10-11 SEPTEMBER 1990
NAIROBI

PROCEEDINGS OF THE CONFERENCE
"THE BIELENBERG RAM PRESS AND SMALL-SCALE OIL PROCESSING"

SPONSORED BY:
Center for Global Action (Lusaka and Tokyo)
Lutheran World Relief (Nairobi and New York)
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(*core funding from U.S. Agency for International Development)
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>Opening Remarks</td>
<td>1</td>
</tr>
<tr>
<td>Presentation by Carl Bielenberg, ATI</td>
<td>2</td>
</tr>
<tr>
<td>Presentation by Russ Read, ATI</td>
<td>6</td>
</tr>
<tr>
<td>Presentation by Isaac Kibuthu, Kenya Ministry of Agriculture</td>
<td>10</td>
</tr>
<tr>
<td>Presentation by James Muthaka, Egerton University</td>
<td>13</td>
</tr>
<tr>
<td>Presentation by John Mugeto, Egerton University</td>
<td>15</td>
</tr>
<tr>
<td>Presentation by Edison Rugumayo, Experiment in International Living</td>
<td>18</td>
</tr>
<tr>
<td>Presentation by Jim Herne, Technoserve</td>
<td>20</td>
</tr>
<tr>
<td>Presentation by Joseph Lungu, Africare/Zambia</td>
<td>22</td>
</tr>
<tr>
<td>Presentation by Tony Swetman, Natural Resources Institute</td>
<td>24</td>
</tr>
<tr>
<td>Presentation by Martin Fisher, ActionAid-Kenya</td>
<td>28</td>
</tr>
<tr>
<td>Presentation by J.A. Ali, Obafemit Awolowo University, Nigeria</td>
<td>32</td>
</tr>
<tr>
<td>Presentation by Joseph Gomez, Catholic Relief Services</td>
<td>33</td>
</tr>
<tr>
<td>Presentation by William Lobulu, Tanzania News Agency</td>
<td>35</td>
</tr>
<tr>
<td>Presentation by Eric Hyman, A. T. International</td>
<td>37</td>
</tr>
<tr>
<td>Presentation by Lynn Schlueter and Dallas Granima, Village Sunflower Project</td>
<td>47</td>
</tr>
<tr>
<td>Presentation by Carlos Zulberti, Egerton University</td>
<td>57</td>
</tr>
<tr>
<td>Presentation by Kiran Man Singh, Agricultural Development Bank of Nepal</td>
<td>63</td>
</tr>
</tbody>
</table>
Appropriate Technology International (ATI) gratefully acknowledges the contributions of the following organizations to the Bielenberg Ram Press and Small-Scale Oil Processing Conference:

- Center For Global Action (Japan) for financial support for overall conference planning, organization, travel, and support costs.

- International Development Research Centre of Canada (IDRC) for financial support to publish and distribute conference proceedings as well as monies for participant travel.

- Lutheran World Relief (East and Southern Africa Regional office) for their administrative and logistical assistance during the conference, and monies for participant travel.

- U.S. Agency for International Development which provides public funds for ATI to carry out its mission.

Conference proceedings compiled and edited by ATI. Special thanks to Ozzie Schmidt, IDRC, for reviewing transcript.

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OPENING REMARKS

Jamie Raile, Appropriate Technology International: I would like to welcome you on behalf of Lutheran World Relief (LWR) and Appropriate Technology International (ATI). We are most pleased that you are able to attend this two day conference on the Bielenberg ram press and small-scale oil processing.

Before I go any further, I would like to thank some additional sponsors of this conference. The Japanese development organization, the Center for Global Action, and the International Development Research Center (IDRC) of Canada have assisted financially in sponsoring the conference. They have helped to make it possible for participants from many different countries to attend. In addition, their contribution will allow the proceedings to be compiled and mailed to all of you as well as others who have an interest in this subject.

ATI and LWR have been working in small-scale sunflower seed pressing since about 1984. It is because of these experiences and the experiences of many of you in this room that we are having this conference. About a year and a half ago, we had a one day meeting in Nairobi to talk about the Bielenberg ram press. One thing that came out of that meeting was the importance of a network to keep informed about what everyone is doing in the field; this second meeting is another attempt to bring people together to share experiences and learn what others have been doing during the last couple of years. Some of you are very familiar with the Bielenberg ram press and some of you may be seeing it for the first time today. We have a variety of people here including engineers, manufacturers, representatives of NGOs and government officials. I think that when you start talking to some of your neighbors, you will be able to share many different experiences.

Now I would like to ask Sigurd Hanson of Lutheran World Relief to say a few words.

Sigurd Hanson, Lutheran World Relief: I would like to extend a special welcome to you on behalf of Lutheran World Relief at this second conference. I see a lot of familiar faces, and some new ones; we look forward to learning from you during the next two days. By the number of you here it is very clear to me that this is a newsworthy event.

Last month ATI and LWR did an evaluation of the Village Oil Project in Tanzania. A comment was made there that I would like to share with you. Someone once said that "when a dog bites a man that ain't news, but when a man bites a dog that's a lot of news." It is clear to me that all of you here have influenced and have played some role in helping press owners to bite the dog, to make a lot of news, and in the process to help a lot of people, their families and their villages. I am very pleased to be here, to be part of
this sponsorship with ATI and our colleagues, and to help move this exciting process along. Thank you.

(Introductions -- see List of Participants)

Presentation by Carl Bielenberg, ATI

Welcome everyone. I was not feeling very well earlier this week, so I got the OK from my boss at ATI not to do a formal presentation. I think there are a lot of substantive issues to cover so I will keep my talk short.

Work on the ram press began in 1985 in Tanzania. At the time that I joined ATI in early 1985 we had already begun a project to manufacture and disseminate a type of manually operated press for sunflower in Tanzania. That press was developed by the Institute for Production Innovation (IPI) in Dar es Salaam, and was essentially a batch press consisting of a cage, a piston, and a mechanical device for applying pressure to the piston. The mechanical device was basically a scissor jack very much like that used for raising a car when changing a tire, with a screw and a handle. The idea was that the further down the piston went into the cage, the more mechanical advantage would be achieved by turning the screw because of the changing angle of the arms of the press.

I went to Tanzania in 1985 to evaluate this press for ATI, and determine whether the IPI press could be disseminated in rural areas around Arusha, and whether it would provide reliable service and maximum economic advantage to the users. At that time this press was still somewhat in the development process. We felt that dissemination and field testing could begin while the technical details were further resolved; there were some problems, particularly with the decortication system for removing the husk from the seed before pressing it.

This press was available in both 20-ton and 80-ton models; the 80-ton model stands roughly 3 meters tall and weighs about 600 kg, the 20-ton model is considerably smaller but rather fragile. Partly because the technology was not ready for dissemination and partly because I was concerned about its cost, I sought to come up with an alternative. We were well aware that the principal technology used in small-scale oil processing is the screw expeller. Considering fuel requirements (it is motorized, which means to operate it in rural areas one would need a diesel engine) and availability of spare parts, the feasibility of local manufacture was not promising. We wanted to put in place a project which could eventually be sustainable without further external inputs, so we looked for a technology which could be manufactured locally, including spare parts, and which, as much as possible, would be independent of fuel and other external inputs.
In 1985 I worked with Them Engineering Company in Arusha to develop the first prototype of the ram press, very similar in appearance to the presses you see outside. There were some refinements made in the design of the cage and other parts. One of the most noticeable features is the divergence of the cage; it gets larger toward the outlet, which is counter-intuitive to a lot of people. That was worked out and was probably responsible for the final success of the prototype which was fabricated in November 1985.

One thing I should make clear is that the ram press is not the answer for everyone. It has a very small capacity - 10 kg seeds per hour under good conditions - and an output of about 3 liters of oil per hour. It is designed for use primarily by villages to produce oil for their own consumption, not for urban areas where the market is larger. Second, it cannot be used for pressing all oilseeds. You certainly would not use it for pressing palm oil for example, because palm does not require as much pressure, and there are a number of technologies including low pressure batch presses and direct throughput presses which are much cheaper and more productive than even a very large ram press.

We are in the process of exploring the range of oilseeds to which the ram press can be applied. It seems that the range is quite broad and includes seeds such as copra, simsim, mustard, and rape. But the data we receive from different organizations is often contradictory, leading us to conclude that factors such as seed quality, moisture content, storage conditions and temperature, are all factors affecting the performance of the press. It is important to understand these parameters before disseminating the press for use with other seeds.

Let me now talk about some of the essential features of the ram press that distinguish it from other extraction systems.

The motorized expeller is a very successful technology that develops pressure by screwing the seed material forward. It develops extremely high pressure as the thread of the screw decreases, because the space for the seed is reduced. Ultimately, by using a back pressure cone, extremely high pressures and very high extraction efficiencies occur, but with an expenditure of great mechanical energy, so much so that the seed actually gets hot in the process. So the motorized expeller is not appropriate for manual operation because human beings do not have enough power to operate it at a reasonable level of productivity. The smallest expellers on the market require about 4 to 5 kilowatts of power, whereas a human being at full power output produces only about 100 watts (a fifty-fold difference in the amount of mechanical power available).

In contrast, the batch press presses a large quantity of seed when in operation, but it takes a great deal of time because the press
is operated cyclically. First the cage has to be filled and the seed tamped; the oil has to flow a great distance through the cage. Most important, because the piston is large, it requires a great deal of force. A typical batch press would have a piston about 200 mm in diameter. The tonnage required to press oil from undecorticated sunflower seed is very high, about 200 kg per square centimeter. This means you need about 60 tons of force (200 mm at 200 kg/cm² = 60) and will have to resort to hydraulics or the feasibility of some other means of applying pressure. This gets costly and raises the question of local manufacture.

The ram press works on the same principle as the batch press, by forcing seed into a chamber which is perforated to allow the oil to flow out. However, the ram press's piston is much smaller (40-50 mm vs. 200-300 mm diameter), so the force required is much smaller. If you were to build a batch press with a smaller cage time would be wasted while waiting for the piston to release the oil, lifting the piston, getting the seed out, and refilling it. In the ram press, the piston is a kind of valve, so that when the piston moves back, the seed automatically refills at the end of the stroke; the piston is used to force the pressed cake out of the end of the cage by means of an adjustable restriction cone.

There is no shearing of the seed in the batch press, it simply compresses the material uniaxially, which means the extraction rate is not high when using whole seed. In contrast, the ram press's divergent cage shears the material because of increased fracturing as the seed goes down the length of the cage.

Now that I have talked about some of the differences among presses and expellers, let me return to the dissemination of the ram press in Tanzania. When the ram press was first introduced, there was a lot of controversy within and outside ATI (including the Tanzania client population and the manufacturers with whom we were working) as to whether this could be considered appropriate technology. The ram press was considered insufficiently productive to be of real interest, particularly to a commercial operator.

But the principals involved in the ATI-funded project (Lynn Schluter and Dallas Granima) felt that in fact it was extremely appropriate for use in villages, and despite many naysayers, went ahead full speed. Their zeal is partly responsible for the success they have had in Tanzania. They were willing to work to overcome the substantial difficulties they faced. These difficulties included the production by farmers of poor quality sunflower seed not appropriate for use in the ram press, as well as opposition from people who were familiar with motorized expellers and felt the ram press was not an appropriate alternative.

Incidentally, while it is true that I invented the ram press, someone recently sent me a clipping showing that a patent for a ram press was applied for in the mid-nineteenth century by an English
firm, designed to be operated by a steam engine. The seed shells were used to partially fuel the steam engine. Basically the principle was the same as the ram press; the technology is not new. Such presses were superseded by expellers when mechanical power became widely available.

This same concept has been used by companies that manufacture briquetters. The ram has an advantage over the screw in developing pressure. The ram generates much less friction between the ram and the material being pressed, thus allowing the mechanical parts to wear longer than those of a screw-type press. I do not want to go into much more detail about this, because I believe that most of this conference should be dedicated to discussing the dissemination process rather than nuts and bolts issues, which I am sure the engineers will be discussing after the conference anyway.

We at ATI are very open to any improvements or alternatives which stem from the work other people are doing in small-scale oil expelling. There are several ram presses which we feel are fully tested and perform reliably in the field; some are being displayed outside today. ATI would be greatly interested in suggestions for modifications and improvements, but we are not giving much emphasis to a motorized version of the press just yet. We are looking for a manual press for the small-scale market. There are some improvements which could be made to increase the ease of operating the press, but they would increase the complexity of manufacturing the press, so we have been reluctant to invest much effort in exploring these improvements.

Whenever you introduce a new technology, you introduce a change in the way people, not just professionals, spend their time. You may be encouraging farmers to grow a crop that they had not been growing, or to use a piece of machinery which is at least somewhat experimental. You do that with a certain amount of trepidation, hoping that the benefits will outweigh the losses incurred when farmers discontinue their previous activities. That seems to be the case in Tanzania, but it may not be the case in other settings. It is also possible to improve the old way of processing sunflower seeds, i.e., pounding and boiling. In Tanzania, the ram press is highly preferred to the traditional process, but again, this may not be true everywhere.

By way of introducing myself, and my perspective on working on the ram press or any other technology, let me explain my background. I lived in Cameroon in the 1970s, where I had a small manufacturing workshop with a Cameroonian partner. With limited capital, we were trying very hard to break even, making all kinds of things, whatever anyone wanted us to produce. After a while I began to recognize the types of equipment that can economically be produced in a small shop, the kinds of things that people can learn to use in a rural setting, and what can be easily marketed. Despite the initial impressions people may have about the ram press's low
productivity, the press has real advantages -- it is fairly simple, the number of parts to be made is fairly small, and it is inherently quite durable because of the small number of wearing parts. The ram press is small enough to load in the back of a pickup truck and transport elsewhere for demonstrations.

It is important that a technology have a level of productivity in line with the level of demand in the village itself. This means the commercial success of the technology will not depend on reaching outside markets, with all the problems involved in transportation and obtaining raw materials. Also if you can achieve (as in the Tanzania project) a sufficient density of ram presses in villages which are not too far from each other, villagers can share their experiences; this helps to reinforce the viability of the technology. They share information about how to repair it, how to get the most oil out of it, and how to manage it so it is as profitable as possible, thus improving the sustainability of the technology. Thank you.

Presentation by Russ Read, ATI

I have been asked to do a short summary of the various models of the press here today. Although the CAPU press has not yet arrived, it will be here later this afternoon.

The ram press was modified originally by Martin Fisher to reduce work effort. The purpose of subsequent modifications was primarily to reduce the cost of the press and increase its durability. In tandem with Martin Fisher's work, Hugh Allen's design was more concerned with improving the durability and reducing the level of work, and less concerned with the cost.

CAPU (Crafts and Artisans Promotion Unit) in Tanzania capitalized on these changes, and then worked primarily to reduce the cost of the press, with the goal of making the press pay for itself faster, so more people would be interested in getting involved in sunflower processing. When you have a chance to see all of the presses, you will see that the CAPU press is a big divergence from the other models. It is much lighter and less expensive to build, and appears to be durable enough for the rural environment if soft shelled sunflower seed is used.

Several new presses have been designed recently. Carl Bielenberg designed one about nine months ago for use with softer seeds. It was also designed with an eye to reducing the cost, increasing the ease of manufacture, and reducing the amount of effort required to operate it. Martin Fisher is experimenting with a new design using round versus square cage bars to make the cage easier to manufacture.
All these presses vary primarily in durability and cost of manufacture. We have not yet run side-by-side tests with all of the presses, with rotating crews, to find out which press design gets the best extraction efficiency. I am not sure whether you will find significant differences in extraction efficiency. More often you will find that differences in operator awareness and training, seed type, temperature of seed, the condition and the storage of seed may have a larger impact in the short run than changes in press design.

**QUESTION ON CAGE DESIGN**

**Martin Fisher, ActionAid-Kenya:** The basic change in the experimental design I developed is the use of round cage bars instead of tapered cage bars as in the other press designs. The other presses have square bars that have been cut in a wedge, so that there is an even gap between each of them. That means that when you are assembling them, to get an even gap, you have to put them all in a fixture and then put a shim, a small piece of metal or wood, all the way around before welding. Care has to be taken that the shims do not shift. After welding you pull out all the shims and you have it. It is not necessarily difficult after you practice; I am sure Carl can whip one together in half an hour or less, but it is difficult to train people who are not familiar with this procedure.

**Russ Read:** There are a lot of presses out there, and not all of them have had the benefit of design improvements which have reduced the effort and improved the extraction efficiency. Those wishing to start a ram press project should deal with others who have been working with the ram press in order to make use of the knowledge already gained in the field, such as ActionAid-Kenya, ATI, CAPU, the Tanzania project. It is worth noting here that even without the design improvements, the original Bielenberg presses in Tanzania are still in use after five years.

**Lynn Schlueter, Village Oil Project:** The work of the Crafts and Artisans Promotion Unit in Lushoto, Tanzania, has been referred to several times, and I would like to explain a little about them. CAPU's aim is to train village craftsmen to make articles that are more profitable for them than the household articles they usually make. They have been successful in training craftsmen to make the ram press with simple equipment and materials.

What our sunflower project has been trying to do in Tanzania is get the press manufactured in several parts of the country so it will be available locally to people who want to buy it. For example, in Iringa, we have had meetings with two or three manufacturers interested in making the press, then we arranged for some of these people to go to Lushoto and take a training course with CAPU. The manufacturer may be very sophisticated, and the person doing the training just a craftsman, yet the manufacturers have appreciated
QUESTION ON DIMENSION OF RESTRICTION CONE

Russ Read: The forces on the threads of the restrictor cone are immense; if you are adjusting the cone often this causes a great deal of wear. If you like the flat design of the restrictor, you might have to move to a heavier thread, so that delicate adjustments, which cause wear on the threads, will not have to be made continually. We think the cone shaped restrictor will reduce the need for that kind of fine adjustment.

Martin Fisher: If you make the neck too narrow, there is not a uniform force, and you may get bending of the neck, or even breakage. So you do not want to use too narrow a neck. But if you use a large one, the frictional moment is too far out, making it difficult to turn. A ball bearing sitting on top of the thread reduces turning friction between the seed and the cone. The ball bearing will reduce wearing, but will also add a bit to the cost.

QUESTION ON USING THE PRESS WITH SOFTER OILSEEDS

Carl Bielenberg: There is quite a difference among the "soft" seeds. For example, copra is quite fibrous, so the spacing of the cage bars is not as critical as it would be with simsim. Copra is also very compressible, so a large piston is needed to take in as much material at one time as possible. Copra also has extremely high yields of oil; other seeds would yield less oil.

Russ Read: So if you are thinking of using the press for softer seeds, especially for copra, it may be worthwhile to redesign
slightly the cylinder and the cage. ATI might be able to provide you some guidelines.

QUESTION ON MATERIAL USED FOR BASE

Russ Read: Three of the presses here today have metal bases. That is a lot of steel. The CAPU design has a wood base, and should theoretically be cheaper. Lynn, can you speak to that?

Lynn Schlueter: In Tanzania, devaluation of the shilling and the increasing price of steel over the years have made the price of manufacturing the press increase continually. We were looking for ways to bring down the cost of the press. CAPU came up with the idea of a wooden base, simply because it was less expensive. In Tanzania, the thing we are most concerned about is the price of the press. For many people, that is a big barrier; if the price is too high to begin with, many people will not get involved in sunflower processing at all.

Martin Fisher: The first press we designed did have a wooden base. That was a design I originated in Tanzania where hardwood is cheaper than metal. In Kenya hardwood is very expensive and softwood is very cheap. But if you make a softwood base, it begins to crack up. In Kenya, the difference in price between a steel base and a softwood base may be a factor of two, but the difference in durability may be a factor of ten. So in Kenya, it makes sense to have a steel base, but that decision depends on local economics.

Lynn Schlueter: Every press has a plate on the bottom that has holes in it for mounting to the base. What you can do is make a cement platform and mount the press on the platform. That makes the press very solid and much easier to use, because it does not rock.

Martin Fisher: I think the reason more people have not attached the press to a platform is that they like to move the press inside at the end of the day. You could still do it if you had removable bolts. On the latest press redesign, we can do this.

QUESTION ON DIFFICULTY OF FINDING MATERIALS

Russ Read: I work in Uganda as does Dr. Rugumayo, and he would probably be the first to admit that finding steel plate is next to impossible. Most of the time you are going out to a scrap yard and scavenging. This is one of the reasons for the different press designs; a lot of the changes have to do with what material is available locally and at what cost. You may have to have someone in the machine shop who is a skilled innovator.
QUESTION ON MANUFACTURING INSTRUCTIONS

Russ Read: CARE has developed a manual for manufacturing the Hugh Allen version of the press. The caveat is that this press design is steel-intensive. In several months, ATI will have another manual available on manufacturing the Fisher version of the press. Also available will be drawings on Carl's recent press design. Information is also available on the design and materials list for the CAPU press.

Carl Bielenberg: What CAPU is striving for is least cost in manufacturing. Least cost is not necessarily the best criterion for an organization to use in deciding whether to disseminate the press in a country which has no prior experience with the ram press. If the press breaks there may not be someone who can repair it. In Tanzania CAPU is bringing the manufacturer as close to the user as possible; if the press breaks the owner can take it back to the original manufacturer for repair. The emphasis on some of the other machines is to err on the side of being slightly overdesigned, so that the stress they are designed to take is more than the press would likely be subjected to. The idea is that if the press goes to a country like Sudan, which has no prior experience with the ram press, the press will not break.

Russ Read: It is also not sufficient to be given a materials list; training is needed. From a machinist's standpoint, it can be quite challenging to make the press operate correctly. The quality of the manufacturing is critical to ensure that the press works with minimum effort and that you get the maximum amount of oil for the seed you are using.

Presentation by Isaac Kibuthu, Kenya Ministry of Agriculture (see paper titled "Rural Oil Protein Processing Sub-Project")

Kenya has many climates, and can grow many kinds of oilseed crops - sunflower, rapeseed, groundnuts, coconut, simsim, and a number of others. The Ministry of Agriculture has encouraged the production of oil crops, mainly by funding research, and also through the extension system. But we have not had anything to do with rural processing before. Despite these efforts, Kenya is not self-sufficient in oil. We estimate demand to be about 150,000 tons annually, about 20% of which is grown in Kenya. The rest is imported, mainly in the form of palm oil coming from Malaysia, which costs Kenya about US 80 million annually. We also have to import seed cake for animal feed.

Many of the problems limiting oil crop production are historical - in the past, we have emphasized the production of cash crops, like coffee, tea and pyrethrum. Oil crops received less attention. The prices paid farmers for oil crops were low and yields were low because of lack of high-yielding hybrid seeds. The marketing
system is not well-developed. The world market is now flooded with artificially cheap palm oil from Malaysia.

The project we are now implementing is titled the "Rural Oil Protein Production and Processing Project." This is one of ten subprojects of a major project funded by the World Bank, called Rural Services Design. The subproject I am discussing now includes oilseed research, extension, and rural processing. It is cofinanced by the World Bank and UNDP. The main objective of this project is to promote economic production of oilseeds and rural processing, in order to satisfy local demand and reduce the need for foreign exchange for oil imports.

The main feature of this project is research to develop a low input production technology for these oilseeds. With Kenya's increasing population, people are being pushed from the high potential areas, which are now producing crops like coffee, tea, pyrethrum, and other high-earning crops, to the marginal areas of the country. That is why Kenya needs low input appropriate technology for the production of oilseeds, geared to those areas where the farmers are now.

We would also like to promote the processing of oilseeds at the rural level. Farmers have traditionally been paid low prices for their oilseeds because most of their fields are far from the urban centers, where the processing facilities are located. The cost of transportation had to be factored in, both for the raw material to be processed, and for returning the final product (oil or cake) back to the rural areas.

Other organizations are involved in this undertaking, not just the Ministry of Agriculture. We are hoping this project will promote interaction among all the institutions involved in oilseed processing. We need to share all the ideas we come up with, and coordinate our extension efforts so we do not confuse the farmers and entrepreneurs we are trying to reach.

The oilseed research for the project is being implemented by the Kenya Agricultural Research Institute (KARI), a parastatal charged mainly with doing research in this country. The extension component is being undertaken by the Ministry of Agriculture. At the moment we are in the midst of a large project we have been implementing for the last five years, called the National Extension Program. It is also funded by the World Bank. We have quite a large extension staff in the field, and believe we are capable of bringing new technology to the farmers in the field. Rural processing is being looked at by a number of rural technology development centers around the country.

The rural technology centers are testing other processing equipment, not just the ram press, but also small-scale expellers including ones currently being made in China. During this period
we expect to locate and find out what equipment can be used at the rural level, test it, select appropriate technologies, and package them.

I am the project coordinator; we also have an agronomist, who is mainly in charge of the extension package, and also some research. There is an agricultural engineer who liaises with the rural technology development centers, and an economist. People have already asked, how viable is this ram press? Is it better for the farmer to produce the seeds, then sell them for pressing by the big dealers? The economist looks at all these aspects.

This project has been in progress for the past year. We have been able to purchase 11 ram presses, and test both the Allen version and the Fisher version. We also have three motorized screw expellers in operation. Through testing we found the ram press feasible for processing sunflower. But for the other oil crops, we still have a problem. Second, the price of the ram press is very high. At the moment there is a monopoly in press manufacture; last year we purchased presses at KSh 30,000 (about $1,600). This year, the manufacturer wanted to more than double that price.

UNDP is willing to fund project consultants. We would like to engage a design and production engineer. We hope he will be able to look at all the issues that have been raised by our technology centers and address these problems. We are also looking at the oil; by the end of the project we want to be able to confidently provide information to the farmer on such issues as nutritional value of the oil and what needs to be done to process it, filter it, make it useful for cooking, determine shelf life, and store it. Also we want to develop a package on the cake for animal feed.

I believe that we are all trying to come up with a technology that is best suited to the farmer. Unless we very closely cooperate with each other, we are bound to cause confusion. I would like to thank ATI for providing a forum for all of us to come together and share experiences.

QUESTION ON TRIP TO VILLAGE OIL PROJECT

Isaac Kibuthu: Six of us involved in this project visited Lynn Schlueter in Arusha in 1988 to see the ram press in operation in the area. We were quite impressed with what they had done. I would say we were able to learn a lot from that trip. But there are still a few questions which could not be answered. The farmers are only purifying the oil by boiling it with water. The cake was being used for animal feed without further processing. We would like to go farther than that.

Willie Salmond, Experiment in International Living: Can Kenya compete with cheaper imported oil? We are struggling with this in Uganda because it is that same cheap oil which moves across the
border into Uganda. Of course the price then goes up quite a bit. We believe in Uganda we can compete fairly well because the price has already increased. I think a key issue for Kenya is whether in fact the oil can be produced competitively.

Isaac Kibuthu: We have two issues there. One is that per capita consumption is low in Kenya, about 5 kg a year. That is even less than the per capita consumption in most developing countries, and way below the consumption in developed countries. So we would like to first, encourage production of oilseeds in marginal areas as well as local processing; and second, with our increasing population and worsening exchange rates, we need more oil than we can afford to import. Even if we cannot compete now at a relatively low level of production, we will get a start on reducing the oil consumption bill in the future.

Elizabeth Feilden, Amani Christian Community Development Project: Women may not be used to cooking with sunflower or other oils. Tests and demonstrations could help women make the switch from Kimbo (hydrogenated palm oil) to oil for cooking.

Martin Fisher: Presently in Kenya, with current prices, you can compete with Kimbo, and make more than 100 shillings in profit per day with a ram press. Given that fact, do we really need a further two years of research before we go ahead with full-fledged implementation and dissemination?

Isaac Kibuthu: We know that the ram press works well with sunflower. Last year we had 11 of these ram presses in the field. This year we are putting 90 in the field for the farmers.

QUESTION ON MARKETING

Martin Fisher: Experience in Kenya has shown that people prefer sunflower oil to Kimbo. The reason they buy Kimbo is because it is cheaper or the only fat available. If you can make sunflower oil two shillings cheaper than Kimbo per liter, people will buy it. The other advantage of sunflower oil is that you can buy it in very small containers which makes it even more marketable because you can only buy Kimbo in cans.

Presentation by James Muthaka, Egerton University (see paper titled "The Vegetable Oil/Protein System Programme: The Kenyan Experience")

I will be talking about the vegetable oil protein system in Kenya. I would like to put our discussion of the ram press in the perspective of this total system.

As stated earlier, Kenya is too dependent on imported oils; about 80% of domestic utilization is provided by imports. The rise and
fall of world palm oil prices over the course of the last 15 years indicates unstable prices for the future.

We decided to do our research in four stages. First, there was a need to review information already available to formulate a proposal for carrying out a complete investigation of the existing oil/protein system in Kenya. This was done by a consultant who will be speaking later on, Dr. Carlos Zulberti.

The second stage was a detailed study of the various components of the oil/protein system with the purpose of identifying principal economic, technical and institutional factors. That study consisted of a set of studies on the oil/protein system in this country; one of the areas examined was rural oilseed processing. Based on the results of that study we started a series of field trials related to production and processing. This third stage is still ongoing. The fourth stage is to outline and implement a program to expand production and processing of oilseeds in Kenya.

I will not discuss the specific implementation of these stages, but for my presentation will comment on some basic concepts for the program we are following. An important concept is the systems approach to the oil protein system in this country. We looked at the system as a series of integrated components which have to be studied as a whole as well as possible areas of improvement for each component.

Next I would like to refer to Figure 3 in my paper. There we have a characterization of the oil/protein system. One of the components shown is rural processing. What we wanted to do was investigate the extent and magnitude of rural oilseed processing in Kenya. A field study was conducted and we discovered that the rural processing component was very limited. In this country there is not a widespread capability for small-scale rural processing.

The investigation of the oil/protein system in Kenya involved statisticians and individuals from various institutions across the country. Please refer to Table 1 which shows who participated in the vegetable oil/protein system diagnostic study. Some of the people who are involved are with us here. Mr. Kibuthu from the Ministry of Agriculture was involved in a study on oilseed production. Dr. Barnabas Mitaru who is also here was involved in a study on the poultry and pig production component. So we have used a broad cooperative approach for our research. I would like to concur with Mr. Kibuthu in the importance of involving others in our work, and also avoiding the duplication of effort.

I would also like to add that there are other projects which have been instigated as part of our program. Besides rural oilseed processing, we will soon have a simsim project. We would like to develop a complete technology package which includes the hardware, information about rural utilization of oil and protein cake, and
also lessons from experience in implementing a rural enterprise. That in a nutshell is the objective of this project on rural oilseed processing.

QUESTION: What will the output be, in regard to rural processing, when this project is complete? Will it be extension literature? What kind of information will ultimately be available to the farmer to make an educated decision about whether or not to become involved in rural processing?

James Muthaka: There are sets of questions to which the farmer will want answers once we take a technology to a rural setting. What type of seed can be pressed in the ram press? Sunflower? Sisal? Others? Groundnuts? In terms of texture and oil content what is the nature of seeds which work well? Once the farmer has the oil -- does he store it, or store the seeds to produce the oil when he needs it? How long can he store the oil? And then there is the cake. What should he do with the cake? Does he mix it with other locally available materials to make the feed? We would like a set of answers to those questions so that the farmer will be able to determine whether the technology is profitable. For instance, if he knows he cannot use the cake to feed his animals, that will change the economics of the press. Without the use of the cake, maybe it is less viable. We are now planning to go to the field to investigate these questions. Mr. Mugeto will be speaking next on the rural processing investigation.

Presentation by John Mugeto, Egerton University (see paper "Bielenberg Ram Press Optimum Settings and Operating Procedures")

My presentation is on a rural oilseed processing project at Egerton University. The Rural Oilseed Processing Project is a separate project of the Vegetable Oil/Protein Project at Egerton. Both are primarily supported by IDRC. We have been watching the Bielenberg ram press since about 1988. That is when we bought our first press from Tanzania. Then we tested a model with the Hugh Allen modifications, made by Jaimen, and we continued testing and working with the press. Our aim was to try to develop procedures for using the press.

This work is part of our larger program on rural oilseed processing. It is a three year project, and we are about six months into the project. We have several aims; one is to produce what we call a technological package. For the ram press, this would be information we can share with the farmers on optimum settings, operational procedures, and all available data on the press. We do not want to think about it as just a machine, the hardware. We want to think about other factors as well, because if the farmer is just given a press, it will not do much good. He will not know the best way to use it.
So we started with the press, but we are now in the process of developing simple methods of filtration and looking at equipment that can be manufactured by "jua kali" (local artisans) in the communities where the press will be introduced. We are also looking at appropriate methods of utilizing the oil. In the areas where we will be introducing the ram press, we need to know the foods people are used to, how best they can use this press to get good tasting cooking oil, and what are the best foods to cook with the oil. We are also looking at the shelf life of the oil, the best method for storing the oil, and the type of containers needed. In addition, we are looking at the proper methods for preparing and using the seed cake for feed, as well as most of the economic implications of a ram press-based enterprise.

My presentation today is based on just one area of our work - the optimum settings for the ram press. When we started to do this work, we felt there was a need to characterize the seed to ensure that we had accurate information. The parameters we used to characterize the seeds included:

1. moisture content
2. percent foreign materials
3. oil content
4. bulk density
5. percentage of kernel and husk for sunflower and groundnuts
6. the location where the seed was harvested, the harvest season and variety (where possible).

The moisture content was obtained after drying the seed. Sometimes we would get seeds with a moisture content as high as 12%, so we would dry them and get the moisture content below 10%. We have worked mainly with sunflower, simsim, groundnut, and rapeseed. For the particulars on the seeds we used please refer to my paper. I would just like to mention that groundnuts have a very low density which means it takes more strokes of the press before oil is obtained.

In addition to the optimum ram press setting, we also wanted to know the number of strokes or time needed for the press to reach steady operation. We find that steady operation is that point after which no further adjustment is needed. We also looked at the rest period at the end of each stroke. Is the optimum rest period two seconds? three? five? What we were trying to look at was the rest period vis-à-vis the extraction efficiency. Also we looked at the sustainability of operations. For example, at zero rest period, after about fifteen strokes, you are sweating and cannot continue. We were looking for a position in between that gives us a balance between the yield and the effort.

We found that the number of strokes necessary to reach steady operation for sunflower is about 67, for sesame 45, and 69 strokes for groundnuts. With no rest period, the operation was too fast,
and the effort could not be sustained. With ten seconds, the throughput was fairly low; also the oil gets reabsorbed in the cake if you rest too long at the end of the stroke. So we felt that a two to five second rest period would be the best. There are five piston positions we looked at; we did not see any clear-cut advantage in any of the positions in terms of extraction efficiency.

We had men who were working for us continuously the whole day (four hours of actual operation). The first day they were paid on a daily basis and we measured the oil and cake they produced. The first day they crushed 36 kilos (four hours). The second day they were paid on the amount of oil produced and they crushed 50 kilos. But they complained that crushing fifty kilos required too much effort. The extraction efficiency was slightly higher on the first day. The oil yield per hour was 1.9 liters on the first day, and 1.8 liters on the second day.

Please refer to the table on page 16 which summarizes results at optimum operation. This is the only place rapeseed is included, because rapeseed was not available at the time of other testing.

One thing I should mention about simsim is that it is easier to press than the other seeds, but when there is too much pressure, the cake tends to extrude from the cage bars without releasing the oil. This is also true for shelled groundnuts.

QUESTION ON SEED TEMPERATURE

John Mugeto: The seed was warmed in the sun for about ten minutes. The actual seed temperature was not determined.

Lynn Schlueter: You found that when you have poor seed it takes more work to crush them; we found that is very true. With good quality seed it is less work. I would like to mention, from a practical standpoint, what actually happens in a village setting in Tanzania when the ram press is being used for high production, that is, press owners want to get as much oil as they possibly can in a particular day.

It has become very popular to hire young men for part-time work—young men who will come to the pressing site and wait their turn to operate the press. They get paid by the hour and will work very hard for, say, one hour, and then leave. They will produce six or seven liters of oil, and get paid a certain number of shillings per liter of oil. They get paid cash immediately, and then someone else will get on the machine and start working it. The machines that have been producing the most oil, a thousand liters a month or so, are sometimes being operated as much as twelve hours a day, and may be used by as many as six or eight different young men in the course of a day. So to talk about one or two people operating the
press for a whole day is really not a practical situation. The reality in village settings is that many people get involved.

John Mugeto: We also found that after about one month, the men could operate the ram press longer. The more one uses the machine, the easier it is to operate.

Presentation by Edison Rugumayo, Experiment in International Living (see paper "Agricultural Machinery Testing and Manufacturing Project in Uganda)

I would like to give a short presentation since most of what I have to say is in my paper, and then Willie Salmond will speak. Our project was initiated in April 1984 by Experiment in International Living under sponsorship from USAID. We operated for one year and then had a break until May of 1990 when the project was reactivated. The results are from the first phase of the project. Our project objectives are to introduce and adapt appropriate technologies for small-scale rural processing of oil.

During the first year, a baseline survey was conducted. We discovered that in Uganda the technologies for oil extraction and the cost-benefit analyses for their use differed according to the different oilseeds. We concentrated on sunflower seed because of its high oil content and relatively cheap production costs as well as farmer preference over other crops. We looked at three different mechanical methods for oil extraction using two different principles – the screw versus the piston. We imported the following:

1. Simon Rosedown Mini 40 from the U.K.
2. Komet from West Germany

In 1988 we locally fabricated a ram press for US $275. We made modifications which included increasing the handle length, simplifying the steel bushing, and increasing the piston diameter.

Please refer to Tables 2.1 and 2.2 which show the performance of all three machines. The extraction rate of the ram press was particularly encouraging despite its low output. The prices of the machines differ considerably; the profitability analysis we did favors the ram press.

The profitability figures were obtained from a cooperative society which was already operating an oil mill. Calculations were based on 38% oil content seed. Table 2.4 shows the annual profit of each press assuming the cost of each one is depreciated over the course of 5 years – which may be unfair to the ram press. After depreciation, the annual profit for the Mini 40 is about $14,000, the Komet about $5,600, and $1,500 for the ram press.
The pay back period is 12 months for the Mini 40, 16 months for the Komet, but only two months for the ram press. This assumes that the operating period is 250 days per year and that enough seeds are available.

It is important that farmers know how much seed is needed to operate each machine. We are assuming an average of one ton of sunflower seed can be obtained per hectare, though the yield can be higher, of course. This means that for the ram press, 12 hectares (12 tons) are needed; for the Komet, 25 hectares (25 tons) are needed; and for the Mini 40, 78 hectares (78 tons) are needed.

Our project has been able to fabricate, and we are now distributing 30 ram presses. For the ram press, we are encouraging farmers--either individually or collectively--to have a minimum of 12 hectares planted in sunflower.

These figures are approximate but they can be used as a guide. If the right high oil content seed is available our figures show that all of the machines are profitable.

As you can tell from the paper, we also tested for aflatoxins, moisture and oil content, protein and pH levels. We believe that seeds should be processed immediately to avoid possible aflatoxin problems. As well, cake should be stored so that it does not become infested during storage.

Our experience has shown that it is not enough for the sunflower seed to have a high oil content, but it must also have a soft shell. Currently, high oil content, soft shelled seeds are being introduced into the country under the sponsorship of USAID.

It is important to remember that unless a country has the technology to produce hybrid seeds, it will have to import them for planting every season. The question for Uganda is whether to use hybrid or open pollinating seed. At this time advocates for open pollinating seeds are winning.

QUESTION ON WEAR OF THE MACHINES

Edison Rugumayo: The presses have not been used long enough to determine the wear on moving parts from hard shelled versus soft shelled seeds--this might take years.

Willie Salmond: As Dr. Rugumayo has said, about 30 presses are being manufactured now and farmers are growing seed. The next step is for us to develop profitable enterprises. Stephen Kadaali is here with us today; Stephen is in charge of E.I.L.'s PVO project. We are discussing a scheme whereby revolving credit will be available from the PVO project to farmer groups. We are now looking at what interest rate to charge. Another idea is to give
a lump sum to a church group, who would then manage the revolving fund. We are trying to decide these questions now.

The press currently costs about $500, or Uganda Sh 360,000 at the current exchange rate. We expect this price to remain steady for a while. The $275 rate cited earlier was from two years ago, and the exchange rate was very different.

QUESTION ON OIL AND CAKE USAGE

Edison Rugumayo: Oil is clarified by adding 1/3 water and 2% salt. Then the water is boiled off, and the oil clarified by letting it stand. We have found that sometimes farmers are mixing the seed cake with maize bran in a ratio of 1 to 4 to feed to their animals.

QUESTION ON HOW THE FARMERS ARE SWITCHING TO SOFT SHELLED SEED

Willie Salmond: The incentive for farmers to grow soft shelled seed is that this is the only way they can get the ram press. To ensure that the right seed is grown, the farmer tells the project how much land is being planted in sunflower, then the farmer is given the right amount of seed. When the harvest is in, the farmer then has to give back to the project twice the amount of seed he or she was originally given - this will allow the scheme to continue operating and expanding.

Presentation by Jim Herne, Technoserve

I will discuss our experience in Rwanda with sunflower oil and start by giving you some brief background information on Rwanda. Rwanda is the most densely populated country in Africa. The average farm size in Rwanda is about 1 hectare and decreasing; thus you can see there are severe land constraints. The market system is not well developed, and the economy is not monetized to any great extent.

Technoserve's approach to vegetable oil is a bit different; we did not start from the technology end but rather the opportunity end. We analyzed a number of different ideas that could be profitable for rural groups in Rwanda and came up with sunflower oil as one that could be attractive. We then identified rural groups we could work with to get realistic data if we put a project in place.

Technoserve in Rwanda is in the process of developing three presses to be used for sunflower processing:

1. UNATA/KIT - batch press with a screw and basket
2. CeCoCo motorized expeller
3. Bielenberg press (Allen version imported from Kenya)
Technoserve lends the equipment to groups, provides management and technical advice, and sells the seed (imported from Kenya) at cost. The groups commit to growing the seed, and have to provide working capital and labor.

To date, we have identified a number of constraints or critical areas that will influence the development of sunflower oil as a rural industry in Rwanda. These include:

1. Competition from imports---Rwanda has a great deal of food aid oil at low prices; it competes with local production. The exchange rate for the Rwanda franc is a disincentive as well - it is very overvalued. Imports are priced cheaply, affecting sunflower oil as well as everything else.

2. Local sunflower varieties have a low oil content (around 20-25%), which is why seed has been imported from Kenya. The Rwandan government wishes to develop better varieties to be grown in Rwanda.

3. An extension program is very important, given the severe land shortage and associated high yield requirement. If you do not have a lot of land, you must do well with what you have.

4. All sources of revenue must be considered. Because there is no Rwandan tradition or industry for animal feeding, cake from non-decorticated sunflower is not valuable. With the KIT press, where we decorticate first, the resulting cake can be ground in a hammermill and sifted. The flour can then be used for human consumption. That cake is thus three times more valuable than cake for animal feed. It is an important revenue source in at least one of our projects.

5. There is no local packaging industry, and plastic bottles have to be imported from Kenya. Packaging is about 20-25% of our sales price.

6. We have done marketing research. We have worked with groups to identify markets for the sunflower oil and found that there is not a market in rural areas. Sunflower oil is a substitute for imported oils, meaning the market for it is in urban areas. Rural people prefer palm oil, so sunflower oil could only replace imported oil, which is only available in the urban areas.

7. The required investment is high, particularly for the motorized expeller. We have to balance the investment and the capacity of the machine with the limited sunflower seed available. We have a chicken and egg problem. Since there is not much sunflower production, we are trying to introduce sunflower as a cash crop and to develop the necessary technology to make it a cash crop, all at the same time. Otherwise it is not of interest to farmers. Importing a Bielenberg press costs $1,500, which is high
considering its capacity. Local manufacturing capability is weak, thus making it difficult to manufacture locally.

Our first experience with the Bielenberg press imported from Nand Singh (Tanzania) was not good. We imported two of their presses; after several hours of operation, the cages burst. We hope the Hugh Allen press we just obtained will give us better results. The extraction rates from the first two presses were good, initially about a 25% yield of oil from a seed with 42% oil content, a hybrid from Kenya. The operators thought that the press was difficult to operate. The Hugh Allen press has been used only about four hours, but so far, it is easier to operate and the extraction rate is the same.

We have also used some equipment from Themi Farm Equipment in Arusha (the IPI scissor jack press), with unimpressive results. The initial investment was about $3,500, and the extraction rates were similar to the ram press. During its first use, the IPI press began to buckle, and we feel that it is not suitable for use. The decorticator, the winnower and the roaster are extremely difficult to operate, and the roaster frequently produced burned or scorched oil.

The UNATA press has been our most encouraging test to date. However, the investment is significant, on the order of $6,000. It is not expensive to operate, is easy to manage, and the extraction rate is the same as the Bielenberg press. We have done about three seasons of testing on it, with limited seed availability.

COMMENTS ON PACKAGING OIL

Willie Salmond: Our experience is that packaging is 1/6th of the cost of the final product. To save this cost to the consumer, we order many extra screw tops. When the consumer brings the plastic container back, we can put on a new, unbroken cap, and reduce the price accordingly.

Since we have to compete with attractively packaged imported oil (Elianto from Kenya), we are planning to put nice stickers on our containers. It will also be less expensive—another incentive to buy it.

Eric Hyman, ATI: In Tanzania, sunflower oil is sold in bulk, and resold in individual containers which are reusable palm oil containers. In the rural areas of Kenya and Zimbabwe, consumers bring their own containers.

Presentation by Joseph Lungu, Africare/Zambia (see paper "Bielenberg Ram Press - Our Experience")
At this time, Africare/Zambia is doing everything from disseminating the Bielenberg ram press, to modifying it, to encouraging small sunflower oil businesses. Two years ago we got our first presses from Nand Singh in Tanzania. In the first phase of our work, we had problems getting oil from the Zambian hard-hulled seeds. So we modified the press to accommodate our seed; this modified press has been in the field for about one year. The seed used was not of good quality and the results were not encouraging. We were getting about 9 liters of oil per 50 kg bag. The seed had also been stored for a year.

In the second phase of our project, we went to the southern province of Zambia which is the main sunflower growing area. With assistance from USAID we tried to introduce a U.S. hybrid (CS 336) seed. Rains were not good last season, and consequently yields were poor. But we did manage to extract 12 liters of oil per 50 kg bag, which is a definite improvement. In areas where there is less rainfall, we are still encouraging composite (non-hybrid) seed.

There are 14 Bielenberg presses in the southern province of Zambia, and one in the eastern province. We hope to be able to evaluate their performance by the end of October. Thus far we know there are some problems with the restrictor threads in the press. Out of the 14 presses in the south, five groups have complained that the restrictor threads have worn badly.

Engineers at the Technology Development Advisory Unit (TDAU) in Zambia have manufactured 27 Bielenberg presses, and they are somewhere in the country. Africare is also hoping to introduce the presses to eight groups in the northwest province.

We have been encouraged to continue this sunflower project because oil is a very scarce commodity in Zambia, particularly in the rural areas. Encouraging local groups to process sunflower for oil should help relieve this condition. We hope that the rural areas, which are hardest hit by this shortage of oil, will benefit from the ram press technology.

QUESTION ON HOW FARMERS OBTAINED THE RAM PRESS

Africare, in conjunction with the appropriate ministries, selected groups (12 women groups, 2 youth groups) which had had previous experience with small-scale loans. These groups each received a press on a loan basis. The groups are expected to pay for the presses in three years. These loans are basically administered by local banks.

QUESTION ON WOMEN OPERATING THE PRESS

When you operate the press for the first time you almost think you will get nothing out of it! But in less than two hours of practice most of the women can operate the press. Most of the women's
groups plan to operate the press among themselves for the first year, because they want all the income to accrue to the group. The women are able to operate the press by dividing themselves into groups of four each day. There are no serious traditional methods in Zambia for producing large amounts of oil from sunflower.

QUESTIONS ON MANUFACTURING

The price of the press this year is 45,000 kwacha (40 kwacha to US $1). Last year the price was 15,000 kwacha, but the kwacha has been devalued severely, causing a jump in price.

Please refer to the TDAU project report. The TDAU handle has a slight angle, which makes it easier to operate although you bend more and go lower to operate it compared to other versions of the press. Three piston sizes are available, depending on the seed to be pressed.

During our next phase, we expect to identify commercial manufacturers to bring down the price of the press. We still need to do a commercial analysis from information obtained from the field.

Presentation by Tony Swetman, Natural Resources Institute (see paper "Review of Options for Small-Scale Oilseed Processing")

First, I would like to explain what the Natural Resources Institute is. NRI is the scientific arm of the UK's Overseas Development Agency. We used to be called the Tropical Products Institute, then the Tropical Development Research Institute, then changed our name once again to the Overseas Development Natural Resources Institute. We are now (and I hope for many years) the Natural Resources Institute - not the Newly Renamed Institute as some people might think!

I would like to talk about some of the options available for small-scale oil processing. There are really five different methods for small-scale oil processing. These are: 1) hot water flotation, 2) bridge press, 3) ram press 4) ghani, and 5) expellers.

1. The hot water flotation process requires a finely ground or grated oilseed which is added to hot water, then boiled for several hours. It is then left to stand. The oil that rises to the top is scooped off and may be further boiled to reduce traces of impurities. This method has been used on groundnuts, sunflower seeds, shea nuts, and coconuts.

--Advantages of this process include low capital costs, low running costs, suitability for households, and easily available equipment.
Disadvantages include low oil yield (40-50% maximum) and the need for efficient grinding equipment (normally a pestle and mortar is used); it is a batch process.

2. The bridge press is used by placing ground oilseed in a container (cylinder) and applying pressure with a screw or jack. Recent work at NRI has shown that for each oilseed a specific amount of water can be added to make oil extraction very easy. In the case of groundnuts, this happens at about 12% moisture. There is a point of diminishing return, beyond which increasing pressure will only minimally increase oil yield. Surprisingly high yields of oil can be extracted at low pressures.

In The Gambia, women do most of the work in preparing oil. They state that the most arduous part of the process is not the pounding of the groundnuts, but applying force to the press. In fact, the focus of attention should be toward educating the user that a lot of force is not needed. There comes a point where you can exert a lot of pressure but only increase the amount of oil extracted by very small amounts, as I just stated.

Advantages of bridge presses include reasonable oil yields (60-65%), suitability for larger groups such as cooperatives, low running costs, and ability to be manufactured locally fairly inexpensively - in The Gambia, it costs about £50 or US $80.

Disadvantages include the need for efficient grinding methods and heating equipment; it is also a batch process.

3. We have already discussed how the ram press works. I am very impressed with the results, particularly in Tanzania, where a niche for the press has been found. It is now used mostly on soft-shelled, high yield sunflower seed, although I am told that in Uganda it is used on sesame. NRI tested the ram press back in February. We found that some villagers have the impression that the oil yield is low. This is because they are looking at the amount of cake produced and not the oil.

Advantages include low capital costs, low running costs, suitability for village groups, excellent yield, some equipment which can be made locally, no pre-grinding equipment necessary (really a big plus in my opinion for this machine); and it is a continuous, not batch, process.

Disadvantages include the very arduous work required, although this has been largely overcome in Tanzania by an itinerant labor force, who work for a short time and move on. But then many different operators are needed.

4. The ghani is a mortar and pestle device normally operated by bullocks, but I have seen it operated by hand. A small quantity of water is added to the oilseed to aid the process (this is a very
old idea, a Russian did this back in the 19th century when he was working with cottonseed). Determining the amount of water to add is done by trial and error in most countries. As the pestle goes around the mortar it crushes the oilseeds. Power ghanis in which the bullock is replaced by a diesel motor are common on the Indian subcontinent.

--Advantages of the ghanis include reasonable oil yield (60%), ability to be made locally, very low running costs, pre-grinding equipment not necessary, and suitability for household or village groups. The ghanis is not used much in Africa yet.

