- 1000 ml - 1
- 500 ml - 2

beakers
- 1000 ml - 1
- 400 ml - 1
- 250 ml - 5
- 150 ml - 2
- 50 ml - 4

Buchner funnels - 3

desiccators - 14

thermometers

- -20 - 110 °C - 5
- -20 - 150 °C - 1
- -10 - 260 °C - 1
- -40 - 220 °C - 7
- -30 - 110 °C - 17

sling psychrometers - 5

hygrometer - 1

desks - 2

lamp stands - 1

aspirators - 3

Computer Room 2

memory expansion board IBM 256 K bytes.
spare disk drive (hard disk)
disk boxes, opened and in use - containing data diskettes, system diskettes and formatted diskettes
mini disk box unopened

thimbles of different elite
power protector cleaner - 1

unopened cassette ribbons - multi-strike for Spinwriter
NEC-6-3550
form feeder for NEC printer - 1
diskettes - unopened and unformatted - 30
system unit + keyboard + visual display unit - 1

printers - with 3 way switch attached - 2
NEC 3550
IBM PC graphics

manuals - 6
a. DOS
b. LOTUS 1-2-3-
c. BASIC 3.0
d. BASIC
e. Guide to operations for IBM XT
f. M STAT

disk register with information pertaining to the respective diskettes used - 1
box files containing important information on parameter - 4
creation of spreadsheets - formula creation etc. for NR-Nyanza, FTDU-Field Trial and Demonstration Unit,WI-Western, computer room IBM PC
box files containing photocopies of lab file information - 2
computer diaries from November 1984 - 1986 - 4

Main Laboratory

office desk with side drawers - 1
tables - 7
vacuum pump - 1
transformer - 1
auto-maize counter - 1
electric balance - 1
ovens - 3

deep freezer - serial no. LM 167039
bench lenses with lights - 3
sample divider (sets) - 2
sieves - 8
stapler - 1
10 drawer cabinet
test-weight funnels and cups - 2

Chubb fire extinguisher with hose reel - 1
fire extinguishers canisters - 4
two-drawer file cabinets - 3

four drawer file cabinets - 1
tables with side drawers - 2
scoops - 36
wall clock - 1

Wiley mill - 1
small square table - 1
RH-temp recorder - 1
table tennis table - 1
dry and wet bulb thermometer - 1
max. and min. thermometer - 1
fire extinguishers - 2

III Miscellaneous Operating Equipment

chairs w/arms w - 6
chairs w/o arms - 28
chairs, high - 2
chairs, typing - 1
dust bins - 11
paper racks - 8
staplers - 2
paper punchers - 1
propane gas tank - 1

IV Library

Grain Biologist Office

1. The Annual Crops of Uganda
2. Pesticide Management and Insecticide Resistance
3. Drying and Storing Combinable Crops
4. Pathology in the Tropics
5. Methods of Analysis
6. Food Microbiology (Third Edition)
7. Plant and Animal Biology (VOL. I&II)

8. Insect Ecology
9. Feed Manufacturing Technology
10. Grains Legume Crops
11. Economics of African Agriculture
12. Agricultural Extension Handbook
13. Entomology Research and Development
14. Poverty and Growth in Kenya

15. Women and Participation in Rural Development
16. Home Making Handbook
17. Food Grain Reserves in Developing Countries
18. Pest Resistance to Pesticides and Crop Loss Assessment
19. Kenya Storage Projects Valuation Study (August 1979)

20. Seed Germination Test
21. Kenya Population and Development

22 Environmental and National Resource Management in Developing Countries
23. A.I.D. Research Development Abstracts Operation Plan for Smallholder Production Services and Credit Project

Administrative Assistant Office

1. The Nature of Mass Poverty
2. Village Technology Handbook
3. The Design of Rural Development (Lesson from Africa by Uma Lele)
4. Kenya: Into the Second Decade
5. Standard Handbook of Engineering Calculations
6. Applied Engineering Science (Handbook for Tables) 2nd Edition
7. Standard Handbook of Mechanical Engineers