--Disadvantages include that the technology has not been transferred to Africa, and a large animal or electrical/diesel power source (or people) is needed; it is a batch process.

5. Expellers use a shearing effect to extract oil; small expellers work on the same principle as large industrial types. Oilseed is forced through a barrel by a wormshaft; as pressure builds up, oil escapes through slits in the barrel.

--Advantages of expellers are their high capacity, suitability for use by large cooperatives or entrepreneurs, and a potentially very high oil yield if operated correctly; it is a continuous process.

--Disadvantages are that expellers are very expensive, a lot of skill is needed to operate them, and a power source is essential. In Africa expellers are not often made in-country, which I think is a big disadvantage; this makes the economics very questionable; they are not suitable for smaller village groups or households.

NRI is trying to develop an expeller that has features suitable for Africa and which can be made in Africa. We field tested one in The Gambia earlier this year with pretty good results on sesame and groundnuts. We designed it with a view to being made in-country; this is the next stage of our work.

So these are the options -- but which should you choose? In my paper I listed several factors to consider; let me go over some of these factors:

1. Which oilseed is to be processed?
2. Is there a market for the product? You can process the oil from copra very easily but sometimes it is smoky in taste and not marketable.
3. What type of throughput is required?
4. What are the relative capital and running costs? Is there a high replacement part requirement?
5. Is the equipment easy to operate?
6. Is there a training requirement, and how will it be carried out?
7. Is a power source required?
8. Is there a high labor requirement?
9. In the case of the expeller, is custom milling envisaged (the customer bringing the product to the milling site)? If this is not done, there will be storage requirements.
10. Can all the costs be covered and provide a margin if required?
11. Social agenda items—technical feasibility, financial viability, suitability for the intended user group, sustainability.
12. Site and oilseed specific issues.

Where does one get this information? I like to think that at our Institute we have a variety of oil processing information available. We have information in print on the optimum moisture content for groundnuts, sunflowers, and coconuts. One of the best sources to start with is the oil extraction booklet (Book #1) published by UNIFEM in 1987, as part of that organization's food cycle technology project. However, this booklet was issued before the ram press really was available, and does not reflect that particular technology. (The booklet is available from UNIFEM's Harare office.)

NRI will be doing research to get baseline data for oilseed processing techniques in seven African countries. This data will be used to focus our R&D efforts for the next two to three years. The results will be published in a manual to come out, hopefully, in July of next year.

QUESTION ON HOT WATER FLOTATION AND FUEL

The hot oil aqueous flotation method does require enormous amounts of fuelwood—another disadvantage. Additionally, changing the process to make it more fuel efficient may render undesirable results for the consumer. In the Philippines, changing the traditional process so that the grated coconut water mixture stands overnight, instead of boiling it for a long time, permits more of the oil to rise to the top, thus requiring less time and fuel to boil off the remaining water. However, the by-product remaining after the traditional long boiling process is sweet and is consumed. The by-product of the shorter processing method is unpleasant tasting, and not at all useful to the consumer.

QUESTION ON WHAT FREE FATTY ACIDS ARE

Tony Swetman: Oil is composed of mixtures of triglycerides, which break down under certain conditions into free fatty acids. These FFAs are not bad for you, and they produce a strong flavor which some people may prefer. To those unused to it though, it may cause diarrhea. The body actually metabolizes triglycerides into FFAs anyway, but some FFAs are unpleasant in taste. To reduce the FFA content it is best to crush the oilseeds as soon as possible after...
the harvest. If seed left over from a previous harvest is used there is a strong likelihood the FFA content will be high.

QUESTION ON STORAGE AND RANCIDITY

Tony Swetman: The fact is, in small-scale oil processing operations, oil is used very quickly, so one does not usually have to deal with rancidity problems. If the oil is properly stored—generally in a dry container filled to the top and stored in the dark, the oil will last at least six months, and maybe even up to one year. But the oil will be sold and consumed before that anyway.

Presentation by Martin Fisher, ActionAid-Kenya

For those of you not familiar with ActionAid-Kenya, let me briefly describe our organization. We are a nongovernmental organization (NGO) working in integrated community development; we are the largest NGO working in Kenya, with a staff of about 500.

The Appropriate Technology Unit of ActionAid was founded in June 1989, and provides technical assistance to ActionAid Kenya’s regional programs. We also have the National Technology, Development, and Training Promotion Program, and provide consulting and information services on appropriate technologies. In Nairobi, we have a workshop and training center. In addition to oilseed processing, we work in low-cost building technologies, animal traction, farm implements, water and sanitation, and food processing. We redesign and modify equipment as necessary and field test it in our regional program. We also identify and train local manufacturers to make equipment.

Manufacturing the ram press locally presents some problems. Even skilled machinists produce cages with great variances, so we are working to redesign the cage to avoid variable cage gaps.

In Kenya at the present time, there is a monopoly on commercial manufacture of the press; Jaimen Mechanical Engineers is producing it. I believe that competition will help to decrease the cost of the press; the press (Hugh Allen version) is currently selling for 30,000 Kenya shillings (US $1300). The cost for materials is about KSh 5,000; therefore I believe a .air selling price would be about KSh 12,000-15,000.

The version of the press ActionAid is working with uses less material than the Allen version; the material cost is about KSh 2,500. We are working with a new manufacturer, and I expect the press to sell for about KSh 7,000 (US $300). I hope this new manufacturer will give good competition to Jaimen Engineering.

We have also done some work on filtering and storage systems. Clarifying the oil by letting it settle naturally works better in
the sunshine than in an enclosed space, but it still takes time. Boiling the oil with water requires lots of fuel. As an alternative, we have designed a prototype filter that can be used.

Requirements for any filter system should incorporate certain principles including:

--high pressure
--large filter surface
--waste particles should not clog filter surface
--use of easily obtainable material (reusable or cheap)

Our filter works on the gravity pressure principle. The capacity of our latest prototype filter is about 1 liter/hour; this volume works okay if you have one ram press; you would need a filter for each press if there is more than one. The filter costs only a few hundred shillings (US$ 10). The brown paper used is available in Kenya at any post office, as it is just wrapping material. After the oil is filtered it is very clear.

In regard to containers, we feel that if the sunflower oil is going to compete with Kimbo or other cheap imported palm oil, then consumers must use their own containers. This is what we are going to push to help keep the cost down. We believe that sunflower oil can be sold profitably, and still be cheaper for the consumer to buy than imported oils. The Bielenberg press can be used for simsim and there appears to be some potential for simsim oil in regions where the seed cannot be transported to a market; otherwise, simsim has a higher price as a food rather than an oil in Kenya.

Because we have cheap palm oil in Kenya, it is unknown whether the sunflower oil will be marketable. Our field tests show that people prefer locally produced liquid sunflower oil to solid Kimbo, but they do not buy it now because it is too expensive.

Our plan for press dissemination is to lend a press to a farmer (who potentially has enough money to buy it) for one season. If the farmer makes money, then he or she will have the option of buying it. If not, we will take it back and loan it to someone else.

I would like to discuss the profitability analysis for a ram press enterprise in Kenya. Three and a fourth kilograms of sunflower seed yield 1 liter of oil plus 2 1/3 kg of cake. The present selling price for seed in Kenya, if it is being sold to commercial oil producers, is between KSh 1.50 and KSh 3.20 per kg. This means that for 1 liter of oil, (at KSh 3.20 per kg) the seed cost is KSh 10.40. If you pay a laborer KSh 3 per liter, at 20 liters/day, that amounts to KSh 60/day, which is a good wage rate in Kenya. Assuming overhead is KSh 1/liter, the total cost is KSh 14.40/liter.
Kimbo costs KSh 22.50 in a liter container; if you buy it in smaller containers it is more expensive. If we sell sunflower oil at KSh 21/liter (or 7 shillings per soda bottle, which is a common measurement), I believe we can compete with Kimbo. With a total investment of KSh 15,000 (Ksh 12,000 for the press plus storage and filter) the owner could recover the investment after pressing 120 (50 kg) bags of sunflower seed. Depending on yield, this amount of seed could be produced in one season on about 12 hectares of land. This also assumes the oil is sold for KSh 21 per liter and the seedcake for KSh 1 per kg. You can sell cake (KSh 1 per kg.) in areas such as western Kenya where there is a lot of zero grazing. The problem I see in Kenya with the ram press is that we really need one or two people working full time on press dissemination. ActionAid is not in a position to do that. I do not think we need a lot more research in Kenya on the ram press; we need to get the presses into the field.

COMMENTS ON MANUFACTURING AND DISSEMINATION

Carl Bielenberg: I have to speak in defense of Jaimen Engineering, which is taking a terrible beating here today! The formal manufacturing sector has greater costs than the informal sector, such as overhead, taxes and marketing. In many cases they are competing with a subsidized enterprise, for example, when an NGO is doing the marketing. It is very difficult for a formal sector manufacturer who has to pay taxes, social security, market costs, etc., to compete with the informal sector.

In my experience, the cost for a formal sector manufacturer to produce a product is about 4 times the cost of the raw material. You can break this down into the cost of raw material (1/4 total cost); direct labor and social security (1/4); cost of rent, electricity (1/4); and the cost of taxes, marketing, overhead, and profit - another 1/4. So if you are talking about 5,000 shillings for the raw material component, than you are talking about 20,000 shillings per machine. This is a strong argument for reducing the quantity of material as well as the complexity of manufacturing. But we do not want to tell a manufacturer to sell an item at a price at which a profit cannot be made.

Informal sector shops probably do not pay taxes, social security, etc.; they do not have marketing costs and usually only produce presses in response to orders (when a down payment has been made). This is quite different from a formal sector manufacturer. For an informal sector manufacturer a 3 to 1 ratio is feasible. But we are trying to promote large-scale dissemination of the ram press; therefore we want some of the marketing costs to be covered in the price.

B.S. Sagoo, Jaimen Mechanical Engineers: I would say the price is high for several reasons - one is overhead. Another is because
customers are not operating the presses correctly; then the presses break and we must repair them.

**Lynn Schlueter:** In Tanzania, in addition to higher prices, we have found that formal sector manufacturers make the customer wait a long time for delivery. Producing the ram press competes with other products they are manufacturing. In the informal sector we have found job shops which are more than happy for the extra business and another product to work with; they deliver the presses more quickly.

**Martin Fisher:** I do not mean to take any credit away from Jaimen. After all, they are the only manufacturer currently making the press and they should be congratulated. Nonetheless, many potential customers are turned away by the high price, and have come to us for help. Perhaps if the price were lowered to KSh 20,000, as Carl suggests, Jaimen would sell more presses and make more money from the additional customers. On the other hand, a private manufacturer has to look at priorities; if he can sell only 30 presses at KSh 30,000, that is still quite a lot of money, and there may be no need to sell any more.

**Willie Salmond:** Even in Tanzania and Uganda where the price of the press is much lower, farmers still complain that the price is too high. This would seem to indicate a need for a revolving credit system.

**Carlos Zulberti:** We should not concentrate just on reducing the cost of making the press - we also need to investigate financing mechanisms like lease/purchase agreements or institutional financing to enable farmers to purchase the press.

**QUESTIONS AND COMMENTS ON NEED FOR FURTHER RESEARCH**

**Martin Fisher:** In regard to further research on the ram press, we have done a complete stress analysis on the different designs, and we know that the machines are not going to break. Perhaps there could be small modifications to the machine to improve the extraction rate slightly. But we know the machine works well and our main efforts now should be in dissemination, not more research on stress tolerances, and so forth.

As for the oil and cake, we should look to the Tanzania experience where farmers found out for themselves what to do with the oil and by-product. In Kenya, people seem to know readily enough how to use the oil, with only a short demonstration. People have not cooked with Kimbo forever; they started to use it as a result of a marketing campaign. The consumer seems willing to buy oil if it is cheaper and perceived to be equal to Kimbo.

**Carlos Zulberti:** Implementation and research need to work together. We are not saying that the ram press should remain in
the lab until all of the questions are answered but rather that research continues while the presses are in the field.

**Willie Salmund:** In Zambia, many presses are being made, but it appears we are losing track of where they are going, so no follow-up can be initiated. We are beginning to be concerned about this happening in Uganda as well. Once the presses are in the field, follow-up is important.

**Carl Bielenberg:** I believe research and dissemination should be one and the same. If you look at the Tanzania experience, information and feedback from villages was needed at every stage of the dissemination process.

**Martin Fisher:** As I said, we feel that there should be two people in Kenya devoted full-time to the critical task of dissemination and follow-up. The ram press technology is obviously important in a wide geographical area of Kenya, not just the five areas in which ActionAid is working. Although we have held demonstrations all over Kenya, we are not in a position to disseminate the press in other areas.

**QUESTION ON THE PROFITABILITY OF SUNFLOWER COMPARED TO OTHER CROPS**

**Martin Fisher:** Sunflower can be an attractive crop to farmers but it also depends on the yield. In some areas, it is considered a throwaway crop because farmers are getting so little money for it. It is hard sometimes to get farmers to switch from maize to sunflowers.

**Peter Jones:** Since sunflower is a suitable crop for arid areas, it may do well in areas where maize does not grow well.

**Willie Salmund:** In Uganda, maize was profitable last year. This year, the price dropped and people are very eager to switch. Thus, the situation can change from season to season.

**Presentation by J.A. Ali, Obafemit Awolowo University, Nigeria**

Until 1986, Nigeria imported most of its vegetable oil. This was the year that the petroleum oil market collapsed, leaving Nigeria with dwindling foreign exchange. Therefore, the government placed an embargo on imported oilseeds, in the hope that this would generate interest in local production, and thus cut back on foreign exchange needed to import oil. This meant that we had to go beyond the traditional methods of oil extraction.

Engineers came up with all sorts of designs for oil extractors. But the initial designs were expensive, and did not take into account how and where the oil was produced - that is, at the
At the village level, nothing has changed, which is why we need this press technology. Women do not have the resources to purchase expensive technology, nor do they have enough technical education to permit them to operate and maintain machinery. We are now witnessing a change in gender roles, where men in urban areas are buying and using the larger, more expensive machinery.

Nigeria is blessed with oilseeds. We have a lot of palm oil. Nigeria used to export palm oil, but now we cannot meet local demand. When palm oil is purchased in the local market two factors determine whether the oil is acceptable; the taste and the color of the oil (it should be red). Palm oil produced in Nigeria by industrial mills is rejected because of the unpleasant taste.

Groundnuts are another source of oil, which is preferred for frying, because palm oil smokes. Melon and simsim (beniseed) are used in stews and not usually processed for oil. If they are used for oil, the oil is mixed with a lower quality palm oil. Until recently no one processed melon or beniseed. Coconut is also only eaten, not processed for cooking oil. We have rapeseed which is being processed by industrial processors. Soybeans are not processed at the village level for technical reasons; rather they are processed by huge solvent extractors. The soybean oil is almost a by-product; what the producers are interested in is the cake. Sunflower is grown mostly on commercial farms.

Nigeria needs inexpensive, easy to operate technologies for use in villages. There is a lack of information on technologies which are available. The government and NGOs are working to organize women into cooperatives, and then lending them available oil processing equipment. We need to go back to the drawing board and come up with presses such as the ram press so that women can maintain their economic power.

QUESTION ON MELON SEED

J.A. Ali: There are two varieties of melon - one is white and the other one is yellow. Melon is the common name; I am not familiar with another name for it. The problem with melon oil (which is used for baby food and commercial bakery products) is that the cake is used for human consumption, and so melon seeds cannot be pressed with the shell. Shelling is done by hand and is very time-consuming.

Presentation by Joseph Gomez, Catholic Relief Services
(See paper "Background on Projects Promoting the Bielenberg Press")
The Gambia is a very small country. Food oil consumption is high, especially in the urban areas. We have five main types of oils - groundnut oil, simsim oil, red palm oil, palm kernel oil, and dairy milk. Groundnut and red palm oil are most widely consumed; other oils are consumed on an ethnic or geographical basis. Palm oil is consumed where palm grows; simsim is consumed where there is access to CeCoCo motorized expellers. Dairy milk oil, extracted from the milk of cows, is very expensive, and only herders/farmers consume it.

A large parastatal owns an oil processing mill, but it cannot meet local demand. CeCoCo expellers (two sizes) are located in rural areas; they have diesel engines, and process 25 kg/hr (small) or 50 kg/hr (large) of sesame. At the local level, farmers extract oil by boiling the sesame; they then sell the cake to commercial processors. In a few villages, there are manual screw presses available for processing groundnuts; the process requires intensive preprocessing labor.

Red palm nuts are boiled in big containers or drums and then crushed with a pestle and mortar; the crushed nuts are separated from the kernels and the juice flesh is boiled again until the red oil floats on top leaving the sediment below. This boiling process is labor-intensive but not costly.

Dairy milk oil is obtained by first leaving milk to ferment for a day or two. Then a jelly-like, yellowish substance is removed from the top and boiled. The end product is oil which is very delicious and expensive because of its scarcity.

Palm kernel oil is made by first cracking the hard kernel leaving a nut which is then pounded by using a mortar and pestle. The pounded nut is put into a pot and boiled with water to obtain oil. This type of oil is not easy to get in The Gambia. Palm kernel oil is used for cooking, either as a sauce or for frying other foods. It is not used for medicinal purposes.

The ram press arrived this year on a trial basis. My paper talks about some of the reactions to the ram press from people who would be using it in the rural areas. Since we are short on time, I will not discuss our preliminary work but will ask you to read the paper. Thank you.

Carl Bielenberg: ATI is promoting another technology for red palm oil extraction. It is an screw expeller which is continuous in operation. Because the pressure needed to extract oil is very low the screw is large and can be made out of common mild steel. This expeller comes in both a motorized and manual version. If anyone would like more information on it please contact me or ATI.
Presentation by William Lobulu, Tanzania News Agency

I would like to present a summary of the PACT-funded case study I did on the dissemination of the ram press in the Arusha region of Tanzania (the Village Oil Project funded by ATI, LWR, USAID, and the Government of Tanzania). The purpose of the study was to determine the impact of the project and participation by the people. Fifteen oil production units were visited during February and March this year. Interviews were held with press holders, their neighbors, restaurant owners who use the oil, and institutions involved in the project. I also obtained information through discussions with the project staff and through observations at the oil production sites.

The objectives of the project were realized with a high degree of success. During the four years of the project, sixty ram presses were introduced in 40 villages. The target was 40 presses in 32 villages. The amount of oil produced annually rose spectacularly from year to year. Before the project started there was a shortage of oil in the project area. During the 1986-87 season, project participants were able to produce a little less than 5,000 liters of oil. After 4 years of project implementation, they produced about 100,000 liters. Families, groups, and institutions owning the press registered a rise in income. Some individuals earned about 1 million Tanzania shillings in the 1989-90 season (about $5,000). This happened in a country where per capita income is about US $250.

There has also been an increase in oil consumption, but this increase is hard to quantify. There have been changes in dietary traditions. Previously many people boiled their food without oil, but now they say that there is more frying of foods. Even in hospitals, some of the nurses say they are advising people to use sunflower oil in the food they feed their children. Although there are no figures, the nurses told me the rate of malnutrition appears to be decreasing a bit. The protein-rich cake is being used as a feed supplement for cattle, and it is claimed that milk production has increased two-fold.

From 1986 to 1989, sunflower production has quadrupled. Many farmers adopted the oil-rich sunflower variety promoted by the project staff (the soft-hulled variety). Another achievement is that part-time employment opportunities have increased.

These achievements were not obtained without challenges. One of the obstacles was that the ram press was a brand new technology, never tested anywhere else; thus those involved had no examples to draw on and the efficiency of the technology was unknown. Also the Bielenberg press was introduced in areas where people had never used any kind of machinery to extract oil before.
Another challenge in disseminating the technology was to keep the price low. It was a new technology and people had to be persuaded to adopt it. If it is expensive nobody will buy it. I am sure Lynn will be able to explain how he faced that challenge. It was also necessary to convince some of the farmers to grow the right kind of soft-shelled, oil-rich sunflower. In some cases people had to forgo growing other crops.

Another challenge, which I think still exists, is promoting the technology among women. Before the introduction of this technology there was little oil extraction in the project area, and it was mainly done by women, mostly using a wooden mortar and pestle.

Another lesson I learned during the course of the study was that voluntary participation of the people is higher when the benefits are apparent. The people saw that there were viable benefits; they could see the results of the technology.

Another lesson was that a project has more chance of success when benefits go directly to individual families, rather than to groups. The output of presses owned by individuals was much higher than those owned by groups. For example, a pressing unit owned by a village council was able to produce just one tenth of the oil which was produced by an enterprising individual.

Successful introduction of this technology among rural people depends on extension services and constant follow-up. The press was at first difficult to operate, and the project might have been abandoned, but with constant follow-up modifications were made to the press and press owners were able to learn what others were doing to operate and repair the presses.

Even if a new technology is available, it will not be adopted by everyone at the same time. Adoption goes in stages. Opinion leaders--priests, teachers, agricultural extension personnel, shopowners--had to adopt the innovation first before everyone else would adopt it. When a new technology first becomes available in the rural areas, it is monopolized by men. But now women are adopting the ram press as well.

QUESTIONS AND COMMENTS ON INVOLVEMENT OF WOMEN

William Lobulu: The early presses were difficult to operate and women were not very enthusiastic about using it. Because of design improvements more women are able to operate it. I am sure the project staff will elaborate on this more.

Eva-Marie Bruchaus: It is not only improving the operability of the press that will convince women to own a press. Your approach must be geared to the language of smallholders and women, who very often do not speak the language of project staff and planners. You
can pass a new technology directly to the smallholder, and directly to women, if the approach is right.

J.A. Ali: One of the problems in Nigeria is access to loans. Men have greater access to loans than women.

QUESTION ON TRADITIONAL OIL EXTRACTION TECHNOLOGY

William Lobulu: Traditional extraction continues to exist because not everyone has access to the ram press. Those who have the press prefer to use it over the very cumbersome traditional method. However, in the project area there was minimal use of the traditional method before the project started.

Eric Hyman: In the Arusha district, there was not really a tradition of using the traditional process. In the area where the new project is, one of the two regions has a lot of traditional processing.

QUESTION ON GROUP VERSUS INDIVIDUAL OWNERSHIP

William Lobulu: Even though individually-owned presses had a higher output, groups should continue to be encouraged to acquire presses. One of the reasons for higher output by individuals is that sometimes it is difficult for a group to arrive at decisions quickly. For example if there is a breakdown, an individual can quickly decide to go to a shop and pay for a repair. But the group may have to meet and discuss before they decide.

Jamie Raile: We will hear more about this from Lynn Schlueter and Dallas Granima. There were some unique circumstances surrounding the first groups formed, it is not just that groups do not work well. The success of the group depends on how the groups are formed and for what reasons.

Presentation by Eric Hyman, A. T. International (see paper "Preliminary Socio-Economic Impact Study of the Ram Press in the Arusha Region of Tanzania")

This paper follows well from Mr. Lobulu's because he set forth some of the general conclusions about the success of the project and now I will be focusing on the specific benefits to the individual press owners and groups who purchased the press.

This evaluation paper is based on a survey of 24 press owners conducted about a month ago; the draft was written quickly so I could present the findings at this meeting. There was a small overlap of maybe 3-4 of the same respondents that Mr. Lobulu talked to, but most of the others were different.
In the original Village Oil Project 60 ram presses were sold in 40 villages of the Arusha region, between January, 1986, and the end of December, 1989. At first progress was slow as the technology was still being refined and farmers were unaware of its existence or benefits. But the rate of dissemination grew steadily after that. Production records were kept for the first 60 presses. In the last processing season, July 1989 through June 1990, these 60 press owners produced over 106,000 liters of sunflower seed oil. Eight of those presses are owned by community groups such as churches, schools, or village administrations. The individually owned presses are being used at a higher capacity use rate than those owned by groups. The 38 presses owned by individual families or partnerships for a full processing season produced an average of 2,400 liters a year, compared to 1,070 liters for the group owned presses.

The ram press is a durable and robust design for village use. All of the presses that were sold in Arusha are still in working order, including the two or three that are not currently being used for various reasons. Some of the earliest presses that were manufactured were not well made, but users have been able to get repairs done locally at relatively minor cost.

The owners of presses have expanded their own planting of sunflower and provided a market for sunflower seeds grown by other farmers. Farmgate prices of soft-shelled sunflower seed have risen faster than the rate of devaluation of the currency. As a result, the amount of sunflower seed grown in the Arusha region increased fourfold over the period from 1986 to 1989, and there was a nearly complete shift from the hard-shelled varieties previously grown to a soft-shelled, open pollinated, high oil content variety known as "Black Record."

The producers in Arusha are involved in sunflower seed oil extraction for an average of 8 1/2 months a year. A total of 52 loans were made in the Arusha region for the 60 press buyers. Some paid cash. Only one loan recipient has not repaid the loan yet, although about 15 of them had to be pushed into repaying by temporarily repossessing the presses before the pressing season. This demonstrates the importance of taking a very serious attitude toward loan collection.

The sample I interviewed consisted of 15 individually-owned enterprises, 2 partnerships and 5 group-owned presses. The sample included 7 presses of the original Bielenberg design, 13 of the presses with Fisher modifications, and 4 of the small CAPU model.

The owners of the individual enterprises or partnerships had the following characteristics: all were male, with an average age of 39; the number of years of education averaged 8; about 2/3 of the sample reported other occupations in addition to farming and sunflower seed pressing; household size averaged 7; over half of
the owners were of the Iraqw tribal group; other tribes represented included Chagga, Mpare, Haya, Meru, and Arusha. Nearly two-thirds were Lutherans and the rest were Moslems or Catholics.

The group enterprises included two Catholic boarding schools, one Lutheran boarding school, a village with 2,500 residents, and a Lutheran church young adults group. The predominant tribal group was also Iraqw for the group owned enterprises. Three of the group enterprises had a hired manager, one will shortly be run by a Norwegian volunteer, and one is managed by a committee.

Before they bought a press, about 2/5 of the sample did not grow sunflowers at all and half of the sample sold sunflower seed unprocessed. Those who previously sold unprocessed seed had grown hard shell varieties, and sold them to the cooperative unions, which they complained were not dependable purchasers and often delayed payment up to 3 months after delivery. They also had to transport the seed an average of 2 kilometers to the "primary societies" for purchase.

Only 2 of the press owners in the Arusha region had previously used the traditional process. One of them had found out about this method in Iringa and the second learned about it from the first. One woman who previously used the traditional method said, "I am glad I do not have to do it that way anymore." All of the enterprises surveyed produced cooking oil for their own use. Except for one of the schools, they all sold oil.

About four-fifths of the enterprises also sell the by-product seed cake, and the rest use it to feed their own animals. Very little of the seed cake gets wasted. The seed cake is most often used as a feed for cows, goats, and pigs and less often for poultry. It is often mixed with maize bran, and sometimes with molasses, squash or gourds, beer malt, or table scraps.

Nearly all of the owners of the 24 presses grow some seed, but only a few grow all of the seed they process. An average of about a third of the seed they press is grown themselves. This provides a substantial market for the other local farmers in the area who cannot afford a press for the time being. In fact, many of the press owners reported that they would buy and process more sunflower seed if they had more working capital to purchase it. A few stated that they buy all of the seed that is offered to them locally.

The press owners who grow some of their own seed have an average of 9 acres planted in sunflower seed, and all are currently planting the Black Record variety. They also reported that they generally increased the area that they planted in sunflower seed after obtaining a press; the average increase in sunflower plantings was 7 acres, although one press owner reported that he had such a problem with bird predation that he decided not to grow any more,
and finds it more profitable to buy from other local farmers. The increase in plantings in sunflower seed has largely been at the expense of maize and beans. The maize farmers have had difficulty selling their crop in the past year to the parastatals, due to the financial problems of the parastatals.

There has also been another shift during the course of the project. Farmers initially began by interplanting sunflower with beans. Now most of them do not interplant anymore, but prefer to get higher yields of sunflower seeds. This reflects the higher value of this crop to them.

Sunflower seed is sold by volume in bags that contain approximately 50 kilograms. Last year, the press owners purchased an average of 149 bags each. Several press owners have established informal contract growing arrangements where they provide the seed to local farmers, and guarantee that they will buy all of their crop at a certain minimum price.

Most press owners are currently paying $5.70 per bag for the seed. After the peak harvest season is over, the price goes up to an average of $9.40 per bag. However some press owners do need to buy all year and sometimes have to pay the higher price because they lack working capital or storage space to buy the whole crop at the time when it is available in the largest quantities. Only 2 of the press owners in the sample buy hard-shelled seed and they pay a lower price for it. In comparison, the government buying price last year was $4.50 per bag ($4.90 this year, but this is somewhat of a theoretical price because often cooperative unions are not buying at all due to lack of money).

During the pressing season, the enterprises operate an average of 5.5 days per week, typically 7 hours per day. For the most part, hired labor is used to operate the presses, which surprised me, based on my experience with palm oil in West Africa where it is predominately a household labor activity. But that may be due to the greater arduousness of this press. Most of the labor is done by young males working part-time, and this does not conflict with their schooling or other agricultural responsibilities, and maintains productivity; it is less fatiguing. Most were paid a piece-rate wage, which averages 12 cents per liter. The group enterprises tend to pay lower wages than the individual enterprises. One worker can press a bag of sunflower seed in about 5 hours, so the average wage for a full 8 hour day would be about $1.14 per day.

About seven-eighths of the press owners do service pressing for other farmers. They serve an average of 12 other households. The service pressing work is done by the regular laborers, rather than the customer, and, in most cases, a share of the oil is left behind rather than a cash payment, which is more convenient for low income farmers. The service fee varies depending on how many presses
there are in the locality and the demand for the service. One third is the average but in some areas it is one fourth, in some areas it is half. The seed cake can generally be taken by the service press customer, although many leave it behind because it is difficult to transport.

Last year, the press owners received an average of 170 liters of oil from service pressing fees from other farmers. Generally it is the adult women in the household who collect this fee.

The price of sunflower seed oil varies considerably even within the Arusha Region itself. In July of this year, the average price was $1.22 per liter for bulk sales in 20 liter tins. It also varies seasonally with the supply. The average maximum price during the year is $1.44 per liter in bulk; the average minimum price in bulk is $1.02 per liter.

Bulk buyers are predominately hotels, restaurants, prepared food vendors, schools, and hospitals, and much less frequently middlemen, which also surprised me. The bulk buyer is generally responsible for transporting the oil from the press owner's site, and the buyer generally has to supply his own tins or return those provided by the seller.

One-third of the producers sell at least some portion of their oil retail at a higher price to households in 1 liter containers. The price averaged $1.55 per liter in July, and of course varies seasonally with supply.

A market has developed for the animal feed from the cake. The price of the cake also varied by location but averaged $1.04 per bag of 50 kg. This price does not vary seasonally, unlike the oil price. Generally, the buyer is also responsible for transporting the seed cake. In some areas, press owners noted that there were only a few people who buy the seed cake but still they had no difficulty in selling their produce. As more people become accustomed to use of this product as an animal feed, it will become even easier to sell.

It has been recommended that the presses be lubricated daily. Most of the press owners are lubricating them but not quite that frequently. Nearly all of the press owners have had to have minor repairs done each year. Some of this was due to normal wear and tear, but a considerable amount of it was due to misuse by the workers. There could perhaps be some training manuals prepared in cartoon form that the workers could use to understand what they should and should not do with the press. Repairs were generally done at local workshops, usually within 5 km of the press site, but at most 10-15 km, and were done in a day or two. The press repair costs averaged between $10.00 and $26.00 per year, varying with the kind of press and the age of the press.
The durability of the press has not proven to be a serious issue because of the ease of repairs and their relatively low cost. Thus it might not be desirable, in an area like Tanzania where local workshops are available, to try to minimize the expected repair costs at the expense of a higher initial capital cost, but that may not be true in other areas.

The users are generally quite satisfied with the ram press, regardless of which model they own. Many of the press owners have seen other versions besides the kind they have. The owners of the original version perceive it to be durable and find the extraction rate to be relatively high because of the high pressures. The main complaint about the original version is the level of effort required.

The Fisher modification is also well liked. It is easier to operate and requires less effort than the original version because the handle is longer and does not have to be pulled back as far, so the workers do not have to bend as much. In some cases two workers were using it, in some cases it was one. Several press owners had placed a large stone on the handle to increase the force supplied.

The owners of the CAPU press like it very much; it is smaller, less costly and lighter. Often people would keep their press inside and take it outside for the actual pressing.

Many of the press owners are building new houses or buying more land or livestock. Others are using the money for working capital to buy more seeds to press. Three of the 24 people interviewed said that they would like to buy an additional ram press within the next year, and two more hoped to buy a motorized expeller, although they had greatly underestimated what that would actually cost them.

On average, the individual press owners reported that their households consumed one-third of a liter of sunflower seed oil per person per week. Most stated that their consumption of cooking oils had gone up substantially after they began producing sunflower seed oil, although a few stated that it had not changed. Tanzania may be somewhat atypical because at the early stages of the project there was an extreme scarcity of cooking oil due to the limitations on imports. That has changed during the course of the project and now imported palm oil and mixed vegetable fat shortening are readily available.

All of the respondents in this area preferred the taste of the sunflower seed oil over most of the domestic or imported alternatives. One stated that, in his area, restaurants and hotels have to use sunflower seed oil or else their customers would not be happy. Some people dislike sunflower seed oil if it is poorly clarified, so all of the press owners were using the boiling method rather than simply letting the oil sit overnight.
Refined, bleached, and deodorized palm oil imported from Southeast Asia is sold, and it is cheaper on a retail basis per liter than the liter price of the sunflower seed oil. It is also available in 20 liter tins, but most households cannot afford to buy it in that large quantity at one time. Vegetable shortening is imported from Kenya. The domestically produced alternatives include ghee, lard, cottonseed oil, and groundnut oil. Most of the ghee is produced locally for subsistence consumption by the farmers with dairy cattle themselves, only small amounts are marketed and generally only during certain seasons of the year. Lard is the least preferred cooking fat in the Arusha region. Some households do prefer ghee over sunflower seed oil when it is available. Groundnut oil and cottonseed oil are only rarely available in this part of Tanzania, but that may be different elsewhere in the country.

The nutritional impacts of increased oil consumption are not clear. It depends on the level of fat consumption and the rest of the diet. Most of the press owners are not among the poorest of the poor, so they were probably were getting decent diets previous to their ownership of the press. They may be increasing their incomes, allowing them to afford a more diverse diet. The nutritional benefits are probably more likely to go to the consumers, who before were not able to purchase as much or any oil, due to the high cost. There may be other health benefits because sunflower seed oil is less saturated than palm oil or shortening.

I did a commercial analysis based on the purchase of a CAPU type press, the cheapest alternative, which costs $325 each. I took various scenarios of production levels, both for commercial pressing by the press owner and different levels of service pressing, and different assumptions of the oil yield, ranging from ten liters to fourteen liters per bag.

I also conducted a sensitivity analysis on high or low seed price levels, as well as high or low prices for the main product, cooking oil. In some cases I included hypothetical loan financing at a commercial rate of interest, and calculated net present values at three discount rates, 10%, 15%, and 20%. I will not go through all the numbers, but they are in the paper. The net present value is positive under all the scenarios except for one in which low production is combined with high price for seeds and a low price for the product. Except for two other cases besides the unprofitable one, for the 24 scenarios, the payback period is less than 1 year.

Commercial financing did not make much difference in the commercial viability of the press, quite probably because the initial capital cost was relatively low. The two assumptions that made the most difference in the analysis were the production level and the product price. A change in the seed price had a much smaller effect. All three of the production levels are reasonably likely
for different scales of production. But it is not too likely that the extreme cases of having a low seed price with a high oil price or a high seed price with a low oil price would occur because the price of seed and the price of oil could be expected to move in the same direction in the absence of price controls.

I will mention just a few points about designing technology transfer projects based on what has been learned from this experience. The initial project involved working with a single manufacturer, and too much reliance was probably placed on assistance to that one manufacturer. Other producers entered the market very easily without similar subsidies. By the time the follow-on project in Iringa and Singida is completed, it is likely that there will be sufficient momentum in the spread of this technology that it can continue through market forces; there are quite a few producers within the country now. So we can probably anticipate a major transformation of the edible oil sector in Tanzania over the next five to ten years or so.

The goal of the follow-on project which is underway now is to expand the dissemination of the ram press in other regions of Tanzania. It is expected that 50 presses will be disseminated in the Singida region, 50 in Iringa, and 50 in neighboring regions. These press operations are expected to yield 250,000 liters of edible oil and 500,000 kg of animal feed. Particular emphasis will be given to enterprises owned and managed by women in this follow-on project.

The current project is encouraging multiple manufacturers to be involved by providing them with training courses on design principles and fabrication techniques. So that training can be put into practice quickly, the project manager places orders after the training is completed with those firms that can offer reasonable price quotes. There are several new producers who have already begun operation. Contacts are being made with organizations involved in assisting women's groups to obtain presses.

The context is a little bit different in these other regions. Sunflower seed is a more important crop in these two other regions than it is in Arusha; there is a longer tradition of growing it. There are few organizations working with villagers and few established women's groups in the Singida region, although there are many in Iringa. The traditional process is common in Iringa but rare in Singida due to differences in fuel availability, because a lot of wood is required in the traditional boiling process. So government forestry officials in Iringa are particularly interested in the potential of the press to reduce fuelwood use.

By the end of June of this year a total of 262 ram presses had been produced in Tanzania; 209 of those had been sold, 53 were still in inventories of the producers. That might have changed over the
past month. Besides Arusha, Singida, and Iringa, press sales have taken place in Morogoro, Kilimanjaro, Tanga, and Dodoma. So far there are 9 producers in 4 of Tanzania's twenty regions who have made prototypes, and ten presses made in Tanzania have been sold to buyers in seven other countries.

QUESTION ON EXCHANGE RATE

Eric Hyman: I used the current official exchange rate which is 193 Tanzania shillings per dollar. The official exchange rate is not grossly out of line, as it was a few years back.

QUESTION ON PROPORTION OF SERVICE PRESSING TO COMMERCIAL PRESSING

Eric Hyman: Almost all the press owners do both commercial and service pressing. The bulk is commercial, but in order to increase the capacity use of the press, press owners are willing to provide service pressing. On average they are receiving about 170 liters of oil in fee payments for service pressing, and if the average fee payment is one-third of volume, then they are pressing over 520 liters of oil in service pressing. However, they press on average 2,400 liters commercially. Their first priority is to press their own seed and the seed that they buy because they can make more profit there, but they can make additional profit by doing service pressing.

COMMENTS

Jim Tanburn: I wanted to make a point about press lubrication which was mentioned in your paper but not your talk. It is important not to lubricate the press with used motor oil, which should be kept as far from food as possible. Modern lubricants are extremely toxic and should not be used around food sources.

Eric Hyman: That is a good point. There were only one or two pressing operations that were using used motor oil. Quite a few were using new motor oil or other kinds of lubricants. About a third were just using sunflower seed oil to lubricate the press, and one was using sewing machine oil because he had a tailoring enterprise.

Willie Salmond: This paper is extraordinarily useful to us in Uganda. We have been following the Arusha story for many years now, and this paper clearly documents what has happened. In Uganda, we have the Ministry of Women in Development. As Dr. Rugumayo said, all of us are under pressure to get this technology into women's groups. We are also exploring ways of getting credit to women owners.

Carlos Zulberti: Some say the press is not "feminine-friendly" because it is difficult to operate. Maybe that is true, but there is another opinion: maybe it should not be made "feminine-friendly"
because already women have too many things to do at home. Then maybe what we should consider is ownership. Ownership should be different from operation. You can have women's groups owning a press operated by men. This would meet both objectives of creating employment and having women owning and benefiting from the use of the press.

**Eric Hyman:** Right. In the Arusha region, in another ATI project I visited, a women's pottery group hired a man to be their manager, and they had both women and men working in their enterprise with benefits going to women who own the enterprise. So both usage issues and management/ownership need to be distinguished. The use issue needs to be considered in light of new design changes as well.

**QUESTION ON WORKING CAPITAL IN FINANCIAL ANALYSIS FRAMEWORK**

**Eric Hyman:** In the analysis, I did not include the cost of working capital for planting sunflower because I assumed that farmers in an area where sunflower seed was already growing could buy the seed. Or if they grew the seed, their opportunity costs are selling it at the same price, so the price factor takes care of it. In an area where sunflowers are not grown yet, you might need to make loans either to the press owners, or even other people without presses to encourage them to grow a new crop. You may need some market guarantees then. The availability of seeds of satisfactory varieties may be more of a constraint than the working capital for planting the crop.

**QUESTION ON DIFFERENCE IN NUTRITIONAL VALUE OF SUNFLOWER OIL IF PROCESSED TRADITIONALLY OR BY RAM PRESS**

**Tony Swetman:** There is not much difference in the nutritional value of the oil whether it is produced with the ram press or boiled in the traditional process. Anti-oxidants (which slow down oxidation of oils and fats and thus check deterioration) may be reduced by boiling.

**Jo Doran:** The increased production of sunflower seed is due partly to the increase in price. But how much is also affected by the fact that the farmer can take sunflower seed to press owners and get cash on the spot for it?

**Eric Hyman:** That is a very important factor. Farmers were having difficulty getting payments from the cooperative union, and the cooperative had become unreliable in purchasing the crops.
QUESTION ON AMOUNT OF OIL SOLD IN BULK

Eric Hyman: Offhand, I would say about two-thirds of the oil is sold in bulk. That surprised me. Maybe the press owners did not know, but most of them believed that the bulk buyers were not reselling it as middlemen, but were using it directly.

Presentation by Lynn Schlueuter and Dallas Granima, Village Sunflower Project, Tanzania

Lynn Schlueuter: Dallas and I were preparing to focus on dissemination issues; we have some points we want to raise and hopefully stimulate a lot of discussion. But a number of issues have been raised that I would like to address first concerning how our project got started. Our project was based in the Arusha region, where there are a predominant number of Lutherans--this is why many of the owners are Lutheran. Also, in Arusha there are very few women's groups. When Hugh Allen and I were working there in the late 1970s we found quite a few women's groups, but for some reason those groups seemed to fade away over the years, and when Dallas and I started this project in 1985 there were very few groups to work with.

The approach we took when we started to disseminate the technology, was that we wanted to disseminate the press to anyone who was interested--not particularly to any one group or another or any certain individual or whatever. A serious constraint initially was that our project steering committee insisted that we only work with groups, not individuals. This really changed our approach, because when we went out looking for groups and could not find any, we had to go to villages and discuss the possibility of forming a group first so that they could get a press. This was an additional burden and created complications.

Also, during the first year of our project, we were restricted to working with one manufacturer. That was a handicap to us because it was not necessarily the best manufacturer to be working with. Things became much easier in the second year when we were able to work with any manufacturer we could find.

I would like to describe what our approach was when we went out to a village. Normally we would go just before planting time; we would take a press, and demonstrate it to a large group of people. We would find out whether they were impressed by what they saw and we would ask them about the seed they were growing. Through discussions we would get an idea whether they were interested in getting a press or not. If they were interested, then we would sell them "Record" seed, which you saw today.

The idea was that if people were interested in the ram press, they would plant the correct seed. We would sell them the seed and they
would plant it. Then we would come by once or twice during the
growing season to see how things were going. And then we would
come by around harvest time to start talking about buying a press.
Of course at that time we had to work with groups. So we would
talk about what would be the most logical group that we could form
in each village. It might be a church group, a youth group, a
village council, whatever. We were also insistent that the village
be successful in growing the sunflower before they could acquire a
press.

So these were some of the obstacles we were faced with initially,
and reasons we got off to a slow start. We were only working with
about eight groups in the first year. Very much to our surprise
and pleasure, ATI stepped in and insisted that it was not fair that
we could only work with groups, but believed we should work with
individuals as well. ATI was able to convince our steering
committee to free us of that obligation. When that happened, the
project took off because we could start to deal with individuals
who were interested in buying presses on their own.

Let me talk a little about loans because so many people are
interested in that. We did have loan funds for presses available
in our previous project and also in the project we are in right
now. We first would ensure that people had seed. If you go out at
harvest time and find that someone needs a loan to buy a press, the
chances of being repaid for the press are greater if you can see
that they have seed to process. The other requirement was a down
payment of 25%. The idea was that these would be short-term loans,
to be repaid within six months. At harvest time, around July and
August, people have seed to press. At that time they can repay the
loan from the oil they are processing. As the season passes and
less seed is available, their ability to repay the loan starts to
drop off dramatically.

We did not charge any interest, but the loans were only meant to be
for three to six months. Some people were doing very well at
repaying loans, others were not. In some cases the press owner
wanted to use the money being earned to purchase more seed and
continue production. At the time we were very interested in seeing
what people could do with this press. How much oil could be
produced and sold using the ram press? In some ways that was more
important to us than getting the loan repayment.

At any rate, people always had excuses for not repaying. This
tended to drag on and sometimes it would continue into the next
harvest season. Another factor, I believe, is that these people
have had the experience that projects come and go. A project gets
started, it offers loans, then maybe the project will close down.
Perhaps they will not have to repay the loan. So you can hardly
blame them for taking this sort of attitude.
When we finally started to take the machines back from people who had not repaid their loans, then we saw a different type of behavior entirely. We took the presses back in January or so, when oil production was starting to drop off quite dramatically. People still did not pay their loans during February, March, April, May, or June. But when harvest season came, all 15 press owners paid their loans at one time. Thus their attitude was not that the press was gone and they really did not care anyway, but rather that they wanted the presses back very much. Administering loans is a big problem. As you can imagine, it was a special burden on Dallas who has been the field officer and had to go around and try to collect these loans. However, the issue of loans is crucial and we have to deal with it.

As Eric pointed out, there were actually only two people doing traditional pressing in the Arusha region that we knew about. They were among the first people we went to see, because we reckoned that if people are already producing oil by some traditional method, they would be a good test for us with regard to the ram press. If they accepted this technology over what they were doing, then we would know we were on the right track. Those were two of the first people to accept the ram press.

Very few women were involved in traditional oil extraction in Arusha, and there were few groups to work with. Our greater concern initially was that we were dealing with an entirely new technology and we did not know what the acceptance rate for the press would be. We were concerned about getting the press out, getting people to start using it, and we were hoping that women would benefit from this technology as a natural process. There are many poor people, many of them women, who cannot afford a press, but they can grow a few bags of seed and take them to the press owner to have the oil extracted. We thought that if women could bring the seed in and get it processed, and get about twice the value of what they would receive by selling the seeds to the government, then that would be a substantial benefit to them. However, that turned out not to be a major source of income for women. In fact, when William Lobulu and Eric Hyman did their studies and came back saying that women were not really benefiting all that much, we were quite disturbed. It made Dallas and me realize that we had to take an entirely different strategy. Now things are a bit different.

In Iringa region there are many women's groups and it is easier for us to find women's groups to work with. In Singida region, where Dallas will be doing most of his work, there are very few women's groups. Thus Dallas will be spending additional time in identifying women who are interested in oil pressing and working with them to form groups as needed. I keep mentioning women's groups rather than individuals because we believe, and I draw mostly upon Dallas' experience, that it is easier for women to maintain control over an enterprise and its profits if it is a
group enterprise. If it is an individual woman, it is much easier for the husband to take control.

COMMENTS AND QUESTIONS ON HOUSEHOLD INCOME

Eric Hyman: It is difficult to make generalizations about how income will be used and who in the household has a say over it; this can vary widely in each culture. Even if the husband takes the income from oil pressing to buy cattle, in the long run this may benefit the family.

Lynn Schlueter: That is true. But there is concern from various sources to try to get economic opportunities to women. This seems to be a very good opportunity. For example, in Iringa region there are many women who process oil in the so-called traditional way of pounding and boiling. So we would like to see women continue this activity but have a ram press instead of the pounding and boiling method. I do agree with the earlier comment that there is no reason why the women cannot own the press and have men do the labor.

Elizabeth Feilden: My experience is with women's groups in southern Kenya. They are very poor. We started with vegetable growing for income generation and the women are making a profit from it. They are now saying that they are making enough money to help feed their children. Things are beginning to change because we have been able to finance the groups in a small way to get started. We found that small women's groups worked best, because when you have a large group it tends to split up and fold. Also there is less profit per woman.

Lynn Schlueter: The other thing I would like to mention, because some people get concerned when they hear talk about individuals, is that when a press is sold even to an individual or individual family, almost always there are many other people in that village who benefit as a result of the press being there. The simple presence of the press in the village stimulates other people to grow sunflower, they can get it pressed, and they can sell the oil immediately, and so forth. Our aim was to get presses in as many villages as possible, because we realized that just having a press in a village creates cooperation, not competition. Few people are able to grow enough seed by themselves to use the press to its full capacity, therefore they have to get the cooperation of others. If we discovered someone in a village trying to take advantage of his neighbors, it was easy to sell another press or two to create a little competition. That happens as well.

Jo Doran: The traditional processing of sunflower done in Iringa—is most of it done for household consumption or for sale?

Lynn Schlueter: We do not know yet. We will be doing a baseline study in all the areas where we will be working to see what the
situation is in the beginning, where and how the oil is sold and consumed, etc., so we can come back in a few years and see what the difference is. So we will be in a much better position later to answer that question. But there is a lot of production going on.

I would like to focus on dissemination issues now. You have been watching our progress in Tanzania, but we have also been looking at you in other countries and wondering why the ram press has not been catching on as fast in your country as it has in Tanzania. To our way of thinking it is because of the whole issue of dissemination. I was pleasantly surprised this morning to hear many people concur with that feeling. There has been so much talk in the past about manufacturing and design issues, and all that sort of thing, and we wanted to put more emphasis on the whole area of dissemination, because I think it is a big consideration, not only for the ram press but for any other kind of technology as well.

In terms of simple village level technologies, many people see the ram press as potentially one of the most beneficial devices available in Africa today. The benefits people can derive from the use of this technology are amazing, for example, cooking oil for home consumption, better nutrition, and better health for both people and their livestock. Also it can help increase milk production, income, and employment at the rural level. Yet as promising as this technology is, the process of dissemination in Tanzania has not been easy. If not for the amount of resources and initiatives devoted to the press initially, it might have faltered completely.

**Dallas Granima:** The first point to keep in mind in attempting to disseminate any village level technology in Africa is that it is a difficult and time consuming process, and thus we should anticipate many obstacles. We have heard the experiences and problems many participants here have faced when bringing the ram press into different areas. We would like to share our experiences in the Tanzanian case.

**Lynn Schlueter:** There have been many obstacles. Some have resulted from individuals and personalities, and others from various factors such as the manufacture of presses, loans, seed varieties, and breakdown of presses. With regard to personalities, I was with Carl when he invented the press and the first day we tried it out, we were very excited. I had worked in the Arusha region before and I had a sense that this was really the kind of technology we could get out to villagers. I knew there were plenty of people who could make use of this technology. In my own mind I could see it going beyond Arusha to other places in Tanzania and perhaps other places in Africa.

Carl soon left Tanzania and went back to Washington, and we both got a similar response. His response in Washington was that ATI
did not quite know what to make of all of this. It was totally
unexpected. In Tanzania I got a similar response from the people
we were working with, such as the steering committee. Our project
was initially geared up to work with another technology, and we
suddenly wanted to switch. I am sure many of you can see from a
programming standpoint that that could cause a lot of havoc. All
of a sudden something changes dramatically. And you cannot really
explain to everyone exactly why you have made this decision to
promote something new. So that was a really big problem. The only
thing we could do was just be persistent and try to work very hard
the first year to demonstrate our case.

We had problems with the manufacturers because they were prepared
to make another type of machine, and they did not really want to
make the type of machine Carl had invented. They did not think it
would be as profitable for them, and this caused problems and
resistance.