8. Agricultural Engineers Handbook
9. Post Harvest Grain Loss Assessment Methods
10. Grain Storage, Part of a System
11. Drying Cereal Grains
12. Grain Storage (The Role of Fungi in Quality Loss)
13. Standard Mathematical Tables 26th Edition
14. Steel Construction Eight Edition

15. An Introduction to Agriculture Engineering
16. Instrumentation for Engineering Measurements
17. Source Book Scientific Calculations - Decision Making
18. Small Farm Grain Storage
19. Village Technology
20. Small Farm Grain Storage (Preparing Grain for Storage Vol I)
21. Midwest Plan Service (Structures & Environmental Handbook)

22. Small Farm Grain Storage (Enemies of Stored Grain Vol. II)
23. 1980 - 1981 Agricultural Engineers Yearbook

V Tools And Equipment

fire extinguishers - 3
10kg detecto scales - 1
hole diggers - 3
100kg detecto scales - 1
standard testing sieves No. 10 - 2
standard testing sieves No. 20 - 2
standard testing sieves No. 40 - 2

stop watch - 1
rakes - 1
hand-grinders - 2
probes - 8
dry and wet thermometer (120 deg. F.) - 1
universal Fisher burner - 1
Fisher scientific thermometer - 6

Centigrade and Fahrenheit thermometer - 1
sheet cutter - 1
30m tape measurer - 1
rat traps - 12
pangas - 6
slashers - 6
bow-saw-frames - 2

screw-drivers - 2
panel saw or hand saw - 3
sickles - 3
knap-sack sprayers - 1
Black Beauty shellers - 1
hand shellers - 4
drums - 6

grip-pliers - 1
nose-pliers - 2
wrench-spanners - 1
spirit level - 1
claw-hammers - 4
hedge snip - 1
jack-plane - 1

ladders - 2
platform scales - 1
jembes - 4
masonry steel - 1
centre-punch - 1
plane-stone - 1
wood-chisels - 3

adjustable spanner - 1
shovels - 3
bench-vise - 1
sugar-bits - 1
plastering trowel - 1
carpentry press - 1
masonry square - 2

3m tape measure - 2
crow-bar - 2
Allen keys (for Wiley mill machine) - 9
saw-set - 1
Tennon-saw - 1
carpentry square - 1
quart hand tester - 1

plum-bob - 1
rough file - 1
sling psychrometer - 3
scraper - 1

VI FDTU (Structures & Equipment) (temporary experimental structure)

A House with inside equipment
200 litre drum - 5
petrol 20 litre jerrycan (for KWC 495) - 1
welded round wire - 20
platform scale - 1

B. Shed with platform (temporary experimental structure)
Basket granaries (used for 1984 trials) - 5
individual platform dryers - 4

C. Drying and Storage cribs (temporary experimental structure)
two section crib - 2
one section - 1

D. Traditional granaries (temporary experimental structure)
unimproved type - 3
improved - 5

E. Platform dryer (temporary)
5. compartment dryer

F. Experimental drying structures (temporary)
bag dryer - 2
cement platform with centre post
with roof - 3
without roof - 4

G. Rain gauge
rain gauge surrounded by a fence - 1

VII Vehicle

Registration mark and no. - KWC 495
Make - Land Rover
Type of body - st-wagon
Colour of body - limestone
Propelled by - petrol
Manufacturer's:
Year of manufacture - eighty four
Type of model - 109
Chassis Type, letter and no. 553121
Engine no. 36133680B
Rating (c.c.) - 2286 cc

This inventory is found agreeable to the parties concerned.

J.M.O. Sewe

Project Manager/Custodian

for Ministry of Agriculture

Fred W. Lenz

Team Leader & Extension Specialist

On-Farm Grain Storage Project

Witnessed by

E. [illegible] Basiye

P. D. A.'s Representative