In the beginning of the project we were working with church groups.
We encountered several missionaries; some of them said take this
thing away, we do not want to see it. Others said they thought it
would never be profitable; some even wrote letters asking us not to
work in their area, because they were afraid it was going to
tarnish their reputation. If we were to falter with this
technology in their area, they were concerned it would look bad for
them. So there were a lot of things to overcome. The only thing
we could do was just continue pushing ahead, and try to demonstrate
our case through actual data from the field.

Dallas Granima: The second point is that because there will be
many difficulties and obstacles to overcome, those responsible for
implementation should be committed to the effort and should also
believe in the usefulness and appropriateness of the technology,
and have a clear notion of who the end users will be.

Lynn Schlueter: In this regard, I think Dallas and I shared a
vision right from the very beginning. We both agreed we were
working with a technology that potentially could be very important.
Carl mentioned the other day a missionary zeal. I do not know if
I would go quite that far, but I think you do have to believe in
what you are promoting. If you are going to disseminate something
you must believe in it, because you are going to receive a lot of
resistance along the way, even if you are promoting a ram press
which is now accepted as a valuable technology.

We, Dallas especially, knew from previous experience what life was
like in these Tanzanian villages, and we were sure the technology
would catch on with some people. So we had an advantage and what
we had to do was demonstrate the press. Thus we tried to get
presses out to the field as soon as possible so we could start to
get some information from the field.
Dallas Granima: There are little things that most people overlook, such as the demonstration process. A very thorough demonstration is needed and it should include operating the press and showing how adjustments are made. Sometimes it is very hard to go through village councils. If you are in the company of someone like my colleague here, a white person, people may say those two have money, they should bring in a Cadillac version of the press. Sometimes we would leave the press for two weeks, and it did not work. But the most important aspect is to find one person really interested in the press. If he does well, then others became interested and eventually the idea catches on.

Lynn Schlueter: We were turned down in one village entirely. It was one of the first villages we went to and we were actually told to take our press and leave. But our approach was simply to go on to the next village and try again. Then we happened to meet Mr. Shadrack, one of the two people in the area who had been processing sunflower seed the traditional way. He turned out to be very enthusiastic about the press, he started using it and produced tremendous amounts of oil. It did not take very long for the neighbors to see what he was doing; now the same village which told us to leave has 3 or 4 presses.

Dallas Granima: In addition to needing time for dissemination to work, we believe it is essential that the implementation effort be highly focused with a full-time effort on one specific technology.

Lynn Schlueter: We cannot say this is true of every technology, but we think it is true of the ram press. If you know there is a serious problem in your country and a technology exists which may be able to resolve that problem, or if it offers substantial benefits to people, then it is worth taking a full-time approach. Some people have to get involved who do nothing else but keep working at it. They may have to work at it for several years before it pays off. I think our project is a good example of that. Jonathan Otto from PACT who visited the project was impressed by the idea that both Dallas and I stayed with this for five years, which is a relatively long period of time when you see people changing so often.

Dallas Granima: As Martin Fisher mentioned earlier, we also believe if the concept is relatively simple, the technology does not have to be perfect before you begin disseminating it to villages. If you have something that works, you can make changes as you go from actual field experiences.

Lynn Schlueter: We do not want to offend anybody here, but we feel it is important to get technology out of the hands of the engineer as soon as possible. It does not have to be perfect before you start. I think a lot of the discussion today about research and dissemination being one and the same is true. There is no reason
to think that our project initially was not a research project, because we were getting presses out into the field to get information, and we got a lot. I was sympathetic to the gentleman from Africare/Zambia, who said he was worried about the stop on the press, that he could see some problems with it. That is one of the disadvantages of this approach; if you put 15 presses in the field and you find out later that there is some technical problem with the design, it is a lot of work to bring the presses back in and repair the problem. But when you compare that to not doing anything except keeping the machine in a research institute, I think you are much better off to err on the side of letting something go wrong in the field and correcting it later. In the process you are gaining much more in terms of information.

Dallas Granima: Once you have something that works and appears to be appropriate for the people you are trying to reach, it is critical to get it into the hands of those who will make maximum use of it. Then a network of village users who can provide production data and other types of feedback can be established. This can be a pilot phase.

Lynn Schlueter: The point is that a network needs to be established. We very much believe you need to do things in incremental stages. That is the way we started, going slowly to see what was happening and building a network at the same time. Until you have a network of users, you are never going to know what the real world problems are in the rural areas. As we started to get feedback from users of the presses, we were able to make significant design changes in the presses to deal better with the different types of seed.

For example, we knew most people in Arusha were growing a hard, very heavy seed, because they were simply selling it by bulk weight to the government. They did not care whether it had oil or not. When we came along with the ram press and realized many people were growing this hard seed, we asked Carl to give us a design for a simple decorticator so we could offer people a decorticator with the press. Carl did come up with a very nice design, I had about six of them made and they worked quite well. But later we found out that this hard seed did not have very much oil in it anyway! So we were increasing the capital cost of the operation to process a very low quality seed. When people realized the value of pressing a better seed with higher oil content, it was relatively easy for them to switch.

Dallas Granima: When we took the ram press to villages for demonstrations, normally we also brought along the hybrid seed with a higher oil content. But we would start with the low quality seed the farmers had and press that and get a certain quantity of oil, then we pressed our seed. Afterwards they would compare the amounts of oil, and see for themselves which was the better seed.
In the beginning we had sunflower demonstration plots, but they were a lot of extra work, and we felt later that it was not necessary. For example, in an area where there are three presses, one person may be getting much more oil than the others. The others will ask the person what is he doing to get more oil than they are getting. Oftentimes the case is that it is the agricultural practices in the field - the spacing, and thinning and so forth. There is a natural process whereby the farmers learn from one another. Once a network of village users has been developed, it is not difficult to introduce design changes, or even another concept if one comes along.

Lynn Schlueter: As many of you mentioned, we started off with a press that was difficult to use, because it had a large piston and took in more seed. Most of the time it required two people to operate the press. Carl had told me at the beginning there could be many changes to the first press but to tread cautiously the first year. If too many changes are made at once you may get lost and not know what is going on. I took his advice. We stayed with this rather cumbersome and inefficient design for the first year. The feedback received from the field was that people liked it but it was very difficult to use.

We were fortunate that Dr. Fisher came along at that time to do some stress tests on the press. I asked him if he had any ideas on how to redesign the press to make it easier to use. That is when he came up with the longer handle idea and other changes. It was simple for us to take the design changes out to the field, because we already had the network established. When the CAPU press came along, it was smaller, easier to use, less expensive, and it was easy for us to start using that press as well. If someone had invented an entirely new hand operated oil press, we could have demonstrated and disseminated that as well, because we had the network already set up.

That is why it is so important to start working in the field, with farmers, to build up this network of users. We have a good relationship with them. We require them to do very few things except keep good production data for us and to allow us to bring visitors once in a while. Dallas makes regular visits and he is able to offer suggestions to them from time to time. They are more than happy to try something new, if we ask them, because they realize it is to their advantage as well.

Dallas Granima: Another point is to be open and flexible with regard to design improvements. By the way, even the very first cumbersome presses are still in operation. We give them numbers, and I know number two and number three are still working, after five years. Though there are obvious advantages of using the more recent press types, the very first versions are still working.
**Lynn Schlueter:** We have gotten suggestions from many people. You would not believe how many engineers there are in the world! Many people would come and say why not try this, and why not try that. Some ideas worked and some did not. Some ideas sounded good in theory but in practice did not work.

**Dallas Granima:** Another important factor in our dissemination process was having funds available to stimulate the manufacture of the ram press. Having a reliable source of money allowed us to control the design of the press and create competition. A project manager has to be able to go to a manufacturer and place an order, because merely promising that there will be customers is not enough incentive for a manufacturer to start manufacturing. Once a manufacturer has demonstrated that he can make a good quality press, we place an order for 5 or 10 presses. Rather than delivering the presses to us, we have the manufacturer hold them at the factory, and we send customers. As one is sold, we order another to be built. This way, the manufacturer will have an inventory and can satisfy customer demand readily.

**Lynn Schlueter:** This was very important because it allowed us to control the design and create competition among manufacturers, as well as work with manufacturers in different geographical areas. If your organization does not have the money to stimulate the production of the presses, it could be very difficult convincing a manufacturer to initially start manufacturing. In addition, when we find a manufacturer interested, we also provide them with training. By helping the manufacturer create an inventory of machines both the manufacturer and the customers are helped. If someone comes to buy a press, and they are told to pay 50% and wait about four weeks, they may become discouraged.

Creating competition has helped keep the price down. We have actually left some manufacturers and gone elsewhere when they became greedy and started charging too much. So we had that kind of flexibility, which was very helpful.

**Dallas Granima:** We would also like to make the point that for widespread dissemination to occur it is necessary to continue to expand the network of users, inform many organizations of the progress made, and work with everyone who is interested in promoting the technology. Right from the beginning we tried to disseminate the information we were gathering.

**Lynn Schlueter:** We tried to let everyone interested know what we were doing, both inside and outside of Tanzania. Though we were restricted to working in the Arusha region, nevertheless we tried to inform people in other areas about what was going on and elicited help from other people. This really paid off.

The best example concerns CAPU. CAPU has manufactured over 100 of those presses now. They came to us first and bought one press and
took it back to their area and then redesigned it to bring down the cost. When we saw it in a picture in the newspaper, we went up to Lushoto to talk to them and later I brought along some other presses we had been using. We did some comparative testing and found that the presses they made were probably the easiest to use because of the shorter handle; it was getting just as much oil, and the price was much lower. Then we switched over to that type of press. We have had a very good working relationship ever since.

Another example is the case of Sokone University in Morogoro. Mr. Ngetti and his partners are working with the Institute for Continuing Education there; they have bought about 20 presses so far, using them in a dissemination program in their area. The point is, you will get help from other places as well as you go along. The more other people you can bring into the process, the more it will pay off in the long run.

Dallas Granima: Before I conclude I would like to congratulate everyone here for their efforts in disseminating the ram press. The last point is, with luck, there will be some pleasant surprises from time to time that will propel the dissemination effort forward.

Lynn Schluter: I mentioned ATI's resistance to the Bielenberg press in the beginning, but after we had a year or so of gathering field data and seeing the response of the villagers, then ATI became very supportive, and this support has been growing ever since. So that has been a very good relationship, and there have been others as well. I mentioned CAPU and Sokone University. PACT sponsored William Lobulu with Tanzanian Newspaper Service to do a case study. In addition, William Lobulu has written several articles about our project. This has helped us tremendously to spread the word about the ram press throughout Tanzania. Now when we go to a new area people have already heard about this technology and it gives us a lot more credibility. We can continue to name other people and organizations who have been helpful in this process, but I think the presence of so many people here today helps to demonstrate that the word does start to spread eventually.

Now in Tanzania we are gearing up for a different sort of effort, moving away from a pilot phase. Our sponsorship has shifted away from the Lutheran diocese of Arusha where it was for the first four years and is now under SIDO (Small Industry Development Organization). SIDO has linkages throughout the country and the project now is very much a nationwide program. We are very hopeful that within the next two or three years the program will have a very significant impact on the oil needs of Tanzania. Thank you.

Presentation by Carlos Zulberti, Egerton University (see paper on "Vegetable Oil/Protein Strategy")
I am working as an IDRC consultant to Egerton University in the Vegetable Oil/Protein System Programme (VOPS-Kenya). I want to make two comments first before getting into the paper. Lynn and Dallas just told us what should be going on if you want to disseminate this press. The comment I want to make first is the importance of flexibility in dealing with innovation. The ram press is not an improved plow. You can put an improved plow in the market and people will buy it because it is an improved plow. Here, if you put the press in the market, nobody would buy it because nobody knows what it is. This means you are dealing with a different type of problem from the dissemination point of view. This press is an innovation, something new to be explained and demonstrated.

The second comment is that I like the expression that Lynn used—that they were always in a "dissemination mode." That should be the case. Sometimes you need research for dissemination, but still you are in a dissemination mode or mood. The final goal is to get these ram presses to farmers, not to do research for its own sake. Some research needs to be done, nonetheless that does not stop the dissemination process.

To turn to our paper, let me start with background on VOPS. IDRC started financing projects for research on oil crops about ten years ago. About eight years ago a regional network for east and southern Africa, and later for south Asia, was created with a permanent coordinator linking the IDRC-financed projects. Later on IDRC expanded the network to include other oil crop projects funded through other sources. This network has had five international meetings, and is basically a network in agronomic and plant breeding.

In 1987, some people at IDRC stated that even with such extensive financing of research on oilseeds, there was not a very large impact. The world was being flooded with palm oil; it was cheap and easy to handle, therefore, why continue to do oilseed research, why not just import instead? They decided to have a consultant do a quick survey in one country (Kenya) that was a heavy importer of oil and see what was going on inside the country with oilseed production and processing. I did that job at the end of 1987.

The conclusions were that a country with a rapidly growing population which imports food oil will have tremendous bills in a few years, even if the price is relatively inexpensive. Even if per capita consumption is low, with a rising population, the import bill will continue to increase. If you are importing oil and not processing it, in time you will be forced to import the cake, too, for your animal feed industry.

In Kenya, as Mr. Muthaka explained, studies were done which looked at oilseed production at the farm level, oilseed processing, the animal feed industry, the dairy and poultry industries, rural
processing, and the policy environment in the country. Those studies are published, and available from Egerton. We discovered that rural processing could have an impact on the problems of Kenya. From a very general program we began to focus on the specific role of rural processing. Most of you people are working the other way around, you are starting with rural processing. At some point we have to get together. Let me explain how we might do that.

After finishing our studies in Kenya, we saw that maybe this situation is not confined to Kenya, but is region-wide. Let us first look at why oils and fats are important. They are important nutrients for cell structure, membrane functions, control of blood lipids, they are a vehicle for oil-soluble vitamins. Fats are needed in our diets. If intake is low, then there is low energy, skin disorders, insufficient brain development, etc. But if you have a high intake you are also in trouble. Then you have obesity, atherosclerosis, etc. Low income countries have low intake of oils and high income countries have high intake. Maybe this is one reason we do not have a strategy to increase oil intake, because normally strategies are copied from developed countries, and there is no strategy for developed countries to increase oilseed production and consumption. They are not interested in that, while low income countries are interested. In rural areas here, people are consuming enough carbohydrates, but not enough energy because the concentration of other nutrients is relatively low. They get full from the amount of food they are eating, but it does not provide enough energy for them.

Let us look at the world situation. Production is increasing faster than consumption, because of increasing prices. It is a market situation. Why? Because the EEC is becoming an important producer of oil, with subsidies last year amounting to $3 billion. Palm oil plantations in Malaysia and Indonesia have heavy international financing, the World Bank is a major financer. One of the biggest owners of the Malaysian plantations are the Kuwaitis --these plantations are flooding the market. Brazil, Paraguay, and Argentina are becoming important soybean producers. The production of oil is becoming concentrated in very specialized regions of the world that have competitive advantages.

We analyzed the 25 countries with the lowest income in the world, and the 25 countries with the lowest consumption of fats in the world. We found that seventeen of the countries were the same--they had low income and low fat consumption. We added three countries which we had no data on oilseed consumption, and ended up with twenty countries on the list; ten are in East Africa. They are Ethiopia, Uganda, Kenya, Rwanda, Burundi, Tanzania, Zambia, Malawi, Mozambique and Madagascar. They consume about 60% of the world average of fat/oil intake per capita. Five countries on the list are in West Africa. These countries are Mali, Niger, Ghana, Togo, and Zaire. The rest are in South Asia--India, Nepal, Bhutan,
Bangladesh, and Burma. In looking at the characteristics of these countries, we found the population is mostly rural and growing rapidly. They have low input agriculture. They are in debt, have problems of accessibility to foreign exchange and require assistance to foster their development. All these countries have foreign assistance.

Let us look at other characteristics of those countries. They produce some type of oilseeds. The oilseeds are consumed directly, crushed locally, or exported as oilseeds; a typical case is Tanzania which exports cottonseed. In spite of having low oil consumption, they export oilseed. Some countries export cake, while some importation of oil and fats is taking place to supplement insufficient local production, and consumption remains depressed. Of these twenty countries the only exception to the rule is Zaire, because of palm oil.

We did a study of one of those countries, Kenya. What did we learn? That oilseeds have low yields, low prices, and provide low income to the farmer. Oilseeds are not a viable alternative for most of them. Consumption of fats is low in the rural areas. Five times as much fat is consumed in urban areas as in rural areas, and for vegetable oils, three times as much.

In the case of Kenya, the problem is not availability. Anyone who knows Kenya knows you can go to any place in the country and you can get soap, Coca Cola and Kimbo. Those products are everywhere. What we begin to understand is not that oils/fats are not available, but the problem is the people cannot afford these fats. Low consumption is due to low affordability. Why? Because one kg of Kimbo costs more than a day of work, about 35% more. Some people in this country are paid 20 shillings a day, and right now the price of Kimbo is 24.40 shillings. Although palm oil may be imported very cheaply into the country, by the time it is sold to the consumer it is not cheap.

Let us look at the policy environment in Kenya. There are price controls at the ex-factory, wholesale, and retail levels. That means 24.40 shillings is not a price that East African industry sets; it is the price set by government. If you are an industrialist and your maximum selling price is fixed, then you try to reduce your input costs to make more money. What you use is the cheapest raw material available, which is palm oil. That is where the competition started. This could be one of the limitations to the development of the industry. The government reviews the price at the request of the industry. When the international price goes up, the industry goes back to the government and says sorry, we are not making any money, can you increase the price? That is normal, many countries do the same, Kenya is no different.

When countries have price controls, either they have a mechanism to review prices periodically, or they are responsive to the industry.
As soon as industry has no more margins, industry pushes for higher prices. Interestingly enough, to promote the local fat/oil industry, duties were imposed on imports; as much as 30% on unrefined oil and 70% on refined oil. But that pushed the price higher, so the government introduced a remission to give the duties back to the importer. That is, we do not have any effective duty in this country on the importation of palm oil.

Let us look at our development problem. As we define it, the problem is how to increase the availability and affordability of oils and fats in the rural areas of developing countries and thus raise consumption and improve the local residents' nutritional status, working capacity, and resistance to certain diseases. That looks like a fair goal for our work.

To solve this problem, two things have been suggested. Everyone talks about promoting local production of oilseeds mostly by increasing the price paid to the farmer. But to increase prices to producers you have to increase prices to consumers. Then normally what is proposed is subsidies. Everyone knows what subsidies can do. There are countries that are suffering terribly because once you introduce subsidies it is very difficult to discontinue them. That is a huge development problem.

The other solution suggested to overcome this problem of low oil consumption is to increase imports. But most low income countries do not have the foreign exchange needed to import. Thus the conventional proposals to increase oil/fat consumption (we are not talking about making money now) are either to increase imports or promote local production.

Maybe rural processing can solve the problem, or at least help relieve it. Why? Because we are competing with an expensive product at the rural level. Palm oil may not be expensive internationally, but when it becomes part of the rural setting, it is an expensive product with which we can compete.

Many of you here are coming from projects that have been dealing directly with rural processing. What we are doing here in Kenya is gaining the support of the politician; maybe we have been better at getting support at the country level than actually doing the things in the field you are doing. There is a way we can meet. What I am referring to is a regional strategy. We call this strategic stages. What we did in Kenya was first to characterize the oil/protein system to fully appreciate and understand the problems, and thereby increase our awareness of potential solutions.

One thing we found very important when we were doing our studies was to involve people from the ministries, people from the parastatals, and people from the universities and the private sector; we created a group with all interested parties. Then nobody was able to criticize the other and feel left out. That was
very useful because it created a national awareness. In the studies mentioned there were more than 40 Kenyan professionals involved. And the information they obtained was passed by each one of them to several others.

Why introduce the ram press in Kenya? Lynn mentioned this morning that in Tanzania they are moving away from the pilot phase, they are trying to become national. But most of the rest of us are still at the pilot stage, or even previous to pilot. We think that this pilot stage and the way Lynn and Dallas did it in Tanzania was a little bit weak. Maybe Lynn would not agree with me. From the agronomic point of view, they were lucky that they had access to good seed fast enough. But in other countries that may not be the case. Maybe in some countries the right agronomic practices are not already there. Then there is a dissemination package that is required, agricultural research, manufacturing technology and financing. For example, it was nice to hear Lynn say what they are doing with manufacturers in helping them keep an inventory. But to implement that at a national level would be difficult.

Let me give you a fast number. Kenya needs roughly 100 million liters of oil per year. How many ram presses would we need? A lot. We are not talking about 100 presses. The solution is the same proportionally in all the countries. That means if you want to really solve the national problem, you will not solve it with ram presses, but at least if you want to make a dent in the problem, you will need many ram presses.

We have to think, if not now but in the future, about solving the problem at the national level. For that reason the dissemination package has to be pretty well formulated not to make many mistakes. Although there are differences within regions, there are still some basic things needed. For example, we do not know what the shelf life of the oil from the ram press is. We do not want a situation where someone is getting sick from eating rancid oil. We believe what is needed is continuous assessment, monitoring and evaluation of the impacts of the various interventions to see what is being achieved.

I was talking about how to collaborate at the regional level. Please refer to the paper where we discuss promotion, catalysis, networking, backstopping and training. We can add more and put some of them together, but basically the idea is to make people aware of all the factors in this equation. Catalysis is important. Some of you are working very nicely at developing the small-scale sector with very little financing.

Networking helps to get people who are doing the same things together to learn from each other. Not everything has to happen at the same time - you can start from pilot stage or characterization; you can start at different places, but you have to do networking. Tanzania is much further ahead in dissemination of the press than
any other country; Kenya is further ahead in characterization of the problem. Maybe Ethiopia is ahead in agricultural research of sunflower. These experiences should be shared, maybe one country specializes in different aspects of the problem and shares it with the other countries; this is what we mean by networking and the team approach.

Backstopping is what Lynn and Dallas have been doing with people from other countries, because they know a little bit more than the rest of us. Finally, training is important. The final goal is to build local capacity within each country to handle this rural processing activity. Thank you.

**Carl Bielenberg:** I am concerned that at some levels of government there may be a perception that successful development of rural processing would reduce the demand for processed imported fats, which is obviously a very profitable activity for some people. And it is pretty clear in my mind that that would not be the case. Rather what you would have is a situation in which rural processing would increase rural consumption of vegetable oil, but it would not greatly displace the importation of oil, especially with increasing populations. It is important for you to be talking with people in government who might misinterpret the likely effects of this technology, and therefore think the result would be to reduce the viability of the existing oil processing technology.

**Carlos Zulberti:** I am in complete agreement. That was one of the beautiful things of having different people together in our groups; it was the industry itself which said their market was basically in the urban area and rural processing would not change that. Besides some of them see a long term potential in which increased yields and production of oilseeds will increase the amount of oilseeds available for them to purchase in-country. Fluctuations in the international market under price controls end up benefiting the industry, because when the profit is low, the industry goes to government and government increases the price. Then when the price on the world market goes down, the large oil producers have a windfall gain. The industry supports the idea of importation. But in Kenya right now, the oil industry knows that this situation will not continue forever and that local development needs to take place.

**Presentation by Kiran Man Singh, Agricultural Development Bank of Nepal** (see paper "Small-Scale Oil Pressing in Nepal")

Nepal is a small country bordered by China and India. Major crops include rice, wheat, maize and millet. Mustard oil, which is similar to rapeseed oil, is the main cooking oil used in our country.

Mustard oil is traditionally processed in the khol press. However, it is a tiresome process and requires more than four people to
operate. It also requires many logs, which are becoming scarce. Mechanical oil expellers have also been imported from India. These are powered mostly by water turbines. In some cases people walk for two days to the nearest mill to process their mustard seed. As you can see, oil processing in our country is not easy.

Besides mustard seed, some seeds from trees in the jungle are pressed manually for medicinal and industrial purposes. But my interest in the ram press is to see whether it can be used to process mustard seed. If it can process mustard, I think we will solve a very big problem in our country. It will give us a mid-level technology between the traditional process and the mechanical expeller.

I am from the Agricultural Development Bank of Nepal and I would like to share some of our experience in technology promotion and dissemination. Although we are a financing institution, because of the nature of our country and the lack of agencies which promote technologies, we are also involved in the promotion and dissemination of technologies. In order for the farmer to develop the rural areas he needs access to technology. So we have to be involved in that aspect, as well as in financing.

We started an appropriate technology unit in the country to bring technologies from developing countries like India to the field and test them. During the testing process, we involve private manufacturers from the very beginning and support them in developing, manufacturing and installing the technology.

We also help farmers obtain loans to acquire the technology. Along with this technology promotion and dissemination program, we have a training program for manufacturers as well as for farmers. We provide training to the manufacturers and also provide the capital to start a workshop. We also provide training to farmers in the operation and benefits of the technology.

We have successfully disseminated two technologies. They are not primarily for oil processing but for micro-hydro power. Micro-hydroelectricity is a big power source in our country. These plants provide mechanical power for agro-processing. Similarly, we are promoting biogas plants. We also promote other technologies in low-cost housing and irrigation and in other areas which I will not discuss here.

But I would like to emphasize that in our country, we have been working as link agents between the manufacturers and the farmers to bring the technology to the farmers' level. I hope that we can use this ram press in Nepal to press mustard seed; my colleague, Mr. Shrestha, from the manufacturing side, is also here to examine this issue with the engineers.
Presentation by Hugh Allen, CARE

I have worked on the development of the Bielenberg press since about 1985. I worked in Kenya until last year in getting the press manufactured by Jaimen Engineers. Since then I moved to Lesotho where we have a project dealing with a number of different technologies including oilseed pressing. We have a very interesting situation in Lesotho. We are surrounded by South Africa which grows sunflower. Sunflower is not grown in Lesotho, largely because the prices paid for it as a local animal feed are too low and the competition from cheap imported South African oil too intense. Nevertheless, we started to look at whether or not the Bielenberg press could play a role in Lesotho.

The first thing we did was to look at the economics of production at the farm level and in the market as a whole. We found that in most of the country it would be possible to introduce the ram press. Substituting sunflower for maize would not yield the farmer more than 60% of what he could get from maize if he continued using traditional methods of production. However, by growing sunflower and using the Bielenberg ram press we have projected more than a 250% return on net financial investment to the farmer. That includes all the additional costs of inputs to grow hybrid seed.

We are fortunate that we are located next to a country which has invested a great deal of money in developing a vast number of hybrid varieties of sunflower—over 60. After looking at the basic economics of production, we looked at the potential yields to farmers and press owners of growing improved varieties of sunflower. We came up with some startling conclusions. The problem in South Africa is that farmers are paid according to tonnage. They are paid 60 cents a kilo for their seed, and it does not matter what the oil yield is. So all the research in that country is skewed to increasing yield by tonnage, and much less to looking at the oil content.

These seeds are of widely varying types. Some are suitable for use in the Bielenberg oil press, and some are not. Our results showed that, depending on the variety of seed chosen from a number of highly reputable seed producers, there could be a difference of 150 liters to a maximum of 325 liters of oil yielded per hectare. The only variable that shifted in this equation was the type of seed chosen. The costs of growing it were pretty much the same across the board. We tested 27 different varieties of seed and we finally came up with criteria for choosing the best type of seed to grow, which is not that simple. You have to satisfy the farmer, and also the press owner who may be a different person altogether, and you also have to satisfy the consumer in terms of taste and apparent quality of the oil. We looked at yield per hectare by tonnage, yield of oil per kg of seed when processed by the press, speed of settling so we could minimize filtration problems, and taste.
When we had tested 27 varieties of seed, we rejected 24 as unsuitable on one or more of these criteria. So our policy in terms of the project is to focus less attention on marginal improvements of the technology, and much more on being very sure about what we are doing when it comes to selection of the proper kind of seed for the farmer. That is the critical variable.

In my opinion, it is most important to first, choose your seed well, and second, press your seed on a sunny day, which can make a difference of 20-30% in oil yield. We worried about speed of settling because we do not want owners of the press to have to wait 3 to 4 weeks before they can sell the oil, and we do not want people to get involved in complex processes of filtering. We have come across two varieties of sunflower seed that settle quickly in about 2 days.

Another variable is residue. It makes a significant difference in the amount of additional processing you have to do, and consequently in the amount of oil you can immediately sell. Finally we found that taste is important. One of the highest yielding varieties that we had settled very quickly and produced a lot of oil. However, it looked like water--very clear--and just on appearance alone people rejected it. They said this could not possibly be a good oil, it does not look like oil. So you have got to play around with all these variables before you get into a project of this type.

Another thing we are focusing on is working capital. Each press, if it is operating throughout the year, can process 25 tons of seed. We process about 100 kg of seed a day with a team of 3 people, so we have begun to look very closely at the issue of working capital. We are concerned that farmers have a lot of capital tied up in seed storage. We want to either improve access to credit or make local arrangements whereby people buy seed at different times throughout the year. We have not come to full grips with this. What seems to be evolving is that we are dealing increasingly with farmers who have a significant amount of land devoted to sunflower. One of our selection criteria for farmer-owners is that they are prepared to grow no fewer than 5 acres of sunflower seed. We are also looking at solutions where a significant proportion of seed is purchased from local farmers, and where some service milling is also done.

Our project came about because the Catholics had a project in Lesotho using the CeCoCo oil expeller. This machine cost about US $12,000, and processed about 300 kg/day. Our machine costs US $1,500 and processes 100 kg/day. With the CeCoCo press, the report at the end of the project indicated they were spending about US $200 a month for maintenance and repairs alone. As a result the technology was discredited, and we initially had a lot of difficulty in getting people to consider the ram press seriously. So when Lynn says that you want to get this thing into the field
I heartily agree, but it has to be backed up with a system that keeps close tabs on what is going on, is prepared to make radical modifications if need be, and quickly repairs broken equipment, because we found the negative effect of a new technology that breaks down quickly can kill it faster than anything else.

A final point, for the engineers here, is that we now use a plastic bearing which does not require lubrication. It is called Meskinite, it is used on trucks for their spring bushings and is easily available and very cheap. If you do have it available I urge you to look at it because it reduces press cost and minimizes the need for rural maintenance, which often is not done.

The other thing we found was that there is a very critical curve to the pressure inside the machine. I found this out during a humiliating experience when I was conducting a demonstration in a village in Lesotho. I told them to put 3 kg of seed in the machine and I will produce a liter of oil. After about 12 minutes I had 950 ml of oil, and was quite pleased with myself. Then an old man came up and asked if he could have a go. We put the 3 kg of seed in, he cranked the handle once or twice, and said it was much too hard to operate, would we ease it off a bit. So we did. I thought he would get less oil. He got 1.05 liters of oil in nine and a half minutes. That is quite a significant finding.

**QUESTION ON YIELDS PER HECTARE**

**Hugh Allen:** Yields vary tremendously. We are lucky in that we have relatively sophisticated breeds of hybrid sunflower, and of course the agro-ecology of Lesotho varies tremendously. In general, the yield per hectare ranges from 700 kg a hectare to 2.2 tons. But the median is hovering just under a ton, about 950 kg. In general, Lesotho farmers tend to use mechanized farming practices for planting, but they are not exact when it comes to making sure they follow the right fertilizer or weeding procedures.

Our project is putting 20 presses into the field this year. We offer a contract to farmers whereby we allow them to use the press freely for a season. We do not provide them with a press until we have seen that they have the seed growing in the field, and space and labor for processing it. At the end of the year, we plan to review the situation with them and they can either hand the press back to us or, alternatively, we can work with them to develop a business plan.

We have encouraged farmers to grow no more than 10 acres of sunflower per press, and also to use two varieties of seed, to minimize the risk. In the first year they can find out all of the problems relating to an oil pressing operation such as growing the sunflower, organizing labor, marketing, etc. We do this because we want the farmers and press owners to come up with the solutions that work for them. We have some ideas about packaging,
distribution and quality control, but we want them to work out the solutions according to their own situation.

There is a press manufacturer in South Africa and another one in Swaziland, a company called New Dawn Engineering. Presses are now being marketed in Mozambique. But the Swaziland manufacturer views the ram press as having the most potential in the so-called Homelands, where there is a lot of poor quality land, low rainfall, a relatively small amount of capital, and the cost of the South African oil is actually quite high. So there seems to be a potential there but we do not know its absolute size.

Presentation by Mamadou Lamine Balde, RADI, Senegal (translated from French by Carl Bielenberg)

Mr. Balde is from an organization called RADI which is an integrated rural development organization located about 100 km from Dakar. The situation there is quite different from Kenya. It is a very arid country which has had a groundnut monoculture since colonial times, plus millet and rice in the Senegal river basin. As a result of the climatic changes in the Sahel it has suffered from very severe desertification and a reduction in agricultural productivity, especially in the demise of the groundnut economy.

RADI is presently working with organizations in the south of the country, which has relatively high agricultural potential because of its rainfall. They are working on two projects, the re-introduction of sesame cultivation as a source of vegetable oil, and as a way of providing vegetable oil to those people who cannot afford groundnut oil. The second project is the extraction of oil from neem seed to be used as a non-toxic (to humans) insecticide on vegetable crops, and also to look at other uses of the neem tree. The tree has been widely cultivated in the Sahel as prevention against desertification.

Some parts of Senegal still cultivate groundnuts on a huge scale; most of the processing is done industrially by large oil mills. The cost of oil produced by these mills is about US $1.25/liter. The farmer receives about US $0.25/kg for groundnuts in the shell. Despite the apparent reasonableness of the retail price for the oil, farmers continue to process their own oil using locally made bridge-type presses. The groundnuts are dehulled, ground in the maize mills, and placed in the bridge press. No water is used in the process. They are able to get fairly high extraction efficiencies. The oil can be sold for about 300 francs per liter not including the price of the container. It is generally sold in bulk or in small bottles brought by the customers. The principal economic advantage is the retention or sale of the cake, which is used for either human consumption or a supplemental animal feed.
RADI is particularly interested in testing a ram press in Senegal with sesame and neemseed. That is the next step in their project.

**QUESTION ON PROCESSING SESAME WITH THE RAM PRESS**

**Carl Bielenberg:** In the work that was done by Egerton, they concluded that they could not obtain high enough pressure to get good extraction efficiency from sesame because of the problem of extrusion. Even if they attempt to make cage bar separation set at .25 mm, some of the cage bars were just separated too far, so the extrusion prevented them from getting enough pressure. It seems that sesame is one of the more tricky seeds to press. You can get very good or very poor results, depending on the press and how you use it.

**Presentation by Miraji Ngetti, Sokoine University, Tanzania (see paper "The Ram Sunflower Oil Press: A Microproject")**

I will just run through the main points of my presentation. I have written something about our microproject in the Sokoine University Extension Project, SEP. This is an extension project; extension and public information are seen as very important components of agricultural development.

Because the performance of the extension service in Tanzania in the last decade has been disappointing, and extension staff have appeared to engage more in regulatory activities to the exclusion of its farmer education role, the Institute of Continuing Education, which is an outreach arm of Sokoine University, in collaboration with the Department of Agricultural Extension, University College, Dublin, Ireland, came up with this project in order to improve the extension services in Tanzania.

This pilot project has operations in three main areas:

a) an ongoing retraining program for the village extension workers

b) extension field work which includes implementation of acceptable development programs with the target villages. In these programs the introduction of the ram sunflower oil press is one of the programs

c) a monitoring and evaluation component

So far we operate in 40 villages in Morogoro Region, only a very small portion of the country, which has as many as 8 to 10 thousand villages.

The innovation development process consists of all the decisions, activities, and their impacts that occur from recognizing a need or
problem, through research, development and commercialization, to diffusion and adoption of the innovation by users. The sunflower oil press as a microproject was introduced into the project villages to help farmers realize some income from their sunflower, due to the fact that the marketing system in the country was failing, as has been explained by various speakers. It was also becoming evident that production of sunflower in those villages was falling. The project felt that the ram press might be a remedy to this problem, and might also help farmers increase their income while also providing a cheap source of oil.

So far we have 15 villages which have the oil press. These were introduced since May 1989 in three installments. Our experience so far shows strong willingness to adopt the innovation, and so far the production of sunflower is increasing. This is because we have been showing the farmers the potential economic value of the crop when they can process it themselves.

Using average figures, farmers were selling sunflower at TSh 30 per kg. Therefore, a 50 kg bag of sunflower would yield 1,500 shillings. Alternatively if the same amount of sunflower is processed, an average of 15 liters of oil is obtained, which when sold at 300 shillings per liter brings 4,500 shillings, which is an average of 90 shilling a kg. So there is a profit margin of almost 60 shillings for one kg of sunflower seed by processing the oil.

There have been new developments. There is an innovative farmer who has taken the Bielenberg press idea and has fabricated a machine oil press driven from the axle shaft of an old abandoned tractor. He is only using the drive shaft of the tractor. I have a video of that for those interested.

We have not started selling the Bielenberg presses yet but have supplied them to villages for demonstration purposes. The extension worker and one villager in each village are provided training. In the beginning we gave the presses free, but in this second phase, starting this year, we will collect TSh 200 for every bag of sunflower processed. This money will be used for a revolving fund to disseminate more machines.

Presentation by Peter Donkor, Technology Consultancy Centre, Ghana

There are 5 main oils commonly found on the market in Ghana—coconut, groundnut, palm, palm kernel oil, and shea butter. The shea nut butter and the groundnut oil are generally produced in the northern part of the country; the others in the south. About 70% of total oil production is done at the rural level by women using traditional methods. Most of the oil produced at the rural level is for local consumption.
The traditional technology used will differ from one area to another. Some attempts have been made by research institutions to upgrade the traditional technologies. My organization has been developing a package for the extraction of palm oil, and this package is capable of producing about 400 liters of palm oil a day. It has also developed a set of equipment for the extraction of shea butter, and is working on other equipment for extracting groundnut oil and coconut oil.

Unfortunately we do not cultivate sunflower in Ghana. If you see sunflower, maybe somebody is using it as an ornamental plant, maybe in front of his building, but on a plantation basis you will not see it. A few institutions have made attempts to cultivate sunflower over the years, but it never came up to a dissemination stage. So the ram press is interesting, but I keep asking myself how this press can fit into the Ghanaian situation.

Unlike some of the countries in papers presented here, extraction in Ghana is only done by women, and unless the technology is such that the women can use it, we are bound to get some problems. One good example is a technology which was introduced to a group of women in Ghana from Mali, a press used for extraction of shea butter. When it got to Ghana, the group that we tried rejected the press. When we went to find out why, we found that for the amount of butter they were getting, the press took longer than the traditional process; also they were getting low yields.

Now there may be a lot of reasons for this. Perhaps the traditional technology in that area of Ghana was more efficient than the technology used in Mali, because I hear in Mali the press is very popular among women. So if it is not popular among these women's groups, it looks like our technology is more efficient than the Malian technology. The other aspect is that maybe the women's group was not trained properly in how the technology should be used. I think in the Ghanaian situation many steps will have to be taken before a technology such as the ram press can be transferred to our people. Thank you.

Russ Read: I was in Ghana last year where a women's group was using a new hydraulic press. The division of labor had changed and women were mainly cooking and steaming and pounding the palm fruits, and the men were operating the machinery. There is a local manufacturer there who got a good deal on importing the hydraulic press components—the ground cylinder, ground piston and seals. The hydraulic press can greatly increase throughput and yields.

Carl Bielenberg: The two presses are very different. The first press described, the press for shea nut from Mali, is an extremely high pressure press with a hydraulic jack. I would say in Ghana, the degree of skill that women practice in shea nut processing is in general very high using the traditional process, they usually get very high extraction rates. In Mali, though, they have found
the hydraulic press quite useful. But it requires extreme skill to use it. Everything has to be done just right, or the yield will not be good.

Peter Donkor: Some of these complications in the process will normally put women off. What we have done is study the operations involved in shea butter extraction and have come to realize that the critical operation is the kneading, which is done by hand. We have developed a kneader which cuts down the time involved and increases the yield by about 50%. I think the women are very pleased with it. We are not using a press.

Presentation by Jim Tanburn, ApT, United Kingdom

ATI has commissioned us to do a manual on the ram press; I am holding a draft of the manual now. It describes the Bielenberg-Fisher version of the press. The plans are to make it into a looseleaf manual so that it can incorporate changes and additions as they come along. I think that changes are inevitable as the press evolves and improves, but at some point you have to draw the line and say now we will have a manual on such and such a version. That is what we have done.

The version of the press in the manual as it stands does need a certain amount of precision machining, and I think it is good not to underestimate what is required. Lynn is talking about going to job shops, and that is possible, obviously; he is doing it. But it has to be done with some care for the quality of the machines produced. You could not take this manual and just give it to a workshop in the informal sector and say, "I will have ten of these please," and be sure of the quality of the machines. It does need monitoring, particularly in the early stages. Having said that, because of the level of machining and the accuracy required, the sort of person who could do that quality of work could work from a manual like this.

Basically the manual consists of a text on how to assemble the press with some isometric perspectives of the various components, and an appendix with all of the technical drawings and measurements you need. There are also chapters on specifications, production capacity, seed preparation, operating instructions, maintenance, clarification of the oil, use of the seed residue, choice of technology, dissemination, and economics, and also a description of the manufacturing jigs and fixtures that would be needed to go into production, a list of machines and equipment required for production, and a cutting list of materials for the press and the jigs. We are very close to finishing the manual and it has been a pleasure to be involved in it.

ApT is an NGO based in the United Kingdom, largely consisting of mechanical engineers. We are involved in local manufacture in a
number of countries and would be very keen to be involved in local production of the ram press on a small scale, either in Kenya or in other countries, if anyone is looking for that type of assistance.

QUESTION ON HUGH ALLEN VERSION OF THE PRESS

Russ Read: CARE has put out a manual on the Hugh Allen version of the press. Their manual consists of a set of drawings with an addendum that is a utilization guide on how to use the ram press once it is built. It does not include instructions on how to manufacture it. For a copy of this manual you should contact CARE. For a copy of the manual ApT is producing on the Martin Fisher version of the press, you should contact ATI.

QUESTION ON AVAILABILITY OF CAPU DRAWINGS

Jamie Raile: As Jim mentioned, we would like the manual to be looseleaf, so new information can be added to it. We do not want to postpone finishing the manual while we are waiting to get CAPU drawings. But there is certainly a lot of interest in the CAPU press and we would like to be able to disseminate those drawings as well as others.

GENERAL DISCUSSION AND QUESTION AND ANSWER SESSION

J.N. Koome, UFUTA, Ltd., Kenya: I am from industry; UFUTA processes coconut and simsim. You may be asking what I am doing here. We are interested in attending this kind of conference because we are dealing directly with the farmers, and everything that will assist the farmers to improve their production of oil crops in this country is important. This particular conference is important to us because down at the Coast, where we have our factories, we have our own farmers who are producing copra. We have our own farmers who are growing seeds. We can assist farmers by passing this information to them and if possible, getting some of these ram presses to demonstrate how they can use them.

A very good example I heard was that of Arusha, where when they introduced these presses, production of sunflower went up more than 1000%. Here in Kenya, we have a strong feeling that if something is done to improve the overall production of oilseeds, the farmers will have enough oilseeds to use the ram presses for their own local village use and be able to provide oilseeds for industry. So that is our major concern, and why we are here. We will pass the information we have learned to the farmers to assist in the dissemination of this technology.

Edward Kingi, UFUTA Ltd., Kenya: For the last two days we have talked about the press and how it has been disseminated, but I think we have slighted discussing the oil itself, which is also very important. Here in Kenya, we have the Kenya Bureau of
Standards which specifies what they want in edible oils; they are look at specific gravity and free fatty acid content; they examine it for copper, arsenic and lead content, and insoluble impurities. Can the oil produced by the ram press pass the Kenya BOS specification? Are we giving the rural population a safe product to consume?

Lynn Schlueter: We are very sorry that the samples outside are poor; they have not been filtered or had time to settle yet. Many people know that the oil settles very nicely and looks fine, just like commercial oil. But the oil from the ram press does pass tests; we have the oil tested and it passes both Tanzania and Kenya Bureau of Standards tests.

QUESTION ON MAKING THE PRESS EASIER TO OPERATE

Carl Bielenberg: A number of efforts have been made to reduce the effort required to operate the press without reducing the size of the cylinder, which affects the press's productivity. The problem is you need to do a certain amount of work per stroke, and no matter how you configure the handle or the crank you basically run up against the same constraint. You are trying to press a certain quantity of seed, to exert pressure you are going to have to do a certain amount of work. The press is not perfectly efficient in the sense that not all the energy you put in the handle is actually used in pressing the seed, because part of it is used to expel the seed through the restriction cone. That is just intrinsic to the design. Without complicating the press, it would be hard to reduce the effort without significantly reducing the productivity.

It is also very difficult to simulate the conditions of use by people who operate the press for a living. They will change the way they use the press, the tightness of the settings, and they will operate the press better and better over time. Even taking several months in a university setting to simulate how it will operate in the field will not get you that kind of information.

Peter Jones: Misheck Kanjanda's children (aged 9, 13, and 14) were able to operate the CAPU press and produce 10 liters of oil in 4 hours.

Jamie Raile: I think that emphasizes the point Carl was making. When we are looking at the amount of effort required and how to operate the press in a university setting, we may not understand how the press will be used at the village level and what can be done by people who have a profit incentive.

And we should not forget some of the basics like warming the seed adequately in the sun first before pressing. In addition to getting better oil extraction this makes the press easier to operate.
Martin Fisher: The ram press uses less effort per liter of oil than almost any other machine available, by a factor of about 50 percent. Which is not to say we cannot make it better, but we will reach a bottom limit somewhere.

Lynn Schlueter: One of the things we like about the CAFU press is that it is possible for women to operate it. We have seen some examples of that already. The CAPU version has a small piston, which means you take in less seed, but you can also operate it more quickly, which is an advantage for somebody who is not quite so strong. The other advantage is that the handle is a bit shorter than the other presses and is more manageable for a woman as well.

DISCUSSION ON WOMEN AND THE BIELENBERG PRESS

Jamie Raile: I still have a problem with women operating the machine if they have not been traditionally processing sunflower seed oil previously. Because if they have already been processing sunflower you are probably lessening their amount of work, but if it is a new activity, no matter how easy, it is still additional physical work. I believe the emphasis should be on owning the press because that is where the income from the processing operation is.

Eva-Maria Bruchhaus: I operated the press this morning, and I am not as strong as an African woman farmer, but I could do it. I think we can reduce the problem if we concentrate on the approach of how to get this press to women. We must work on disseminating the information to women. The level of effort required to operate the press is not the only issue. If you just put the press in front of women and they do not know exactly how it works, then of course they will see it as difficult or hard. So I think we need not make it easier, but we must improve the approach.

Jo Doran: We also need to stress women's access to credit and how that is going to be managed. Women need access to credit to enter the technology field.

Jamie Raile: The issue of operating the press may also be very specific to the country, tradition, and women involved. We heard examples discussed where women operate the press in pairs, and do not want to hire a laborer to do it and forego some income. There are also women's groups who hire laborers.

QUESTION & ANSWERS

QUESTION: In Tanzania, how many individual buyers go directly to the manufacturer without going through the project?

Lynn Schlueter: In the case of CAPU, they sell many presses direct to customers. In Arusha, where our project was working, this was
not as common. The manufacturers we have been working with for two or three years are on their own now. Customers go to them directly. We are assisting new manufacturers who have just started in the last few months by placing initial orders with them. We are also trying to show the manufacturer that there is a market for the press.

QUESTION: Has the Bielenberg press been tried anywhere and then rejected? What have been the reasons for rejecting it?

Jim Herne: It is not that we have rejected the press. But the economics in Rwanda are a bit different. The cake from the ram press is used for animal feed (because it is not decorticated). But in some places the cake is used for human consumption and it has a higher value than cake used for animal feed.

Martin Fisher: One women's group was given a press and pressed two-year old seed; they got very little oil. By the time we came and showed them how much oil could be obtained from fresh seed, they were no longer interested. The wrong approach initially caused it to be rejected. The role extension plays is very significant.

Lynn Schlueter: In the very beginning, we had some initial problems around Arusha town. Some press owners had difficulty in finding labor. But in rural areas this has not been a problem.

QUESTION: How can bird predation on sunflower be lessened?

Lynn Schlueter: Try to plant sunflower away from forests and water, which attracts birds. Also, we have found it helps to get everyone in an area to plant at the same time, because the birds can only eat so much.

Roy Kleinschmidt: There is a new sunflower hybrid variety that reduces bird predation because the head hangs down (weaver birds can still get to it).

Russ Read: In Uganda, small boys have been hired to throw sticks and stones.

Willie Salmond: A buffer zone between forests and farmers works in Uganda to protect crops from birds and chimps. Also the chimps scare away the birds!

DISCUSSION ON THE CREDIT ISSUE

Eva-Maria Bruchhaus: I would recommend that credit programs have an interest rate that covers inflation. In West Africa, one year's grace period is allowed. It is easier to repay loans in the second
year. With the ram press, the money earned the first year could be used to increase their stock of seed to process.

Jamie Raile: Sometimes giving more time is not the answer. There are many competing needs for the money within the family. Some people need to be reminded that they have to pay back a loan. Perhaps small payments in the first year would get people in the repayment habit.

Carlos Zulberti: The actual availability of money is not the only problem, it is also the logistics. It is a lot of work having to go around and collect the installments. Has anyone here tried lease/purchase agreements, in which a loan is made to the manufacturer, who then in effect administers the loan?

Martin Fisher: That would be a big strain on the manufacturer. In Kenya, there are a large number of people who can get money together from friends without the aid of a formal credit system. That is the group we are targeting. They may not be the poorest segment, but we do not have the funds for a credit scheme.

Wilas Lohitkul: In Thailand we have set up village committees to manage a revolving loan fund, so that our overhead can be reduced. These committees decide on the criteria for loans, the payback arrangements and the follow up. We have had a 100% repayment rate. There is social pressure to pay back; others cannot get loans if someone defaults. Local extension officers select the committee members. We link various social objectives, like family planning or public health, to the loans.

Kiran Man Singh: In Nepal, the ADBN provides credit to farmers for these types of activities. What are the problems with using commercial banks in Africa?

Lynn Schlueter: In our experience in Arusha, Tanzania, there is about a 95% default rate on loans, so most organizations, including commercial banks, are shy about making loans.

Miraji Ngetti: It is very difficult in Tanzania for families to meet the requirements of commercial banks.

Martin Fisher: In Kenya, commercial banks require land as collateral. Many potential customers are very reluctant to put up their land as collateral. There are projects which are working with banks; the ILO has programs which guarantee 50% of the loan; they are working with commercial banks.

Carl Bielenberg: In West Africa, there is a tontine system. Every week, all the members put a small amount of money into an unlocked box. Anyone can take money from it at any time, as long as it is repaid with a certain amount of interest. A tontine is similar to
a village committee, because it is based on trust and peer pressure.

CLOSING COMMENTS

Jamie Raile: All of you will be mailed the conference proceedings and papers. ATI could not have presented this conference on our own, and I would like to thank once again International Development Research Centre of Canada through their offices in Nairobi and the Center for Global Action in Japan, for their financial contributions. In addition, the assistance provided by Lutheran World Relief was invaluable. I would especially like to thank all of you for coming and contributing to this meeting.

Sigurd Hanson: It is clear to me there is a community of people here with lots of energy. Please note that the root of community is communicate. We have been doing a lot of this. As a director of an NGO I feel a lot of responsibility to keep this energy and communication going. My eyes have been opened these last two days. I just want to thank all of the participants for being here, as well as ATI for coordinating this conference.
ON PRESSES DISPLAYED AT CONFERENCE
BY RUSS READ AND MARTIN FISHER:

Hugh Allen Version - Manufactured by Jaimen Engineering (manual available from CARE)

This press is robust, its operation is smooth, and it is well constructed. It is probably the most expensive press to manufacture. It uses a lot of flame cut plate, which means there is substantial waste. The current cost of materials used to make this press in Kenya is about 5,000 Kenya shillings. We feel that its current selling price - KSh 30,000 - is therefore too high.

A grease gun is provided (the only press with grease nipples). The backstop plate is weak and has bent in the field a number of times, but Jaimen claims that this is now reinforced. This is the only press that still has adjustable tie arms. Tie arms change the position of the piston relative to the front major pin. If they are adjusted to a long length, more seed falls into the cylinder per stroke. It has been shown that it is better when the piston enters the cage slightly, but if the tie arms are adjusted too long, the piston never reaches the cage.

Also, the more seed that falls into the cylinder, the harder the press becomes to operate. It is difficult to make quick adjustments to the tie arms, because a large spanner (wrench) is required. The nuts come loose in the field, unless they are painted in, but of course they become difficult to adjust if they are painted in. If someone forgets to lubricate the bushings in the front, the tie arms can actually bend, since they are not made from rigid flat bar.

This press has a curved restriction cone with a very smooth outlet. If the cake can come out smoothly at the far end, then there will be less loss of energy due to friction. This could translate into higher pressure in the cylinder with less effort than required on the handle; not everyone agrees with this.

Because the machine is made from plate, it is quite large and expensive. The separation between the tie arms is wide, which means that stronger pins are needed.

Martin Fisher Version - Manufactured by Jaimen Engineering
(ATI will be publishing a manual on this press design);
This press is made entirely from standard sized flat bars and a rectangular hollow section for the handle. No gas cutting is required. The pins (the shafts that hold the bushings that carry the load) do not have to be as strong as for a wider machine, and they are less likely to bend, particularly the cross pin at the end of the piston. However, the cross pin is thicker, because it is designed for 10 tons of force at the end of the piston. The press has to be designed with two things in mind—the force at the end of the piston, and the number of people hanging on the handle. The handle can take up to 200 kg hanging on the end. As such, this is a very strong machine.

The cage bars are made from 10 mm by 10 mm flat bar. as opposed to the Allen press (14 mm x 14 mm). Instead of a bored tube for the cylinder, there is a standard 1 1/2 inch thick wall pipe. However, this pipe is not strong enough to take the load and therefore a hopper support is required. Without the hopper support, there is a real danger of the cylinder breaking. The end of the stroke is always in the same place. However, the top, or start, position of the stroke is adjustable with a simple screw stop. The top determines the back position of the piston, which in turn determines how much seed goes into the cylinder. If adjusted forward, the throughput of the press is lowered, but the stroke is easier, and the mechanical advantage is slightly increased. If adjusted back to lengthen the stroke, then the throughput is higher.

In contrast to this stroke adjustment, which determines the amount of seed pressed per stroke (throughput, measured in kg of seed per hour), the cone adjustment determines the pressure in the cage and the amount of oil yielded per kg of seed. These two adjustments can be varied to match operator strength and the desired output of the machine.

This press is lubricated by oil. The tie arms are fixed in length, and made of 40 mm x 10 mm flat bar, which is stiffer than the rods on the Allen press. However, fairly good jigging is required, otherwise the tie arms will be of slightly different lengths. One tie arm should be made using a jig, and the other should be put together on the machine.

This press is bolted onto a wooden platform to save money and weight. But if a soft wood is used, it needs to be replaced every six months or so. This press has a straight restriction cone and restriction ring with sharp edges on both sides, but because of the longer cage length, the operation is still quite smooth.

CAPU VERSION - Manufactured by CAPU

The idea behind this press was to try and make the least expensive press possible. Therefore it is also the smallest. It is made out of 100 mm x 10 mm flat bar with no plate cutting. It has a very
short cage. The cage bars have a very small taper and are now machined by village craftsmen with an angle grinder on a jig, as opposed to being turned out on a lathe or shaper.

The cage rings are not made out of plate, but 12 mm round bar. The restriction cone has a small ball bearing on the inside of the cone between the standard adjusting bolt and the cone itself. This makes it easy to turn, and one does not have to fight all the friction of the seed against the cone. The cone is on a removable plate which slides in and out. The Allen and Fisher press also have this.

The cylinder is comparatively short, and bored out of thick machined tube. A pipe cylinder in early models was problematic, because the pipe bent, causing the piston to jam inside it. There are holes in the bottom of the cylinder to assist in clearing jams in. The oil leaves the press on one side of the cage, which means the operator can see it as it is being pressed.

The whole machine sits on an angle iron stand about a foot and half off the ground. The operator thus has a different position, and there is a lot of space for the cake to fall down underneath. It is mounted on a very lightweight angle iron piece to bring it up to that height.

The handle is not removable, but it is much shorter and lighter than other handles (60 mm by 60 mm by 2 mm square section tubing). It would be too weak except for the 1/2 inch reinforcing bar.

There is no stroke adjustment. There is a wooden stop for the bottom of the stroke attached to the long wooden base. The tie rods are very short and welded onto the machine, and not on a jig. At the end of the rods there is 20 mm x 50 mm flat bar, notched to allow for slight misalignment between the two sides.

The pins are very small (40 mm), and the piston is also a 40 mm shaft, which means that a manufacturer only needs one size shaft. However, 40 mm pins can bend readily.

Martin Fisher Experimental Version

This experimental press has several innovations to reduce the size and cost of the press and maintain robustness. It has not been tested. All of the pins are slightly smaller (57 mm versus 63). The base is now made from 100 mm x 50 mm x 6 mm channel, as opposed to the flat bar.

The cage is not made from tapered flat bars, but from 12.5 mm round bars. Every other bar is machined to present a gap. The reinforcing rings are made from the round bars. There are 14 cage bars, eight of which are machined. The taper is obtained by taking a 40 mm x 40 mm angle, and a 65 mm x 10 mm flat bar, and
compressing the round bars between the angle and the flat bar, so that the angle and the flat bar actually protrude into the cage on the wide end to form the cage taper.

The largest material is the 57 mm bright steel shaft, the pins and the bushing. The cylinder is made out of two pieces of pipe (a 2-inch pipe with a 1 1/2 inch pipe inside), with a machine bushing to tie them together at the end. The purpose of this is to counteract bending stresses on the cylinder; however, it may be cheaper to machine the cylinder from a round bar.

There is no restriction ring to speak of, the last 10 mm plate is machined at a slight taper. There is a 45 mm taper in the cone. A skirt fits around the cone, bringing it around to 75 mm. Seed has a tendency to jam between this skirt and the end cage plate.

The tie arms are fixed in length (40 mm x 10 mm). The removable cone does not slide, but is bolted on with 8 mm bolts. There is an adjustable handle stroke, with the top position adjusted with a 5/8 inch (20 mm bolt and a couple of nuts, including a lock nut. There is a 20 degree offset between the pins and the angle of the handle. When the pins are parallel to the ground, the handle angles up 20 degrees. This was made to allow an operator to hang from the handle, rather than having to push down. This same feature appears on the Martin Fisher version.

The bottom handle and piston position is actually 6 degrees from top dead center, which means that the final motion is not wasted going to top dead center, where almost zero motion is obtained. The base is metal, and comes in two parts. The part fixed to the press comes to where the removable handle ends, making the machine about a meter long without the long handle. The base can then be bolted either to a wooden base or concrete floor, or the metal base extension can be attached. The current cost of materials for this press in Kenya is KSh 3,500, and it should sell for about KSh 12,000.

Carl Bielenberg Version - Manufactured by Carl Bielenberg
(drawings available from ATI)

This press was designed for low cost, high output, and reasonably good oil extraction rates, and has only been tested on good quality sunflower seeds.

The piston is 52 mm, which is larger than the others. A 38 mm piston was tested; it was found that the same yield was obtained from a 52 mm piston with a two-fold increase in productivity. The effort needed to operate was similar because with the 38 mm piston, the cone was tighter. The force on the handle was the same; the pressure in the cylinder was greater. The greater pressure did not improve the yield.
This press has a shorter cage than either the Allen or Fisher press - it is the same length as the CAPU press. Different cage lengths were tested, and the yield did not change. A shorter cage is cheaper to manufacture.

The plate holding the restriction cone is fixed. This is because it is used for a handle stop and serves as reinforcement of the press frame. The cone is still removable through the hole in the front of the frame, where the cage is attached. The choke itself is 63 mm in diameter, the hole in the frame is 75 mm, and the hole in the choke plate is 70 mm. The cone, when screwed into the choke plate, prevents seed from spilling out. The choke plate is not a ring, and cannot be deformed when the cage is tightened.

The main body parts of this press are made from 125 mm x 12.5 mm flat bar. This size bar may not be readily available in some developing countries. Cut 1/2 inch plate would have to be used instead.

The cone thread and the plate that holds the cone must both be machined. It may not be the best design to manufacture in an area where manufacturing facilities are primitive.
UPDATE ON MARTIN FISHER EXPERIMENTAL VERSION

After a few days of using the press, it was discovered that the seedcake tends to jam in between the round cage bars, and seriously restricts the flow of oil. This result indicates that the idea of using round cage bars was not a success, and in the future, cages should still be made using rectangular and tapered cage bars.

However, the trick of machining the cage bar shims directly onto the cage bars was a valuable lesson, and one which can be used even with rectangular bars.

A new cage was manufactured using rectangular bars with shims machined in; it was easy to assemble, and the cage gaps were uniform.

A restriction ring was also added, made from 3 mm plate, with a hole 6 mm smaller than the hole in the cage end plates. The restriction cone skirt was also made to a smaller diameter so that it could fit through the end plate hole.

The press was then tested with these modifications and it now performs well. A very quick comparison run with Kenyan black hybrid seed was made among the new press, the old Fisher model, and the new Bielenberg model. This new design extracted about 10% more oil per kg of seed than the others, but it yielded lower throughput in kg per hour.
AGENDA

10 September 1990

8:30 - 10:30
Coffee and Registration
Welcome, Opening Comments: ATI and LWR
Introductions - all participants
Background on Development of Press: Carl Bielenberg, ATI

10:30 - 11:00
Coffee Break

11:00 - 12:30
Press/Filtering Demonstrations
Manufacturing Issues/Concerns
Moderator: Russ Read, ATI

12:30 - 2:00
Lunch

2:00 - 3:30
Kenya Ministry of Agriculture/World Bank
Oilseeds Project: Isaac Kibuthu, Project Coordinator

Egerton University/IDRC Vegetable Oil and
Protein System Programme:

--James Muthaka, Egerton University
--John Mugeto, Egerton University

3:30 - 4:00
Coffee Break

4:00 - 5:00
Participants' Experiences with Bielenberg Press:

--Jim Herne, Technoserve/Rwanda
--Joseph Lungu, Africare/Zambia

11 September 1990

9:00 - 10:30
Alternative Technologies for Small-Scale Oil Processing: Tony Swetman, Natural Resources Institute, U.K.
Participants' Experiences with Bielenberg Press:

--Martin Fisher, ActionAid/Kenya
--J.A. Ali, Obafemit Awolowo University, Nigeria
--Joseph Gomez, CRS, The Gambia

10:30 - 11:00 Coffee Break
11:00 - 12:30 Tanzania Village Oil Project

--Findings of PACT Case Study: William Lobulu, Tanzania News Agency
--Socio/Economic Impact of Ram Press in Arusha Region: Eric Hyman, A.T.I.
--Ram Press Dissemination Issues/Concerns: Lynn Schlueter, Project Manager and Dallas Granima, Extension Manager

12:30 - 2:00 Lunch
2:00 - 5:00 National Strategies for Promoting Rural Oil Processing Activities - Carlos Zulberti, Egerton University

Participants' Experiences with Bielenberg Press and/or Small-Scale Oil Processing:

--Kiran Man Singh, ADBN, Nepal
--Hugh Allen, CARE/Lesotho
--Mamadou Lamine Balde, RADI, Senegal
--Miraji Ngetti, Sokoine University, Tanzania
--Peter Donkor, Technology Consultancy Centre, Ghana

Question and Answer Session
Conference Closure
Moderator: Jamie Raile, ATI

CONFERENCE SPONSORS:

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Lutheran World Relief (Nairobi and New York)
International Development Research Centre (Nairobi and Canada)
Appropriate Technology International (Kampala and Washington)*

(*core funding from U.S. Agency for International Development)
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SUMMARY OF PARTICIPANT RESPONSE

1. Have you previously been involved with the ram press?
   YES  27
   NO   16

   If so, how? Workshops, universities, production and testing, read literature, own personally, involvement in programs

2. Have you previously been involved with other small-scale technologies for oil extraction?
   YES  14
   NO   29

   If so, how? Design of other types of extractors (palm nut, coconut, palm oil, shea butter, groundnut), introduction of other kinds of expellers (Italian, CeCoCo, pneumatic), financing of mechanical oil expellers

3.a. Did you learn anything new about the ram press and sunflower seed extraction at this conference?
   YES  43
   NO   0

   b. How will you use this information?

   Will attempt to acquire press, improve this or other press or press development programs, promote dissemination in villages/women's groups, encourage sunflower growth

4. Overall evaluation of the conference:
   a. EXCELLENT  9
      VERY GOOD  31
      AVERAGE  3
      NO RATING  1

   96
b. What did you like?

Positive interactions and exchanges among a wide range of knowledgeable experts, commitment to achievement of a common objective, well-prepared, useful papers, machinery demonstration

c. What didn't you like?

Noisy environment; press demonstration too crowded; no visits to actual press sites; conference too short; some presentations (especially technical papers) too long; all papers should have been available for reading ahead of time; sitting arrangements not conducive to good discussions

6. Evaluation of conference room facilities:

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<td>0</td>
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<td>NO RATING</td>
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Comments: Excellent, other than noise, poor ventilation and layout, needed more secretarial services (photocopying, faxes, telephones, etc.)

7. Evaluation of hotel facilities (not everyone stayed at hotel)

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Comments: very good lunches, chaotic front desk conditions, more secretarial services needed


Hyman, Eric L. "Preliminary Socio-Economic Impact Study of the Ram Press in the Arusha Region of Tanzania." p. 113-132


Muthaka, James K. "Vegetable Oil/Protein System Programme--The Kenyan Experience." p. 179-190


Zulberti, C., Schmidt, O., and Mugeto, J. "Dissemination of the Oilseed Ram Press." (Draft) p. 231-242

Zulberti, C., Schmidt, O., and Navarro, L. "The Generation of a Vegetable Oil/Protein Strategy for Countries with Low Dietary Fa Intake." (Draft) p. 243-250

Handout, "TDAU Modifies Bielenberg Ram Press." p. 251-256

Handout, "Village Oil Press Project (SIDO)." p. 257-260

Handout, "Information about the Bielenberg Ram Press Designed by CAPU - Lushoto." p. 261-264
BACKGROUND ON FOOD OIL PROCESSING IN THE GAMBIA

A Paper presented to the Conference on Replication of the Bielenberg Ram Press - Nairobi, Kenya

Sept. 10 - 11, 1990

By: Joseph Gomez
CRS/The Gambia
Sept. 10, 1990
1.0 Introduction

In the Gambia, food oil consumption is very high, hence it is a purchased item, especially in the urban and semi-urban areas. In these areas as opposed to other areas in the country, it is at times difficult to get substitute ingredients to oil such as groundnut paste and some edible leaves.

There are about five different categories of food oils consumed by the people countrywide, namely groundnut oil (salad), sesame oil, red palm oil, palm kernel oil and dairy (milk) oil, which is mainly obtained from the milk of cows. Groundnut and red palm oils are the most widely consumed; the others are consumed on a geographical or ethnic basis. The palm kernel oil is consumed in areas where there exist a lot of palm trees, for instance in the Foni region, and is consumed by the Jola tribe, mainly. Sesame oil is mainly consumed in the rural areas benefitting from the services of the CRS grant CeCoCo Expellers, managed by the Sesame Growers Associations. The dairy (milk) oil is mainly consumed by cattle owners such as Fulanis and their close friends.

2.0 Oil Processing Technologies in the Gambia

There is a large-scale parastatal (GAMB)-owned oil mill which processes and refines groundnut oil for the domestic market, though it cannot meet the local demand, since edible oil is being imported by businessmen into the country. This parastatal exports crude oil also.

The 16 CeCoCo expellers, which are of two different sizes, H54(9) and H52(7), are all located in the rural areas. These expellers are motorised with diesel engines and process 50 kg and 25 kg per hour respectively. They are managed by SGAs and a processing fee of fifty bututs (1/2 GMD) is levied to each farmer for processing 1 kg of either sesame or groundnuts, irrespective of expeller size. Farmers refine their crude oil by boiling, and the by-product, cake, is either sold to the SGAs at twenty bututs per kg, or taken away by owners for use as animal feed or for soap-making.

There are manual screw plate presses, principally for groundnuts, in some rural villages where custom-pressing is particularly prevalent. These manual screw plate presses are very labour intensive, entailing the steaming and pounding of groundnuts on a repeated basis, before the paste is put in the press. These presses remain popular with some village entrepreneurs, but the technology needs some modification to ease the high labour demand.

Palm oil processing is also ethnic and region-specific. Women of specific tribes (Jolas/Manjagoes) are predominantly engaged in this trade. The ripened palm nuts are boiled in big containers or
drums (barrels) and then crushed in mortars with the use of pestles. The crushed nuts are separated from the kernels and the juicy flesh boiled again until the red oil floats on top, leaving the sediment below. This process is also labour-intensive, but not very costly since it necessitates no recurrent costs.

Dairy oil (milk) processing is mainly done by cattle owners as mentioned earlier. Fresh milk is left to ferment over a day or two. The upper part of the fermented milk is jelly-like with a yellowish substance, which is removed and boiled. The end product is an oil which is very delicious and expensive, because of its scarcity.

The palm kernel oil is produced by first of all cracking the hard cover, leaving the nut, which is pounded using a mortar and pestle. The pounded kernel is put into a cooking pot and boiled with water added to it. The oil rises to the top where it can be removed for use. This method is also labour-intensive and it is not easy to get this type of oil in The Gambia.
BACKGROUND ON PROJECTS PROMOTING
THE BIELENBERG OIL PRESS

CRS/THE GAMBIA: EXPERIENCE WITH SESAME

A paper presented to the conference on replication of the Bielenberg oil press
Nairobi, Kenya

Presented by:

Joseph Gomez
CRS/The Gambia
Sept. 10, 1990
CONTENTS:

1.0 Introduction/Background

2.0 Introduction of The Bielenberg Press in The Gambia and Preliminary Field Level Participatory Trials with Sesame

2.1 Findings from the Preliminary Field Level Trials

2.2 Farmers' Observations/Reactions

3.0 Field Level Commissioning of the Press For Usage Information Gathering

4.0 Usage Information for the Bielenberg Oil Press in Samba Kalla-NBD

4.1 Analysis of Data Collected

5.0 Conclusions/Recommendations
1.0 INTRODUCTION/BACKGROUND

The Catholic Relief Services/The Gambia Program has been in existence since 1964. It started with general relief services in hospitals and maternal and child health centers (MCH) in the rural areas, rendering assistance in the areas of food and medical supplies to clients in these health institutions. A decade later, the Health and Nutrition Program (HNP) was initiated, targeting mothers and their children of under five years of age. Food commodities such as imported rice, oil, and skimmed milk were distributed to participants of the HNP Centers to supplement their diet.

In 1982, Catholic Relief Services (CRS) decided to introduce an agricultural component to the program -- the Oilseed Promotion Project. The objective of this project was that the mothers enrolled in the HNP would produce and consume sunflower to augment their diets. Due to climatic and agronomic problems for the sunflower crop, which caused it to fail, sesame was introduced as a substitute for sunflower. Before then, sesame was used in The Gambia as a purely medicinal plant. With the promotional campaigns mounted by CRS field staff, the crop was fully accepted by farmers countrywide. However, eventually two constraints were noticed by the farming population -- processing and marketing.

Since CRS was interested in seeing to it that farmers (mothers in the HNP) growing the crop would consume it (oil) in their diets, the agency provided sixteen oil expellers of two different sizes to farmers in the rural areas on a grant basis. With this move, other problems arose during the latter part of the project relative to the sustainability and management of these expellers when CRS handed them over.

With the adoption of the Institution Building Strategy (IB) by CRS, the agency went into partnership with the Sesame Growers' Associations (SGAs), and the above-mentioned problem remained the responsibility of the SGAs, since they are responsible for the upkeep and replacement of these expellers. At the moment, the financial viability of most of these expellers is too low, meaning that their chance of replacement by the SGAs is questionable.

With the above scenario, both CRS and the SGAs are exploring, and would exploit, other low-cost alternatives for oil processing.

2.0 INTRODUCTION OF THE PRESS AND PRELIMINARY FIELD LEVEL PARTICIPATORY TRIALS WITH SESAME.

The Bielenberg press currently being tested in The Gambia was purchased through a PACT grant early this year, 1990, which should also be handed over to RADI in Senegal. The grant included the
cost of the press, travel costs from Tanzania, fabrication of a handle and platform, and costs to cover field level testing. The press was received in The Gambia on February 23, 1990.

On February 28th, the press was tested in the laboratory with sesame and groundnuts by a team from ODNRI. Groundnuts were not suitable, thus leaving sesame for continual testing. On March 12th and 13th, the press was placed for trials in four villages in the central part of the country. (See Appendix 1 and 2 for criteria for selecting the villages and checklist used, respectively). The methodology used in the participatory trial was a demonstration, observation and discussion strategy facilitated by an ODNRI Research Scientist, Keith Southwell, and myself.

2.1 FINDINGS

In one of the villages, it took a group of villagers (both men and women) almost 45 minutes to process 3.5 kg of sesame seeds. This was done in pairs with intervals for discussions. The seeds yielded 950 ml of oil.

At another village, 4 kg of sesame seeds were crushed, and yielded 1 litre of oil. The demonstrations cum discussion sessions took one hour, followed by a protracted discussion about the press.

In the two remaining villages, which are not far from each other, 3 kg of seeds were processed in an hour's time and yielded 550 ml of oil. This timing included demonstration and discussion sessions, followed by lengthy discussions.

2.2 FARMERS' OBSERVATIONS/REACTIONS

- By-product (cake) is not as well crushed in comparison to cake processed by CeCoCo expellers
- Sesame is "wasted" since a lot of it is not properly crushed (quality of cake)
- Women farmers from three of the four villages visited observed that the press is labour-intensive (intense energy demand)
- Low oil yield as compared to CeCoCo expellers (approximately 50 percent versus 90 percent)
- The more the cage bars of the press were tightened to enable proper crushing of the seeds, cake dropped off from the oil exit point, thus releasing sediment into the oil
- Seventy-five percent of villagers visited suggested that the press is ideal only if the technology is improved upon

3.0 FIELD LEVEL COMMISSIONING OF THE PRESS FOR INFORMATION GATHERING ON USAGE.

After completion of the above two day field level participatory trials in four villages, it was decided by CRS to commission the press for a long-term period (1 - 2 months) in one
of the villages where the first trials were conducted and where people expressed interest in the press. The objective of this exercise was to enable CRS to obtain some usage information by letting the villagers use the press according to their own initiative and interest. In order to facilitate the collection of such usage information at the village level, a simple questionnaire was developed (see Appendix 3) for monitoring the press and collecting data.

The press was first commissioned in Sarra Kunda in April but after six weeks, there was no usage data because it was unutilized. The reasons for the press not being utilized by the villagers were:

- There was no individually-owned sesame produce left in the village, except the communally-owned sesame produce of the women's group
- Members of the women's group were reluctant to use the press to process their seeds (80 kg) because of the "inefficiency" of the press relative to its low oil yield, and the poor quality of cake obtained as compared to the CeCoCo expeller product
- The technology of the press has discouraged some farmers, especially women, to try the press on their own initiative (labour intensive)

The press was recommissioned in another village called Dippa Kunda in June, but withdrawn again in mid-July when there was no usage information. The reason for the press not being put into use was mainly lack of individually-owned sesame.

4.0 USAGE INFORMATION FOR THE BIELENBERG RAM PRESS IN SAMBA KALLA

Since there was no usage information in the two above named villages situated in the central part of the country, CRS continued to make contacts with villagers through their village based staff on the availability of sesame at village level where the press could be used by farmers to crush their seeds. The ram press was finally put into use during the month of August in Samba Kalla in the western part of the country where it was recommissioned for the third time in early August.

4.1 ANALYSIS OF THE DATA COLLECTED

A total of seven questionnaires (Appendix 3) were administered during the period from August 6th to the 26th. Ten farmers (seven males and three females) used the press to crush a total of 38 kg of sesame, yielding a total of 5.3 litres of oil and 23.5 kg of cake. A total of 130 minutes (roughly 2 hours) was spent crushing the 38 kg of sesame, indicating the slow nature of the press.

According to the above data, it could be deduced that a lot of cake and oil is lost by using the press because of its low output
of cake and oil in comparison to other oil presses, such as the CeCoCo.

Seven out of ten farmers interviewed who used the press refined their oil by boiling, while three farmers refined theirs by letting the oil settle over a day or two. The boiling method was preferred by the majority of farmers because they urgently wanted to use the oil in preparing their meals.

Information on the utilization of cake by farmers indicated that eight farmers out of ten used the cake (mixed with salt by some farmers) for livestock feed. Two farmers mixed the cake with some chemicals (pesticides) and broadcasted it in already planted sesame fields to attract and kill pests/insects hunting for already sown sesame seeds. However, cake was not used by humans for consumption.

Concerning the general impressions of farmers about the press, five farmers rated it to be fair, three rated it to be good, and two rated it to be poor.

Among other observations, the common ones highlighted were:

- The ram press is slow and tedious to operate especially by female farmers, therefore can only efficiently process small quantities of sesame
- Oil and cake output is low relative to the quantity of sesame crushed
- The press is ideal for farmers far from CeCoCo expellers, and could assist those farmers who urgently need sesame oil for their daily meals
- The press is cost-effective and requires no recurrent costs such as diesel

5.0 CONCLUSIONS/RECOMMENDATIONS

As one could derive from this paper, the Bielenberg ram oil press was used basically on a test basis since its arrival in The Gambia with sesame oilseed only. A chance was given to both men and women (the latter being CRS's target group in the rural areas) of different ethnic and geographic backgrounds to use the press in order to make a comparison of opinions on this new technology. There was commonality relative to farmers' comments/reactions in both the field level participatory trials and the long-term commissioning of the press.

The press could be more ideal for Gambian communities where individual farmers of sesame grow the crop mainly for consumption (oil), and yet are constrained by distance from using existing oil extracting centers. The demand for the press was established in Samba Kalla, when farmers requested that it be left in the village for its continual usage.
However, the acceptability rate of the press would be higher, especially among Gambian female sesame farmers, if the technology were improved upon, taking into consideration its labor-intensiveness and efficiency in oil/cake output.

I hope and pray that this conference on the replication of the Bielenberg Press will do justice to the Gambian farmers, if some of their comments/reactions are considered by the experts, already users, and the able designer of the press, Carl Bielenberg.
## APPENDIX 1

### SELECTED VILLAGES FOR VILLAGE LEVEL PARTICIPATORY TRIALS ON RAM OIL PRESS

<table>
<thead>
<tr>
<th>NAME OF VILLAGE</th>
<th>CRITERIA FOR SELECTION</th>
</tr>
</thead>
</table>
| **1. SARAKUNDA** | - Far from oil mill center (app. 47 km)  
- No traditional screw press for groundnuts  
- Located within 50 km of Farafenni  
- Having kafo which is producing sesame  
- Mandinka Community |
| **2. NDAKAR - DIPPA KUNDA** | - Having an existing traditional screw press for groundnuts  
- Located within 50 km of Farafenni  
- Sesame is cultivated by villagers  
- Wolof Community |
| **3. MAKAFARAFENNI** | - No traditional screw press for groundnuts  
- Having kafo which is producing sesame  
- Located within 50 km of Farafenni  
- Not far from the oil mill center (approx. 13 km)  
- Wolof Community |
| **4. ILLIASSA** | - Having CeCoCo H54 Machine Oil Expeller  
- Located within 50 km of Farafenni  
- Having kafo which is producing sesame  
- Mandinka Community |
APPENDIX 2

INFORMATION TO BE OBTAINED ON VILLAGE LEVEL PARTICIPATORY TRIALS ON THE RAM OIL PRESS

CHECKLIST

1. How long will it take two men/two women to process 10 kg of sesame?

2. What quantity/amount of oil and cake is obtained from 10 kg of sesame?

3. Opinions on the oil and by-products (e.g. cake) compared to those produced by CECOCO Machines and other local/traditional oil presses.

4. Which tasks tend (by "tradition") to fall to men and women?

5. Do women have enough strength and stamina as compared to men to carry out all tasks? If not, which ones?

6. How and where do villagers produce their oil?

7. Type of food processing technologies available in the village, e.g., Coos mill, etc.

8. Villagers' reactions about the Ram Press' relative acceptability/rejection (general observations).
APPENDIX 3

BIELENBERG RAM OIL PRESS USAGE INFORMATION

DAILY FORM

Name of person monitoring:..................................................

Name of village:.................. Date:...........................

No. of Hours used:......... No. of kg sesame processed.............

No. of workers, Male:.................... Female:................

Liters of oil obtained:............. No. of kg cake:.............

Was oil refined? ....Yes .....No If Yes, how? ........ Boiled

When Refined? Date:.............

........ Filtered

........ Settled

Cake was utilized by: ...... Selling, Price: ...... Date: .......

...... Human Consumption Date: .......

...... Animal Consumption Date: .......

If cake was consumed by humans, how was it prepared?

...... Mixed with sugar. ....... Ingredient for sauce. ....... Other

General impression by clients: ...... good. ...... fair. ..... poor

Other observations: ..........................................................

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Preliminary Socio-Economic Impact Study

of the Ram Press

in the Arusha Region of Tanzania

by

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November 2, 1990

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Research for this paper was supported by Appropriate Technology International (ATI). The author would like to acknowledge the substantial assistance provided by Lynn Schlueter and Dallas Granima (Tanzania Small Industries Development Organization), Sig Hanson (Lutheran World Relief, East Africa Regional Office), Jamie Raile (ATI).
Introduction

This paper discusses the socio-economic impacts of the ram press -- a small-scale, manual technology for edible oil extraction invented in late 1985 by Carl Bielenberg, an engineer on the staff of Appropriate Technology International (ATI). Since 1986, this press has been disseminated on a commercial basis through a development project in the Arusha region of Tanzania, with support from ATI, Lutheran World Relief, and P.L. 480 funds from the U.S. Agency for International Development. In 1990, a follow-on project was initiated to extend dissemination of the press in two other regions of Tanzania -- Iringa and Singida. Figure 1 shows the location of these areas. Similar activities are underway in Zimbabwe and other countries in East and Southern Africa.

In Tanzania, the ram press is being purchased by farmers who are pressing their own sunflowerseed production and offering service pressing for other farmers in their areas. The press is now being manufactured by multiple independent local workshops in the country. This paper examines the socio-economic impacts of the ram press in the area of the initial project, the Arusha region, as of mid-1990. It is based on a sample survey of press owners and users and interviews with press manufacturers and project staff. A commercial analysis was conducted based on data from the survey and other sources.

Status of the Technology

The original ram press that was first developed required a considerable amount of effort to operate. The second version, known as the Bielenberg-Fisher (B-F) model, was a modification that made the press much easier to use. The B-F model has a longer handle with cross-bars that stops at a 45° angle to reduce the bending needed and increase the leverage.

The third version was developed by a parastatal, the Craftsmen and Artisans Promotion Unit (CAPU) located in Lushoto. The CAPU design is smaller and much less expensive, although it is capable of producing about as much oil as the earlier versions of the press. In the CAPU version, the piston and cage are smaller, the chamber and pipe are narrower, and the base is made of wood instead of metal. It became necessary to develop this version as a result of large increases in the price of imported steel following a series of large devaluations of the Tanzanian currency (Over the course of the Arusha project, the exchange rate fell from 17 T. shillings per U.S. dollar to 193). Although the force necessary for each stroke is less with the CAPU press than the earlier models, more strokes are required to press a given amount of seed so the total effort is about the same as with the earlier models. Several modifications of the CAPU press have since been made. The cage bar openings have been reduced in size from 0.40 to 0.25 mm so that the press can be used for extracting oil from either sunflower or sesame seeds.
FIGURE 1. Two Main Sunflower Production Areas in Tanzania
All of the manufacturers currently active in producing the press have adopted the CAPU design changes. It costs between $285 and $390, depending on the manufacturer. CAPU itself has sold the largest number of ram presses, 108 as of mid-1990. Since 1989, Themi has been producing the CAPU design of the press. Its current price, which includes a 30% profit margin, is $340 with the base. A parastatal in Arusha, the Small Industries Development Organization, had produced 16 presses and a private firm in Kilimanjaro had produced 6. United Engineering Co. in Arusha had produced 7 presses early on, but was no longer an active manufacturer because it is more interested in producing its main product, grain mills.

The ram press works best with soft-shelled varieties of sunflowerseed. A soft-shelled variety with a relatively high oil content known as black record is recommended. A 50-kg bag of this variety of seed can yield 10-15 liters of oil depending on how the pressure has been adjusted and the effort of the operators. A conservative estimate of typical yields would be 12 liters per bag.

Attempts to press hard seed result in a low oil extraction rate and may cause the press cage to burst if the pressure is increased too much. If hard seed is all that is available, it should be decorticated before pressing. A simple, bicycle-powered decorticator developed by Bielenberg has been produced in Tanzania by Nand Singh and copied by Themi. It takes 30 minutes to decorticate one bag of sunflowerseed with this device, but the design needs to be improved due to its susceptibility to breakdowns. Alternatively, it may be possible to successfully press a mix of hard and soft seeds without prior decortication.

Production Achievements

The Themi Farm Implements Co. was originally interested in producing a larger scissors-jack press designed at the Institute of Production Innovation (IPI) of the University of Dar es Salaam. It soon become apparent that the IPI press was for too large a scale of production, and cost too much because it required prior use of auxiliary equipment (a decorticator, scorcher, and roller), and was susceptible to breakdowns. The project ordered the first set of ram presses from Themi, but the quality was only fair. At that time, Themi expected that it could earn more profits from the IPI presses. A private workshop in Arusha town, Nand Singh, then began producing to make the ram press on a commercial basis. Through June 30, 1990, it has sold 46. Eventually, Themi recognized the superiority of the ram press and, as of mid-July 1990, it has produced 50 presses of this type. Themi has not received any orders for IPI presses in the past two years and now recommends purchase of the ram press instead.

In the original project, 60 ram presses were sold in 40 villages in the Arusha region between January 15, 1986 and December 30, 1989. Progress was slow at first as the technology was still being refined and farmers were unaware of its existence and
benefits, but the rate of dissemination grew steadily. In the first year, just 6 presses were sold, but the number sold per year rose to 13 in 1987, 15 in 1988, and 26 in 1989. Another 14 presses were sold in Arusha in the first half of 1990 after the original project ended and attention was directed to dissemination in two other regions, Iringa and Singida, in the follow-on project.

Production records have been kept for the first 60 ram presses sold in the Arusha region. In the processing season that ran from July 1989 through June of 1990, owners of these presses produced over 106,400 l of sunflowerseed oil. Eight of these presses are owned by communal groups such as churches, schools, or village administrations. The seven communally owned presses in operation for a full processing season production between 168 and 1,694 l of oil in the 1989-90 season; the average production was 1,070 liters. One of the communally owned presses was only obtained after the processing season was well underway. A press purchased in 1986 by a church group was not used last season as the missionary responsible became involved in other things.

The individually owned presses are being utilized at a higher capacity use rate than those owned by groups. The 38 presses operated by individual families or partnerships for a full processing season produced from 128 to 6,260 l in that year and the average was nearly 2,440 liters. Eleven of the individually owned presses had been purchased after the peak production period had passed and two of the presses obtained earlier were not in use that season. One of the individually owned presses in disuse was purchased by a missionary in an area where agricultural conditions are poor and little sunflowerseed is grown and the local people are mainly Masais who are not culturally inclined to intensive agriculture. The other press that was not being used is owned by a businessman who is too busy with other commercial interests to manage a micro-enterprise for edible oil extraction.

The ram press is a durable and robust design for village use. As of mid-1990, all of the presses sold in Arusha are in working order, including the three that have not been used in the past year. Some of the earliest presses manufactured were not made well, but users have been able to get repairs done locally at a relatively minor cost.

The 60 producers in Arusha are involved in sunflowerseed oil extraction an average of 8.5 months per year. In this region, sunflowers are planted from February to March and harvested from July through September. The peak months for processing sunflower are August through November, with more than 10% of the annual total in each of these months. In March and April, less than 5% of the annual production of oil is processed per month. There is little or no production in May and June.

A total of 52 loans were made to press buyers in the Arusha region through the original project. Loan repayment rates have been high due to the profitability of the technology. Only one recipient of a loan from this project has failed to repay the debt;
however, 15 presses had to be temporarily repossessed before the pressing season to obtain timely repayments. This does, however, show the importance of taking a serious approach to loan collection.

No interest was charged on the six-month loans to farmers on the grounds that the funds were just going to end up in the church accounts. Alternatively, the project could have been structured to establish a revolving credit fund for replication of the technology outside the original target area.

The press owners have expanded their own planting of sunflower and provided a market for sunflower seeds grown by other local farmers. Farmgate prices of soft-shelled sunflower seed have risen faster than the rate of devaluation of the currency. As a result, the amount of sunflowerseed grown in the Arusha region increased four-fold from 1986 to 1989 and there has been a nearly complete shift to the soft-shelled variety with a high oil content that is best used with the ram press (Schlueter 1990).

Survey Findings

A survey was conducted of the owners of 24 of the 60 presses sold in the Arusha region through the original project between January 15, 1986 and December 30, 1989. The sample consisted of 15 individually owned enterprises, 2 partnerships (one with 2 presses), and 5 group-owned enterprises. Two of the individual enterprises owned 2 of the presses. The sample included 7 presses of the original design, 13 of the Bielenberg-Fisher design, and 4 of the CAPU model. Thirteen of these presses were manufactured by Nand Singh Co., 6 by Themis, 4 by CAPU, and 1 by United Engineering. Three-quarters of the respondents obtained loans through the project to buy presses and the rest paid cash.

The owners of the individual enterprises or partnerships had the following characteristics. All were male and their ages ranged from 28 to 59 years, with an average age of 39. The respondents had between 0 and 14 years of education, with an average of 8 years. About two-thirds of the sample reported other occupations in addition to farming and processing sunflowerseed oil. Their household sizes spanned from 1 to 12, averaging 7 persons. Over half of the owners were of the Iraqw tribal group; other tribes represented included Chagga, Mpare, Haya, Meru, and Arusha. Nearly two-thirds were Lutherans and the rest were Moslems or Catholics.

The group enterprises included a Catholic boarding school with 320 students and 17 teachers, another Catholic boarding school with 640 students and 30 teachers, a Lutheran boarding school with 320 students and 18 teachers, a village with 2,500 residents, and a Lutheran church young adults group with an undetermined number of members in the parish. The predominant tribal group was also Iraqw. Three of the group enterprises had a hired manager, one is run by a Norwegian volunteer, and 1 is managed by a committee.
Before the project, the value added in processing sunflowerseed was not captured locally. Prior to purchasing a press, 42% of the sample did not grow sunflowers at all and 50% sold sunflowerseed unprocessed. The farmers who previously sold sunflowerseed formerly grew other varieties with hard shells. Farmers sold seed unprocessed to the cooperative unions, which resold them to parastatals in another region that produced the oil using large-scale technology. These farmers complained that the cooperative unions were not dependable purchasers and there were often delays in payment of up to 3 months after delivery. They also had to transport the seed to local "primary societies" for sale; the median distance was 2 kilometers. Several reported that they had paid $0.26 per bag to transport their seed to the primary societies, although others used oxcarts at no cash cost.

The traditional process of sunflowerseed oil extraction consists of the following steps: First, the seed is roasted for 5-10 minutes. While, the seed is still warm, it is pounded in a mortar with a pestle until a fine flour is produced. The flour is placed in a drum of water and heated for 3-4 hours until drops of oil accumulate on top. This oil is skimmed off with a ladle. Then, the oil is reboiled for 15 minutes to evaporate the water. With this method, one woman can process 9 kg of sunflowerseed in 4 days. It also requires a large amount of fuelwood.

In the Arusha region, few people process sunflowerseed by the traditional method. Only 2 of the press owners there (both located in Endakiso) had previously used oil by the traditional process. One of them had found out about this method in Iringa and the second learned it from the first. One woman who previously used the traditional process said, "I am glad I do not have to do it that way anymore". In part of the target area of the follow-on project, sunflowerseed oil is extensively produced by the traditional process.

All of the enterprises surveyed produce cooking oil for their own use. Except for one of the schools which does not have a surplus, all sell oil for cash. About four-fifths of the enterprises also sell the byproduct seed cake; less than half sell all or most of it. The others use seed cake to feed their own animals and one used it as mulch for crops. More than half use all or most of their seed cake themselves. Only a small portion of the seed cake gets wasted.

The seed cake is most often used as a feed for cows, goats, and pigs and less frequently for poultry. It is often mixed with maize bran and sometimes with molasses, cucurbits, beer malt, or table scraps. There is anecdotal information that milk production increases when malnourished cows are fed the seed cake.

All but 4 of the owners of the 24 presses grow some of their own seed, but only 2 grow all of the seed that they process. On average, the press owners grow 36% of their seed requirements themselves. This provides a substantial market for the produce of other farmers in the area who cannot afford or manage a pressing
enterprise. In fact, many of the press owners reported that they would buy and process much more sunflowerseed if they had sufficient working capital to purchase it. A few stated that they buy all of the seed offered to them locally.

The press owners that grow some of their own seed have between 1 and 40 acres in this crop; the average area that they have planted in sunflowers is 9 acres per press. One press owner decided not to plant any this year because he had low yields last year due to bird predation. All of the press owners that grow sunflowers are currently planting the black record variety, which has a soft shell and high oil content.

All of the press owners who grow sunflowers increased the area they devoted to this crop after obtaining a press; the average increase was 7 acres. One respondent rented additional land for sunflowers at a cost of $7.80 per acre per growing season. The increase in sunflower plantings has largely been at the expense of maize and bean cultivation. In 1989, the parastatals failed to buy any maize, the major crop in the area, from farmers.

At present, three-quarters of the press owners that grow sunflowers have them in pure stands. This is a change from earlier in the project when interplanting of sunflowers with beans was more typical. Reported yields of the black record variety in pure stands ranged from 4 to 15 bags per acre, with an average of 8 bags. When interplanted, respondents obtained yields of 2.5 to 8 bags per acre with that variety, and the average was 5.5 bags per acre. The lowest yield reported was due to heavy predation by birds. Bird predation is usually less of a problem where there are extensive stands of sunflowers in the same area. The hard-shelled varieties reportedly have a slightly lower yield of seed. The shift in cultivation from other crops to sunflower and the reduction in the interplanting of sunflowers in favor of pure stands are indications of the change in the relative value of this crop.

Almost two-thirds of the seeds pressed by the respondents are purchased from other farmers. Sunflowerseed is sold by volume in bags that contain approximately 50 kilograms. In the most recent month, the beginning of the sunflower harvest season, 88% of the press owners purchased some sunflower seeds. The amount purchased by the enterprises that buy sunflowerseed ranged from 3 to 72 bags for the month and averaged 26 bags. Last year, these press owners bought between 22 and 322 bags of seed; the average amount was 149 bags. Several press owners have established informal contract growing agreements with local farmers, guaranteeing to buy all of their sunflowerseed harvest at a certain minimum price and sometimes providing planting seeds of the black record variety.

Most press owners are currently paying $5.20-$6.20 per bag of black record seed. After the peak harvest season is over, the price goes as $7.80-$10.40 per bag of black record. Some press owners buy enough during the peak harvest season to meet their anticipated production for the year. However, many are unable to
do so because of limited working capital and lack of storage space and consequently have to pay the higher prices later in the year. Only 2 of the press owners buy hard-shelled seed and they pay a lower price for it -- $4.66 per bag on average.

In comparison, the government buying price per bag of sunflowerseed of any variety was $4.50 in 1989 and it was set at $4.92 for the 1990 harvest. The government prices are theoretical because most of the cooperative unions did not have money to buy any crops last year or this year as they have lost their overdraft privileges. As a result, the large-scale parastatal factories in Morogoro and Mwanza have not been producing sunflowerseed oil.

During the pressing season, the enterprises operate from 4-7 days per week; the average is 5.5 days per week. The number of hours of operation per day ranges from 5 to 12, with a mean of 7. For the most part, hired labor is used to operate the presses. Only 5 of the enterprises regularly use unpaid household labor for this task and just one uses household labor exclusively. One of the schools relies on unpaid student labor. Most of the hired labor is done by young males working part-time. The part-time work is less fatiguing, maintains productivity, and does not conflict with the laborers' schooling or other agricultural responsibilities. The enterprises generally employ between 2 and 6 part-time workers to operate the press; the average number is 3. Some enterprises also hire a full-time manager.

Most of the enterprises pay a piece-rate wage, varying from $0.08- $0.16 per liter of oil produced. The average wage is $0.12 per liter produced. Most of the group enterprises pay less, about $0.04 per liter because they can obtain student labor or church labor on a semi-volunteer basis. Since one worker can press a bag of sunflowerseed in 5 hours, the piece-rate wages most commonly paid yield earnings of $0.91-$1.37 per day. Sometimes labor is hired to clean the seed at a piece rate of $0.16-$0.26 per bag. Where full-time managers are employed, they are paid $15.50-$24.50 a month.

About seven-eighths of them do service pressing for other farmers. The number of people from other households served by a press ranges from 2 to 50, averaging 12. Both men and women take advantage of pressing services and the work is done by the regular hired laborers, rather than the customer. In most cases, a share of the oil is left as payment instead of cash. The service pressing fee varies with the degree of local competition. Where there are a relatively large number of presses in an area, the fee is one-quarter to one-third of the oil extracted. The fee is often half of the oil where the density of presses is lower compared to the demand for the service. Two-thirds of the providers of service pressing allow the customers to take the seed cake if they want it, while the rest retain the cake for sale or personal use.

In the most recent month, the respondents who offered pressing services reported that the amount of oil they received in service fees ranged from 3 to 139 l; the average was 40 liters. Last year,
the estimated receipts from service pressing were between 10 and 8081 of oil, averaging 171 liters. Most often, this in-kind fee is collected by an adult woman in the household, but in many cases it is collected by an adult man. Less frequently, it is collected by hired laborers or managers.

The producer price of sunflowerseed oil varies by location even within the Arusha Region. In July of 1990, the bulk price in 20 l tins ranged from $0.91 to $1.55 per liter, and averaged $1.22. It also varies seasonally with the supply. The average maximum producer price in bulk over the past year was $1.44 per liter, ranging from $1.04 to $1.81. The prices are highest from February to May. The average minimum bulk price was $1.02 per liter and the range was $0.83-$1.30. The prices are lowest from July to October.

Bulk buyers commonly include hotels, restaurants, prepared food vendors, schools, and hospitals. Less often, press owners sell to middlemen. In July of 1990, middlemen typically resold sunflowerseed oil at $1.40 to $1.55 per liter. About two-thirds of the time, the bulk buyer was responsible for transport costs. When the seller has to bear the transport costs, the average cost was minimal -- $0.03 per liter. The buyers either have to supply their own tins or return those provided by the seller. Empty 20-l tins originally used for palm oil sell for $1.30.

One-third of the producers sell at least a portion of their sunflowerseed oil directly to households in containers of 1 liter or less. In July 1990, most of the producers who sold retail quantities charged $1.55 per liter. Usually, these customers were neighbors and relatives. None of the producers interviewed sold the majority of their output directly on the retail market.

A market has developed for animal feed from the seed cake left over after oil extraction. The price of the seed cake varies in different places from $0.52 per bag to $2.59 in July of 1990; in most places it was $1.04. However, this price does not usually vary seasonally. Generally, the buyer is responsible for transporting the seed cake from the press site. In some areas, press owners noted that there are only a few buyers for this byproduct, although they do not have much difficulty selling it. Gradually, more people are getting used to this new animal feed.

It is recommended that the presses be lubricated daily. Most press owners are lubricating the presses, but only one-fifth of them are doing so on a daily basis. The usual frequency of lubrication is one to three times per week. About one-third are using motor oil, one-third use grease, and one-third just use sunflowerseed oil. One respondent relied on used motor oil and another preferred sewing machine oil. Since grease stays in place better than motor oil, it is less likely to contaminate the edible oil. Motor oil costs $2.60-$3.10 per liter while grease sells for $3.10-$4.10 per kilogram. The opportunity cost of using sunflowerseed oil is its selling price of $0.91-$1.44 per liter. Most press owners report that a container of motor oil or grease lasts for a full processing season.
Nearly all of the press owners have had to get minor repairs done each year. Some of this was due to normal wear and tear, but a sizable number of the cases were due to misuse by workers. In general, these repairs were done at local workshops, usually within 5 km of the press site. Only one-fifth of the respondents had to travel 20 km or more to have repairs done. Typically, the repairs were done in a day or 2-3 days at most.

In most cases, the repair costs were between $10.00 and $26.00 per year at current prices. The kinds of repairs necessary depend on the age of the press and the specific version. With the original model, the parts that have needed repairs or replacement most often include the rods at about $7 each, the sleeve at $10-$29, and the piston at $23. The B-F model was prone to breakage of the handle, which required welding at $2-$9 per time. Other minor problems have included replacement of the adjustment cone support at $3-$10, repair of the sleeve at $3-$21, filing of pivot pins at $10, bulging of the cage bars at $6-$8, and bolts and bearings at $1-$3. Owners of the CAPU model have had to replace the sidebar support bolts at $6 and fix the metal support for the piston at $3. Jamming of the sleeve and some other minor problems have been corrected by project staff.

Since the largest number of presses in the sample were of the B-F design, the total reported incidence of repairs for this model was greater. However, for the most part, the B-F model is less fragile than the original design because it was engineered to compensate for user abuse. The respondents have reported fewer repairs of the CAPU design so far because these presses are newer and there were not as many in the sample. The durability of the press was an important issue in the beginning, but at this point it has been shown that the costs and difficulty of having repairs done are at an acceptable level. It might not be desirable to try to reduce the expected repair costs further through design changes that would significantly increase the purchase price of the press.

Users are generally quite satisfied with the ram press, regardless of which model they own. Many of the press owners have seen other models of the press. Owners of the original version perceive it to be durable and find the extraction rate relatively high due to the higher pressures achieved. The main complaint about the original version is the level of effort needed. Several owners suggested improving the rods so they do not snap as easily and strengthening the sleeve.

The B-F model is well liked. It is easier to operate and requires less effort than the original version because the handle is longer and does not have to be pulled back as far. As a result, the workers do not have to bend as much. Two workers can operate the B-F press at once to reduce the effort needed, but it can also be used by one worker if the adjustment cone is kept looser. However, decreasing the pressure also lowers the extraction rate. In fact, several press owners placed a large stone on the handle to increase the pressure, which makes the work harder but more productive. Rapid wear of the pivot pins and side supports was
cited as a problem. Also, the base shifts when the handle is pulled and separating the press from the base caused the handle to break.

Owners like the CAPU press because it can easily be operated by one person since it is smaller and lighter. A common problem with the early CAPU press was that the piston got stuck in the sleeve. This has subsequently been corrected by drilling holes in the sleeve and strengthening it.

Many of the press owners are building new houses or buying more land or livestock. Others have used the increased income for working capital to buy more seeds to press. Some are using part of their profits to pay school fees for relatives outside their immediate household. Press owners may also gain intangible benefits from running a successful micro-enterprise such as greater confidence and self-reliance.

Three of the 24 press owners said that they would like to buy an additional ram press within the next year. Two more hoped to buy a motorized expeller to expand their scale of operations; however, both greatly underestimated the cost of a new expeller. An imported expeller is more suited for a medium-scale producer than a micro-enterprise. A small-scale expeller made in India costs over $4,150 excluding tariffs and transport from the port of Dar es Salaam. There are at least four expellers in the project area, but none are in working order.

On average, the individual press owners reported that their household consumes one-third of a liter of sunflowerseed oil per person each week. Most stated that their consumption of cooking oils had gone up substantially after they began production of sunflowerseed oil; but several noted no change in their own consumption of oil. Tanzania may be somewhat atypical because of the extreme scarcity of cooking oils just before the project began due to previous government policies. Since then, Tanzania's macro-economic policies have changed; now imported palm oil and mixed vegetable fat shortening are readily available.

All of the respondents preferred the taste of sunflowerseed oil over most of the domestic or imported alternatives. One stated that, in his area, restaurants and hotels have to use sunflowerseed oil to please their customers, especially for cooking chapatis. A local hospital buys sunflowerseed oil because it is high in polyunsaturated fats. Some people do not like artisanal sunflowerseed oil if it is poorly clarified.

Refined, bleached, and deodorized palm oil under the brand name Korie is imported from Southeast Asia. Most people in the Arusha region do not like it very much. One respondent said palm oil has a "heavy taste that irritates the throat". People do buy palm oil because it is cheaper and some mix it with sunflowerseed oil to reduce its taste. Palm oil costs between $1.09 and $1.55 for a liter. When purchased in 20-l containers, consumers get a free re-usable metal tin that can be re-used or resold. Vegetable
shortening under the brands Kowboy and Kimbo is imported from Kenya. The price of shortening ranges from $2.07-$2.59 per kilogram in 1.0 or 0.5 kg containers.

The domestically produced alternatives include ghee, lard, cottonseed oil, and groundnut oil. Some of the respondents did prefer ghee over sunflowerseed oil. However, most ghee is produced locally for subsistence consumption and only small quantities of it are marketed. Ghee is only available seasonally (January through May). When it can be found, ghee sells for an average of $1.74 per liter and the price ranges from $1.46 to $2.55. Lard is the least preferred cooking fat in the Arusha region. A liter of lard costs an average of $1.03, with a range of $0.73-$1.46, in used beverage containers that hold 0.71 liters. Groundnut oil is only rarely available in this part of the country and sells for about the same price as sunflowerseed oil. Cottonseed oil is cheaper, costing between $0.99 and $1.16 per liter in 20-1 tins, but it too is infrequently marketed in the Arusha region.

The nutritional impacts of increased consumption of edible oils in the diet depend on the previous level of fat consumption and the rest of the diet. Since press owners are not generally the poorest of the poor, most would now have access to alternative cooking oils and fats. Insufficient information is available to judge whether there are any nutritional benefits from increased oil consumption within producer households. However, sunflowerseed oil may be better for the health than the heavily saturated alternatives of palm oil or shortening. There might also be nutritional benefits to producer households from income gains that allow an increase in the food budget for greater diversity and protein in the diet. If the increased supply of sunflowerseed oil reduces consumer prices of this product, there could well be nutritional benefits for low-income households that would otherwise consume insufficient quantities of oils and fats.

Financial Analysis

A financial analysis was conducted based on data from mid-1990. The analysis assumed use of the CAPU press at the average level of commercial production of the 45 active producers in the Arusha region in operation for a full season or more. The average level of service pressing was taken from the survey of the 24 press owners. The financial analysis was also carried out for a high production scenario and a low production scenario. The high production scenario consists of commercial pressing of 33% more seed than the average throughput as well as 29% more service pressing. The low production scenario assumes 33% less commercial pressing and 29% less service pressing than the average. The average production scenario makes the conservative assumption of 12 liters of oil per bag of the recommended seed variety, whereas the yield is assumed to be 14 l/bag in the high production scenario and 10 l/bag in the low production scenario. The yield of seedcake is inversely proportional to the yield of the higher-value oil. The oil loss in clarification ranges from 3% in the high production
scenario to 4% in the average production scenario and 5% in the low production scenario.

A sensitivity analysis was also done on the effects of paying higher or lower than average raw material prices for seed to press as well as the receipt of higher or lower prices for the main product, cooking oil. The analysis was conducted both with and without hypothetical loan financing at a commercial real rate of interest. Table 1 summarizes the above assumptions and the rest incorporated in the commercial analysis. The net present value was calculated at three real discount rates, 10%, 15%, and 20%.

Table 2 contains the results of the financial analysis. The net present value is positive under all of the scenarios except the one in which low production is combined with a high seed price and a low product price. Except for two other cases besides the unprofitable one, the payback period is less than 1 year. The payback period is under 2 years for the average production/high seed price/low oil price case, and less than 3 years for the low production/average seed price/low oil price case. The inclusion of commercial financing made hardly any difference in the commercial viability; for example at the 15% discount rate the financing increased the net present value from $5,500 to $5,520.

The two assumptions that made the most difference in the sensitivity analysis were the production level and the product price. A change in the seed price had a much smaller effect on the net present values. All three of the production levels are reasonably likely for producers operating at different capacity use rates. However, it is less likely that the positive and negative extremes of (1) low seed prices with high oil prices or (2) high seed prices with low oil prices will occur because these prices tend to move in the same direction in the absence of government intervention.

Replication of the Technology

A follow-on project to extend dissemination of the ram press to two other regions of Tanzania began in January of 1990. It is being implemented through the parastatal Small Industry Development Organization (SIDO) with funding from Lutheran World Relief, Appropriate Technology International, and P.L. 480 funds provided by U.S. AID to the Tanzanian Government. The objectives of this project are to:

- Establish 150 village oil production units including 50 in the Singida Region, 50 in Iringa Region, and 50 in neighboring regions. These production units are expected to yield 250,000 l of edible oil and 500,000 kg of enriched animal feed supplement and generate part-time employment.
TABLE 1. Assumptions for the Financial Analysis

Production Scenarios:

A. Average Production  
B. High Production  
C. Low Production

Annual throughput -- A: 200 bags; B: 266 bags; C: 133 bags  
Service pressing per year -- A: 42 bags; B: 54 bags; C: 30 bags  
Yield of oil -- A: 12 l/bag; B: 14 l/bag; C: 10 l/bag  
Yield of seedcake -- A: 39 kg; B: 37 kg; C: 40 kg  
Oil loss in clarification -- A: 4%; B: 3%; C: 5%

Assumptions That Are The Same in All Scenarios:

Capital Costs  
Press -- $337 (expected lifetime = 10 years)  
Used metal drums (1 at $30; expected lifetime = 2 years)  
20-1 tins (10 at $1.55; expected lifetime = 3 years)  
Wage for cleaning seed -- $0.21/bag  
Wage for pressing -- $0.12/1  
Fuelwood cost per batch -- $0.26/bag  
Lubricant cost per year -- $8.20  
Repair cost per year -- $26.00  
Transport of oil -- $0.05/l  
Transport of seedcake -- $0.00/bag  
Service pressing fee (share of the oil) -- 33%  
Service pressing fee (share of the cake) -- 50%  
Price of seedcake -- $1.04/bag

Sensitivity Analysis of Key Prices:

Seed price -- Average: $6.22/bag; Low: $5.18/bag; High: $7.77/bag  
Price of oil -- Average: $1.22/l; Low: $0.91/l; High: $1.55/l  
Inclusion of hypothetical financing -- 80% of press costs; no grace period; 2-year repayment period; 5% real interest rate  
Discount rates for each scenario: 10%, 15%, and 20%
Table 2. Results of the Financial Analysis

<table>
<thead>
<tr>
<th>Scenario</th>
<th>10%</th>
<th>15%</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average production w/average prices</td>
<td>7,120</td>
<td>5,500</td>
<td>4,350</td>
</tr>
<tr>
<td>Average production w/financing</td>
<td>7,130</td>
<td>5,520</td>
<td>4,380</td>
</tr>
<tr>
<td>Average production w/high seed price</td>
<td>5,380</td>
<td>4,140</td>
<td>3,270</td>
</tr>
<tr>
<td>Average production w/low oil price</td>
<td>2,840</td>
<td>2,160</td>
<td>1,670</td>
</tr>
<tr>
<td>Average production w/high seed price &amp; low oil price</td>
<td>1,110</td>
<td>800</td>
<td>590</td>
</tr>
<tr>
<td>Average production w/low seed price</td>
<td>28,280</td>
<td>6,410</td>
<td>5,080</td>
</tr>
<tr>
<td>Average production w/high oil price</td>
<td>11,670</td>
<td>5,060</td>
<td>7,200</td>
</tr>
<tr>
<td>Average production w/low seed price &amp; high oil price</td>
<td>12,830</td>
<td>9,960</td>
<td>7,920</td>
</tr>
<tr>
<td>High production w/average prices</td>
<td>12,960</td>
<td>10,070</td>
<td>8,010</td>
</tr>
<tr>
<td>High production w/high seed price</td>
<td>10,660</td>
<td>8,270</td>
<td>6,570</td>
</tr>
<tr>
<td>High production w/low oil price</td>
<td>6,280</td>
<td>4,840</td>
<td>3,820</td>
</tr>
<tr>
<td>High production w/high seed price &amp; low oil price</td>
<td>3,970</td>
<td>3,040</td>
<td>2,380</td>
</tr>
<tr>
<td>High production w/low seed price</td>
<td>14,510</td>
<td>11,270</td>
<td>8,970</td>
</tr>
<tr>
<td>High production w/high oil price</td>
<td>20,080</td>
<td>15,630</td>
<td>12,460</td>
</tr>
<tr>
<td>High production w/low seed price &amp; high oil price</td>
<td>21,630</td>
<td>16,840</td>
<td>13,430</td>
</tr>
<tr>
<td>Low production w/average prices</td>
<td>2,910</td>
<td>2,210</td>
<td>1,720</td>
</tr>
<tr>
<td>Low production w/high seed price</td>
<td>1,760</td>
<td>1,310</td>
<td>1,000</td>
</tr>
<tr>
<td>Low production w/low oil price</td>
<td>550</td>
<td>370</td>
<td>240</td>
</tr>
<tr>
<td>Low production w/high seed price &amp; low oil price</td>
<td>(600)</td>
<td>(530)</td>
<td>(480)</td>
</tr>
<tr>
<td>Low production w/low seed price</td>
<td>3,680</td>
<td>2,820</td>
<td>2,200</td>
</tr>
<tr>
<td>Low production w/high oil price</td>
<td>5,420</td>
<td>4,170</td>
<td>3,290</td>
</tr>
<tr>
<td>Low production w/low seed price &amp; high oil price</td>
<td>6,190</td>
<td>4,780</td>
<td>3,780</td>
</tr>
</tbody>
</table>
Promote the cultivation of soft-shelled varieties of sunflowerseed with a high oil content.

Establish a local capacity for manufacturing the press in Singida and Iringa.

Collaborate with local and national organizations in Tanzania that are interested in this technology.

Emphasize establishment of village oil production units owned and managed by women who are producers of sunflowerseed.

This project is encouraging ram press production by multiple manufacturers by providing them with training courses on the design principles and fabrication techniques, which include actual construction of presses. So that the training can be put into practice promptly, the project places an order with these firms soon after completion of the training if reasonable price quotations are given. The new producers include SIMAC in Singida, Marare in Iringa, Muhumula in Iringa, Zana Za Kilimo in Njombe, and Azimio in Arusha.

Contacts are being made with organizations interested in assisting women's groups to obtain the press. So far, orders on behalf of women's groups have been placed by the Lutheran Diocese of Iringa and the Maryknoll Sisters. Use of the press is being demonstrated by both women and men at local cooperative offices, trade shows, and agricultural expositions. Handouts have been prepared describing the press, cultivation and harvesting techniques for sunflowers, and the organization of women's groups for oil extraction.

The context for the project is different in the new target areas. Sunflower is a more important crop in the Singida and Iringa Regions than in the Arusha Region and there is a longer tradition of growing it. There are few organizations working with villagers and few established women's groups in the Singida Region, although many exist in Iringa Region. As in Arusha, the traditional process of sunflowerseed oil extraction is rare in Singida, but it is common in Iringa. Since Singida is a semi-arid area with scarce fuelwood resources, the traditional process is less practical. Iringa has extensive forests although deforestation is proceeding rapidly. Government forestry officials are interested in the potential of the press to reduce fuelwood requirements in sunflowerseed oil extraction there. Planting and harvesting times for sunflower also differ in the new project areas. Sunflower is planted in December or January in Iringa and January or February in Singida. The harvest time is May through July in Iringa and June through August in Singida.

The benefits have already begun spreading to other regions of the country. By the end of June 1990, a total of 262 ram presses had been produced in Tanzania as a result of the first project, the first six months of the follow-on project, and spontaneous
replication both within and outside the project areas. Of these presses, 209 had been sold and 53 were still in inventories of the manufacturers or distributors at that time. Areas besides Arusha with concentrations of ram press sales include Morogoro (36), Singida (31), Kilimanjaro (14), Iringa (12), Tanga (12), and Dodoma (6). So far, 9 manufacturers in four of Tanzania's twenty regions have sold ram presses, and another three have made 1 or 2 prototypes.

Ten of the ram presses made in Tanzania have been sold to buyers in seven other countries: Zambia, Rwanda, Kenya, Zimbabwe, Sudan, Gambia, and the United Kingdom. Ram presses are also being made in Zimbabwe with support from another ATI project.

Conclusions

There is a high degree of consumer satisfaction with all versions of the press. The presses are being used at a high and increasing rate of utilization. Individually owned presses are generally being used more intensively than group-owned presses. Press owners report having had only minor mechanical problems, but have had little difficulty in getting the necessary repairs or spare parts done locally and at minimal cost. A market has also emerged for sale of the seedcake as animal feed.

The amount of sunflower grown in areas with small-scale pressing enterprises increased sharply as a result of higher producer prices and the emergence of a reliable local market. Furthermore, a major shift in the variety of sunflower planted from the hard-shelled types to a soft-shelled variety that is most easily processed with the ram press has been accomplished with little difficulty.

Press owners report substantial increases in their incomes as a result of the machine, in amounts well in excess of typical urban salaries. These observations are confirmed by the financial analysis. At average, high, and low levels of commercial and service pressing, this technology is quite profitable under realistic assumptions for input and product prices.

Service pressing is a common practice that spreads the benefits of the technology to other local farmers who do not own a press themselves. The labor-intensive ram press technology also provides benefits to the hired operators, most of whom are young men hired on a flexible, part-time basis. Women household members are generally involved in clarifying the oil and often in marketing the oil or overseeing service pressing operations. Some women who prepare fried foods for sale also benefit by having more regular supplies of cooking oil. The issue of nutritional benefits from increased consumption of sunflowerseed oil requires further investigation.

Nutritional benefits from increased consumption of vegetable oil may be more significant for low-income consumers than for the
producer households because most press owners can afford to buy other imported cooking oils and fats, which are currently available in the country. There may be other nutritional benefits to producer households where income gains allow the food budget to be increased.

Some more general lessons about the design of technology transfer projects have also been learned from this experience. The project design placed too much reliance on assistance to a single manufacturer. The subsidies provided to that manufacturer did not prove to be necessary for other producers. In fact, the first manufacturer to actually begin commercial production of the ram press received no subsidies at all. By the time that the follow-on project in two other regions of the country has been completed, it is likely that the ram press technology will be well-established enough so that it can continue to spread on its own through market forces. As a result, a major transformation of the edible oils sector in Tanzania is anticipated.
BIELENBERG RAM PRESS OPTIMUM SETTINGS
AND
OPERATING PROCEDURES

by

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Paper Presented at
THE BIELENBERG PRESS CONFERENCE

Organized by
APPROPRIATE TECHNOLOGY INTERNATIONAL
Nairobi, Kenya
10-11 September, 1990
ABSTRACT

Bielenberg Ram Press Optimum Settings and Operating capacity with Sunflower, Simsim and Groundnut.

The Rural Oilseed Processing Project (ROPP), an Egerton University/IDRC sponsored project, started tests in June 1990 to determine the optimum operational settings and capacity of the Bielenberg ram press. The model used was the Allen/Amen sigh modification. Oilseeds used in the tests were sunflower, simsim (sesame) and groundnut (peanuts).

The optimum settings tested were: choke position, number of strokes to achieve steady operation, rest period at end of each stroke and piston position in cylinder or length of draw bar. Operational capacity was determined with sunflower seed only. Optimum choke positions obtained in the tests were: sunflower 3.8-3.9 cm (5 1/2-5 1/4 threads); simsim 4.1-4.2 cm (4 3/4-4 1/2 threads); groundnut 3.9-4.0 cm (5 1/4-5 threads). Number of strokes to reach steady operation was 67 for sunflower, 45 for simsim and 69 for groundnut. Optimum rest period was 2-5 seconds, giving a stroke frequency of 5-6 strokes/min. Five piston positions or draw bar lengths were tested, but none of them showed a clear cut advantage in extraction efficiency or effort required. However, it was observed that the handle was heavier on the return stroke when draw bar lengths were 69 and 71.5 cm, but throughput was highest at these positions.

When the draw bars were shortened to 68.2 and 67.4 cm, there was a back flow of oil into the cylinder. There was a slight decrease in extraction efficiency when draw bars were 67.4 cm long. Throughput was lower at these positions because of a lower rate of feed into the cylinder per stroke. The piston position recommended in view of these observations is achieved when draw bars are 68.2 to 69 cm long.
Introduction

Over the last 3-4 years since it was designed and fabricated in Tanzania by Carl Bielenberg, the use of the ram press has spread to many areas in the Central and East Africa region. The first ram press in Egerton was acquired from Tanzania in 1988 under an IDRC/Egerton University-supported project. Later in 1989, another press with modifications by Hugh Allen was loaned to the project to carry out tests. We worked with these models to gather preliminary information on operational procedures and carry out field introduction to gather farmers reaction. This information will be presented as part of Egerton University Vegetable Oil/Protein System program (VOPS) working paper series.

Information presented in this paper was generated as part of a bigger project, the Rural Oilseed Processing Project (ROPP), sponsored by IDRC. Some of the tests were designed with input from Appropriate Technology International (ATI). The ROPP project will start by generating a Technological Package which will include information on: (1) ram press optimum settings, operational procedures, adjustments, maintenance, etc, (2) simple methods for the filtration of oil that can be fabricated by local "Jua Kali" artisans, (3) appropriate methods for the utilization and storage of oil, (4) proper methods for preparation and feeding of cake and (5) economic implications of a ram press based enterprise. This technological package of hardware (ram press) and software (supporting information) will be introduced to farmers and traders during field visits.

The first comprehensive information on the ram press was put together by Hugh Allen of CARE International, Nairobi in May 1989. His manual on the Bielenberg ram press presents information on seed preparation and operation, maintenance and manufacture of the press. However, some of the information on seed pretreatment, performance, and maintenance requirements for the press were based on tests that were not exhaustive enough. Some of the tests were done by Hugh Allen in conjunction with the ROPP team at Egerton University. No tests were carried out on the optimum settings of the ram press or its performance with different types of seeds. In order to generate this information, tests detailed in this paper were carried out at Egerton University by the Rural Oilseed Processing team.
Materials and Methods

Equipment

The following is the list of equipment used in these tests:

1. Ram press (Bielenberg - Allen modification) with two cages - sunflower cage with size of cage bar openings (slots) averaging 0.55 mm and simsim cage averaging 0.4 mm. Range of the size of cage bar openings was 0.1-1.0 mm for sunflower and 0.1-0.7 mm for simsim.
2. Stopwatch
3. Balance (accurate to 0.1 g)
4. Graduated cylinders
5. Oil containers
6. Seed and cake containers
7. Fanning mill (air and screen) seed cleaning machine
8. Air oven

Procedure

1. Seed characterization

Seed purchased for use in the tests were characterized using the following parameters:

1. Moisture content (MC): Determined by drying ground seeds in an air oven at 103 degrees centigrade for 2 hrs.
2. Percent foreign materials: A 250 g sample was placed at the top of a set of sieves and shaken using a Ro-Tap (shaker) machine for five minutes. Materials equal in size to the seed were hand picked.
3. Oil content: Determined by solvent extraction using petroleum ether.
4. Bulk density: Determined by weighing a sample of seed in a one liter container.
5. Percent by weight of kernel and husk: This was determined for sunflower and groundnut by shelling 100 g of seed by hand.
6. Other information noted included: Location where seed was grown, harvest season, and variety (where possible).

Details of the procedures followed in determining the above parameters are shown in appendix B, with sample calculations for sunflower. Where MC was high (>=10%), the seeds were dried in the sun to a MC of 6 - 8% before extraction. In the case of rapeseed, the seed was only characterized.
2. Rate of filtration through different materials.

A 0.5 HP suction pump was used in filtering sunflower oil at room temperature of about 20°C. The filtering materials used were a 0.7 micrometer filter paper, cheese cloth and ordinary khaki paper. A given amount of oil was poured into the funnel with the filter material. The time it took the oil to filter through was then recorded.

3. Optimum Ram Press Settings and Operating Conditions.

The optimum ram press settings and operating conditions were defined as conditions at which there was a balance between extraction efficiency and corresponding ram press performance parameters such as effort required to operate, throughput, and percentage of footings in the oil. Optimum settings and procedures determined were:

1. Choke position.
2. Number of strokes necessary to attain steady state operation.
3. Length of rest period at end of each stroke.
4. Piston position in cylinder and the corresponding length of draw bars.

Seeds used in all tests was cleaned with a Fanning Mill (air and screen) seed cleaning machine and warmed in the sun for at least 30 minutes.

3.1 Determination of optimum choke position at which extraction efficiency was high but effort required to operate not excessive.

This was the first setting determined and all other settings and operating procedures were determined at optimum choke position. Five kilograms of seed were pressed in order to get the material moving steadily through the press. The tests were then carried out with choke set at six different positions from nearly closed to open. At each position, one kg of seed was pressed, with three replications in each case. Choke position was measured in terms of the length of the choke tail piece from the choke bracket and also in terms of number of exposed threads on the opposite side (opposite the tail piece).

3.2 Determination of time and number of strokes after pressing started for ram press to reach steady operating condition.

This condition is attained when no further adjustment of the choke is necessary. Operation of the ram press starts with the choke screwed in to completely close the cage opening. As the pressure builds up, the choke is screwed out when the effort required becomes excessive. A position is eventually required where cake steadily comes out during each stroke.
The test was carried out starting with an empty cage and the following parameters recorded: number of strokes before oil started to flow out, total number of strokes, position of choke for each adjustment and whether the choke was being opened or closed in each adjustment.

### 3.3 Optimum length of rest period at end of each stroke.

This test was carried out at optimum choke position and after the press reached steady operating conditions to ensure that these variables had no effect on oil yield and effort required. Four rest periods, 0, 2, 5, and 10 seconds were used. Two kg of seed were pressed for each rest period with three replications in each case. The amount of oil, number of strokes, and time were recorded.

### 3.4 Optimum piston position and length of draw bars.

Piston position affects the rate of feed of the press because it determines the size of hopper opening into the cylinder. It also affects the handle position at which pressing or crushing of seeds starts. This is the point at which maximum effort is required from the operator. Piston position is altered by adjusting the length of the draw bars. The five piston positions tested when handle was at uppermost position were:

1. Piston inside cylinder about 2 cm from the hopper opening (position 1); length of draw bars was 71.5 cm.
2. Piston flush with hopper opening (position 2); length of draw bars was 69.1 cm.
3. Piston extending about 1 cm into hopper opening (position 3); length of draw bars was 69 cm.
4. Piston covering about one-half of hopper opening (position 4); length of draw bars was 68.2 cm.
5. Piston covering almost three-quarters of hopper opening (position 5); length of draw bars was 67.4 cm.

One kg of seed was pressed per test with each test done in duplicate. After tests at a given position were completed and piston adjusted to the next position, 2 kg of seed were pressed with appropriate adjustment to bring press to steady operation before tests at the new position commenced. These were the last tests and it was observed that the press could be operated comfortably with choke at a higher (pressure) position. But this was because the stop that actually absorbs the pressure from the choke had been pushed back slightly, therefore the choke needed to be adjusted to a higher value to compensate for this movement.
4. Sustained Operation Tests

The objective of these tests was to determine ram press capacity over a long period of time. Two operators alternated, each pressing 3 kg of seed at a time. During the first day, the two operators were paid on a daily basis while on the second day payment was based on the amount of oil produced. Amount paid per liter of oil was based on the oil produced and amount paid during the first day.
RESULTS AND DISCUSSIONS

1. Seed characterization

Values obtained for the various parameters for characterizing different seeds are shown in Table 1 below. The first lot of sunflower seed purchased from Oil Crop Development (OCD) in Nakuru had a low oil content yield, on average 15%. Lots purchased later had much higher yields of up to 25%.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sunflower</th>
<th>Simsim</th>
<th>Groundnut</th>
<th>Rapeseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content, %</td>
<td>8.74&lt;sup&gt;1&lt;/sup&gt;</td>
<td>6.1</td>
<td>6.34&lt;sup&gt;2&lt;/sup&gt;</td>
<td>3.04</td>
</tr>
<tr>
<td>Foreign materials, %</td>
<td>2.1</td>
<td>1.8</td>
<td>--</td>
<td>0.45</td>
</tr>
<tr>
<td>Oil content, %</td>
<td>34</td>
<td>48.9</td>
<td>29.7</td>
<td>40</td>
</tr>
<tr>
<td>Kernel, %</td>
<td>65.1</td>
<td>--</td>
<td>72.6</td>
<td>--</td>
</tr>
<tr>
<td>Husk, %</td>
<td>34.9</td>
<td>--</td>
<td>27.4</td>
<td>--</td>
</tr>
<tr>
<td>Bulk density, kg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>365.5</td>
<td>604.4</td>
<td>251.1</td>
<td>641.2</td>
</tr>
</tbody>
</table>

<sup>1</sup> Moisture content on wet basis
<sup>2</sup> After drying
<sup>3</sup> Uncleaned seed
2. Rates of filtration are shown in Table 2. The values show that the higher the rate of filtration the lower the clarity of the oil.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Time (hrs)</th>
<th>Amount Filtered ml</th>
<th>1/hr</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter paper</td>
<td>0.122</td>
<td>32.33</td>
<td>0.265</td>
<td>clean and consumable oil</td>
</tr>
<tr>
<td>Cheese cloth</td>
<td>0.100</td>
<td>102.97</td>
<td>1.03</td>
<td>with only a single fold, the oil is dirty. Clean oil was obtained if folded 6 times.</td>
</tr>
<tr>
<td>Khaki paper</td>
<td>0.106</td>
<td>26.33</td>
<td>0.248</td>
<td>very clean oil</td>
</tr>
</tbody>
</table>

3. Determination of Optimum Ram Press Settings

3.1 Optimum Choke Position

Choke position has significant effect on the various parameters that determine ram press performance and efficiency. These include throughput, oil yield, extraction efficiency, and effort required to operate the press. It is necessary therefore, to determine the optimum choke position and then evaluate all other parameters at this optimum position.

Results obtained with sunflower, unshelled groundnut and simsim are shown in Tables 3.1(a), 1(b), 1(c) and in figure 1. Choke position was measured in terms of the length of the choke tail piece from the bracket holding choke and also in terms of the number of exposed threads on the inside of the bracket. The optimum choke position was 3.8-3.9 cm (5 1/2-5 1/4 threads) for sunflower, 3.9-4.1 cm (5 1/4-4 3/4 threads) for simsim and 3.9-4.0 cm (5 1/4-5 threads) for groundnut. At these positions, extraction efficiency was 58.8-60.3% for sunflower, 45.4-47.9% for simsim, and 62.6-73.1% for groundnut. This range depends on the oil content of seed, operator strength and seed condition. The range could be higher or lower than that specified above depending on the variation in these factors. Above the highest range, effort needed to operate was high while below the lowest range extraction obtained with sunflower was possibly due to the low quality of seeds with an oil content of 34%. Seed purchased later had a higher oil content of 38% and had an average extraction efficiency of 66.8%, as shown in the sustained test results. Simsim could not withstand high pressure in the cage. The cake tended to extrude through the cage.
bar openings with little oil if pressure in the cage was high. This caused the low extraction efficiency shown above.

TABLE 3.1 RESULTS OF TESTS TO DETERMINE OPTIMUM CHOKE POSITION

(a) Sunflower

<table>
<thead>
<tr>
<th>Choke (cm)</th>
<th>3.6&lt;sup&gt;1&lt;/sup&gt;</th>
<th>3.7&lt;sup&gt;2&lt;/sup&gt;</th>
<th>3.8&lt;sup&gt;3&lt;/sup&gt;</th>
<th>3.9&lt;sup&gt;4&lt;/sup&gt;</th>
<th>4.0&lt;sup&gt;5&lt;/sup&gt;</th>
<th>4.1&lt;sup&gt;5&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>position (threads)</td>
<td>6</td>
<td>5 3/4</td>
<td>5 1/2</td>
<td>5 1/4</td>
<td>5.0</td>
<td>4 3/4</td>
</tr>
<tr>
<td>Oil yield, kg</td>
<td>0.233</td>
<td>0.218</td>
<td>0.205</td>
<td>0.20</td>
<td>0.155</td>
<td>0</td>
</tr>
<tr>
<td>Extraction efficiency, %</td>
<td>68.5</td>
<td>64.1</td>
<td>60.3</td>
<td>58.8</td>
<td>45.6</td>
<td>0</td>
</tr>
<tr>
<td>No. of strokes</td>
<td>36</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>

1 Operation difficult even with two people.
2 One person, but still a bit difficult. Can be operated here depending on seed condition and operator strength.
3 Operation range.
4 Fewer strokes because cake was coming out freely with no back pressure.
5 No oil – the little obtained was due to residual pressure from the previous position.
6 Oil content of seed = 34%.

(b) Simsim

<table>
<thead>
<tr>
<th>Choke (cm)</th>
<th>3.7&lt;sup&gt;1&lt;/sup&gt;</th>
<th>3.9&lt;sup&gt;2&lt;/sup&gt;</th>
<th>4.1&lt;sup&gt;3&lt;/sup&gt;</th>
<th>4.2&lt;sup&gt;4&lt;/sup&gt;</th>
<th>4.35&lt;sup&gt;5&lt;/sup&gt;</th>
<th>4.5&lt;sup&gt;5&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>position (threads)</td>
<td>5 3/4</td>
<td>5 1/4</td>
<td>4 3/4</td>
<td>4 1/2</td>
<td>4 1/4</td>
<td>4</td>
</tr>
<tr>
<td>Oil yield, kg</td>
<td>0.226</td>
<td>0.222</td>
<td>0.234</td>
<td>0.184</td>
<td>0.129</td>
<td>0</td>
</tr>
<tr>
<td>Extraction efficiency, %</td>
<td>46.2</td>
<td>45.4</td>
<td>47.9</td>
<td>37.6</td>
<td>26.4</td>
<td>-</td>
</tr>
<tr>
<td>No. of strokes</td>
<td>22</td>
<td>22</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>19</td>
</tr>
</tbody>
</table>

1 Cake forced out through cage openings. Very little oil produced.
2 Oil splashing out through cage openings mixed with cake particles.
Oil splashing out. Cake particles fewer and smaller. Splashing avoided by bringing the handle down slowly.
Easy to operate. Oil not splashing and few cake particles.
No oil.

Simsim required less effort to press as compared to sunflower. However, the pressure that could be applied was limited by cake extruding through of cage bar openings.

(c) Groundnut (Unshelled)

<table>
<thead>
<tr>
<th>Choke position (thread)</th>
<th>Oil yield, kg</th>
<th>Extraction efficiency, %</th>
<th>No. of strokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 5 3/4 5 1/2 5 1/4 5 3/4 4 3/4 4 1/2</td>
<td>-- 0.257 0.236 0.217 0.186 0.156 0</td>
<td>-- 86.5 79.5 73.1 62.6 52.5 0</td>
<td>-- 52 51 49 48 48 0</td>
</tr>
</tbody>
</table>

1. Too difficult to operate because of size of seed.
2. High percentage of cake particles forced through cage openings.
3. Optimum range.

3.2 Number of strokes for ram press to reach steady operating condition

Results of these tests are shown in Table 3.2(a-c). The values shown are the average of three replications. Choke position was determined by counting the number of threads exposed on the inside of the bracket holding the choke and also measured in terms of the length of the choke tail piece from the choke bracket, in cm. The direction of adjustment, that is, whether opening or closing the choke was indicated.
TABLE 3.2 NUMBER OF STROKES FOR RAM PRESS TO REACH STEADY CONDITION

(a) Sunflower

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Fully closed</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>close</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of strokes</td>
<td>0</td>
<td>35</td>
<td>40</td>
<td>42</td>
<td>45</td>
<td>49</td>
<td>51</td>
<td>60</td>
<td>67</td>
</tr>
<tr>
<td>Choke position (cm)</td>
<td>2.7</td>
<td>3.0</td>
<td>3.2</td>
<td>3.5</td>
<td>3.6</td>
<td>3.7</td>
<td>4.0</td>
<td>3.7</td>
<td>3.9</td>
</tr>
<tr>
<td>(Threads)</td>
<td>8</td>
<td>7 1/2</td>
<td>7</td>
<td>6 1/2</td>
<td>6</td>
<td>5 1/2</td>
<td>5</td>
<td>5 1/2</td>
<td>5 1/4</td>
</tr>
</tbody>
</table>

(b) Sisim

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Fully closed</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>close</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of strokes</td>
<td>0</td>
<td>17</td>
<td>22</td>
<td>28</td>
<td>31</td>
<td>33</td>
<td>36</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Choke position (cm)</td>
<td>2.3</td>
<td>2.4</td>
<td>2.7</td>
<td>3.2</td>
<td>3.6</td>
<td>4.0</td>
<td>4.2</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>(Threads)</td>
<td>9</td>
<td>8 3/4</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4 1/2</td>
<td>4 3/4</td>
<td></td>
</tr>
</tbody>
</table>

(c) Groundnut

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Fully closed</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>close</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of strokes</td>
<td>0</td>
<td>45</td>
<td>49</td>
<td>53</td>
<td>57</td>
<td>63</td>
<td>69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choke position (cm)</td>
<td>2.7</td>
<td>3.2</td>
<td>3.6</td>
<td>4.0</td>
<td>4.5</td>
<td>4.2</td>
<td>4.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Threads)</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>4 1/2</td>
<td>4 3/4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The operational pattern observed was:

(1) During the initial stages as the cage is filled, pressure builds up until a point is reached when it becomes difficult to operate. This happens after about 35 strokes for sunflower, 17 strokes for simsim and 45 for groundnut, but depends on how much the choke was screwed in initially. The oil started flowing out after 30, 14, and 39 strokes for sunflower, simsim, and groundnut, respectively. Groundnut required a higher number of strokes because of low bulk density.

(2) After this, the choke is adjusted (opened) after every few strokes (2-5), when the effort required is excessive. For simsim this was after the cake started coming out of cage openings. The number of strokes before choke adjustment depended on the operator for sunflower and groundnut.

(3) After about 47 strokes with 5 threads on the inside for sunflower and 57 strokes and 4 threads for groundnut, the uncrushed seeds that enter the cage during filling start coming out. In two strokes, most of these seeds exit, causing a sudden loss in pressure, making it necessary to close the choke. Several strokes follow (5-10) during which pressure rebuilds in the cage. At this point, crushed seeds (cake) start to come out and another adjustment (opening) is made. During this adjustment, the choke is moved to the optimum position already determined and operation can continue uninterrupted. For simsim the seeds that enter during initial filling are crushed at the choke and therefore no loss in pressure is experienced.

(4) For simsim, the number of strokes needed to reach steady operation were fewer. This was because the pressure in the cage was forcing the cake through cage openings necessitating a faster opening of the choke. It took 45 strokes as compared to 67 for sunflower to reach steady operation. For groundnut, the choke is opened to a lower value (4 threads) because larger pieces of partly crushed seeds have to be forced out during the initial stages.

Other observations of a general nature were:

1. The bracket holding the choke tended to be pushed upward due to the reaction of the choke to the cake moving against it. This caused erratic operation, requiring adjustment of the choke after every 5-10 strokes (irregular number). This made most of the data that had been generated unreliable and most tests had to be repeated. A stop was welded to stop this movement.

2. The number of strokes before adjustment for sunflower and groundnut depended on operator. A heavier person took more strokes than a lighter one. A tired operator took fewer strokes.
3. Time spent was not relevant because some time was spent making adjustments.

4. To fill the cage during the initial stage required 0.912 kg of seed for sunflower, 0.636 kg for simsim and 1.04 kg for groundnut.

3.2 (d) This test was carried out to determine the pattern of operation when the cage was initially filled with sunflower cake.

The results are shown in Table 3.2 (d) below. The cage was filled with cake until there was pressure and then seeds were used.

3.2 (d) Sunflower cake

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Fully open</th>
<th>open</th>
<th>open</th>
<th>open</th>
<th>close</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of strokes</td>
<td>0</td>
<td>20</td>
<td>23</td>
<td>27</td>
<td>34</td>
</tr>
<tr>
<td>Choke position (cm)</td>
<td>2.8</td>
<td>3.5</td>
<td>3.7</td>
<td>4.1</td>
<td>3.9</td>
</tr>
<tr>
<td>Threads</td>
<td>8</td>
<td>6 1/2</td>
<td>5 1/2</td>
<td>5</td>
<td>5 1/4</td>
</tr>
</tbody>
</table>

Observations:

1. The cake was forced into the cylinder since it was not free flowing. At the choke, the compressed cake was not coming out freely therefore the choke could be adjusted by a large value without loss in pressure. This resulted in relatively few strokes (about one-half) to reach steady operation, as compared to filling with whole seed.

3.3 Optimum rest period

Results of these tests are summarized in Table 3.3. The rest period affects oil yield, throughput and sustainability of operation. Fast operation, equal to zero rest period, was difficult to maintain, although throughput was high. However, oil yield was lower for fast operation because as soon as the piston was withdrawn at the start of next stroke, there was some back suction and oil stopped flowing. This is clearly shown by the figures in Table 3.3.

Oil yield increased from 12.8% with a 0 second rest period to 16.4% with a 5 second rest period. But the yield decreased to 15.8% with a 10 second period. This reduction occurred because the long period allowed some of the oil to be reabsorbed by the cake within the cage.
Other observations were as follows:

1. 0 second rest period - operation was difficult to maintain for one person even for 2 kg of seed. The operator was relieved after 15-20 strokes. Throughput was high but extraction efficiency was low. This combined with operator fatigue makes this rest period untenable.

2. 2 second rest period - One operator was able to finish 2 kg of seed. However, it was not possible to maintain this pace over a long period of operation.

3. 5-second period - Operation was sustainable over a long period. Throughput and extraction efficiency were reasonable. However, the tendency when operating without timing is for the operator to rest for a period of 2-5 seconds.

4. 10-second period - Throughput is low without any corresponding increase in extraction efficiency.

<table>
<thead>
<tr>
<th>TABLE 3.3 OPTIMUM REST PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest Period of seed (kg) strokes</td>
</tr>
<tr>
<td>sec.</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

The press was operated with choke at 5 1/4 threads.

3.4 Optimum piston position and corresponding length of bars

Results of the tests to determine optimum piston position are shown in Table 3.4. Although five positions were tested, none of them showed a clear cut advantage over the rest. When the lengths of the draw bars were 69.1 and 71.5 cm, the handle felt heavier on the return stroke. Throughput was highest at 69 cm. It was lower than expected at 71.5 cm. This was because some of the seeds that had already fallen into the cylinder were pushed back into the hopper by the piston on the downward stroke. When the drawbars were shortened to 68.2 and 67.4 cm, there was a back flow of oil into the cylinder. Throughput was lower at these positions because of a lower rate of feed. There was a slight decrease in extraction efficiency when draw bars were 67.4 cm long. Piston position recommended in view of these observations was when the piston was flush or extending about 1 cm into the hopper opening. This occurs when the draw bars are 68.2 or 69 cm long.
TABLE 3.4 OPTIMUM PISTON POSITION

<table>
<thead>
<tr>
<th>Piston position</th>
<th>Draw bar</th>
<th>Oil yields</th>
<th>Throughput</th>
<th>No. of strokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>71.5</td>
<td>17.98</td>
<td>6.97</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>69.1</td>
<td>18.01</td>
<td>9.13</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>69</td>
<td>17.9</td>
<td>11.32</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>68.2</td>
<td>17.09</td>
<td>7.87</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>67.4</td>
<td>16.13</td>
<td>6.18</td>
<td>42</td>
</tr>
</tbody>
</table>

4. Sustained Operation Tests

Results of sustained processing of sunflower are shown below.

<table>
<thead>
<tr>
<th></th>
<th>1st day</th>
<th>2nd day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount processed</td>
<td>36 kg</td>
<td>50 kg</td>
</tr>
<tr>
<td>Actual operation time</td>
<td>4.8 hr</td>
<td>7.04 hr</td>
</tr>
<tr>
<td>Oil yield</td>
<td>9.27 kg</td>
<td>12.5 kg</td>
</tr>
<tr>
<td>Cake</td>
<td>26.7 kg</td>
<td>37.5 kg</td>
</tr>
<tr>
<td>Throughput</td>
<td>7.5 kg/hr</td>
<td>7.1 kg/hr</td>
</tr>
<tr>
<td>Extraction efficiency</td>
<td>67.8%</td>
<td>65.8%</td>
</tr>
<tr>
<td>Oil yield rate</td>
<td>1.9 l/hr</td>
<td>1.8 l/hr</td>
</tr>
<tr>
<td>Cake yield rate</td>
<td>5.6 kg/hr</td>
<td>5.3 kg/hr</td>
</tr>
</tbody>
</table>

148
### TABLE 4. SUMMARY OF RAM PRESS PRODUCTION FIGURES AT OPTIMUM SETTINGS

<table>
<thead>
<tr>
<th></th>
<th>Sunflower</th>
<th>Simsim</th>
<th>Groundnut</th>
<th>Rapeseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput, kg/hr</td>
<td>7.3</td>
<td>11.1</td>
<td>4.1</td>
<td>9.65</td>
</tr>
<tr>
<td>Oil yield rate, kg/hr</td>
<td>1.85</td>
<td>2.7</td>
<td>0.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Kg of seed/kg of oil</td>
<td>3.95</td>
<td>4.1</td>
<td>5.1</td>
<td>3.85</td>
</tr>
<tr>
<td>Oil yield, kg/kg of seed</td>
<td>0.253</td>
<td>0.24</td>
<td>0.2</td>
<td>0.26</td>
</tr>
<tr>
<td>Extraction efficiency %</td>
<td>66.6</td>
<td>49</td>
<td>67.3</td>
<td>65</td>
</tr>
</tbody>
</table>

1. Choke position was 5 1/2 threads
2. For sunflower, these figures are the average of those obtained in the sustained operation tests.
3. Calculations to obtain these values are shown in Appendix A. Sample calculation are shown for sunflower.

**Oil content:**
- Sunflower 38%
- Groundnut 29.7%
- Simsim 48.9%
- Rapeseed 40.0%

The effectiveness of the operators improved with time. It was observed after one month of working that each of the two workers could operate for longer periods before being relieved. They were also able to operate at higher (pressure) choke position which meant higher extraction efficiency. Because of the close fit of piston in cylinder, the draw bars must be adjusted to exactly the same length - otherwise the press becomes difficult to operate due to misalignment.
APPENDIX A

Procedures for the calculation of Ram Press Production Figures.

Values shown are the average of those obtained during the sustained operation tests.

1. Throughput = kg seed pressed/hr
2. Oil yield rate = kg oil produced/hr
   \[ \frac{43 \text{ kg}}{5.9 \text{ hr}} = 7.3 \text{ kg/hr} \]
3. Oil yield = kg of oil obtained per kg of seed
   \[ \frac{10.88}{43 \text{ kg seed}} = 0.253 \]
4. Extraction efficiency = oil yield/oil content of seed

\[ \text{e.g., let oil yield} = 0.253 \]
\[ \text{oil content} = 38\% \]

Extraction efficiency = \( \frac{0.253}{0.38} = 66.6\% \)

APPENDIX B

Procedures used in the characterization of sunflower, simsim, groundnut and rapeseed.

Parameters used for characterization were:

1. Moisture content
2. Percent foreign material
3. Oil content
4. Percent by weight of kernel and husk for sunflower and groundnut
5. Bulk density

1. Moisture content

Objectives: To determine moisture content.
Equipment: Weighing balance, air oven, thermometer, moisture cans, hammer mill.
Procedure: A 500 gm sample was ground in the hammer mill using a 5 mm sieve. Ground samples were placed in moisture cans and all appropriate weights taken. The cans were then placed in an oven, maintained at 103 degrees centigrade, for two hours.

Results were tabulated in Table B1 and moisture content calculated as shown.
Table B1

<table>
<thead>
<tr>
<th>Can No.</th>
<th>Mass of empty can (g)</th>
<th>Mass of can + seed before drying (g)</th>
<th>Mass of can + seed after drying (g)</th>
<th>Moisture lost (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>19.65</td>
<td>33.8</td>
<td>32.6</td>
<td>1.2</td>
</tr>
<tr>
<td>5</td>
<td>19.9</td>
<td>32.1</td>
<td>30.9</td>
<td>1.2</td>
</tr>
<tr>
<td>G4</td>
<td>19.4</td>
<td>30.7</td>
<td>29.8</td>
<td>0.9</td>
</tr>
<tr>
<td>6</td>
<td>20.1</td>
<td>32.8</td>
<td>31.7</td>
<td>1.1</td>
</tr>
<tr>
<td>A2</td>
<td>21.6</td>
<td>34.2</td>
<td>33.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

CALCULATION

Average mass of seed before drying = 12.599
Average mass of seed after drying = 11.499
Average mass of moisture lost = 1.19

MC wet basis = \( \frac{1.1}{12.59} \times 100 \)

= 8.74%

MC dry basis = \( \frac{1.1}{11.49} \times 100 \)

= 9.57%

2. Foreign Material

Objective: Determine percent foreign material.
Equipment: Weighing balance, set of sieves, Ro-tap (shaker) machine, stop watch.
Procedure: A 250 g sample was weighed and placed on the top sieve, and the set of sieves placed on the Ro-tap machine. The sample was shaken for 5 minutes, after which material equal in size to the seed was picked by hand. The foreign material and clean seed were then weighed. Three replications were done.

Results were tabulated as shown in Table B2 and percent foreign matter calculates as shown.
### Table B2

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Seeds Ave.</th>
<th>Foreign material Ave.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>16.30</td>
<td>0.40</td>
</tr>
<tr>
<td>10</td>
<td>225.30</td>
<td>1.10</td>
</tr>
<tr>
<td>20</td>
<td>224.80</td>
<td>3.80</td>
</tr>
<tr>
<td>30</td>
<td>224.10</td>
<td>0.45</td>
</tr>
<tr>
<td>50</td>
<td>224.70</td>
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</tr>
<tr>
<td>Pan</td>
<td></td>
<td>0.4</td>
</tr>
</tbody>
</table>

Weight of clean seed = 242.3 g  
Total weight of foreign material = 5.08 g  

Clean seeds = \( \frac{242.3 \times 100}{247.38} \) = 97.9%  
Foreign material = \( \frac{5.08 \times 100}{247.38} \) = 2.1%  

Bulk density  
Objectives: Determine bulk density  
Materials and equipment: Weighing balance, 1 liter container clean and uncleaned sunflower seed  
Procedure: Samples of seed were picked in the density container and weighed  
Calculating:  
Average weight of seeds = 604.40 g  
Volume of container = 1 L = 1000 cm³  
Bulk density = \( \frac{\text{Mass}}{\text{Vol.}} \) = \( \frac{604.40}{1000} \) = 0.6044 g/cm³  
\( \text{Bulk density} = 0.6044 \times 10^6 \text{cm}^3/\text{m}^3 = 604.4 \text{ kg/m}^3 \)  
\( \frac{1000\text{g/kg}}{1000\text{g/kg}} \)
INTRODUCTION

The objective of the Rural Oil Protein Processing Project (ROPPP) sub-project is to satisfy the demand for edible oils and for protein cake. In meeting this objective, the sub-project will reduce the utilization of foreign exchange on importation of oils and protein cake. In the first instance successful implementation of the ROPPP sub-project should satisfy rural demand. Additionally it will generate surpluses which can be sold to urban refineries and feed industries. The sub-project thus has a substantial capacity to improve rural diets and incomes.

The technology design and development (TDD) section of the Agricultural Engineering Division has identified two types of oil-processing machines for testing and analysis. The equipment is ideally suited for use by local entrepreneurs, self-help groups or co-operatives. They are thus meant to be easy to acquire, use and maintain by the clientele. The processing equipment are:

i) A manual ram oil press

This is a cage type expeller, locally manufactured by JAIMEN ENGINEERING LTD., of Nairobi. It goes by the trade name of Bielenberg Oil Press, and currently sells for Kshs 30,000. The oil is obtained when the operator presses down on the long handle, which activates the ram. The ram moves inside a tapering cage containing the oil seeds. The oil is expelled under pressure from the ruptured cells.

ii) A motorised screw expeller

This is a screw-type expeller manufactured by Benz Agricultural Machinery Works of China. It consists of the expeller coupled to a 12 HP diesel engine running at 2000 rpm or a 5.5 KW electric motor running at 1440 rpm. The expeller costs Kshs 30,000.00, the diesel engine, Kshs 94,000, and the electric motor Kshs 50,000. The mechanism of oil expulsion is the same as that described in part (i) above.

RESULTS AND ANALYSIS

The results of the tests have not all been submitted to date. Notable absences of results are from Siakago and Siaya stations. Of the rest, Homa Bay and Bungoma stations submitted no results on cake outputs. This is a serious omission. The only stations that submitted tentative results on extraction efficiency were Nakaru and Matuga. Otherwise, all stations have results on raw materials throughput, cake output and oil yield per unit mass and per unit time. These results are given in Appendices A1 and A2.
On the basis of these findings, groundnuts have the highest throughput followed by simsim and sunflower respectively, when using the manual ram press (MRP). However, oil yield per unit mass has sunflower giving higher than both simsim and groundnuts which give the same yields.

The protein cakes derived sells at Kshs 2.80 to Kshs 3.00/kg to ADC Ltd. or to Ufuta Ltd. However, sunflower oil has no known price or outlet so far. Although one or two stations have quoted and used a price of Kshs 20.00/l based on the retail price of "Elianto" corn oil, this is deemed misleading. "Elianto" is not a justifiable basis of comparison because it is not sunflower derived and is furthermore fully refined, unlike the sunflower oil under consideration. It is recommended here that the Ufuta Ltd. price for crude coconut and simsim oil of Kshs 14.50/l be used as the price guide. This is the price utilised in this report.

The raw material prices utilised are the highest quoted in the station reports, while the product prices used are the lowest. Admittedly therefore, this report may be seen as representing a pessimistic view.

TECHNICAL FEASIBILITY

The motorised screw expeller (MSE) has only been tested at Matuga. The results with dried copra are rated as excellent, however with simsim no oil was expelled. The MSE is thus technically viable for oil extraction from dried copra but not for simsim.

The MRP is reported by all stations as technically viable. In all cases reported oil was pressed from sunflower, groundnut and simsim at rates averaging about 0.2 l/kg of oil seeds. However, it was criticised for being difficult to clean - requiring up to two hours in some instances. It was also denounced for requiring too much effort to operate, thus ruling out the possibility of extra expenses on labour. The long handle has been singled out as particularly cumbersome and irritating to operators of average or less than average height. On a more positive note, its extraction efficiency of 80% as specified by the designer was achieved in at least one station which reported this. Except for these minor points, technical feasibility is not in doubt.

ECONOMIC FEASIBILITY

All the station reports indicated some attempt at economic assessment. This is in recognition of the fact that technical feasibility must be backed by economic feasibility. These two in turn are pre-conditions for social acceptability. Without exception, all stations went for simple break-even analysis, computing the minimum selling price for crude oil or the minimum amount of oil seed required to match the technical capability of the machine. Proceeding this way, groundnut and simsim were found
unsuitable as the revenues from oil and cake could not cover the production cost. Sunflower was found to be more promising. These analyses are simplistic and incomplete. The said analyses failed to account for every single aspect of production costs. In particular, they did not consider the opportunity cost of capital and that of the entrepreneur's time and skills. They also failed to consider the fact that the whole project occurs in a time framework. To correct the anomaly arising from the stated inadvertencies, a cash flow analysis is utilised here. All the aspects mentioned above are included. This analysis applies equally well to an individual entrepreneur (herein called a farmer), a self-help-group or a co-operative society. The assumptions made are indicated in each table. Appendices A3 and A14 have all the details, crop by crop, and for each, two scenarios are considered. The first case occurs if the farmer uses his own funds to acquire the equipment; the second scenario has the farmer obtaining a loan comprising 60% of the purchase price.

In all four cases, the net cash flows are all negative for the first five years considered. The most significant contributor to this for all the four is the opportunity cost of capital and the management input. Without these, both sunflower and coconut would show positive net cash flows, especially if a loan is availed. If we therefore considered the naive case where the management input is zero and the opportunity cost of capital is zero, we can quickly and erroneously recommend the two. However, one can find no just cause for proceeding thus. Nevertheless, if cost of production can be lowered and the product prices improved, then coconut and sunflower should be the oil crops to pursue.

The case of groundnuts and simsim is different from sunflower and coconut. Account must be taken of the fact that sunflower is grown almost exclusively for oil production in urban-based industries. Coconut is grown for its oil, copra, and shell. Most important, however, is that the use of coconut oil for food, cosmetics, and medicinal value is well established at the Coast. Coconut oil is produced both domestically and in rural and urban-based industries. Against this background one realizes the great disparity between groundnuts and simsim on the one hand and coconut and sunflower on the other.

Groundnuts and simsim, besides oil production, are consumed directly as food in their own right. They are eaten as snacks - a very lucrative market. In addition, simsim is valued for its aphrodisiac properties (real or imagined) by Arab nationals - hence its popularity at the Kenyan coast. These facts have pushed up the price of the raw materials considerably. Inspection of Appendices A6 to A11 indicates that the raw material cost is the largest element of the cost of production, for groundnut and simsim oil. Thus, to produce groundnut and simsim oil economically, one needs a situation where raw material prices are lower and/or product prices are higher. The farmer situation would be undesirable for
the effects it might have on production of these crops. The latter would work if the oils thus derived have very special uses that would merit large price increases. As at the present moment, both cases are seen as highly unlikely. But for future work, the aphrodisiac properties of simsim oil need to be investigated. If they actually exist, then there is scope for increasing the price of simsim oil and a chance for oil processors to make a profit.

By way of oil crops, it is thus apparent that the development of sunflower and coconuts stands the best chance. Cottonseed and rapeseed have greater resemblance to sunflower in these aspects, and are thus worth more serious attention than they are currently receiving.

SOCIAL ACCEPTABILITY OF THE PRODUCTS

The products of rural oil processing are basically edible oil and a protein cake. These are joint products produced in fixed proportions. In addition, there may be husks and shells depending on the crop and the method of production.

All the station reports make absolutely no reference to what becomes of the protein cake or husks if they are not sold. However, the importance of the protein cake can not be overemphasized, because Kenya imports protein cake to meet the local demand for animal feed. It would thus be pertinent to get some ideas on the effects of feeding the cake directly to livestock, and on how it should be mixed with other farmer-grown fodder. Possibilities of it being channelled into rural feed milling enterprises also need to be looked into. Until that is done, one would be hard put to discuss its social acceptability as animal feed.

A dimension that has been explored by Catholic Relief Services (CRS) is the use of the groundnut cake as human food—a protein supplement. CRS did not meet with much success in this endeavor, because the target group showed poor response. Nevertheless, this dimension needs to be reviewed in the light of CRS experiences.

Some stations distributed the crude oil to various people for trial testing. By and large, all those who tried the product agreed that it was a fine product save for the following:

i) The product had residues, and hence required filtration;

ii) It had a peculiar smell which disappeared on thorough heating;

iii) The keeping quality is poor unless the bottle/container is tightly sealed and kept in a cool, dry place.
It is thus apparent that the oil produced this way can gain social acceptability if proper marketing arrangements are made.

CONCLUSIONS AND RECOMMENDATIONS

i) The price of the MRP is on the higher side. Particularly because it can be fabricated locally in 'Jua Kalis' it is recommended that the purchase price be lowered to that recommended by Action Aid Kenya, Ltd. i.e. Kshs 15,000.

ii) Cleaning of the MRP reduces the time in which it can be utilised effectively. It is recommended that the design be improved for quick and easy cleaning.

iii) The product prices are too low to keep an entrepreneur in business. An upward price adjustment is therefore recommended for the products.

iv) The raw material price for simsim and groundnuts comprises a substantial proportion of the production costs for their oils. It is recommended that these two crops be omitted. Instead, cottonseed and rapeseed should be investigated.

v) The entrepreneur's cash flow position is improved by the provision of a loan. A suitable loan package should be made available to qualified entrepreneurs.
# Manual Ram Expeller

## Summary of Test Results

<table>
<thead>
<tr>
<th>STATIONS</th>
<th>SUNFLOWER</th>
<th>GROUNDNUT</th>
<th>SIMSIM</th>
<th>COCONUT *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TP</td>
<td>OY</td>
<td>CO</td>
<td></td>
</tr>
<tr>
<td>HOMA BAY</td>
<td>10,000</td>
<td>18,900</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>OY</td>
<td>2,700</td>
<td>4,800</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>BUKURA</td>
<td>8,000</td>
<td>18,900</td>
<td>19,000</td>
<td></td>
</tr>
<tr>
<td>OY</td>
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<td>3,300</td>
<td>4,320</td>
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</tr>
<tr>
<td>CO</td>
<td>6,300</td>
<td>15,500</td>
<td>14,000</td>
<td></td>
</tr>
<tr>
<td>MATUGA</td>
<td>TP</td>
<td>OY</td>
<td>CO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13,000</td>
<td>77,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUNGOMA</td>
<td>7,000</td>
<td>21,600</td>
<td>14,000</td>
<td></td>
</tr>
<tr>
<td>OY</td>
<td>1,400</td>
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</tr>
<tr>
<td>CO</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>MAKURU</td>
<td>8,800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OY</td>
<td>1,900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIAKAGO</td>
<td>TP</td>
<td>OY</td>
<td>CO</td>
<td></td>
</tr>
<tr>
<td>SIAYEA</td>
<td>TP</td>
<td>OY</td>
<td>CO</td>
<td></td>
</tr>
<tr>
<td>MEAN</td>
<td>8,600</td>
<td>19,700</td>
<td>15,550</td>
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</tr>
<tr>
<td></td>
<td>1,990</td>
<td>4,160</td>
<td>3,310</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6,600</td>
<td>15,500</td>
<td>11,380</td>
<td></td>
</tr>
</tbody>
</table>

**TP**: Throughput kg/yr  
*Results with the Motorised Screw expeller only.*  
**OY**: Oil Yield lt/yr  
**CO**: Cake Output kg/yr
### MEANS

**Sunflower, Simsim, Groundnut**

<table>
<thead>
<tr>
<th>1. Throughput</th>
<th>SUNFLOWER</th>
<th>SIMSIM</th>
<th>GROUNDNUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) kg/hr</td>
<td>6.0</td>
<td>10.8</td>
<td>13.7</td>
</tr>
<tr>
<td>b) kg/yr</td>
<td>8,600</td>
<td>15,550</td>
<td>19,700</td>
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</table>

<table>
<thead>
<tr>
<th>2. Oil Yield</th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) l/kg</td>
<td>0.23</td>
<td>0.21</td>
<td>0.21</td>
</tr>
<tr>
<td>b) l/hr</td>
<td>1.38</td>
<td>2.30</td>
<td>2.88</td>
</tr>
<tr>
<td>c) l/yr</td>
<td>1,990</td>
<td>3,310</td>
<td>4,150</td>
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</table>

<table>
<thead>
<tr>
<th>3. Cake Output</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) kg/hr</td>
<td>4.6</td>
<td>7.9</td>
<td>10.7</td>
</tr>
<tr>
<td>b) kg/yr</td>
<td>6,600</td>
<td>11,380</td>
<td>15,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Prices</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) raw material</td>
<td>3.00-3.30</td>
<td>5.00-20.00</td>
<td>17.50-30.00</td>
</tr>
<tr>
<td>b) oil kshs/l</td>
<td>---------</td>
<td>14.50</td>
<td>----------</td>
</tr>
<tr>
<td>c) cake kshs/kg</td>
<td>2.80</td>
<td>2.80-3.00</td>
<td>2.80</td>
</tr>
<tr>
<td>d) stock kshs/</td>
<td>---------</td>
<td>--------</td>
<td>----------</td>
</tr>
</tbody>
</table>

**Assumptions**

i) 6 hrs/day; 240 days/yr; 1440 hrs/yr

ii) Labor: (a) Skilled @ 30.00/day
     (b) Unskilled @ 20.00/day
     (c) Total labour cost: 15,600.00 p.a.

iii) Repair, maintenance and storage costs at 20% of purchase price.

iv) Interest rates of 15%
OIL CROP: Sunflower

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVENUES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Oil</td>
<td>28,855</td>
<td>28,855</td>
<td>28,855</td>
<td>28,855</td>
<td>28,855</td>
</tr>
<tr>
<td>ii) Cake</td>
<td>18,480</td>
<td>18,480</td>
<td>18,480</td>
<td>18,480</td>
<td>18,480</td>
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<tr>
<td>iii) Soap Stock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL REVENUE</td>
<td>47,335</td>
<td>47,335</td>
<td>47,335</td>
<td>47,335</td>
<td>47,335</td>
</tr>
<tr>
<td>COSTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACHINE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Purchase</td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) R.A.M. + Storage</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
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</tr>
<tr>
<td>LABOUR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Skilled</td>
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<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
</tr>
<tr>
<td>ii) Casual</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
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<tr>
<td>RAW MATERIAL</td>
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<td>30,100</td>
<td>30,100</td>
<td>30,100</td>
<td>30,100</td>
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<tr>
<td>O.C. CAPITAL</td>
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<td>9,675</td>
<td>15,626</td>
<td>22,470</td>
<td>30,340</td>
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<tr>
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<td>36,000</td>
<td>36,000</td>
<td>36,000</td>
<td>36,000</td>
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<tr>
<td>TOTAL COST</td>
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<td>95,575</td>
<td>110,826</td>
<td>108,670</td>
<td>116,540</td>
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<td>NET CASH FLOW</td>
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<td>(48,540)</td>
<td>(54,491)</td>
<td>(61,335)</td>
<td>(69,205)</td>
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<tr>
<td>CUMULATIVE CASH FLOW</td>
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</table>

* Repair and maintenance costs @ 10% of purchase price. Storage costs include insurance; both estimated at 5% of the purchase price.
## OIL CROP: Sunflowers

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REVENUES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Oil</td>
<td>28,855</td>
<td>28,855</td>
<td>28,855</td>
<td>28,855</td>
<td>28,855</td>
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<tr>
<td>ii) Cake</td>
<td>18,480</td>
<td>18,480</td>
<td>18,480</td>
<td>18,480</td>
<td>18,480</td>
</tr>
<tr>
<td>iii) Soap Stock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL REVENUE</strong></td>
<td>47,335</td>
<td>47,335</td>
<td>47,335</td>
<td>47,335</td>
<td>47,335</td>
</tr>
<tr>
<td><strong>COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MACHINE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Purchase</td>
<td>12,000</td>
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<td></td>
<td></td>
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<tr>
<td>ii) R.A.M.+Storage **</td>
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<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
</tr>
<tr>
<td><strong>LABOUR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Skilled</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
</tr>
<tr>
<td>ii) Casual</td>
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<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
</tr>
<tr>
<td><strong>RAW MATERIAL</strong></td>
<td>30,100</td>
<td>30,100</td>
<td>30,100</td>
<td>30,100</td>
<td>30,100</td>
</tr>
<tr>
<td><strong>O.C. CAPITAL</strong></td>
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<td>3,870</td>
<td>6,250</td>
<td>8,990</td>
<td>12,140</td>
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<td>36,000</td>
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<td>36,000</td>
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<tr>
<td><strong>TOTAL COST</strong></td>
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<td>90,070</td>
<td>92,450</td>
<td>95,190</td>
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<td>Disbursement</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Principal</td>
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<td>(2,700)</td>
<td>(1,350)</td>
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<td><strong>NET CASH FLOW</strong></td>
<td>(46,365)</td>
<td>(53,085)</td>
<td>(45,115)</td>
<td>(47,855)</td>
<td>(51,005)</td>
</tr>
<tr>
<td><strong>CUMULATIVE CASH FLOW</strong></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* The loan element is 60% of machine price repayable in two years at 15% p.a.

** Repair and maintenance costs are 10% of purchase price. Storage costs include insurance; both estimated at 5% of the purchase price.
### Throughput

<table>
<thead>
<tr>
<th></th>
<th>Nakuru</th>
<th>Bukura</th>
<th>Bungoma</th>
<th>N. Bay</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) kg/hr</td>
<td>6.1</td>
<td>5.7</td>
<td>5.0</td>
<td>7.1</td>
</tr>
<tr>
<td>b) kg/yr</td>
<td>8,800</td>
<td>8,000</td>
<td>7,000</td>
<td>10,000</td>
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</table>

### Oil Yield

<p>| | | | | |</p>
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<th></th>
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<tbody>
<tr>
<td>a) l/kg</td>
<td>0.21</td>
<td>0.23</td>
<td>0.20</td>
<td>0.265</td>
</tr>
<tr>
<td>b) l/hr</td>
<td>1.30</td>
<td>1.30</td>
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<tr>
<td>c) l/yr</td>
<td>1,900</td>
<td>1,900</td>
<td>1,400</td>
<td>2,700</td>
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### Cake Output

<p>| | | | | |</p>
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<tr>
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</thead>
<tbody>
<tr>
<td>a) kg/hr</td>
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<tr>
<td>b) kg/yr</td>
<td>6,800</td>
<td>6,300</td>
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### Prices

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<tr>
<td>a) raw material</td>
<td>3.30</td>
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<tr>
<td>b) oil kshs/l</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>c) cake kshs/kg</td>
<td>2.80</td>
<td>2.80</td>
<td>?</td>
<td>?</td>
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<tr>
<td>d) stock kshs/</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
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</tbody>
</table>

### Assumptions

1. 6 hrs/day; 240 days/yr; 1440 hrs/yr
2. Labor; (a) Skilled @ 30.00/day
   (b) Unskilled @ 20.00/day
   (c) Total labour cost: 15,600.00 p.a.
3. Repair, maintenance and storage costs at 20% of purchase price.
4. Interest rates of 15%
OIL CROP: Simsim

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
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<tbody>
<tr>
<td><strong>REVENUES</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>i) Oil</td>
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<td>47,995</td>
<td>47,995</td>
<td>47,995</td>
<td>47,995</td>
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<tr>
<td>ii) Cake</td>
<td>31,864</td>
<td>31,864</td>
<td>31,864</td>
<td>31,864</td>
<td>31,864</td>
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<tr>
<td>iii) Soap Stock</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>TOTAL REVENUE</strong></td>
<td>79,859</td>
<td>79,859</td>
<td>79,859</td>
<td>79,859</td>
<td>79,859</td>
</tr>
<tr>
<td><strong>COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>MACHINE</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>i) Purchase</td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) R.A.M. + Storage</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
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<tr>
<td><strong>LABOUR</strong></td>
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<td></td>
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</tr>
<tr>
<td>i) Skilled</td>
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<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
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<tr>
<td>ii) Casual</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
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<tr>
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<td>311,000</td>
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<tr>
<td><strong>O.C. CAPITAL</strong></td>
<td>4,500</td>
<td>9,675</td>
<td>15,626</td>
<td>22,470</td>
<td>30,340</td>
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<td><strong>TOTAL COST</strong></td>
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<td>(321,741)</td>
<td>(296,916)</td>
<td>(302,867)</td>
<td>(309,711)</td>
<td>(317,581)</td>
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</table>

* Repair and maintenance costs @ 10% of purchase price. Storage costs include insurance; both estimated at 5% of the purchase price.
## Manual Ram Expeller
### Cash Flow Analysis
### With a Loan Element *

**OIL CROP: Simsim**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REVENUES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Oil</td>
<td>47,995</td>
<td>47,995</td>
<td>47,995</td>
<td>47,995</td>
<td>47,995</td>
</tr>
<tr>
<td>ii) Cake</td>
<td>31,864</td>
<td>31,864</td>
<td>31,864</td>
<td>31,864</td>
<td>31,864</td>
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<tr>
<td>iii) Soap Stock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL REVENUE</strong></td>
<td>79,859</td>
<td>79,859</td>
<td>79,859</td>
<td>79,859</td>
<td>79,859</td>
</tr>
<tr>
<td><strong>COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MACHINE</strong></td>
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<tr>
<td>i) Purchase</td>
<td>12,000</td>
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<tr>
<td>ii) R.A.M.+Storage **</td>
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<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
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<tr>
<td><strong>LABOUR</strong></td>
<td></td>
<td></td>
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<tr>
<td>i) Skilled</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
</tr>
<tr>
<td>ii) Casual</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
</tr>
<tr>
<td><strong>RAW MATERIAL</strong></td>
<td>311,000</td>
<td>311,000</td>
<td>311,000</td>
<td>311,000</td>
<td>311,000</td>
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<tr>
<td><strong>O.C. CAPITAL</strong></td>
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<td>8,990</td>
<td>12,140</td>
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<td>373,350</td>
<td>376,090</td>
<td>379,240</td>
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<td>Disbursement</td>
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<td>(9,000)</td>
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<tr>
<td>Interest</td>
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<td>(1,350)</td>
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<td><strong>NET CASH FLOW</strong></td>
<td>(294,741)</td>
<td>(301,461)</td>
<td>(292,491)</td>
<td>(296,231)</td>
<td>(299,381)</td>
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<td><strong>CUMULATIVE CASH FLOW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* The loan element is 60% of machine price repayable in two years @ 15% p.a.

** Repair and maintenance costs a 10% of purchase price. Storage costs include insurance; both estimated at 5% of the purchase price.

---

**BEST AVAILABLE DOCUMENT**
## OIL CROP: SIMSIM

### Annex B

<table>
<thead>
<tr>
<th></th>
<th>Bungoma</th>
<th>Bukura</th>
<th>Matugo</th>
<th>Nakuru</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Throughput</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) kg/hr</td>
<td>10.0</td>
<td>13.3</td>
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</tr>
<tr>
<td>b) kg/yr</td>
<td>14,000</td>
<td>19,000</td>
<td>13,000</td>
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<td><strong>2. Oil Yield</strong></td>
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<td>a) l/kg</td>
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<td>0.23</td>
<td>0.30</td>
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<td>b) l/hr</td>
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<td>3.00</td>
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<tr>
<td>c) l/yr</td>
<td>2,900</td>
<td>4,320</td>
<td>4,200</td>
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<tr>
<td><strong>3. Cake Output</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) kg/hr</td>
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<td>5.9</td>
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<tr>
<td>b) kg/yr</td>
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<td><strong>4. Prices</strong></td>
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<td>a) raw material</td>
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<td>15.00-20.00</td>
<td>5.00</td>
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<td>b) oil kshs/l</td>
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<tr>
<td>c) cake kshs/kg</td>
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<td></td>
<td>2.90</td>
<td></td>
</tr>
<tr>
<td>d) stock kshs/</td>
<td></td>
<td></td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>

### Assumptions
- 6 hrs/day; 240 days/yr; 1440 hrs/yr
- Labor: (a) Skilled @ 30.00/day
  (b) Unskilled @ 20.00/day
  (c) Total labour cost: 15,600.00 p.a.
- Repair, maintenance and storage costs at 20% of purchase price.
- Interest rates of 15%
## OIL CROP: Groundnuts

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REVENUES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Oil</td>
<td>60,175</td>
<td>60,175</td>
<td>60,175</td>
<td>60,175</td>
<td>60,175</td>
</tr>
<tr>
<td>ii) Cake</td>
<td>43,400</td>
<td>43,400</td>
<td>43,400</td>
<td>43,400</td>
<td>43,400</td>
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<tr>
<td>iii) Soap Stock</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL REVENUE</strong></td>
<td>103,575</td>
<td>103,575</td>
<td>103,575</td>
<td>103,575</td>
<td>103,575</td>
</tr>
<tr>
<td><strong>COSTS</strong></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>MACHINE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Purchase</td>
<td>30,000</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>ii) R.A.M. + Storage</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
</tr>
<tr>
<td><strong>LABOUR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Skilled</td>
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<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
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<tr>
<td>ii) Casual</td>
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<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
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<tr>
<td><strong>RAW MATERIAL</strong></td>
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<tr>
<td><strong>O.C. CAPITAL</strong></td>
<td>4,500</td>
<td>9,675</td>
<td>15,626</td>
<td>22,470</td>
<td>30,341</td>
</tr>
<tr>
<td>Management Input</td>
<td>36,000</td>
<td>36,000</td>
<td>36,000</td>
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<td><strong>TOTAL COST</strong></td>
<td>601,000</td>
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<td>662,726</td>
<td>669,570</td>
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<tr>
<td><strong>NET CASH FLOW</strong></td>
<td>(578,025)</td>
<td>(553,200)</td>
<td>(559,151)</td>
<td>(565,995)</td>
<td>(573,865)</td>
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<td></td>
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</table>

* Repair and maintenance costs 10% of purchase price. Storage costs include insurance; both estimated at 5% of the purchase price.
# OIL CROP: Groundnuts

## Cash Flow Analysis

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REVENUES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Oil</td>
<td>60,175</td>
<td>60,175</td>
<td>60,175</td>
<td>60,175</td>
<td>60,175</td>
</tr>
<tr>
<td>ii) Cake</td>
<td>43,400</td>
<td>43,400</td>
<td>43,400</td>
<td>43,400</td>
<td>43,400</td>
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<tr>
<td>iii) Soap Stock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>103,575</td>
<td>103,575</td>
<td>103,575</td>
<td>103,575</td>
</tr>
</tbody>
</table>

| **COSTS**       |         |         |         |         |         |
| MACHINE         |         |         |         |         |         |
| i) Purchase     | 12,000  |         |         |         |         |
| ii) R.A.M.+Storage ** | 4,500  | 4,500  | 4,500  | 4,500  | 4,500  |
| **LABOUR**      |         |         |         |         |         |
| i) Skilled      | 10,800  | 10,800  | 10,800  | 10,800  | 10,800  |
| ii) Casual      | 4,800   | 4,800   | 4,800   | 4,800   | 4,800   |
| **RAW MATERIAL**| 591,000 | 591,000 | 591,000 | 591,000 | 591,000 |
| O.C. CAPITAL    | 1,800   | 3,870   | 6,250   | 8,990   | 12,140  |
| Management Input| 36,000  | 36,000  | 36,000  | 36,000  | 36,000  |
| **TOTAL COST**  | 660,900 | 650,770 | 653,350 | 656,090 | 659,240 |

| **LOAN**        |         |         |         |         |         |
| Disbursement    | 18,000  |         |         |         |         |
| Principal       | (9,000) | (9,000) |         |         |         |
| Interest        | (2,700) | (1,350) |         |         |         |
| **NET CASH FLOW**| (551,025)| (557,745)| (549,775)| (552,515)| (555,665)|

- * The loan element is 60% of machine price repayable in two years @ 15% p.a.
- ** Repair and maintenance costs @ 10% of purchase price. Storage costs include insurance; both estimated at 5% of the purchase price.
## OIL CROP: GROUNDNUTS

### Throughput

<table>
<thead>
<tr>
<th></th>
<th>Bukura</th>
<th>H. Bay</th>
<th>Bungoma</th>
</tr>
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<tbody>
<tr>
<td>a) kg/hr</td>
<td>13.1</td>
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<td>15.0</td>
</tr>
<tr>
<td>b) kg/yr</td>
<td>18,900</td>
<td>18,400</td>
<td>21,600</td>
</tr>
</tbody>
</table>

### Oil Yield

<table>
<thead>
<tr>
<th></th>
<th>Bukura</th>
<th>H. Bay</th>
<th>Bungoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) l/kg</td>
<td>0.177</td>
<td>0.250</td>
<td>0.200</td>
</tr>
<tr>
<td>b) l/hr</td>
<td>2.3</td>
<td>3.3</td>
<td>3.0</td>
</tr>
<tr>
<td>c) l/yr</td>
<td>3,300</td>
<td>4,800</td>
<td>4,300</td>
</tr>
</tbody>
</table>

### Cake Output

<table>
<thead>
<tr>
<th></th>
<th>Bukura</th>
<th>H. Bay</th>
<th>Bungoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) kg/hr</td>
<td>10.7</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>b) kg/yr</td>
<td>15,500</td>
<td>4,300</td>
<td>4,300</td>
</tr>
</tbody>
</table>

### Prices

<table>
<thead>
<tr>
<th></th>
<th>Bukura</th>
<th>H. Bay</th>
<th>Bungoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) raw material</td>
<td>18.00-30.00</td>
<td>17.50-17.50</td>
<td>25.00-25.00</td>
</tr>
<tr>
<td>b) oil kshs/l</td>
<td>----------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>c) cake kshs/kg</td>
<td>2.80</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>d) stock kshs/</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
</tbody>
</table>

### Assumptions

1. 6 hrs/day; 240 days/yr; 1440 hrs/yr
2. Labor: (a) Skilled @ 30.00/day
   (b) Unskilled @ 20.00/day
   (c) Total labour cost: 15,600.00 p.a.
3. Repair, maintenance and storage costs at 20% of purchase price.
4. Interest rates of 15%
## Annex 12

### Motorised Screw Expeller

### Cash Flow Analysis

Entrepreneur's Own Funds

**Oil Crop: Coconut (Matuga case)**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REVENUES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Oil</td>
<td>584,640</td>
<td>584,640</td>
<td>584,640</td>
<td>584,640</td>
<td>584,640</td>
</tr>
<tr>
<td>ii) Cake</td>
<td>37,440</td>
<td>37,440</td>
<td>37,440</td>
<td>37,440</td>
<td>37,440</td>
</tr>
<tr>
<td>iii) Soap Stock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL REVENUE</strong></td>
<td>622,080</td>
<td>622,080</td>
<td>622,080</td>
<td>622,080</td>
<td>622,080</td>
</tr>
<tr>
<td><strong>COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MACHINE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Purchase</td>
<td>94,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) Expeller</td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii) R.A.M. *</td>
<td>31,000</td>
<td>31,000</td>
<td>31,000</td>
<td>31,000</td>
<td>31,000</td>
</tr>
<tr>
<td>iv) Insurance + Stor.**</td>
<td>12,400</td>
<td>12,400</td>
<td>12,400</td>
<td>12,400</td>
<td>12,400</td>
</tr>
<tr>
<td>v) Fuel and Oil ***</td>
<td>28,800</td>
<td>28,800</td>
<td>28,800</td>
<td>28,800</td>
<td>28,800</td>
</tr>
<tr>
<td><strong>LABOUR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Skilled</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
</tr>
<tr>
<td>ii) Casual</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
</tr>
<tr>
<td><strong>RAW MATERIAL</strong></td>
<td>466,560</td>
<td>466,560</td>
<td>466,560</td>
<td>466,560</td>
<td>466,560</td>
</tr>
<tr>
<td><strong>O.C. CAPITAL</strong></td>
<td>19,350</td>
<td>41,603</td>
<td>67,193</td>
<td>96,622</td>
<td>130,465</td>
</tr>
<tr>
<td>Management Input</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td><strong>TOTAL COST</strong></td>
<td>757,710</td>
<td>655,963</td>
<td>681,553</td>
<td>710,982</td>
<td>744,825</td>
</tr>
<tr>
<td><strong>NET CASH FLOW</strong></td>
<td>(135,630)</td>
<td>(33,883)</td>
<td>(59,473)</td>
<td>(88,902)</td>
<td>(122,745)</td>
</tr>
<tr>
<td><strong>CUMULATIVE CASH FLOW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Repair and maintenance @ 25% or purchase price.

** Insurance and storage @ 10% of purchase price

*** @ 3 l/hr of diesel oil
## ANNEX 13

**MOTORISED SCREW EXPELLER**

**CASH FLOW ANALYSIS**

**WITH A LOAN ELEMENT**

**OIL CROP:** Coconut (Matuga case)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REVENUES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Oil</td>
<td>584,640</td>
<td>584,640</td>
<td>584,640</td>
<td>584,640</td>
<td>584,640</td>
</tr>
<tr>
<td>ii) Cake</td>
<td>37,440</td>
<td>37,440</td>
<td>37,440</td>
<td>37,440</td>
<td>37,440</td>
</tr>
<tr>
<td>iii) Soap Stock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL REVENUE</td>
<td>622,080</td>
<td>622,080</td>
<td>622,080</td>
<td>622,080</td>
<td>622,080</td>
</tr>
<tr>
<td><strong>COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MACHINE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Purchase</td>
<td>37,600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) Expeller</td>
<td>12,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii) R.A.M. **</td>
<td>31,000</td>
<td>31,000</td>
<td>31,000</td>
<td>31,000</td>
<td>31,000</td>
</tr>
<tr>
<td>iv) Insurance + Stor.</td>
<td>12,400</td>
<td>12,400</td>
<td>12,400</td>
<td>12,400</td>
<td>12,400</td>
</tr>
<tr>
<td>v) Fuel and Oil ***</td>
<td>28,800</td>
<td>28,800</td>
<td>28,800</td>
<td>28,800</td>
<td>28,800</td>
</tr>
<tr>
<td><strong>LABOUR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Skilled</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
<td>10,800</td>
</tr>
<tr>
<td>ii) Casual</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
<td>4,800</td>
</tr>
<tr>
<td><strong>RAW MATERIAL</strong></td>
<td>466,560</td>
<td>466,560</td>
<td>466,560</td>
<td>466,560</td>
<td>466,560</td>
</tr>
<tr>
<td><strong>O.C. CAPITAL</strong></td>
<td>7,740</td>
<td>16,640</td>
<td>26,377</td>
<td>38,649</td>
<td>52,182</td>
</tr>
<tr>
<td>Management Input</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td>TOTAL COST</td>
<td>671,700</td>
<td>631,000</td>
<td>641,237</td>
<td>653,009</td>
<td>666,542</td>
</tr>
<tr>
<td><strong>LOAN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disbursement</td>
<td>74,400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal</td>
<td>(38,700)</td>
<td>(38,700)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td>(11,610)</td>
<td>(5,805)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NET CASH FLOW</td>
<td>(25,530)</td>
<td>(53,425)</td>
<td>(19,157)</td>
<td>(30,929)</td>
<td>(44,462)</td>
</tr>
<tr>
<td>CUMULATIVE CASH FLOW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Loan Element of 60% of purchase price repayable over two years @ 15% p.a.
** Repair and maintenance @ 25% of purchase price
*** @ 3 l/hr of diesel oil

---

**BEST AVAILABLE DOCUMENT**

171
# Motorized Screw Expeller

**Oil Crop:** Coconut (Dried Copra)  
**Annex 14**

<table>
<thead>
<tr>
<th>Matuga</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Throughput</strong></td>
<td></td>
</tr>
<tr>
<td>a) kg/hr</td>
<td>54</td>
</tr>
<tr>
<td>b) kg/yr</td>
<td>77,760</td>
</tr>
<tr>
<td><strong>2. Oil Yield</strong></td>
<td></td>
</tr>
<tr>
<td>a) l/kg</td>
<td>0.52</td>
</tr>
<tr>
<td>b) l/hr</td>
<td>28</td>
</tr>
<tr>
<td>c) l/yr</td>
<td>40,320</td>
</tr>
<tr>
<td><strong>3. Cake Output</strong></td>
<td></td>
</tr>
<tr>
<td>a) kg/hr</td>
<td>26</td>
</tr>
<tr>
<td>b) kg/yr</td>
<td>37,440</td>
</tr>
<tr>
<td><strong>4. Prices</strong></td>
<td></td>
</tr>
<tr>
<td>a) raw material</td>
<td>6.00</td>
</tr>
<tr>
<td>b) oil kshs/l</td>
<td>14.50</td>
</tr>
<tr>
<td>c) cake kshs/kg</td>
<td>1.00</td>
</tr>
<tr>
<td>d) stock kshs/</td>
<td></td>
</tr>
<tr>
<td><strong>5. Fuel+Oil: l/hr</strong></td>
<td>3.00</td>
</tr>
</tbody>
</table>

**Assumptions**

i) 6 hrs/day; 240 days/yr; 1440 hrs/yr  
ii) Labor:  
   (a) Skilled @ 30.00/day  
   (b) Unskilled @ 20.00/day  
   (c) Total labour cost: 15,600.00 p.a.  
iii) Repair, maintenance and storage costs at 20% of purchase price.  
iv) Interest rates of 15%
AFRICARE ZAMBIA

BIELENBERG RAM PRESS: OUR EXPERIENCE

PRESENTED AT THE BIELENBERG RAM PRESS CONFERENCE,
SEPTEMBER 10TH - 11TH, 1990
NAIROBI, KENYA

PRESENTED BY
Joseph K.T. Lungu
AGRIBUSINESS TRAINING OFFICER

Africare/Zambia
Box 33921
Lusaka, Zambia

Africare/Washington
440 R Street, NW
Washington, DC 20001
I. INTRODUCTION

Africare is a private, nonprofit organization, dedicated to improving the quality of life in rural Africa. Since 1971, Africare has helped Africans grow more food, develop water resources, improve health services and protect the environment. Africare has also provided emergency assistance to refugees and drought victims.

II. EDIBLE OIL PRODUCTION IN ZAMBIA

The edible oil supply in Zambia is far from being adequate. Oil becomes increasingly scarce as one goes from town centers to rural areas. Zambia's annual production of cooking oil falls short by 50% of meeting the domestic demand. This shortfall is partly created by the low production of oilseed by farmers. Sunflower production has slumped in recent years mainly because of low farmgate prices fixed by the government. The pity of it all is that the small-scale farmers who are the producers of sunflowers, soybeans and groundnuts are the last ones to be supplied with oil.

The Bielenberg ram press seems to be the villager's reliable friend in this situation of short oil supply. The Bielenberg ram press is simple to operate, simple to maintain, and most suitable for small-scale production of oil.

III. AFRICARE/ZAMBIA AND THE BIELENBERG RAM PRESS

Africare bought two presses from Arusha, Tanzania in 1988. Because of differences in seed types (i.e. those found in Zambia were thick hulled seeds) modification was necessary to the original presses. The Technology Development Advisory Unit of the University of Zambia (TDAU-UNZA) worked on increasing the machines working advantages and operational efficiency. This modification program was funded by USAID/Zambia. A "new look" Bielenberg ram press is now available through TDAU.

Notable changes made to the original press are as follows:

- HANDLE - is bent rather than straight
- RESTRICTOR - from cone to flat
- PISTON - has been fitted with a sleeve
- PISTON SIZES - 42mm, 39mm, 33mm diameters to suit seed types
- DIRT CHAMBER - has been provided
- HOPPER - has no neck
- CAGE BARS - have been arranged spirally

The main objective, therefore, of promoting production of edible oil via the ram press is:
a) To assist rural communities in meeting their cooking oil requirements. This would make it unnecessary for the villagers to travel large distances for oil. Oil plays an increasingly important role in the diets of rural people.

b) The rural communities would run these oil production units as businesses in order to raise income. Mainly women and youth groups have been encouraged to participate under this programme.

**SPECIFIC PROJECTS**

**MAKOWA OIL PROJECT**

**Location:** Eastern part of Zambia, 450 kilometers from Lusaka.

The first Bielenberg ram press distributed by Africare in Zambia was at Makowa village where a 37 member association called the Kowanani Association of Small-Scale Farmers and Manufacturers has been established.

Sponsored by Africare's USAID Matching Grant Agribusiness programme, the main aim of the project was:

a) Establishment of a business that would process sunflower and sell oil and cake.

b) To bring oil closer to the people of Makowa area. The catchment area covers people.

On March 28, 1989, a brief training on the operation of the press was held for the operators and members of the committee. Production records such as Daily Oil Production Record (date, weight of seed crushed, oil produced) and Daily Oil Stocks were set up. Also a receipt book and cashbook were introduced.

On 29/3/89, sunflower processing and oil production started. After ten months of production, i.e., up to the end of May, 1990 (there was no production during the months of August, November, and December of 1989), production figures were as follows:

- 5568 kg sunflower seed crushed
- 986.5 liters oil produced
- Avg. of 0.18 liters per kilogram of seed, or 9 liters per 50 kg bag.
The following summarizes Makowa's oil production.

<table>
<thead>
<tr>
<th>Month</th>
<th>Seed Crushed (kg)</th>
<th>Oil Produced (l)</th>
<th>Est. Cake (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar/Apr 1989</td>
<td>790</td>
<td>182.5</td>
<td>395</td>
</tr>
<tr>
<td>May 1989</td>
<td>1035</td>
<td>224.0</td>
<td>517</td>
</tr>
<tr>
<td>June 1989</td>
<td>795</td>
<td>125.5</td>
<td>397</td>
</tr>
<tr>
<td>July 1989</td>
<td>510</td>
<td>75.0</td>
<td>255</td>
</tr>
<tr>
<td>August 1989</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>September 1989</td>
<td>415</td>
<td>65.5</td>
<td>208</td>
</tr>
<tr>
<td>October 1989</td>
<td>23</td>
<td>4.5</td>
<td>12</td>
</tr>
<tr>
<td>November 1989</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>December 1989</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dec/Jan 1990</td>
<td>850</td>
<td>146.0</td>
<td>425</td>
</tr>
<tr>
<td>February 1990</td>
<td>500</td>
<td>58.0</td>
<td>250</td>
</tr>
<tr>
<td>March 1990</td>
<td>300</td>
<td>48.5</td>
<td>150</td>
</tr>
<tr>
<td>April 1990</td>
<td>350</td>
<td>57.5</td>
<td>175</td>
</tr>
<tr>
<td>Totals</td>
<td>5560</td>
<td>986.5</td>
<td>2784</td>
</tr>
</tbody>
</table>

NB: There has been no production since May, 1990 to date due to non-availability of seed. Members have not yet delivered the seed to the press. About 115 x 50 kg bags are expected. In August, November and December, 1989 workers (operators) did not work due to disagreements with the committee.

During January, February, and March, 1990 the production faced two problems.

(i) Seed was of very poor quality
(ii) The work was done at night to allow the operators to attend to their gardens during the day.

PROBLEMS ENCOUNTERED

(a) Seed supply

The quality of seed used in the press has been of low quality. The Association used seed bought from other villagers - this was local seed. The seed was stored in traditional bins for nearly one year before it was used. Even though a sample of the seed indicated an oil content of 34%, the age of the seed affected oil produced. Forty bags of hybrid seed bought from the District Cooperative Union in November 1989 was partially soaked or germinated. It was suspected to have been stored for a long time before it was sold. The amount of oil produced between December and April shows the effects.

(b) Ram Press Maintenance

A tucked welding of the cylinder sleeve kept coming out and the villagers cleverly improvised by holding it in position with
bolts. During a further modification, TDAU slipped a sleeve over the piston which would later be the replaceable part of the piston. This tucked sleeve keeps coming out and remains in the cylinder whenever the operators apply too much pressure on the handle.

(c) Wear and Tear

The initial piston and cylinder that went with the press on March 28th, 1989 was replaced due to increased clearance on the piston and cylinder after 4918 kg of seed was crushed. NB: With proper training for basic maintenance and with supply of the essential parts (the piston sleeve and bushings/cylinder) the ram press would continue to work without stoppage for a longer time.

(d) Production Supervision

The association's supervision of the operators was very lax and this contributed to lower production, for example:

- The association failed to set weekly production targets
- They did not review production to find reasons for very low production or high production
- The operators worked so independently that they could "hide" some liters of oil for personal use.

(e) Oil Availability

The ram press has been able to supply oil to people living in villages up to a radius of 15 to 20 km, including people from a nearby refugee center. The oil supply is insufficient to satisfy everybody. Thus the demand for more oil is still there.

(f) Sunflower Cake

Not much interest has been shown by the local people in using the sunflower cake to feed their livestock. Traditionally, these villagers do not own much livestock except pigs, goats and fowl. Traditionally too many people here do not prepare special feeds for their animals, especially cattle. The idea of providing livestock feed is new and needs to be systematically introduced to the farmers. At present, cake value would range between USD 0.12 and 0.24 per kg. On average, every kg of sunflower yields 0.6 kg to 0.8 kg of cake.

(g) Increased Sunflower Production

In 1987 the Association grew 5 hectares of sunflower after being promised the press. In 1988, due to the press not being available to the association, no sunflower was grown. In 1989, 15 hectares out of which 100-115 bags of sunflower are expected to be grown. (This yield is due to poor rainfall in the 1989/90 season.)
THE SOUTHERN PROVINCE SUNFLOWER OIL PROJECT

This edible oil project in which Africare has proposed the use of the ram press technology in oil production started in the Southern province of Zambia in June, 1989. It covers seven districts and in year 3, 1992, Africare hopes to have established 21 ram presses. The oil presses will be given to the groups, on a medium term loan basis. Also to be supplied under a medium term loan will be materials for building the press houses. One of the commercial banks (Lima Bank) will collect all monies paid back into a revolving fund. Lima Bank has also agreed to provide a seasonal loan for sunflower seed and fertilizer. This project is being funded by USAID and NORAD. This will eventually involve the establishment of 21 oil business groups, mainly involving women. It is hoped that at the project's completion, 60,000 liters will be produced annually by these enterprises. This oil will benefit an estimated 4000 adults and school children. At present oil prices, the value of the oil will be nearly K2 million.

ESTABLISHMENT

So far, 14 women and youth groups have been established. After the press was demonstrated to them all, the groups grew 15 hectares of sunflower each, initially expecting a yield of 9,000 kg per group. The yield, however, turned out to be very poor due to poor rainfall. On average, the groups expect to harvest 20-40 bags of sunflower (1,000-2,000 kg). Fourteen new look ram presses have been installed at fourteen sites - two presses per district.

EVALUATION OF PRODUCTION

The first evaluation seminar to assess progress and problems being encountered in production by the groups will be held at the end of September, 1990.

IN CONCLUSION

A demonstration show of the ram press has been conducted by Africare in various communities, especially in the Southern province. TDAU through Africare has displayed and demonstrated the working of the ram press at national agricultural shows during the last two years. The ram press has also been taken to sunflower field days in order to show its place where sunflower production is concerned. The exposure of the Bielenberg ram press has attracted a lot of interest from the public. Many people have been asking the price of the press and where it can be obtained. To many farmers, both small and large, who are out of town this technology is a big attraction. I bet, given the right quality of seed, either sunflower or groundnuts, many more liters of oil would flow where they never used to flow in the rural area. But if the machine is to really benefit the poor rural person - its shelf price will really need to be affordable.

178
VEGETABLE OIL/PROTEIN SYSTEM PROGRAMME
THE KENYAN EXPERIENCE

JAMES K. MUTHAKA

1. INTRODUCTION

The purpose of this paper is to share with workshop participants the experience of designing, developing and implementing the Vegetable Oil/Protein System (VOPS) program in Kenya, including the various steps taken, the different actors participating and some of the results being obtained. Emphasis is on the potential role of small-scale rural oilseed processing technology in the development of the oil/protein system in Kenya.

The integrated approach being followed to characterize, analyze and generate research and policy interventions of the oil/protein Production, Processing, Marketing and Utilization (PPMU) system has as its main objective the generation of an awareness on the work being done, the appraisal of its usefulness and, the assessment of its potential for implementation in Kenya and other developing countries. A partial objective is to generate a methodology for sectoral development with potential for application in other agricultural sectors in Kenya.

2. OILCROP DEVELOPMENT IN KENYA AND THE INTERNATIONAL ENVIRONMENT

It is worthwhile to start by making a few observations about the edible oil and livestock industries in Kenya. The country is still heavily dependent on imported raw materials for edible oils with importation covering about 80 percent of domestic utilization including the requirements for soaps and detergents. The level of foreign exchange expenditure is the highest among imported agricultural commodities. Imports are mainly palm oil. Moreover, the country is also forced to import protein cake, a by-product of oilseed processing that is used for formulating animal feeds for the growing livestock industry.

However, in spite of this level of importation, domestic per capita consumption is well below the world average and dietary energy obtained from oils/fats is below the amount recommended. On the other hand, per capita consumption of oils and fats in rural areas is much lower mainly due to inadequacy of incomes and supply constraints. At the same time, the country has a wide variety of oilcrops that are grown or can be grown in several agroecological zones. However, the area planted to oilcrops remains low. Current estimates put it at less than one percent of total cropped area. Oilcrop production is further reduced by low yields and poor returns relative to other crops and livestock activities.

Looking into the future, population growth and its spatial redistribution will increase the demand for oil and cake. Increases in per capita incomes and changes in tastes and
preferences that accompany these changes will further add to this
growth in demand. The level of importation is therefore expected
to continue growing.

As an importing country we have to consider the international
market situation from which we import. World market prices for
oilseeds, oil and oilmeals are characterized by huge price
variations and unpredictability. This observation is supported by
Figure 1 which uses palm oil, the main imported raw material, as an
example. A similar situation exists for cake as shown in Figure 2,
which uses soybean meal as an example.

These fluctuations in prices have implications for the future
development potential of the domestic oilcrop sector, as
illustrated by the discussion in the East African Regional Office
of the International Development Research Centre in October 1987.
The main concern was whether IDRC should continue supporting
activities in oilcrop research when its future looked so bleak.
Was it worthwhile to promote domestic oilcrop production,
processing and utilization in view of these factors? What were the
possible areas for improvement, if any?

Based on discussions held with a number of informed Kenyans
from Government, research institutes, industry and a potential
international consultant, the need for a four stage investigation
aimed at establishing the economic as well as technical feasibility
of oilseed production and processing -- with particular reference
to the market for animal feed -- was identified.

The four stages in the process of investigation were:

a) A review of information pertaining to the oil/protein system
in order to formulate a proposal for carrying out a complete
investigation of the existing system (3 months).

b) A detailed study of the various components of the oil/protein
system with the aim of identifying the principal economic,
technical and institutional factors affecting the economic and
technical feasibility of oilseed production and processing in
Kenya (8-9 months).

c) Based on the results of the above-mentioned study, a series of
field trials related to selective aspects of oilseed
production and processing (2 years).

d) On the basis of the above mentioned research, and in
conjunction with government authorities, farmer organizations,
enterprises in the food industry, and other donor agencies,
specification and implementation of a program to expand Kenyan
production and processing of oilseeds (2+ years).
Figure 1: Palm Oil Prices
Sum/Mol, cif N.W. Eur.

US$/MT (Thousands)

YEARS

- Data
- 20 yrs
- 15 yrs
- 10 yrs
- 5 yrs
3. EXPERIENCE AND LESSONS FROM THE VOPS (K) PROGRAMME
   BASIC CONCEPTS OF THE PROGRAMME

   a) THE SYSTEMS APPROACH

   The oil/protein subsector was conceptualized as a system with several interacting components which have to be analyzed to be able to properly describe and understand it. It was envisaged that by following a systems approach it would be possible to identify those research and policy interventions required to modify the oil/protein subsector to better satisfy national objectives without unexpected and undesirable effects. At the same time the complementarity and conflicts between the components were to be analyzed for the purpose of programming sectoral development.

   b) INCREMENTAL PROCESS TO RESEARCH SUPPORT

   From the start, the VOPS programme was meant to follow an incremental process whereby each step of the investigation was predicated on prior demonstration, from the results of the previous stage, that oilseed production and processing cannot be ruled out on economic grounds. The concept of an incremental process also connotes the notion that knowledge and understanding of systems and the social, economical and political environment in which they evolve must be generated sequentially -- step by step -- because tomorrow's research cannot be properly defined until today's results are out. In other words, the investigations required to generate meaningful results and improved recommendations must be based in previous accumulated experience and the continuous assessment and improved understanding of an ever-changing reality.

   The first step in following the incremental process was taken in November, 1987 by retaining the services of a consultant -- through a Divisional Activity Project (DAP) -- to prepare a report leading to the identification of a possible research project on the feasibility of oilseed production and processing for edible oils and protein cake in Kenya.

   The Divisional Activity Projects (DAP) provide an IDRC internal mechanism for the financing of relatively low cost activities leading, in most cases, to the identification and development of full fledged projects.
The table below shows the various steps which have followed the initial one, and how the programme and its financing have developed since then.

**THE INCREMENTAL PROCESS APPLIED TO THE FINANCING OF THE VEGETABLE OIL/PROTEIN SYSTEM PROGRAMME IN KENYA**

<table>
<thead>
<tr>
<th>VOPS Programme Terminology</th>
<th>IDRC Terminology</th>
<th>Amount Approved Canadian Dollars</th>
<th>Effective Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>DAP 1</td>
<td>16,400</td>
<td>November, 1987</td>
</tr>
<tr>
<td></td>
<td>DAP 2</td>
<td>26,060</td>
<td>February, 1988</td>
</tr>
<tr>
<td></td>
<td>Extension</td>
<td>9,555</td>
<td>April, 1988</td>
</tr>
<tr>
<td>Stage II</td>
<td>Phase 1</td>
<td>234,100</td>
<td>May, 1988</td>
</tr>
<tr>
<td></td>
<td>Phase 2</td>
<td>223,100</td>
<td>February, 1989</td>
</tr>
<tr>
<td>Stage III</td>
<td>Core Phase 3</td>
<td>641,000</td>
<td>September, 1989</td>
</tr>
<tr>
<td></td>
<td>Satellites DAP 3</td>
<td>6,000</td>
<td>September, 1988</td>
</tr>
<tr>
<td></td>
<td>DAP 4</td>
<td>8,000</td>
<td>January, 1989</td>
</tr>
</tbody>
</table>

The consultancy was carried out as expected and the report was discussed on the 24th of January, 1988 and a presentation made at the Fourth Oil Crops Network Workshop at Njoro, Kenya from the 25th to the 29th of January, 1988. The main output from this initial exercise was the general characterization of the oil/protein system which was represented by a diagram (Figure 3) showing seven major interrelated components, including the policy environment.

The gathering at Njoro was attended by several Kenyan professionals from universities, ministries, research institutes and the private sector plus a sizable representation of IDRC staff including the Deputy Director, two Associate Directors and several Programme Officers of AFNS and the Regional Director for East Africa. The interest demonstrated by the Kenyan professionals in the subject made IDRC confident of the need for the continuation of the investigation -- following the previously described incremental process -- by carrying out a comprehensive study of the various components of the system.

Egerton University through its Division of Research and Extension showed the interest and willingness to assume the leadership and coordination responsibility and became the recipient of the second DAP. To develop the proposal for the comprehensive study of the sub-sector, two workshops were organized with the participation of about 50 Kenyan professionals. They were held on February 16 and March 15, 1988. The participants of these workshops organized themselves into seven groups following the
FIGURE 3: THE CHARACTERIZATION OF THE OIL/PROTEIN SYSTEM IN KENYA

- OILSEED PRODUCTION
  - FATS AND OILS INDUSTRY
  - RURAL PROCESSING
    - ANIMAL FEED INDUSTRY
      - DAIRY PRODUCTION
      - POULTRY & PIG PRODUCTION
        - PRESENT CONSUMPTION OF MILK & MILK BY-PRODUCTS
        - PRESENT CONSUMPTION POULTRY & PIG PRODUCTS
          - FUTURE DEMAND FOR MILK & MILK BY-PRODUCTS
          - FUTURE DEMAND POULTRY & PIG PRODUCTS
    - PRESENT CONSUMPTION OF EDIBLE FATS & OILS
      - FUTURE DEMAND FOR EDIBLE FATS & OILS

POLICY ENVIRONMENT
INTERNATIONAL MARKETS
FUTURE DEMAND
characterization of the subsector (see Figure 4), under the leadership of carefully selected group team leaders representing a wide spectrum of institutions and professional expertise. The participating professionals and their institutions are shown in Table 1.

Each group generated a workplan for the next month, having as the main objective the preparation of a proposal and a budget to carry out the investigations related to their main area of interest. The draft proposals prepared by the groups were used to develop a unified and definitive proposal which was presented to IDRC for consideration on April 15, 1988. The objectives of the research project became known as Vegetable Oil/Protein System (Kenya) (VOPS), Phase I.

The various groups visited farmers, extension agents, local authorities, managers of crushing plants and refineries, feed millers, government officials, etc. They gathered primary and secondary information and by October 29, 1988 presented their preliminary results in a seminar which was held in Nairobi with the participation of special guests, mostly from government agencies. As can be seen from Figure 3, one of the components that was investigated was rural oilseed processing. The main objective was to investigate the extent and magnitude of small-scale rural oilseed processing in Kenya.

One of the key research interventions arising from the field investigation was the generation of rural processing technology packages adjusted to local conditions that would require the participation of professionals in various subject matters, such as agricultural engineering, agriculture, animal production, home economics, and agricultural economics. This would ensure that the dissemination process was properly designed, taking into consideration the production of oilseeds that are easy to crush at the rural level, the economics of processing, the utilization of oil and cake obtained by humans and animals respectively, and the marketing of surpluses.

Phase I generated more interest and enthusiasm among Kenyan scientists, administrators and policy makers than expected, pulling the project along faster than anticipated. To meet this high level of interest, a "bridging" phase -- to consolidate achievements and complete Phase II -- was conceived until Phase III was approved and fully operational.

The general objective of this bridging phase was to develop the institutional base and coordination capacity of Egerton University to ensure that ongoing oil/protein system research in Kenya met national need in an efficient and sustainable manner.

A Phase III project proposal was prepared and presented to IDRC for financing in April, 1989, approved by the Board of Governors in June, and became effective on the 7th of September, 1989.
FIGURE 4: STUDIES OF THE VEGETABLE OIL/PROTEIN SYSTEM IN KENYA
PRODUCTIVE, INDUSTRIAL AND CONSUMPTION ACTIVITIES

BEST AVAILABLE DOCUMENT
<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>MINISTRIES</th>
<th>PARASTATALS</th>
<th>UNIVERSITIES</th>
<th>PRIVATE ENTERPRISE</th>
<th>IDRC</th>
<th>RESEARCH ASSISTANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agriculture Livestock Industry Development</td>
<td>KARI</td>
<td>KIRDI</td>
<td>Edgerton</td>
<td>Nairobi</td>
<td>Oil Crop</td>
</tr>
<tr>
<td>General Coordination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oilseed Production</td>
<td>Kivuthu</td>
<td>Oggema</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fats &amp; Oils Industry &amp; Consumption</td>
<td>Tuamwari</td>
<td>Oggema</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Feed Industry</td>
<td>Bartilol</td>
<td>Oggema</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dairy Production &amp; Consumption</td>
<td>Waamwamba</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poultry &amp; Pig Production &amp; Consumption</td>
<td>Gichohi</td>
<td>Oggema</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policy Environment, Int Markets and Future Demand</td>
<td>Githu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm &amp; Trading Center Processing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Group Leaders
Based on the experience of the previous research stages, a two tier approach was proposed for Phase III for the future research process to be consistent with governmental objectives:

- The first tier is a core unit which includes an analytical group, which will facilitate the integration and coordination of an evolving research program, and support a continued systematic sharing of research results with policy and decision makers, researchers, and other main actors in the oil/protein system;

- The second tier consists of a collection of satellite projects to carry out distinct, though linked, in-depth applied research. Each project addresses itself to the intervention points identified within the seven components of the system. These projects are separately funded and implemented under the coordination of Egerton University as part of an integrated national research network.

DAPs 3 and 4 were generated to finance the purchasing of a manually operated ram press and an engine-driven expeller for laboratory experimentation. DAP 2 financed the field experimentation required to start the process of designing a methodology for the diffusion of the oil extraction technology at the rural level. These efforts were related to the preparation of one of the satellite projects -- rural oilseed processing in Kenya. During the field demonstrations, the ram press and the expeller were both well received by the rural population visited, thereby creating an incentive for further investigation.

A satellite project on oilseed processing was prepared by the staff of the Department of Agricultural Engineering of Egerton University. The project was submitted to IRC and approved for funding and is now operational under the third phase of the VOPS program. The project aims to develop a methodology for wider dissemination of a complete technology package which included small-scale hardware, knowledge of rural utilization of oil and of the protein cake, and experience with the small-scale equipment as a rural enterprise. The current research agenda in this project will be the theme of the presentation by my colleague Mr. Mugeto, who is team leader for that project.
THE RAM SUNFLOWER OIL PRESS: A MICROPROJECT IN THE SOKOINE UNIVERSITY EXTENSION PROJECT [S.E.P]

by

MIRAJI NGETTI


Agricultural Officer - Institute of Continuing Education, Sokoine University of Agriculture.

191
BACKGROUND TO THE S.E.P.

The Sokoine University Extension Project (S.E.P.) was initiated in 1988 because of experiences drawn from the existing extension situation in Tanzania in which:

(a) Extension and farmer education are regarded as the most important inputs into agricultural development;

(b) The performance of the extension service in the past ten years has been disappointing because of poor management and leadership and the absence of effective work programs and evaluation procedures;

(c) Extension staff seem to be strongly oriented toward regulatory work almost to the exclusion of its farmer education role.

The Project (SEP) is a collaborative effort between the Institute of Continuing Education of the Sokoine University of Agriculture and the Department of Agricultural Extension, University College, Dublin, Ireland.

SEP is a pilot project with the main objective of restructuring the extension service at village level, retrain staff and develop and effective operational procedure.

The project has operations in three major areas:

(a) An ongoing retraining program which will enable village level extension workers to acquire the expertise necessary to operate effectively.

(b) Extension field work which includes the implementation of acceptable development programs with the target villages. Programs (referred to as microprojects) which have been initiated thus far and ongoing include oxen use; use of low-cost agricultural inputs such as compost manure, marejea (Crotalaria ochroleuca) and agroforestry practices; promotion of horticulture; and introduction of ram sunflower oil press and promotion of RECORD sunflower cultivation.

(c) An ongoing monitoring and evaluation program.

The project operates in 40 villages in the Morogoro Region. It draws active support from the District Extension Service as well as from the Regional level.

It is hoped that farmers in the project villages will get the benefit of the improved performance of their extension staff; initiation and introduction of various development programs; and
generally improved packages which will lead to higher production and improved standards of living.

**INTRODUCTION OF THE OIL PRESS**

The innovation development process consists of all the decisions, activities, and their impacts that occur from recognizing a need or problem, through research development, and commercialization, through diffusion and adoption of the innovation by users, to its consequences.

The sunflower oil press microprojects were introduced into the project (SEP) in a bid to help farmers realize some income from their sunflower after the failure of the marketing system in the country. It was becoming evident that the level of production of sunflower as a cash crop was dropping. Thus, the project coordinators thought that the ram press could provide a remedy for this problem in that it would promote sunflower production as well as provide a cheap source of cooking oil.

So far there are fifteen villages with ram oil presses. They were supplied in three installments: the first in mid-May, 1989, the second in August, 1989, and the third in December of the same year. The oil press microprojects have been well received in these villages and there is evidence that production of sunflower is rising as a consequence.

Technological innovations are promoted to improve the efficiency of production or production potential of an agricultural commodity. In Tanzania, the price of sunflower seed is T. Shillings 30 per kilogram. On the other hand, 50 kilograms of seed (at an average price of Tsh 90 per kg) give an average of 15 liters of oil, which fetches Tsh 4,500 at Tsh 300 per liter. Thus, processing of sunflower seeds adds value of Tsh 60 per kilogram. This is very remarkable aside from the fact that sunflower oil has a ready market within the villages. Furthermore, the sunflower oil pressing activity utilizes off-season labor would otherwise be underutilized.

**NEW DEVELOPMENTS/ADAPTATIONS**

An elite farmer has developed, from the Bielenberg idea, a motor-driven oil press. The farmer, Mr. Ephara Metta, owns a workshop jointly with Mr. Alexander Mboya with some metal working machines. Mr. Metta first tried a screw-type oil press, which he later discarded in favor of the piston type. The press is in every way similar to the Bielenberg press, with the exception that it is driven with the axle shaft of an old Fordson Tractor Motor.
Power is generated by a 10 HP diesel engine (or motor). The engine speed of 3000 RPM is reduced through a mechanism of gears to a desired level at the axle drive. The tractor gear system is also used to vary the speed of the piston according to requirements.

This elite farmer/engineer has also thought of times when sunflower is not adequate to warm the sunflower before pressing. In such circumstances, a charcoal burner with a few pieces of charcoal is placed under a chimney which opens onto a wide tray containing sunflower seed. Heat is continuously generated by putting the seed residue from the press on the fire. A sieve has also been added to filter out chaff before the oil is collected in a bucket.

Mr. Metta collaborates with staff of the Agricultural Engineering and Land Planning Department of the Sokoine University of Agriculture. Staff of this department who were closely involved in this development include Dr. T.E.M. Simalenga, Dr. N. Hatibu and Mr. V.C. Silayo. But behind all this is a young engineer, Mr. Ainamani Kimambo, who is a form four (ordinary level secondary school) graduate from Minja Technical Secondary School, specializing in Civil Engineering.

At the end of our conversation, Mr. Metta said that given resources, mostly mild steel channels, plates and bolts, and given the readily abundant scrap tractor transmission units, he can make approximately ten units per month.

Although this improvement is desirable, the original hand operated (manual) type press should be maintained as it is ideal for the small scale and poor farmers who form the majority of our rural population.
A STATUS REPORT

Presented at the Bielenberg Ram Press Conference, September 10-11, 1990, at the Jacaranda Hotel, Nairobi, Kenya

By:

Dr. Edison W. Rugumayo
Project Consultant
EXPERIMENT IN INTERNATIONAL LIVING
AGRICULTURAL PROCESSING MACHINERY PROJECT
1.0 INTRODUCTION

Since no specific written report was submitted to the February 20, 1989 meeting on the Oil Seeds and the Bielenberg Ram Press, it is necessary to introduce the project first. The project was initiated in April, 1988 by the Experiment in International Living (EIL) and sponsored by U.S.A.I.D. The objectives of the project are to introduce and adapt simple, highly efficient, affordable and manageable technologies for small-scale processing and manufacturing of vegetable cooking oils and sugar by local farmers for use in Uganda.

During the first one year phase of the project period, vegetable oil extraction from some oil seeds was studied and a baseline survey of Uganda's edible oil production carried out. The results of the study showed that cost benefit ratios for different oil extraction technologies vary from one oil seed to another. Hence, the project initially concentrated on one oil crop, sunflower, because of its high oil content, relatively inexpensive production cost and consumers preference as opposed to other crops. Mechanical methods for oil extraction from sunflower seeds were selected.

2.0 MECHANICAL METHODS INVESTIGATED:

Three different types of small oil expellers using two different principles (the screw and the piston) were imported into the country for comparative performance tests to fulfill the above stated objectives.

2.1 Simon Rosedown Mini 40

This expeller operates on the screw principle and has a capacity of 40 kg of sunflower seeds per hour. A 6.84 horsepower lister petter diesel engine powers the expeller. The cost of the Mini 40 and the engine C.I.F. Entebbe Airport was U.S. Dollars 14,072.

2.2 The Komet Screw Oil Expeller DD 85 G

This expeller has a throughput of 15 kg of sunflower seed per hour and is driven by a motor of 1.8 horsepower or 1.34 kW. It costs $US 6,532 C.I.F. Entebbe Airport. It operates on the same principle as the Mini 40.

2.3 Bielenberg/Fisher Ram Press

This press operates on the piston principle and has an estimated throughput of 10 kg of sunflower seed per hour. It is manually operated and costs $US 1,718 to import. The same
press was locally fabricated at a cost of $US 275. The locally fabricated press has been modified. The modifications include:

2.3.1. An increased handle length of 195 cm instead of 145 cm for the imported Bielenberg/Fisher press;

2.3.2. The new handle included three crossbars at distances of 105, 150, and 195 cm from the pivot pin which led to an increase in press pressure of about 50%;

2.3.3. The elaborately machined steel bushing connecting the pin to the tie bars at the pivot end was replaced with a simple steel bushing. This simplified press manufacture and reduced time and cost;

2.3.4. The piston and pin diameter was increased from 37 mm to 50 mm in order to accommodate the threaded tie arms. The performance of the three types of presses is shown in Tables 2.1 and 2.2 where grey and white striped seeds and black coated peredovick seeds were used for comparison.

**TABLE 2.1**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Mini 40 Press</th>
<th>Komet Press</th>
<th>Local Ram Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crushing Capacity, kg/hr</td>
<td>40</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Oil Extraction Rate, %</td>
<td>16.1</td>
<td>25.3</td>
<td>17.3</td>
</tr>
<tr>
<td>3</td>
<td>Oil Extraction Efficiency, %</td>
<td>38.9</td>
<td>61.1</td>
<td>42.2</td>
</tr>
<tr>
<td>4</td>
<td>Residue Oil in Cake, %</td>
<td>33.7</td>
<td>26.8</td>
<td>31.7</td>
</tr>
<tr>
<td>5</td>
<td>Cake Portion of Seed, %</td>
<td>75.0</td>
<td>60.0</td>
<td>76.0</td>
</tr>
</tbody>
</table>
TABLE 2.2

Performance of three oil expellers using grey and striped seed with whole seed oil content of 38%.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Mini 40 Press</th>
<th>Komet Press</th>
<th>Local Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crushing Capacity, kg/hr</td>
<td>40</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Oil Extraction Rate, %</td>
<td>18.3</td>
<td>23.1</td>
<td>16.6</td>
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<tr>
<td>3</td>
<td>Oil Extraction Efficiency, %</td>
<td>48.2</td>
<td>60.8</td>
<td>44.2</td>
</tr>
<tr>
<td>4</td>
<td>Residue Oil in Cake, %</td>
<td>27.4</td>
<td>21.3</td>
<td>27.2</td>
</tr>
<tr>
<td>5</td>
<td>Cake Portion of Seed, %</td>
<td>76.0</td>
<td>70.0</td>
<td>78.0</td>
</tr>
<tr>
<td>6</td>
<td>Cost in U.S. $</td>
<td>14,072</td>
<td>7,632</td>
<td>275</td>
</tr>
</tbody>
</table>

Tables 2.1 and 2.2 indicate that, for sunflower seeds with high oil content, the three presses have comparable extraction rates.

The extraction rate of the ram press is particularly encouraging despite its low output. The prices of the presses differ considerably and the profitability as shown below is favorable to the ram press.

NOTE:--
Some of the data in Tables 2.1 and 2.2 were calculated as shown below. Seed crushing capacity was obtained by dividing the weight of the sample used by the time needed to press oil from it.

The oil extraction rate was obtained by dividing the weight of boiled and filtered oil by the weight of the seed sample and multiplying the ratio by 100.

Oil extraction efficiency was obtained by dividing the oil extraction rate by the oil content of the seed.

Percent of oil left in cake:
100 (measured oil content of seed X weight of seed sample - weight of boiled and filtered oil) / Weight of Cake
2.4 PROFITABILITY OF OPERATING THE THREE PRESSES

The data used to evaluate each press was obtained from a cooperative society oil mill and is given below:

Cost of diesel per liter = US$ 0.45
Cost of sunflower seed per kg = US$ 0.25
Labor cost per person per day = US$ 2.50
Selling price of oil (Tin of 18 kg) = US$ 42.50
Selling price of cake per kg = US$ 0.135
Annual working days = 250
Cost of one kWh = US$ 0.25

The calculations are based on the grey and white striped seeds shown in Table 2.3.

**TABLE 2.3**

Performance parameters based on grey and white striped sunflower seeds.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Mini 40 Press</th>
<th>Komet Press</th>
<th>Local Ram Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crushing capacity, kg/hr</td>
<td>39.0</td>
<td>12.5</td>
<td>5.7</td>
</tr>
<tr>
<td>2</td>
<td>Crude oil output, l/hr</td>
<td>8.57</td>
<td>3.64</td>
<td>1.14</td>
</tr>
<tr>
<td>3</td>
<td>Filtered oil output, l/hr</td>
<td>7.79</td>
<td>3.16</td>
<td>1.06</td>
</tr>
<tr>
<td>4</td>
<td>Extraction rate, %</td>
<td>18.3</td>
<td>23.1</td>
<td>16.8</td>
</tr>
<tr>
<td>5</td>
<td>Extraction efficiency, %</td>
<td>48.2</td>
<td>60.8</td>
<td>44.2</td>
</tr>
<tr>
<td>6</td>
<td>Residue oil in cake, %</td>
<td>27.4</td>
<td>21.3</td>
<td>27.1</td>
</tr>
<tr>
<td>7</td>
<td>Cake portion of seed, %</td>
<td>76.0</td>
<td>70.0</td>
<td>78.0</td>
</tr>
<tr>
<td>8</td>
<td>Cost in U.S. $</td>
<td>14,072</td>
<td>7,632</td>
<td>275</td>
</tr>
</tbody>
</table>
### TABLE 2.4

Profitability of the presses.

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Mini 40 Press</th>
<th>Komet Press</th>
<th>Local Ram Press</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.4.1 Expenses:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crushing capacity, kg/hr</td>
<td>39.0</td>
<td>12.5</td>
<td>5.7</td>
</tr>
<tr>
<td>Cost of seeds per 8 hour day</td>
<td>78.0</td>
<td>25.0</td>
<td>11.4</td>
</tr>
<tr>
<td>Diesel consumed in l/hr</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cost of diesel per day, $</td>
<td>9.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cost of two workers/day, $</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Electric power used per day, kWh</td>
<td>-</td>
<td>10.7</td>
<td>-</td>
</tr>
<tr>
<td>Cost of power per day, $</td>
<td>-</td>
<td>2.675</td>
<td>-</td>
</tr>
<tr>
<td>Cost of maintenance per day, $</td>
<td>5.0</td>
<td>2.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total daily expenses, $</strong></td>
<td>97.0</td>
<td>35.175</td>
<td>16.9</td>
</tr>
<tr>
<td><strong>2.4.2 Revenue:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil output per hour, liters</td>
<td>7.79</td>
<td>3.16</td>
<td>1.06</td>
</tr>
<tr>
<td>Sales of oil per day, $</td>
<td>134.0</td>
<td>54.35</td>
<td>18.23</td>
</tr>
<tr>
<td>Cake output per day, kg</td>
<td>224.0</td>
<td>70.0</td>
<td>36.0</td>
</tr>
<tr>
<td>Sales of cake per day, $</td>
<td>30.24</td>
<td>9.45</td>
<td>4.86</td>
</tr>
<tr>
<td><strong>Total daily revenue, $</strong></td>
<td>164.24</td>
<td>63.80</td>
<td>23.09</td>
</tr>
<tr>
<td>Daily profit, $</td>
<td>67.24</td>
<td>28.625</td>
<td>6.19</td>
</tr>
<tr>
<td>Annual profit, $</td>
<td>16,810.0</td>
<td>7,156.25</td>
<td>1,540.00</td>
</tr>
<tr>
<td>Machine cost, $</td>
<td>14,072.0</td>
<td>7,632.0</td>
<td>275.0</td>
</tr>
<tr>
<td>Assumed machine life, years</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Annual depreciation, $</td>
<td>2,814.4</td>
<td>1,526.4</td>
<td>55.0</td>
</tr>
<tr>
<td>Profit after depreciation, $</td>
<td>13,995.6</td>
<td>5,629.85</td>
<td>1,485.00</td>
</tr>
<tr>
<td>Pay back period, months</td>
<td>12</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Annual seed requirements, tons</td>
<td>78</td>
<td>25</td>
<td>12</td>
</tr>
</tbody>
</table>

The profitability figures given above are only approximate, other expenses like salaries for administrative staff, transpc and office equipment have not been considered. But they can used as a guide for preliminary decision making. As the resul indicate, if the right high oil content seeds are available, all the machines are profitable. In addition, if the ram press can be modified to be operated continuously by one person, its pay-back period is much less than that of both the Rosedown and Komet expellers.
2.5 MODIFICATION CONSIDERATIONS

The proposed modifications are shown in Appendix I and some of them have been made in the ram press currently being produced and used in Uganda.

3.0 QUALITY DETERMINATION OF SOME RAW OIL SEEDS AND THEIR PRODUCTS

Raw samples of sunflower, simsim and groundnut seeds, together with oil and cake obtained from each were tested for aflatoxins, moisture content, purity, protein content and pH levels.

3.1 AFLATOXINS

The samples were analyzed semiquantitatively according to the Hollady Minicolumn Technique, preset at 8ppb. Observation of dark blue color indicates aflatoxin levels higher than 8ppb, blue color indicates levels equal to 8ppb, while light blue indicates levels less than 8ppb.

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>OBSERVATION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower</td>
<td>Light blue color</td>
<td>Positive, but levels not up to 8ppb.</td>
</tr>
<tr>
<td>G/nuts</td>
<td>No blue color observed</td>
<td>Negative, levels not detectable.</td>
</tr>
<tr>
<td>Simsim</td>
<td>Light blue color</td>
<td>Positive, but levels not up to 8ppb.</td>
</tr>
</tbody>
</table>

CAKES

The same method was used as above, and all samples showed a light blue color indicating that they were positive but not to 8ppb.

EXPLANATION AND COMMENTS

It is not easy to completely avoid aflatoxins in foods, especially those obtained from seeds. The acceptable level in most of the tropics is 8ppb. Once levels exceed this, the foods are quite unsafe, for both humans and animals.

In the case of fresh samples, they all looked new, without mold infestation. Maybe this is why the levels were low. If, however, they are kept very long, especially shelled groundnuts, aflatoxin levels will be high, due to mold.
Infestation, including *Aspergillus flavus* which causes aflatoxins.

**Aflatoxin Prevention in Whole Seed:**

1. Groundnuts should be kept in their shells after drying.
2. All samples must be processed after being kept dry to acceptable moisture content.
3. It is better to process fresh samples.

In the case of the cake, the levels shown are still safe for animal feeding. However, the storage conditions should be improved so that they are not infested during storage.

**Aflatoxin Prevention in Cake:**

1. Store completely dry cake.
2. Store in protective bags, preferably polyethylene bags.
3. Feed or supply them to animals as soon as possible, i.e. do not store too long because the cakes are in ground form, which increases the surface area for mold growth.

### 3.2 MOISTURE CONTENT OF FRESH SAMPLES USING DISTILLATION METHOD

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Approximate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnuts</td>
<td>10.49895</td>
<td>10.5%</td>
</tr>
<tr>
<td>Simsim</td>
<td>12.16569</td>
<td>12.2%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>11.779418</td>
<td>11.8%</td>
</tr>
</tbody>
</table>

### 3.3 MOISTURE CONTENT OF CAKE USING DISTILLATION METHOD

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Approximate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnuts</td>
<td>4.3581</td>
<td>4.4%</td>
</tr>
<tr>
<td>Simsim</td>
<td>3.4627</td>
<td>3.5%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>3.8942</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

### 3.4 OIL CONTENT OF FRESH SAMPLES USING THE HEXANE METHOD

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Approximate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnuts</td>
<td>39.9327</td>
<td>39.9%</td>
</tr>
<tr>
<td>Simsim</td>
<td>50.3010</td>
<td>50.3%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>37.8508</td>
<td>37.9%</td>
</tr>
</tbody>
</table>

### 3.5 OIL CONTENT OF CAKE USING THE HEXANE METHOD

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Approximate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnuts</td>
<td>1.3415</td>
<td>1.34%</td>
</tr>
<tr>
<td>Simsim</td>
<td>0.9831</td>
<td>0.98%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>1.8705</td>
<td>1.87%</td>
</tr>
</tbody>
</table>
3.6 **PURITY OF CRUDE OILS**

The amount of solids as impurities were determined using the suction method.

1. **GROUNDNUT OIL**
   % solids (impurity) = 3.7218 \(\approx\) 3.7%
   % purity = 96.3%

2. **SIMSIM OIL**
   % solids (impurity) = 1.7241 \(\approx\) 1.7%
   % purity = 98.3%

3. **SUNFLOWER OIL**
   % solids (impurity) = 8.1698 \(\approx\) 8.2%
   % purity = 91.8%

3.7 **PROTEIN CONTENT OF CAKE AS PART OF NUTRITIVE VALUE**

1. Groundnut cake - 30.9845 \(\approx\) 31%
2. Simsim cake - 21.4065 \(\approx\) 21.4%
3. Sunflower cake - 34.4081 \(\approx\) 34.4%

3.8 **PH LEVELS OF OILS**

1. Groundnut Oil - 6.3
2. Simsim Oil - 6.5
3. Sunflower Oil - 6.8
4.0 THE IMPORTANCE OF USING THE RIGHT TYPE OF SEEDS

Experience has shown that it is not enough for the seed to have only a high oil content if a lot of oil is to be extracted economically. For best extraction efficiency, the seed must have a soft shell and be cheap to buy. Hard shell black peredovick varieties with an oil content of about 42% which are similar to the Tanzanian soft-shelled black "Katamani", which is possibly the record variety, yielded less oil per unit of weight of raw seed, as shown below. The type of oil seed used and its cost are equally important, as shown in Table 4.1 below:

Table 4.1 Importance of Seed Type and Cost

<table>
<thead>
<tr>
<th>No.</th>
<th>SEED TYPE</th>
<th>SEED WEIGHT PRESSED, KG</th>
<th>OIL YIELD LITERS</th>
<th>COST PRICE $</th>
<th>SELL PRICE P/L</th>
<th>PROFIT ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OIL $</td>
<td>CAKE $</td>
<td>TOTAL $</td>
</tr>
<tr>
<td>1</td>
<td>Peredovick</td>
<td>5</td>
<td>1</td>
<td>1.25</td>
<td>2.15</td>
<td>2.285</td>
</tr>
<tr>
<td>2</td>
<td>Katumani</td>
<td>4</td>
<td>1</td>
<td>1.00</td>
<td>2.15</td>
<td>2.285</td>
</tr>
<tr>
<td>3</td>
<td>Simsim</td>
<td>3</td>
<td>1</td>
<td>1.50</td>
<td>2.15</td>
<td>2.285</td>
</tr>
<tr>
<td>4</td>
<td>Groundnuts</td>
<td>3</td>
<td>1</td>
<td>1.50</td>
<td>2.15</td>
<td>2.285</td>
</tr>
</tbody>
</table>

Table 4.1 shows that a profit increase of about 80% can be realized by processing soft-shelled Katumani as opposed to processing hard-shelled peredovick sunflower seeds. The same table shows that processing soft-shelled Katumani gives a profit increase of approximately 61% in profit over processing either Simsim or groundnuts. Currently, new high oil content and soft-shelled sunflower seeds are being introduced into Uganda under the sponsorship of U.S.A.I.D. At the same time, about 30 modified Bielenberg ram presses have been fabricated locally and are being distributed to deserving farming NGOs.
SMALL-SCALE OIL PRESSING IN NEPAL

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and

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Shrestha Engineering Works
Bhairahawa, Nepal

Presented at the "Conference on Oil Pressing" organized by
Appropriate Technology International, Washington, DC, USA
at Nairobi, Kenya from 10-11th September, 1990
1. BACKGROUND

Nepal is a small landlocked country having boundaries with China to the north and India to the south, east and west. Agriculture is the mainstay of the economy, accounting for more than 68 percent of GDP and 75 percent of exports and providing a livelihood to 94 percent of the population. The principal crops are paddy, wheat, maize, millet and mustards. According to the 1981 census, Nepal has a population of about 15 million with an annual growth rate of 2.66 percent. The per capita income is estimated at about US $160.

Of the total land area of 141,000 sq. kilometers, 32 percent are covered by forest, 52 percent are pasture, meadows, barren or under perpetual snow and only 16 percent are considered to be arable. Broadly, the country can be divided into three well defined physiographical belts running east to west - the mountain region with altitudes ranging from 16,000 - 29,000 feet, the hill region with altitudes of 1,000 - 10,000 feet and the terai region with altitudes varying between 200 - 1,000 feet above sea level. The terai is a narrow flat land (average width of 30 Km) along the southern border which is an extension of the Indian Gangatic plain. It covers approximately 23 percent of the land area and produces the bulk of the country's food grains. The hill region consists of high ridges and stepped slopes and is interspersed with many valleys along its numerous streams and rivers. It covers nearly 43 percent of the land area and the majority of the population reside in this region. The snow-capped mountain region runs parallel to the border with Tibet to the north. This region covers around 34 percent of the country and livestock plays the most important role in its economy.
2. OIL PRESSING PRACTICES IN NEPAL

2.1 Kol

In the rural areas where ghattas\(^1\) are in operation, the janto, a traditional grinding stone, is virtually no longer in operation except for processing of pulses and small quantities of grains in rural households. The grinding of maize and millet are normally done in the nearby traditional ghattas which have been in existence for many years. In the rural households they still have the traditional paddy processing unit called the dhikki, but the women prefer to take whatever paddy they have to process to the nearby mills. The Kol is a traditional technology to press mustard for oil. It has almost vanished from the rural setting because it requires hard work to press the mustard in a Kol. More than four persons are needed to operate a Kol. Furthermore, the logs required for making a Kol are getting more scarce every year due to the rapid deforestation in the rural areas.

2.2 Mechanical Oil Expeller

With the introduction of diesel engines and water turbines, the mechanical oil expeller was also installed in Nepal. It is estimated that there are around 600 oil expellers in operation in the country. The majority of them are powered by water turbines. Oil expellers are imported mainly from India. The common size of the oil expellers which are installed in the country are 4 bolt and 6 bolt. The Agricultural Development Bank of Nepal (ADBN) is the main source of financing for oil expellers in rural areas.

3. FEATURES OF THE OIL EXPPELLER

The general specifications of the oil expellers which are common in Nepal are presented in Annex-1.

Experience has shown that the pressing time and the number of persons required are considerably lower for the oil expeller than for the Kol. The mechanical oil expeller also yields a higher percentage of oil from mustard than that from the Kol. The yield from the oil expeller is 30-33 percent oil and 67-70 percent oil cake. Moreover, the mechanical oil expeller has relieved the rural people from the physically taxing and arduous task of oil extraction in the traditional Kol.

\(^1\) Ghatta is the Nepalese word for a simple wooden water mill for grinding grain.
4. ADBN'S EFFORTS

The Agricultural Development Bank of Nepal (ADBN) is a development financing institution established with the principal objective of modernizing the agriculture sector and improving the quality of lives of the rural people through a credit program.

ADBN has been providing loan support to individual entrepreneurs to undertake different agricultural and rural development activities including the installation of an oil expeller in the country. Besides, it also provides technical assistance to manufacturers for the development and production of appropriate technology. The Shrestha Engineering Work of Bhairahawa is one of the manufacturing units which is being supported by ADBN. In addition to its regular branches for operating credit programs, it has appropriate technology units established in rural areas to develop, promote and disseminate appropriate technologies suitable to local skills and resources.

5. CONCLUSIONS

In Nepal, mustard oil is the principal cooking oil. Recently, people have started using groundnut oil and soybean oil. Besides, there are numerous tree seeds available in the jungle, from which oil is traditionally pressed for medicinal and industrial purposes. If these seeds could be pressed mechanically, it would help the industrialization process of the rural areas. As stated earlier, the ADBN and some other agencies are working on the local manufacture of an oil expeller. However, there is a lot of work to be done for the effective transfer of technology in the country.
### General Specification of Mechanical Oil Expeller

<table>
<thead>
<tr>
<th>Size</th>
<th>Chamber Size (cm)</th>
<th>Capacity (Kg/Hr)</th>
<th>Power Required (HP)</th>
<th>Approx. Weight (kg)</th>
<th>Measurement L X B X H (m)</th>
<th>RPM of Main Shaft</th>
<th>RPM of Pulley</th>
<th>Dia. of Main Shaft (mm)</th>
<th>Dia. of Pulley (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 bolts</td>
<td>46 x 8</td>
<td>40</td>
<td>5</td>
<td>550</td>
<td>1.5x1.0x1.5</td>
<td>40</td>
<td>-</td>
<td>45</td>
<td>46</td>
</tr>
<tr>
<td>6 bolts</td>
<td>60 x 10</td>
<td>70</td>
<td>5-7</td>
<td>900</td>
<td>2.0x1.0x1.0</td>
<td>35</td>
<td>175</td>
<td>48</td>
<td>56</td>
</tr>
<tr>
<td>9 bolts</td>
<td>63 x 13</td>
<td>130</td>
<td>12</td>
<td>1500</td>
<td>2.0x1.0x2.0</td>
<td>30</td>
<td>180</td>
<td>63</td>
<td>68</td>
</tr>
<tr>
<td>Double Standard</td>
<td>68 x 13</td>
<td>200</td>
<td>20</td>
<td>2200</td>
<td>3.0x1.0x2.0</td>
<td>22</td>
<td>132</td>
<td>63</td>
<td>76</td>
</tr>
</tbody>
</table>
REVIEW OF OPTIONS FOR SMALL-SCALE OILSEED PROCESSING

Tony Swetman and Keith Southwell
Natural Resources Institute (NRI) Chatham, Kent, UK
Review of options for small-scale oilseed processing

Tony Swetman and Keith Southwell

ABSTRACT

Most developing countries have oilseed processing facilities, but these are generally large scale plants located in or near the urban centers. Remote rural areas are often unable to obtain supplies of vegetable oils or animal feed, due to logistical problems or poor transport infrastructure, even though oilseeds are grown locally. Small-scale techniques are available to enable people in these areas to process their own oilseed resources, but the most appropriate depend on circumstances such as the scale of operation required and the availability of power sources. Methods include small powered expellers, manual or animal-powered mechanical presses, and simple procedures dependent on the release and separation of oil from oilseeds which have been ground and suspended in water.

The yield, throughput, equipment costs, advantages and disadvantages of the available techniques, and recent NRI research on the subject, are reviewed below.

RESEARCH AT NRI

Various levels of small-scale oilseed processing technology have been examined in the UK and developing countries:

(i) NRI has worked in collaboration with a British company in the development of a small-scale oilseed expeller (Rosedowns Mini 40) for use in the rural areas of developing countries. NRI has been responsible for setting up expeller operations in the Sudan (groundnuts), Malawi (macadamia nuts), Zambia (sunflower seed), Cameroon (palm kernels) and the Cook Islands (copra).

(ii) The effect of the boiling time, seed water ration, grinding method and other factors on the extraction of oil from sunflower seed using simple water flotation methods has been studied to determine the optimal conditions of extraction.

(iii) The influence of moisture content and pressure on the extraction of oil from fresh grated coconut, groundnuts and other oilseeds has been investigated using a manual plate press.

(iv) A NRI expeller has been developed, incorporating the most suitable features of available equipment based on the experiences of Oilseed Section staff members.
### OIL YIELDS AND CAPACITY OF AVAILABLE METHODS

<table>
<thead>
<tr>
<th>Method</th>
<th>Location</th>
<th>Oilseed and Yield in Liters per 50 kg Seed</th>
<th>Capacity (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Water Flotation</td>
<td></td>
<td>Sunflower (5-6 liters)</td>
<td>20 nuts/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coconut (2-3 liters from 50 nuts)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sunflower (8 liters), Sesame (15-16 liters)</td>
<td>50 nuts/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundnuts (14 liters)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rapeseed (16-18 liters)</td>
<td></td>
</tr>
<tr>
<td>B. Ghani</td>
<td></td>
<td>Sunflower (10 liters)</td>
<td>40 - 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundnuts (16 liters)</td>
<td>400 nuts/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coconuts (4-5 liters from 50 nuts)</td>
<td></td>
</tr>
<tr>
<td>C. Manual Presses</td>
<td>UK</td>
<td>Groundnuts (18 liters)</td>
<td>200-240</td>
</tr>
<tr>
<td>(1) Bridge Press</td>
<td>Zambia</td>
<td>Sunflower (9 liters)</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Tanzania</td>
<td>Coconuts (4-5 liters from 50 nuts)</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Tanzania</td>
<td>Sunflower (10 liters)</td>
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<td></td>
<td></td>
<td>Sunflower, high oil content (15 liters)</td>
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<td></td>
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<td>Groundnuts (18 liters)</td>
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<td></td>
<td>Coconuts (4-5 liters from 50 nuts)</td>
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<td></td>
<td></td>
<td>Sunflower (8 liters), Sesame (15-16 liters)</td>
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<tr>
<td></td>
<td></td>
<td>Groundnuts (14 liters)</td>
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<td>Rapeseed (16-18 liters)</td>
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<td></td>
<td>Sunflower (9 liters)</td>
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<td></td>
<td>Sunflower, high oil content (15 liters)</td>
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<td>Groundnuts (18 liters)</td>
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<td>Sunflower (9 liters)</td>
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<td>Sunflower, high oil content (15 liters)</td>
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<td>Groundnuts (18 liters)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Coconuts (4-5 liters from 50 nuts)</td>
<td></td>
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<tr>
<td>D. Expellers</td>
<td>UK, Africa</td>
<td>Sunflower (9-11 liters), Sesame (10-18 liters)</td>
<td>120 - 150</td>
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<tr>
<td>Various Models</td>
<td>South Pacific</td>
<td>Copra (28-30 liters), Groundnuts (11-19 liters)</td>
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<tr>
<td></td>
<td>Indian Sub-continent</td>
<td>Palm Kernels (15-19 liters), Rapeseed (14 liters)</td>
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# ADVANTAGES AND DISADVANTAGES

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Suitable for:</th>
<th>People Involved</th>
</tr>
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<tbody>
<tr>
<td>A. Water Flotation</td>
<td>Simple equipment.</td>
<td>Batch process. Traditional Method: low yields and capacity. Seed residue cannot be stored as cattle feed. Extracted oil must be dried if stored</td>
<td>Household</td>
<td>1-2</td>
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<tr>
<td>C. Manual Presses</td>
<td>Higher yields and capacity than flotation methods</td>
<td>Batch process. Can be labor intensive. Requires ancillary equipment (i.e. seed grinders and deorticators). Equipment must be purchased</td>
<td>Village/farmers group. Entrepreneur</td>
<td>up to 6</td>
</tr>
<tr>
<td>(1) Bridge Press</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Ram Press</td>
<td>High yields from high oil content sunflower seeds</td>
<td>Arduous work-need for many laborers. Equipment must be purchased. Batch process.</td>
<td>Village group.</td>
<td>Many</td>
</tr>
</tbody>
</table>
Appendix 1

Water Flotation Methods

(i) Pounded oilseed is suspended in water in an oil drum and the mixture boiled for several hours over a fire. After boiling, the mixture is left to stand during which time the liberated oil floats to the top and is scooped off with a cup or dish.

(ii) Grated coconut is squeezed in a cloth and the extracted coconut milk left to stand. A cream floats to the surface of the milk and is scooped off. Clear oil is obtained by boiling off the water in the cream.

Manual Presses

Ground oilseed is placed in a vertical metal cylinder. Pressure is applied by a circular steel plate which is forced down by a hand operated screw, a scissor jack or hydraulic jack. Extracted oil flows out through holes cut into the side of the cylinder. Other devices include the Bielenberg-Fischer ram press which is a recent introduction to the field of small-scale oilseed processing.

Continuous Expellers

Small or baby expellers work on the same principle as the large industrial type. Oilseed is forced through a horizontal barrel by a wormshaft similar in design to those used in meat mincers. Pressure is built up within the wormshaft and barrel by control of a choke at the outlet of the machine. Extracted oil escapes through narrow slits in the barrel.

Ghanis

The ghani is a pestle and mortar device which is traditionally powered by bullocks. A small quantity of water is added to the oilseed which is then crushed by the pestle, resulting in the release of oil. The extracted oil escapes through a hole cut in the base of the mortar. Power ghanis are now widespread in the Indian sub-continent where they are mainly used to process mustard seed and rapeseed.
References

(1) Southwell, K.H. and Harris, R.V. For submission to *Journal of the Science of Food and Agriculture*

(2) Hammonds, T.W., Harris, R.V., and Head, S.W. In print, *Tropical Science.*

Further information on any of these processing operations can be obtained from:

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Chatham Maritime
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THE ECONOMICS OF OILSEED PROCESSING USING THE RAM PRESS

C. Zulberti, L. Navarro and J. Muthaka

Presented at the Bielenberg Oil Press Conference
September 10 - 11, 1990

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The Economics of Oilseed Processing Using the Ram Press

1. **INTRODUCTION**

The ram press is a manually operated machine for extracting liquid oil from oilseeds. It presses the seed with a piston inside a slotted cage. The pressure breaks the seeds and extracts the oil which drips through the slots in the cage. The residual -- which comes out through an adjustable opening at the end of the cage -- is a cake of relatively high protein content.

This chapter lists and describes most of the costs incurred and the income generated by operating the ram press. The objective is to delineate a methodology for the economic analysis and evaluation of using the press under various circumstances.

2. **COSTS**

The costs of operating the ram press to process oilseeds can be classified in five main categories: investment, repairs and replacements, opportunity cost of capital, oilseeds and labor. All costs and benefits will be expressed on a per liter of oil extracted basis.

2.1 **Investment Costs**

The investment costs include two components: the cost of the ram press itself and the cost of accessory equipment.

2.1.1 **The Cost of the Ram Press**

The cost of the ram press itself is the principal component of the investment. Usually, it is depreciated on a year to year basis during the operational life of the machine. The yearly rate is calculated using standard depreciation formulas. This is appropriate when the equipment is run at a relatively constant rate throughout the years. Since this is not expected to be the case with the ram press, it is suggested that the total price be spread through its lifetime, taking into account its effective use. For that purpose the life span will not be measured in calendar years; instead, it will be estimated as the total quantity of oil the ram press is able to extract during its lifetime, expressed in liters. By dividing the initial cost of the ram press by that amount, the cost of the original investment per liter of oil extracted will be obtained.
The equation to represent this cost is:

\[ PCL = \frac{PP}{TL} \]

Where:

- **PCL** is the cost of the press per liter of oil extracted (Kshs\(^2\)/liter)
- **PP** is the original price of the ram press (Kshs)
- **TL** is the estimated total amount of oil the ram press is able to extract during its lifetime (liters).

### 2.1.2 Cost of Accessory Equipment

To operate the ram press, some additional implements, utensils, and supplies are required: plastic sheets, buckets, screens, filters, containers, etc. Their cost is part of the initial investment and is needed through the life of the ram press. For that reason, its cost is divided by the total amount of oil the ram press is able to extract to express it on a per liter basis, even if some of the equipment has a shorter life and has to be replaced (see repairs and replacements below).

The equation to represent this cost is:

\[ ECL = \frac{PE}{TL} \]

Where:

- **ECL** is the cost of the equipment per liter of oil extracted (Kshs/liter)
- **PE** is the price of the equipment (Kshs)
- **TL** is the estimated total amount of oil the ram press is able to extract during its lifetime (liters).

### 2.1.3 Total Investment Cost

The total investment cost per liter of oil produced is obtained by adding its two components as follows:

\[ \text{Total Cost per liter} = PCL + ECL = \frac{PP}{TL} + \frac{PE}{TL} = \frac{PP + PE}{TL} \]

---

\(^2\) The monetary unit used is the Kenyan shilling (Kshs), because the calculations in the example to follow are based on the Kenyan situation.
ICL = PCL + ECL

Where

ICL is the investment cost per liter of oil extracted (Kshs)

ECL is the cost of the equipment per liter of oil extracted (Kshs/liter).

2.2 Repair and Replacement Costs

Closely related to the cost of the investments are the expenses to repair the ram press and replace some of the accessory equipment to keep it operational. Experience on the magnitude of these costs is not yet available, but at least a rough estimate should be included to enhance the evaluation. Using a percentage of the original investments as an estimate of repair and replacement expenditures, the cost is:

\[ RC = (PP+PE) \times KR/100 \]

Where

RC is the total cost of repairing the ram press during its lifetime and the cost of replacing the accessory equipment (Kshs)

KR is the percentage of the investment which is estimated will be spent in repairs and replacement (percent).

The repair and replacement cost per unit of oil extracted is, then, as follows:

\[ RCL = \frac{RC}{TL} \]

Where:

RCL is the cost of repair and replacement per liter of oil extracted

TL is the estimated total amount of oil the ram press is able to extract during its lifetime (liters).

2.3 Opportunity Cost of Capital

As mentioned elsewhere in the manual, two alternative purchasing modalities for the acquisition of the ram press are envisaged. The first one is the payment of its price on a single installment and the second one is a lease-purchasing agreement in which the machine is paid in several installments. For calculation purposes, it is possible to represent both modalities by using a
yearly financial charge which will either represent the cost of borrowing the capital required to pay for the machine and the accessory equipment all at once, or the interest charged in the lease-purchasing arrangement. That financial charge also represents the opportunity cost of having capital tied up in the machine and its accessory equipment.

To compute the financial charge which will closely represent the opportunity cost of using the capital, two parameters have to be taken into consideration: the financial charge -- interest rate -- imposed by lending institutions and the rate of inflation. The equations are as follows:

\[
EF = FC - RI
\]

Where:

EF is the effective financial charge (percent)
FC is the financial charge for borrowing funds (percent)
RI is the rate of inflation (percent).

Then, the opportunity cost for capital is calculated as follows:

\[
CCY = (PP \times PE) \times EF / 100
\]

Where:

CCY is the opportunity cost per year of the capital invested (Kshs).

The opportunity cost of capital is expressed on a per year basis regardless of how much the ram press is used. To express it on a per unit of oil extracted basis, the yearly opportunity cost of capital has to be divided by the estimated amount of oil the ram press will extract per year. This is calculated as follows:

\[
CCL = CCY / YL
\]

Where:

CCL is the opportunity cost of the capital per liter of oil
YL is the yearly estimated oil output of the press in liters.
2.4 Cost of Oilseeds

The cost of oilseeds is the price at which they are traded in the area. The price of seed has to be divided by a coefficient which represents the quantity of oil that is obtained from a given quantity of seed. The formula is as follows:

\[ CSL = \frac{PS}{KO/100} \]

Where:

- CSL is the cost of seed per liter of oil produced (Kshs/l)
- PS is the price of the seed in the local market (Kshs/kg)
- KO is the quantity of oil extracted from 100 kg of oilseed (1/100 kg).

2.5 Labor Costs

The proportion of oil and cake to be obtained from oilseeds depends on the oil content of the seeds, on the amount of pressure exerted on them, and on the length of time such pressure is maintained. At higher pressures and longer periods of sustained stress between strokes, more oil (the high-value product) and less cake (the low-value product) are obtained.

Higher pressures are achieved by tightening the back-pressure plug, reducing the opening through which the cake comes out. This raises the force that the operator has to apply on the handle of the ram press at each stroke. As a consequence, the amount of energy he has to expend during his working day increases.

The operators payment modality has to take into consideration this operational characteristic to generate the right kind of incentives leading to higher efficiency and greater economic benefits.

There are four modalities which could be used to pay laborers who operate the machines. These are: payment by period of time worked, by quantity of seed processed, by total quantity of oil obtained and by quantity of oil obtained from a given amount of seed.

2.5.1 Payment by Period of Time Worked

The proper operation of the ram press to obtain a relatively high proportion of the oil contained in the oilseed and a significant amount of products at the end of the day requires a considerable amount of sustained physical activity during
relatively long periods of time. If the laborers are paid on a per day basis they will reduce their efforts by cutting down on the amount of seed processed and by loosening up the back pressure plug to ease operation.

Payment by period of time worked does not appear suitable to generate the kind of incentive which will ensure the required amount of continuous effort.

2.5.2 Payment by Quantity of Seed Processed

This is an improvement from the previous system, but still has shortcomings.

The operators will have the incentive to increase throughput, but still there is no reason why they will tighten the back-pressure plug to increase the oil extraction and/or lengthen the resting period between strokes to give time for the oil to drip. A high quantity of seed will be processed, but the proportion of oil extracted will be low and the cake will be quite oily.

2.5.3 Payment by Total Quantity of Oil Extracted

A better system is to pay the operators by the amount of oil obtained. In this way they will try to tighten up the back-pressure plug to a level that, while still manageable, will increase the amount of oil extracted.

However, to increase the amount of oil to be obtained per day, the operators will try to speed up the number of strokes per unit of time. These will result in losing efficiency because -- as it has been shown experimentally -- the length of time in which pressure is sustained between strokes has an effect on the amount of oil obtained from a given quantity of seed. If the resting time is cut too short, the proportion of oil is reduced.

2.5.4 Payment by Quantity of Oil Produced from a Given Amount of Seed

The payment modality which appears to render the right incentives is to provide the operators a given amount of seed -- a 50 kg bag of sunflower seed seems appropriate -- for one day's processing, and pay them per quantity of oil extracted from it. In this way the back-pressure plug will be adjusted to the maximum level the operators can work with and, since speed is not as important, they will rest enough between strokes to achieve a high level of oil extraction.

This payment modality represents a fixed cost of labor per unit of oil produced which must be added to the rest of the costs.
At least two laborers are required to operate the machine. While one executes the strokes, the other heats up the seed in the sun, adds seed to the feeder, collects the oil and the cake, etc. Since an important amount of effort is required, the operators will take turns -- every half hour or 45 minutes -- at running the ram press.

The cost of labor can be represented as follows:

\[ LCL = 2 \times WL \]

Where:

- \( LCL \) is the cost of labor per liter of oil produced (Kshs/l)
- \( WL \) is the wage paid to each laborer per liter of oil extracted (Kshs/l)

2.6 Total Costs

The total costs are obtained by adding up the five categories as follows:

\[ TCL = ICL + RCL + CCL + CSL + LCL \]

3.0 Benefits

The ram press produces a combination of two products (oil and cake) in different proportions depending on the type of seed, its oil content, the pressure exercised over the seeds and the duration of the resting period between strokes.

3.1 Benefits from the Oil

Since all the costs were calculated per liter of oil produced, one of the benefits to be obtained is the price at which a liter of oil can be sold.

\[ OBL = PO \]

Where:

- \( OBL \) is the benefit to be obtained per liter of oil extracted (Kshs/l)
- \( PO \) is the price of oil produced (Kshs/l)

3.2 Benefits from Cake

The other benefit to be obtained is by selling the cake.
To express the benefits obtained from the cake on a per unit of oil basis, the amount of cake produced has to be related to the quantity of oil obtained. This is achieved by using the following equation:

\[ Q_{CL} = \frac{K_C}{K_O} \]

Where:

\( Q_{CL} \) is the quantity of cake obtained as residual per liter of oil extracted (kg/l)

\( K_C \) is the percentage of cake obtained from the oilseed (percent)

\( K_O \) is the quantity of oil extracted from the oilseed (l/100 kg).

The equation to calculate the benefits from the cake is:

\[ C_{BL} = P_C \times Q_{CL} \]

Where:

\( C_{BL} \) is the benefit to be obtained by selling the cake per liter of oil extracted (Kshs/l)

\( P_C \) is the price of cake.

3.3 Total Benefits

The total benefits are obtained by adding the benefits generated by selling cake and oil as follows:

\[ P_L = T_{BL} - T_{CL} \]

Where:

\( P_L \) is the profit per liter of oil extracted (Kshs/l).

Profits could also be expressed on a per year basis by multiplying the profits per liter of oil extracted by the amount of oil extracted per year as follows:

\[ P_Y = P_L \times Y_L \]

Where:

\( P_Y \) are the profits per year.
Finally, it is possible to calculate the profit generated by the ram press during its lifetime. This is achieved by multiplying the profits per liter of oil extracted by the total amount of oil that the ram press is expected to produce during its lifetime as follows:

\[ PT = PL \times TL \]

Where:

PT is the total profits generated by the ram press during its lifetime (Kshs).

5. **BREAK EVEN POINT**

Another important way to present the results is to calculate what the price of oilseeds should be for the operation to break even. It is computed as follows:

\[ BEP = KO/100 \times (TBL-ICL-RCL-CCL-TCL) \]

Where:

BEP is the price per kg of oilseed at which the operation of the ram press produces neither profits nor losses (Kshs/kg).

6. **ESTIMATION OF PARAMETERS**

The following values have been estimated under Kenyan conditions. It is expected that this information will be improved through experience in the field.

6.1 **Price of the Ram Press**

The price at which the ram press is being sold by the only Kenyan manufacturer is Kshs 30,000.00.

\[ PP = 30,000.00 \text{ Kshs} \]

6.2 **Total Oil Production by the Ram Press During its Lifetime**

Since the ram press was invented just five years ago, there is not enough experience on its durability. Nevertheless, a total processing capacity of 10,000 liters of oil during its full life cycle seems a reasonable estimate.

\[ TL = 10,000 \text{ liters} \]

6.3 **Price of the Accessory Equipment**

The total value of the equipment required to operate the ram press has been estimated at Kshs 5,000.00.
PE = 5,000 Kshs

6.4 Proportion of the Value of the Investment Spent on Repairs and Replacements

It is assessed that during its lifetime, repair expenses will be equivalent to half the value of the machine.

KR = 50 percent

6.5 Financial Charge for Borrowing Funds

A good estimation for the opportunity costs of using the capital is the interest rate which is currently being charged for short term loans minus the inflation rate (see next paragraph). At present, that interest rate is 18 percent.

FC = 18 percent

6.6 Rate of Inflation

The rate of inflation to use is the one estimated by the government or by financial institutions. At present, the rate is 10 percent.

RI = 10 percent

In some countries, credit to the agricultural sector is subsidized and the borrowing rate is below the rate of inflation, making the effective financial charge negative. In others, the rate of inflation is substantially underestimated, making the difference between borrowing rates and the inflation rate very high. These unrealistic figures can seriously distort the analysis. In such cases, it is suggested to use a value between 5 to 10 percent for the effective financial charge for the calculation.

6.7 Quantity of Oil Produced

The experience of the ELCT/DAR Village Sunflower Project in Tanzania shows that one ram press was able to produce over 6,000 liters in a year. This should be taken, at present, as the top limit. It appears that a reasonable production level is around 2,000 liters per year.

YL = 2,000 liters
6.8 **Price of the Seeds**

The price of the oilseed is that price at which it is traded in the rural areas. At present, the price of sunflower seed in Kenya is 160 Kshs per 50 kg bag.

\[ SP = 3.20 \text{ Kshs/kg} \]

6.9 **The Proportion of Oil Obtained from the Oilseed**

The proportion of oil to be obtained from the seed varies with the type of oilseed, the variety, the efficiency of extraction, etc. An extraction rate of 28 liters of oil per 100 kg of sunflower seed seems reasonable.

\[ KO = 28 \text{ l/100 kg} \]

6.10 **Wages**

The operation of the ram press does not require specialized personnel. Unskilled laborers can learn how to operate it in a few minutes. Nonetheless, as was explained above, the handling of the ram press requires a considerable amount of physical effort.

To attract workers willing to spend that extra energy, the compensation should be somehow higher than the normal pay for a day of work in the field. The present rate in Kenya is Kshs 20.00 per day. Since it is estimated that 14 kg of oil can be obtained from a 50 kg bag of sunflower seed in a working day, the laborers should be paid Kshs 2.00 per liter of oil obtained. In this way, the total daily remuneration will amount to Kshs 28.00.

\[ WL = 2.00 \text{ Kshs/l} \]

6.11 **Price of Oil**

The price of oil should be based on the price of similar commodities available in the market. It is foreseen that to make the crude oil extracted by the ram press competitive it should be priced cheaper than the most commonly used products. A ten percent reduction is suggested. In the Kenyan case, the most widely used fat is KIMBO which sells for Kshs 24.40 per tin of one kg. The suggested price for the ram press oil is Kshs 22.0/liter.

\[ PO = 22.0 \text{ Kshs/l} \]

6.12 **Proportion of Cake**

The price of cake is related to the price of seed. Normally, the cake is traded at 75\% the price of the seed. Since, as is mentioned below, the price of sunflower seed is Kshs 3.20 per kg,
the price of the sunflower cake can be estimated at Kshs 2.40 per kg.

\[ PC = 2.40 \text{ Kshs/kg} \]

7. **CALCULATION OF PROFITS AND BREAK-EVEN POINT**

The table at the end of the text shows all the calculations using the estimated values presented above.

The profit per liter of 5.49 Kshs represents 25 percent of the cost of production and will result in a profit for the year of Kshs 10,986, and a total profit during the ram press lifetime of Kshs 54,929.

To break even, the processor can pay up to 4.74 Kshs per kg of sunflower seed. This is an increase of 48 percent over the present price.

8. **CONCLUSIONS**

The example presented shows that under the conditions existing in Kenya at present, the operation of the ram press is economically feasible. It generates enough benefits to cover all the costs and still make a profit. Moreover, it creates employment for two workers and increases the value added at the local level.

This ex-ante assessment shows very promising results which should be tested at the field level for reliability. It is expected that data will be collected every year by many operators to have a more precise and specific evaluation. If proven correct, they will be a great incentive to promote and adopt the ram press as a technically and economically feasible innovative technology.
### The Economics of Oilseed Processing Using the Ram Press

<table>
<thead>
<tr>
<th># CODE</th>
<th>PARAMETERS</th>
<th>FORMULAS</th>
<th>UNITS</th>
<th>VALUE</th>
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<tbody>
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<td>LOE</td>
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<td>Wage Paid per Laborer per LOE</td>
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<td>PO</td>
<td>Price of Oil</td>
<td>Kshs/kg</td>
<td>3.20</td>
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<tr>
<td>12</td>
<td>KC</td>
<td>Proportion of Cake Obtained from Seeds</td>
<td>Percent</td>
<td>28.00</td>
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</tr>
<tr>
<td>13</td>
<td>PC</td>
<td>Price of Cake</td>
<td>Kshs/l</td>
<td>5.00</td>
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### Intermediary Calculations

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<tr>
<td>PCL</td>
<td>Cost of the Ram Press per LOE</td>
<td>Kshs/t</td>
<td>3.00</td>
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<tr>
<td>ECL</td>
<td>Cost of Accessory Equipment per LOE</td>
<td>Kshs/l</td>
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<td>RC</td>
<td>Total Cost of Repairs and Replacements</td>
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<tr>
<td>EF</td>
<td>Effective Financial Charge</td>
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<td>CCY</td>
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<td>QCL</td>
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### Final Calculations

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<td>RCL</td>
<td>Repairs &amp; Replacement Costs per LOE</td>
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<td>Break Even Point for Price of Seeds</td>
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</table>
DISSEMINATION OF THE OILSEED RAM PRESS

C. Zulberti, O. Schmidt, and J. Mugeto

1 Dr. Carlos Zulberti is the International Development Research Center (IDRC) of Canada consultant with the Vegetable Oil/Protein System Programme at Egerton University, Kenya; Mr. O.G. Schmidt is the East African Regional Office Programme Officer for Post-Production Systems of the Agriculture, Food and Nutrition Science Division of IDRC; and, Mr. J. Mugeto is the Deputy Leader of the Oilseed Processing Project financed by IDRC at Egerton University.
1. INTRODUCTION

Oilseeds is a generic term for seeds which contain a relatively large amount of extractable oil. Methods of obtaining oil have changed considerably since the mortar and pestle were first used to crush oilseeds. The Chinese ground oilseeds in stone mills, heated the meal in open pans and then extracted the oil with a wedge press. The Romans invented the screw press to obtain olive oil and the Indians developed the bullock-powered mortar and pestle "ghani". The Dutch introduced the stamper press in the 17th century, which was replaced by the hydraulic press in the 19th century. Modern industrial plants primarily use large-scale continuous screw expellers, or solvent extraction, or a combination of both methods.

Many people, both in developed and developing countries, associate vegetable oil production with large-scale industrial plants mostly located in urban areas. They often do not realize that hand-operated devices can be used to extract oil from oilseeds at the rural level.

One of these devices -- the oilseed ram press -- was invented by Carl Bielenberg of Appropriate Technology International in Arusha, Tanzania at the end of 1985. This new implement neither enhances an already existing technology nor improves a well-known piece of equipment; it is a genuine innovation. Its potential users have never seen or operated a ram press and most of them are unaware of its existence. Moreover, since up to now fewer than three hundred presses have been manufactured thus far by job shops, the financial and other requirements of scale production and distribution have not been yet determined.

The widespread utilization of the oilseed ram press in rural areas of several developing countries has the potential to increase the availability of reasonably-priced vegetable oils, improve nutrition, generate employment, boost producer's income, and reduce dependency on imported products. To guarantee such generalized use, a comprehensive dissemination strategy must be generated. This strategy must ensure that the machine becomes known, interest is generated in using it as the basis for a viable enterprise, and it is manufactured and distributed for sale at an affordable price.

2. DISSEMINATION STRATEGY

Development agencies interested in promoting the utilization of the ram press need to formulate a dissemination strategy based on the characteristics and conditions of the country or region in which they will operate. The ingredients of that strategy are outlined in the figure at the end of the text. While the issues to be tackled could be similar in different countries/regions, the
ways to deal with them would vary substantially. Consultation with local authorities, entrepreneurs, farmers and the population in general is necessary to generate a suitable strategy.

The dissemination strategy for the oilseed ram press requires three main components. The first component is an extension package aimed at potential ram press users/buyers who need to know how to produce oilseeds, operate the ram press, utilize the oil and cake, and market their surplus. The second is a promotional venture directed to the establishment of the manufacturing, distribution, and servicing capacity -- backed up by a financial support system -- to make the ram press available to interested buyers. The third component provides information to all of those concerned with the economic feasibility of using the ram press. The first two issues are addressed in the present chapter, the third is presented in a separate one.

2.1 Buyer/User Extension Package

2.1.1 Oilseed Production Technology

Although the ram press can crush various types of oilseeds, it has been used primarily to extract oil from sunflower seed. Therefore, the following information refers to sunflower cultivation. However, the same material could be prepared for other oilseeds that can be processed by the ram press.

Not all kinds of sunflower seed can be successfully used with the ram press.

The preceding statement has been emphasized because using the wrong type of seed could result in insufficient oil extraction. The ram press requires plump, soft-shelled sunflower seed with relatively high oil content. Hard-shelled, high oil content seed has to be partially dehulled before using with the press. Hard-shelled, low oil content varieties used to produce bird-seed, and poorly filled seeds produce meager results.

Oilseed producers need to know the following:

- the variety or hybrid recommended for the area (in most cases, oil crops in developing countries are cultivated without fertilizers. If that is the case, the variety or varieties recommended should perform well without fertilizers)
- where to obtain the seed and the expected price to pay for it
- cropping season(s)
- association with other crops (rotations, relay and multi-cropping arrangements)
- land preparation
- method and rate of seeding
- fertilizer application (if fertilizer is being used in the area). The recommendation should include which commercial
type of fertilizer to use, where to buy it, how much to pay for it and when to apply it
- pesticide application (products recommended, purchasing information, and dosage and application times)
- weeding (how often and when)
- determination of maturity
- harvesting method
- treatment immediately after harvesting (e.g. drying)
- use of crop residues
- threshing
- packing
- storing.

2.1.2 Ram Press Use

The operation and maintenance of the ram press are described in chapter xx of this manual. The user of the ram press needs information on:

- pre-treatment of the seed:
  - drying
  - winnowing
  - grading
  - warming

- operation of the press:
  - loading
  - adjusting
  - continuous running
  - maintenance
  - repairs

- labor requirements
- cleaning of the oil
  - settling
  - filtering
  - boiling with water
- packing of oil
- storage of oil
- period of safe use of the oil (shelf life)
- packing of cake
- storage of cake
- period of safe use of cake (shelf life)

2.1.3 Oil Utilization

Rural communities in Eastern and Southern Africa use the following types of cooking oil:

- liquid oils which are produced locally by pounding and boiling oilseeds;
- crude oils produced by relatively small crushing and neutralizing plants and sold in small quantities at local markets;
- bottled refined liquid oil that is locally produced or imported;
- packed vegetable fats which are obtained by hydrogenation of imported oils in industrial operations located in the same or neighboring country.

Oil obtained through the first two sources will have almost the same appearance and taste as the oil produced by the ram press. Therefore, substituting oil produced by the ram press for the crude oils should pose no major problems.

In the third case, the characteristics will be similar but not the same. The appearance, taste and shelf life of the commercially produced oil will be different due to packaging and refining. The price will be the primary factor in determining the acceptability of the oil.

Because people consume vegetable fats for many different reasons (availability, taste, price) research is needed to determine how best to promote among this group acceptance of the crude liquid oil produced by the ram press.

The following checklist will help the ram press promoters obtain information about current oil usage and the possibilities of substituting oil produced by the ram press:

- description of the main oils and fats consumed in the area
- determination of how much is home-produced and how much is purchased
  - for the home produced oils:
    - oilseed used
    - method of extraction
    - quantity produced
    - type of filtration
    - storage
    - sales to neighbors
    - price charged
    - availability throughout the year
  - for the purchased oils identify:
    - suppliers
    - size or volume of the packages or fractions being sold
    - prices
    - origins of the products
    - availability throughout the year
- description of the most frequently consumed dishes in the area prepared using the fats and oils identified as used in the area being studied
- comparison of those dishes prepared with the oils and fats normally used and with the oil obtained from the ram press
- selection of the most appropriate means of communication to reach the population of the area (field days, a stand or market days, leaflets, posters, house visits, etc.)
- development of an information package

2.1.4 Cake Utilization

The co-product of extracting oil from oilseeds using the ram press is a cake with a relatively high protein content. Because it retains residual oil, the cake also has a high energy content.

The local availability of the highly nutritious cake to feed livestock, especially dairy cows, is one of the most important advantages of using the ram press to obtain oil in rural areas. Low levels of protein and energy intake limit small farmer dairy production. Supplementing available pastures, forage, and crop and industrial by-products with cake could significantly increase local milk production and subsequently improve a family's nutrition and income. In rural areas dependent on compounded feeds, making cake available would reduce the cost of milk production.

To investigate feed utilization and promote cake consumption, the following activities should be performed:

- identification of dairy producers in the area
- description of the normally used technologies of production (especially feeding methods) feeds being used feeds obtained from the farm feeds purchased source of supply prices
- development of recommendations for the utilization of one to two kilograms of cake per animal per day based on the animal's weight, production levels, and quantities and types of feedstuffs being consumed.

2.1.5 Types of Ownership and Methods of Operation

The estimated throughput capacity of the ram press is 50-70 kilograms of sunflower seed per eight hour day. Fifty kilograms of sunflower seed will yield 13 to 15 kilograms of oil, and 32 to 35 kilograms of cake.

To operate the machine year round (300 days) at 50 kg/day, 15,000 kilograms of sunflower seed are required. At present, yields of 500 to 1,000 kilograms per hectare, 15 to 30 hectares of
sunflower must be planted to produce the amount of seed required to operate the machine at full capacity. No small farmer has that amount of land.

It would only take the output of a full week of ram press operations to provide an average family with one year's oil supply. The amount of cake generated each day would supplement the daily feeding of 20 cows.

In other words, continuous operation of the ram press requires more land than small farmers have and will yield more oil and cake than small farm families and herds can consume. Operating a ram press to produce oil and cake for only a single farm family is not economical.

The ram press can be owned individually or collectively. Collective ownership can be broken down into institutional ownership (existing cooperatives, farmers' and women's groups, schools, etc.) and group ownership (groups especially formed to buy and operate a ram press).

a) Individual Ownership

Individual owners could process their own oilseed and consume the oil and/or cake produced. But they will neither cultivate enough land with oil corps, nor utilize enough oil and cake to justify owning a ram press simply for personal use. Thus, individual ram press owners would generally operate one of two types of enterprises -- commercial or custom service. Commercial operations purchase oilseeds and sell oil and cake. The custom service operator processes the farmers' oilseeds into oil and cake in return for a processing fee in cash or in kind.

A commercial operation requires working capital to purchase the oilseed, and storage facilities for the unprocessed seed. Additional storage space is needed to stock the oil and cake produced until they are sold to customers.

Custom service processing requires neither working capital nor storage space. Capital is needed only to purchase the ram press itself. In both cases the owner can use family labor or hire laborers.

b) Collective Ownership

Institutions would most likely engage in custom service processing using hired labor. Or, cooperatives or farmers' groups may purchase a ram press and rent it out on a daily basis. When people join a group to use the ram press, the time when each member is entitled to use the press, his maintenance obligations, disposal mechanisms in case of group disagreements, etc. needs to be determined in advance.
To promote individual or group ownership of the ram press in an area, the following information is desirable:

- identification of existing institutionalized groups in the area. Members of groups which are already cohesive units may be interested in processing their own oilseeds
- identification of about thirty farmers interested in forming a group to buy a ram press to process their own oilseeds
- identification of individual entrepreneurs who are interested in buying a ram press, either to operate it commercially or to provide custom services to oilseed producing farmers.

2.1.6 Marketing of Surpluses

Because surpluses will be common, particular attention should be paid to storing, packaging, pricing and selling of surplus oil and cake. Little information is available about the shelf life of either oil or cake under various environmental conditions. Thus, until research proves otherwise, it is recommended that both oil and cake be used within a month of production.

Oil could be stored in 20 liter plastic or metal containers with tight fitting lids, and cake in gunny sacks or plastic bags. The cake should be kept in a clean, dry, insect-free place and should not be exposed to the sun. The cake can be sold in the same bags in which it is stored, or in small quantities in paper or plastic bags. Because most families cannot afford to buy 20 liters at a time, the oil will need to be divided into smaller units. The consumer can be requested to bring her/his own container, such as a clean soft drink bottle.

Prices of oil and cake will be determined by market forces. Nevertheless, as a starting point, it could be recommended that the cake be sold for around 75% of the price of the oilseed and the oil at the same price as other locally produced oils, or 10 to 20% below the commercially available products.

2.2 Manufacturing, Distribution, and Financing Promotional Venture

2.2.1 Initial Manufacturing of the Ram Press

Sophisticated machinery is not required to manufacture the ram press; it can be produced by a workshop equipped with a lathe and an electric welder. While the ram press is not difficult to build, to ensure satisfactory operation and to avoid breakdowns, it must be manufactured with a certain level of precision. The correct materials should be used and the different components must be manufactured according to specifications and within tolerance limits.

To ensure that a quality product is manufactured, the following activities should be completed:
- listing of materials required
- identification of material suppliers and their prices
- preparation of manufacturing cost estimates
- identification of engineering workshops that possess the required machinery and are interested in trial manufacturing
- discussion of price, form of payment and delivery time (preferably the payment should be made upon delivery of the completed machine; if an advance is required, it should be calculated to cover the costs of all the raw materials and part of the labor costs)
- agreement on the criteria for acceptance of the machine (tolerance in relation to specifications, performance under real conditions)
- selection of one to three workshops, with adequate manufacturing capacity to build the presses "on a trial basis", according to agreed specifications
- conducting standardized lab tests to evaluate completed trial machines and preparation of technical reports on their performance
- discussion of the reports with workshops to correct possible inaccuracies and to verify their interest in wide-scale manufacturing
- modification of advice to users based on results of trial ram press operations.

2.2.2 Wide-Scale Manufacturing of the Ram Press

To manufacture ram presses on a wider scale, jigs and fixtures will need to be developed to guarantee quality (interchangeability of parts) and reduce costs. In addition, quality control mechanisms will have to be established to ensure that minimum standards are met and maintained.

To foster wide-scale manufacturing of the ram press, the promoters need to:

- develop a set of jigs and fixtures compatible with the machinery available in most local workshops (assisted by those workshops)
- determine desirable size of batch orders, prices in relation to the size of the order, form of payment, and requirements for financing
- determine distribution arrangements.

The promoter should continue to identify workshops until a desired number of reliable manufacturers becomes operational.
2.2.3 Distribution of the Ram Press

Because most manufacturers of the ram press would be located in larger towns distant from rural users/buyers, a distribution system must be established.

A first step in this process will be to understand the existing distribution system for agricultural inputs, especially tools, implements and small machines. The following activities are suggested:

- identifying the organizations (government, cooperatives, producers associations, private, etc.) which distribute farm inputs in the country
- compiling information on markups, commissions, ownership of the products, maintenance of stocks, guarantees, repairs, etc.
- selecting those institutions which provide a good service and which are genuinely interested distributing the ram press
- determining (assisted by press manufacturers and distributors) who will transport the ram presses to oilseed growing areas, who will be responsible for the press repairs during the guarantee period, and who will be in charge of replacing faulty parts. These discussions will also help to determine commissions, establish forms of consignment and payment, and to identify financial requirements.

2.2.4 Financing, Manufacturing, and Distribution

To buy raw materials in advance, and pay labor and other production costs, manufacturers need sizable amounts of operating cash which most small workshops cannot raise. Short term financing for working capital will be required.

Press distributors might have similar problems. Individual local operators would not be willing or able to tie up their scarce working capital in three or four ram presses (the expected minimum stock). If the distributor is a national organization with several branches, the money required to stock several machines in each branch would also be substantial. A loan program to provide capital to both manufacturers and distributors must be set up.

To develop a credit system for ram press manufacturers and/or distributors, the following activities should be completed:

- identify whether lack of funds could prevent interested parties from manufacturing and/or distribution ram presses
- identify financial institutions which could be interested in and/or other organizations to distribute them
- discuss possible funding arrangements with financial institutions, manufacturers and distributors.
Many potential buyers will not be able to pay the full purchase price of the ram press on delivery. Two types of financial arrangements could be provided: an outright loan to cover a significant percentage (around 80%) of the cost of the ram press or a lease-purchase contractual arrangement. Under a lease-purchase arrangement, an individual, group, or institution leases the ram press for a specified period of time at a fixed fee which may be applied against the purchase price. If the renter keeps the ram press the entire period and pays the installments on time, he becomes the legal owner of the machine. If he decides to give back the ram press at any time before the end of the contract, he is not liable for further payments, and does not have the right to reclaim payments already made.

To develop a credit system for press buyers, the following activities should be completed:

- identify whether lack of funds could prevent interested parties from purchasing the ram press
- identify financial institutions which could be interested in making loans of financing lease-purchase schemes for buying ram presses
- explain financial options to potential buyers and request opinions on which options are the most desirable
- develop a credit scheme which will be acceptable to all concerned.

3. CONCLUSIONS

The preceding pages have presented lists of factors which should be considered by government institutions, development agencies, or NGOs that are interested in disseminating the oilseed ram press. The lists, while comprehensive, are not complete. Press promoters should realize that issues not previously anticipated will inevitably arise. Therefore, keeping open lines of communication among buyers/users, manufacturers, distributors, and financiers is very important for new alternatives not yet considered.
GENERATION OF A VEGETABLE OIL/PROTEIN STRATEGY
FOR COUNTRIES WITH LOW DIETARY FAT INTAKE
C. Zulberti, O. Schmidt, and L. Navarro¹

September 10-11, 1990

¹ Dr. Carlos Zulberti is a Consultant with the Vegetable Oil/Protein System Programme at Egerton University in Kenya, funded by the International Development Research Center (IDRC) of Canada. Mr. Ozzie Schmidt is the Post Production Systems Programme Officer and Dr. Luis Navarro is the Agricultural Economics Programme Officer in the Agriculture, Food and Nutritional Science Division of IDRC located at the East Africa Regional Office in Nairobi, Kenya.
GENERATION OF A VEGETABLE OIL/PROTEIN STRATEGY FOR COUNTRIES WITH LOW DIETARY FAT INTAKE

Introduction

Oils and fats are important nutrients required by humans as sources of energy and essential fatty acids for cell structure, membrane functions and control of blood lipids, and as a vehicle for oil-soluble vitamins. Low intake of dietary fats results in insufficient energy for productive work, produces skin disorders, and affects the development and function of the brain. High intake of dietary fat deteriorates health due to conditions such as obesity, atherosclerosis, etc.

For some developing countries, the problem is how to increase fat consumption and, for many developed ones, how to reduce it. These conflicting objectives have not permitted the adaptation of policies of developed countries to the less developed ones. This contradiction may help to explain why a strategy to deal with the fat deficiency problem in some Third World countries has not evolved.

World Situation

An analysis of the world situation shows that the production of oilseeds, oilmeals, and oil and fats has significantly increased in the past few years. The yearly rate of growth in the international supply of these three commodities outpaces the rate of population growth. The long run effect has been a drop in international prices. The rise in supply came as a consequence of three structural changes which will have lasting effects. The EEC became an important producer and trader of oilseed products; palm oil production in Malaysia and Indonesia grew at more than ten percent per year; and soybean production increased significantly in Brazil, Argentina, and Paraguay, which joined the USA as the biggest producers and exporters. These changes have taken place through subsidies in the EEC -- at levels of more than three billion US dollars per year -- and through government support and international financing for exportable goods in the other countries.

Many middle and high-income countries are taking advantage of the favorable international situation and importing a large share of their needs at relatively low prices. Others are not so prosperous. They cannot afford to spend much more of their scarce foreign exchange on edible oils and fats.
The Situation in Low Income Countries

A comparison between the 25 countries with the lowest availability of fats and the 25 countries with the lowest GNP per capita per year shows 17 countries on both lists. By adding to the list the three countries within the lowest ten in terms of GNP per capita per year, for which there is no information on fat availability, a group of 20 countries was formed for analysis. Ten of these countries are in Eastern and Southern Africa. They are: Ethiopia, Uganda, Kenya, Rwanda, Burundi, Tanzania, Zambia, Malawi, Mozambique, and Madagascar. Five are in Western and Central Africa: Mali, Niger, Ghana, Togo and Zaire. The other five are in South Asia: India, Nepal, Bhutan, Bangladesh, and Burma.

The general information gathered for those countries shows that, in spite of the differences in size, population, and land availability, their similarities go beyond low consumption of fats and low GNP. Their populations are mostly rural and increasing rapidly. They practice low input agriculture. They are already in debt, having problems of accessibility to foreign exchange and requiring assistance to foster their development.

By combining the information on oilseeds production and the international trade of oilseeds and their derived products -- oils and cakes -- for the 20 countries under analysis also show some interesting patterns of similarity were discovered. Almost all the countries produce some type of oilseeds. Most of these oilseeds are consumed directly or processed within the countries. The oil extracted is consumed locally and often part of the cake is exported. Some importation of oils and fats is taking place, and it is used to supplement the insufficient local production. Nevertheless, the levels of fat intake remain depressed. This pattern is consistently seen in most of the countries analyzed with the possible exception of Zaire.

The Situation in Kenya

The oil/protein sub-sector of one of the countries -- Kenya -- was analyzed further following a Production, Processing, Marketing and Utilization System (PPMUS) approach. Some eye-opening results were obtained.

Oil crop yields are low. This is so because oilseeds are grown in marginal lands or in fallow periods, mostly in association with other crops. They are considered secondary crops by the farmers and almost no agricultural research to develop technological packages adjusted to their conditions has been carried out.

The combination of low yields and low producer prices prevents oil crops from being a viable cropping alternative. The processors
cannot pay higher prices and still make a profit under government controlled consumer prices.

Whereas the average intake of fats is low for Kenya as a whole, it is much lower in the rural areas. The urban population consumes five times more visible fats and three times more vegetable oils and fats than their rural counterparts.

The lack of access to oils and fats by the rural population leads to two main questions. Are they available, and can the population afford them? Since, in the specific case of Kenya, availability does not seem to be a problem, affordability emerges as the main constraint.

While the CIF price of imported palm oil at Mombasa varies between US$ 0.30 and 0.40 per kg, by the time it reaches the consumer -- after refining, fractionating, packaging, transportation, margins for wholesalers and retailers, advertisement, etc. -- it costs a little over $1.00 per kg.

So, the value of the imported product -- vegetable oil -- more than doubles in the process of becoming commercially available. Thus, the price of one kg of the most commonly available commercial cooking fat is higher than the daily salary of farm workers. That price relation makes the oils and fats unaffordable for many rural dwellers.

A similar phenomenon takes place with the protein cake which, because of its price, is not widely utilized as animal feed to improve livestock yields.

Refiners/packers strongly favor the importation of oils because, as a consequence of their low international prices, they can sell greater quantities -- mostly in urban areas -- and make a higher margin than if they sell locally produced commodities.

The Development Problem

A systematic analysis of the international situation, the identification of common characteristics in countries with low dietary fat intake and the utilization of the PPMUS approach in Kenya have led to a much better understanding of the development problem. Low intake of dietary fat -- below desirable levels for useful work and proper health -- is prevalent in the rural sector of many countries of Eastern and Southern Africa, West and Central Africa, and South Asia. These low levels of intake are caused by the shortage of oils and fats in the countryside at an affordable price.

The key question is how to increase the availability and affordability of oils and fats in the rural areas of developing countries to raise consumption and improve the nutritional status,
working capacity, and resistance to certain diseases of the local residents.

Conventional Proposals

The conventional proposals to increase imports and/or promote local production do not provide viable solutions to the shortage of affordable edible oils. Most of the countries analyzed have negative trade balances and can ill afford to spend more of their scarce foreign exchange resources to increase the importation of oils and fats. Nevertheless, if they decide to do so, some of them will confront distribution problems and most of them will still have the affordability issue to deal with.

The expansion of local production requires the introduction of promotional policies which will make the cultivation and processing of oilseeds lucrative. Since the potential for the immediate introduction of technological innovations to significantly reduce the unit cost of oilseed production is bleak, those promotional policies must include higher prices to producers. The end result of an increase in prices to farmers will be higher prices to consumers which will escalate the problem of affordability even more.

Subsidies have not successfully dealt with the affordability problem because they are costly to implement, do not properly reach the target population, and introduce distortions which lead to the wrong allocation of scarce resources. Thus, the orthodox recommendations cannot deal with the problems of availability and affordability at the same time, without the introduction of undesirable subsidies.

Innovative Solution

The search for innovative solutions led to the identification of decentralized processing as a possible option for dealing with the problems of availability and affordability at the same time. The recently (1985) invented manually-operated ram press can produce in rural areas, or even at home, a commodity -- vegetable oil -- which before was only commercially available.

This innovation alters the economic factors which must be considered by farmers in deciding if they should produce oilseeds. They do not have to sell their oilseeds to urban processors and compete with cheap imported oil anymore. Now the oil obtained by processing oilseeds rurally will be competing with a commercial imported product which costs more than twice as much in the rural shops as it does at the port of entry. The rural consumers will have access to a cheaper source of vegetable oils, be able to increase their consumption and satisfy the original development objective. Moreover, the farmers will have the extra benefit of access to the locally produced cake to feed their animals.
The introduction of rural processing has to be closely linked with the generation and dissemination of appropriate and lucrative agricultural technologies for oilseed production. The genetic, agronomic and pest and disease control experiments leading to the generation of that technology will have to closely reflect farmers' conditions and the requirements of the ram press for oil extraction.

The assessment of policy interventions and the monitoring of the oil/protein sector reactions to research and dissemination activities is the third component of the package and will ensure that the impact of various actions is properly supervised and controlled.

**Strategic Stages**

The strategy for decentralizing oilseed processing will have several stages. The timing of these stages will be sequential or in parallel depending on the characteristics and commitment of farmers, entrepreneurs, professionals and government officials in each country. The initial phase will be the execution of a PPMUS type of study to characterize the attributes of the oil/protein subsector, create appreciation of its problems among a group of interested professionals and identify research, dissemination and policy intervention points.

Following the descriptive and awareness stage, the pilot introduction of the ram press will be carried out. This stage will include experimentation with the popularization methodology; assessment of the potential for local manufacturing; and evaluation of the rural dwellers' reaction to the processing method being used and to the product being obtained.

As part of the adjustment of the popularization package to local conditions, research will be carried out to develop agricultural technology packages for the production of oilseeds and for proper utilization of the products obtained from processing — liquid oils and protein cake. If pilot activities prove successful, a nationwide popularization program will be established. A unit in charge of assessing and monitoring the effects of the various research, dissemination and policy interventions will be established to follow up the development of the oil/protein subsector.

**Main Activities**

Five main activities at the international level have been identified as necessary to implement the strategy: promotion, catalysis, networking, backstopping, and training. At present, the characteristics of the oil/protein system and its constraints are unknown in most countries, as is the potential of rural processing to significantly increase the intake of fat in the rural areas. In
low fat intake, low GNP per capital countries, promotional activities are required to generate local professionals' awareness about the problems and their possible solutions.

Once the problems are understood and the likely solutions perceived, pilot project implementation should be encouraged. Institutions will have to work together and look for financial backing from government, private sector and bilateral and/or multilateral donors to implement projects which will test whether some of those solutions really work under various conditions. A catalytic role should be played to accelerate the process of project preparation, appraisal, acceptance and implementation.

The package of solutions being proposed is innovative, in the sense that it is unknown to most professionals in the field and has yet to be tested to see if it can really produce the desired results. Networking activities are required to facilitate the interchange of information, sharing of resources, movement of germplasm, etc.

Two new concepts will be introduced to more effectively and efficiently execute these networking activities. They are the "T" and harrow concepts.

The first concept represents the situation by which one country does methodology development or in-depth subject matter studies for other countries to apply or use, and the second one combines several of those "T"s for a common objective. These concepts are based on the idea that planning should be one of the networking activities to rationalize the allocation of research and implementation resources at the regional level.

A network coordination unit composed of coordinators for one or more of the network components plus their support staff working on a permanent or quasi-permanent basis are required. The coordinators could be located in the same or different locations, depending on which country the methodological and in-depth studies are taking place. Backstopping local researchers will be one of the important functions of the coordinators to ensure that the research methodology, procedures and analytical techniques used will generate results which are reliable enough to be used within the country and to be shared with other countries as well.

Little, if any, long-term impact will be achieved if the local institutional capacity to execute research, carry out studies, implement projects, and assess, monitor, and evaluate results is not properly built up. For that to happen, both formal and on-the-job training will be required. The formal training will take place in local as well as foreign universities, especially those which develop a special interest in the work being carried out and want to develop themselves as centers of excellence in specialized areas. The on-the-job training will be provided, initially, by the
coordinators. As the programme grows, the newcomers will receive training in those countries which have more experience or will be visited by professionals from the region with enough experience to help in the implementation of the local projects.

Donors' contributions will be required for the implementation of this strategy at the regional level. It is anticipated that no single donor will finance the whole effort. It will be in the mandate of the networking coordination unit to procure support from a pool of donors to finance the networking activities and the individual projects of the participating countries.

Conclusion

There are few cases when the right combination of factors offers the opportunity to have a significant impact on the poorer sectors of the world community, the rural dwellers in the less developed countries of Africa and South Asia. This appears to be one of those rare opportunities. It is hoped that the required amount of technical and financial support will be forthcoming to implement the various components of the strategy and achieve the far reaching developmental goals.
The Bielenberg sunflower seed press was developed by Appropriate Technology International in 1985, in Tanzania. In mid-1988, the oil expelling ram press was introduced in Zambia by AFRICARE and IRDP-Mansa. However, it quickly became clear that it needed to be modified because of the differences between the Tanzanian and Zambian seeds. The workmanship of the original presses was also quite shoddy and some of the machines simply could not work.

The Technology Development and Advisory Unit, on request from AFRICARE, started a program to test and adapt the press to Zambian circumstances. The program included demonstrations of the press to assess the reaction of the farmers, particularly women, to the machine. AFRICARE wanted to use the machine in such a way that it would be an incentive to farmers to grow more and better varieties of sunflower.

This first project developed very well and even before the end, it was decided to start a second phase to redesign and manufacture a series of prototypes, identify Zambian manufacturers and ensure quality control of the machines produced during the first year. The machines have been redesigned and the first (37) T.D.A.U. modified Bielenberg presses have been installed in the field. The unit plans to construct a further 20 presses. The project was sponsored with funds from U.S.A.I.D.

The redesigned ram press

To press the sunflower seed commonly available in Zambia, greater pressure is needed than the original Tanzanian design could provide. In order to reach this pressure without burdening the operator, T.D.A.U. redesigned the sizes of the pistons and the cylinders and changed the handle and its position.

The machine now delivered by T.D.A.U. can be fitted with three sizes of cylinders: 42mm, 39mm, and 33mm. The users of the press can simply adjust the machine according to the quality of the seed (hybrid/composite) and according to the strength of the operator (man/woman).

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1 From the T.D.A.U. Newsletter, Vol. 2, No. 1 June 1990, Page 15
THE PERFORMANCE OF THE NEW PRESS

The productivity (liters per hour) and the extraction efficiency (liters per 50kg) of the machine are dependant on the quality of the seed and the strength of the operator.

With the help of the sunflower experts at Mount Makulu and their laboratory, where oil content was measured, the important characteristics of the seed were assessed. These were the oil content, the age of the seed and the fibrous structure. Hybrid seed with high oil content and soft hulls gives the best results. Composite seed, more than a year old, with a higher oil content (35.5%), gives poorer results than younger seed with a lower oil content (33.2%).

CONCLUSIONS

A tentative conclusion of the tests of the ram press with different types of seed is that, for the hybrid seed, an extraction efficiency of between 70 - 80% can be reached. The productivity with a 39mm piston is between 1.5 and 2 liters per hour. These figures are laboratory results. They reflect the potential of the machine. Whether or not these figures are met in the field depends on the operators and the production schedule used.

Field tests of the ram press have been implemented by the Kasisi Farmer Training Center and the Kowanini Association in Makowe Village, Petauke. Because Kasisi is involved in the continuation of T.D.A.U.'s laboratory tests, production at this center has not been continuous. The Petauke press has been in the field since 1989, with minimum interference from T.D.A.U. or AFRICARE, who are involved in the extension part of the project. To date, 4,418 kg of sunflower have been processed, yielding 828 liters of cooking oil. The production has been fluctuating between 20 and 55 kg of sunflower per day. The efficiency ranged from 36 - 71%.

A TECHNICAL SUCCESS

The field results prove that the T.D.A.U. modified ram press is a technical success. They also show that a lot of attention still needs to be paid to the operation of the press in the field, particularly to the technical training, the business training, and the organizational form in which the ram press will be used.

T.D.A.U. has made a thorough analysis of the economics of the ram press in comparison to other methods of small-scale oil expelling. The ram press is a clear winner. But whether the machine will be a success in the grim realities of Zambia's economy depends on T.D.A.U., NGOs, AFRICARE, and the Village Industry Services in solving operational problems in the field.
The original design of the handle is shown in figure 1a, while the T.D.A.U. design is shown in figure 1b and 1c. The advantage of the position of the handle as shown in 1b is that the operator can also use her or his weight to bring the handle down. The original design has, however, the advantage of being more ergonomic: there is less stress on the operator's spine.

As shown in figure 1c, the T.D.A.U. handle can be turned 180 degrees and therefore the operator can choose his own position.

**Figure 1a**

Note:  
- Walking distance \( \approx 1930 \text{ mm} \)  
- Using mainly arm muscle  
- Crank radius 100mm (R)

**Figure 1b**

Note:  
- Walking distance \( \approx 600\text{mm} \)  
- Using arm muscles and weight  
- Handle bent to lower down compression point (2) on handle  
- Crank radius (R) = 100mm

**Figure 1c**

New handle possibilities:  
- position: Fig. a  
- after turning it 180°  
- position: Fig. b

253
WEAR AND TEAR

During the tests, it became clear to the T.D.A.U. engineers that wear and tear on the cylinders would be a problem. The problem occurs when the clearance between the piston and the cylinder becomes so large as to allow the slivers of the cake or husks to pass through, as shown in Figure 3. By moving the piston backwards in the cylinder, the slivers become compressed, hampering the upward stroke. This leads to the rapid wearing out of the compressed parts of the piston and cylinders. In the end, the piston gets stuck. To overcome this problem, the so-called "dirt chamber" is applied, as shown in Figure 2.

The husk slivers sticking to the piston will now be scraped off. Secondly, the oil leaking along the side of the piston and the cylinder, flows down into the space at the bottom. This prevents oil from being pressed into the seed holder, where it causes the bridging of the seed, leading to the blocking of the holder channel.

Although the dirt chamber increases the life span of the piston and cylinder, replacement of both will inevitably be necessary. To replace them as they are in the original design is an expensive exercise.

Figure 2.

REPLACEABLE PARTS

In order to keep the cost of spare parts low, and to make replacement easy in the T.D.A.U. design, the piston is designed
with a sleeve and for the cylinder there are easily replaceable parts, as shown in figure 3.

In the ram press, the function of the restrictor is to create the necessary back pressure on the cake. The tests showed that the conical shape of the original design causes the cake to be compressed together near the restrictor. For the hybrid seed, this problem can be solved with a few powerful strokes. With composite seed, the machine will get stuck. After some experiments, a simple new design came out, as shown in Figure 4. The T.D.A.U. design also includes modifications that would make the machine cheaper and easier to manufacture in Zambia.

Figure 3

Original design

(piston sleeve (spare part))

(replaceable cylinder)

255.
LARGE SCALE MANUFACTURING

The results of field tests of the ram press, up to now are grounds for optimism. The press brings cooking oil to areas where the commodity has rarely been seen, if at all in many years. So far the users and would-be users, in considerable numbers, have made their own simple, but probably realistic calculations, and have decided to place orders for the press. Potential buyers will, however, need a bit of patience. T.D.A.U. is now implementing some last tests and preparing for large-scale production which will be handed over to the Zambian entrepreneurs and then the floor will be open for users.

Figure 4

original design

new (TDAU) design
VILLAGE OIL PRESS PROJECT (SIDO)

INFORMATION FOR WOMEN'S GROUPS INTERESTED IN PRODUCING COOKING OIL USING THE HAND OPERATED RAM PRESS

One of the aims of the VILLAGE OIL PRESS PROJECT sponsored by Small Industries Development Organization (SIDO) is to assist women's groups in Tanzania to establish their own village enterprises for producing cooking oil and animal feed from sunflower and sesame. Such enterprises would make use of the hand-operated Bielenberg ram press being introduced by our Project. The following information may be helpful to groups that are considering establishing their own cooking oil production activities using this technology.

Cost and Availability of the Ram Press. The average cost of ram presses presently being manufactured in Tanzania is Tshs 60,000/= (June, 1990). The ram press is available from manufacturers in Arusha, Lushoto, Singida and Iringa.

Operating the Ram Press. The ram press is a relatively easy machine to use and maintain (please see our hand-out of information on how to operate and maintain the press, and how to clarify the oil and use the residue for animal feed). Only one person is required to operate the press at any given time. While women can operate the press, we recommend that the group hire young men to do the work (as they should be able to apply greater force and produce more oil). While only one person operates the press at a particular time, several laborers should be trained to use the press, because one person will usually operate the press for two to three hours and then another will take over the work. The laborers should be paid for each liter of oil they produce as soon as they complete their work (Tshs 20/= per liter is usually paid). Thus, one young man may work for two or three hours and produce 6 to 9 liters of oil - he would be paid 120/= to 180/= for his work, before another young man gets started. This kind of labor is very popular with young men, providing they get paid as soon as they complete their work.

The Importance of Growing the Right Type of Seed. The degree of financial success resulting from a ram press oil production enterprise will depend greatly on the quality of the seed being processed. Many sunflower producers grow a poor quality hard black seed that contains very little oil. The type of seed we recommend to use is a soft-hulled variety known as "RECORD"; it is sold by TANSEED, and is also available from our project.

Oil Production Time and the Amounts Produced. A 50 kilo bag of sunflower seed (of the RECORD type) can be processed in 5 to 6
hours. The amount of oil to be extracted should be between 12 to 16 liters - 14 liters per 50 kilos is a good average.

**Producing Adequate Amounts of Seed.** Since a 50 kilo bag of sunflower seed can easily be processed in one day, it is not difficult to process 30 bags of seed in a month. And during the four or five months following harvest time when seed is readily available. 150 bags of seed can easily be processed. Because so many bags of seed can be processed using the ram press, it is necessary that the group members themselves and their neighbors all get involved in producing sunflower or sesame, in order to have adequate amounts of seed to process. Women who do not live in areas where sunflower or sesame are grown should not get involved in oil production, as they will face serious problems obtaining seed. It is essential that women who intend to initiate their own oil production activities live in an area where they and their neighbors can produce 100 bags or more of seed each season.

**Providing a Service to the Community.** Many ram pressing enterprises are operated like maize grinding mills in that each day some family in the village brings in their seed to be processed. After the operators finish pressing the seed, the amount of oil produced is measured. Half of the oil is then collected by the family which brought the seed (they will also take the seed residue for their animals). The other half of the oil produced is left with the group owning the press as payment for the service. By so doing, a family bringing in 50 kilos of seed to process might receive 7 liters of oil from the total of 14 liters produced (the other 7 liters would be left as payment). If that family sells those 7 liters of oil for Tshs 250/= per liter, they would receive Tshs 1,750. If the 7 liters paid to the women's group is sold for Tshs 250/= per liter, the group would receive Tshs 1,750/= less the payment for labor (20/= per liter for 14 liters = 280/=), or Tshs 1,470/=.

**Income for the Women Operating the Oil Production Enterprise.** For a women's group to operate a successful oil production enterprise, it must have an adequate supply of good quality seed to press and, if they process one bag of seed a day, they should be able to generate Tshs 40,000/= per month for their group. But in order for the group to be successful, it must manage its business well - in addition to having a steady supply of good quality seed to process. For example, there are many questions to be resolved regarding the management of the activity, such as the following:

- Where will the oil processing be done?
- Where will the press be stored?
- Who will make sure that seed will be available each day?
- Who will oversee the work of the laborers?
- Who will pay the laborers?
Who will measure the oil produced, and make sure that it is divided properly?
Who will be responsible for storing and clarifying the oil?
Who will sell the oil?
Who will keep the money for the group?
Who will keep records on the amounts of oil produced?
How many days per week will the press be operated?
How many hours will it be operated per day?

As with many income generating activities, there is a lot of work to be done in order to be successful in producing cooking oil. But because the ram press technology is relatively simple and easy to use and maintain, the chances of success are very good for women's groups that are well organized.

Women's groups interested in the possibility of establishing their own oil production enterprises are encouraged to contact the

VILLAGE OIL PRESS PROJECT
Arusha International Conference Center
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ARUSHA

P.O. Box 1409
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INFORMATION ABOUT THE BIELENBERG RAM PRESS
DESIGNED BY CAPU - LUSHOTO

The hand-operated Bielenberg ram press was invented by Carl Bielenberg in Arusha, Tanzania, in October 1985. The ram press was first introduced to farmers in the Arusha Region by the Evangelical Lutheran Church of Tanzania Diocese of Arusha (ELCT/DAR) Village Sunflower Project. In four years time, 60 ram presses were being operated in 40 villages; their total oil production in 1989 exceeded 100,000 liters.

Thus far, at least 4 different designs of the ram press have been made, though each model operates in basically the same way - all are hand-operated. The ram press described below, was designed by the Craftsmen and Artisans Promotion Unit (CAPU) in Lushoto, Tanzania. It is an efficient, low cost model that can be manufactured by local metal shops in Tanzania.

SPECIFICATIONS

1. The Bielenberg ram press has been designed to extract oil from sunflower seed. Sesame and groundnuts can also be processed by the ram press, providing the cage is made with narrower gaps where the oil comes out.

2. The press is surprisingly easy to use. One person can operate it for several hours.

3. An especially important feature of the ram press is that it can efficiently extract oil from whole sunflower seed - providing the seed is soft-hulled (i.e. seed that can be torn in half with one's fingers). Using soft-hulled seed greatly simplifies the oil production process, as whole seed can be put directly into the press. But hard-hulled sunflower seed must be dehulled before it can be used in this press. The use of hard hulled sunflower seed is also discouraged because it seldom matches the oil content of soft-hulled varieties. For these reasons, prospective buyers of the ram press are always encouraged to grow only soft-hulled sunflower varieties, such as RECORD, sold by TANSEED outlets in Tanzania.

4. The total weight of the press is approximately 65 kg (excluding the wooden base). The ram press is mounted on a wooden base that allows it to be portable. But if the press it to be used at only one site, it is recommended that it be removed from the wooden base, and fixed onto bolts set in a cement platform for more stability and easier use.
5. All the various parts of the ram press are manufactured locally, and spare parts are readily available.

**Production Capacity**

1. When used properly (see Operating Instructions, below), the Bielenberg ram press can extract as much as 75% of the oil present in sunflower seed.

2. The amount of oil that can be extracted from 50 kg of sunflower seed will depend on the amount of oil it contains. In general, one can expect to get 12 liters of oil from fair quality seed, but as much as 18 liters or more from seed with a high oil content.

3. The amount of time it takes to process 50 kilos of seed will also vary; it will depend on the amount of oil in the seed, and the experience of the operator. It may only take 3 1/2 hours to process 50 kilos, or it may take as long as 7 hours. A reasonable average over time might be 14 liters of oil, from 50 kilos of seed, in 5 working hours.

**Seed Preparation**

1. Only soft-hulled sunflower seed can be pressed successfully without having to first remove the hulls from the seed. Hard-hulled seed should not be used in this press.

2. In preparation for pressing, the seed should be winnowed carefully to remove dirt, dust, and other waste matter—oil production will be reduced if such impurities are not removed.

3. Just before pressing the seed, spread it out in the sunlight for about 10 minutes. By warming the seed, more oil can be extracted. Hot, sunny weather is ideal for getting maximum oil production when using a ram press.

**Operating Instructions**

1. The Bielenberg ram press is operated by raising and pulling down a long handle, which drives a steel ram into the cage cylinder where the seed is pressed. The stroke of the handle goes from the vertical position to waist level.

2. When the handle is in the upright position, the steel ram is pushed out, and seed will automatically be fed from the hopper into the cage cylinder.

3. Each time the handle is pulled down, a small stream of oil should come from the underside of the cage. (More oil production can be achieved if the operator pauses for a few
moments until the oil stops flowing, before raising the handle again.

4. If the press is new, the cage must first be filled with seed. In order to fill it, first tighten the adjustment screw fitted at the end of the cage to prevent the seed from falling out. Put some of the warm seed into the hopper of the press. Then, move the handle from the upright position to the waist level position several times, until pressure begins to build. However, before the amount of pressure becomes too great, loosen the adjustment screw a little after each stroke, in order to allow some of the residue to be extruded from the cage. Continue to adjust the screw a little after each stroke, until the optimal amount of pressure is created.

5. Since it is not necessary to empty the cage at the end of the working day, the cage will almost always be filled with seed residue. When beginning to use the press each day, first loosen the adjustment screw a little; then put some seed in the hopper, and move the handle up and down a few times. This will force out some of the seed residue, and allow some unpressed seed to enter the cage. After a few strokes, gradually tighten the screw after each stroke, until an optimal amount of pressure is created. (Some seed residue should be extruded with each stroke.)

6. CAUTION: While a good amount of pressure is needed to get satisfactory oil production, too much pressure is not good. Always loosen the adjustment screw a little before the amount of pressure becomes too great; if too much pressure is created, the press might be damaged. For this reason, never have more than one person operate the press at a time.

MAINTENANCE OF THE RAM PRESS

1. The ram press is very easy to maintain. Prior to each day's use, the press should be oiled, especially those parts that rotate. The oil being produced is quite satisfactory for lubricating the press.

2. The press should be cleaned at least twice per week. Cleaning the press is quite simple, as the machine does not have to be disassembled. Simply pour hot boiled water over the cage cylinder. Scrub the cage with a brush and use a knife to remove any residue caught between the cage bars. Finally, pour more hot water over the cage to rinse it clean.

CLARIFYING THE OIL

1. Because whole seed is being pressed, the oil that comes out of cage cylinder will be quite black. The blackness is caused by coloration from the seed hulls.
2. Clarifying the oil is not difficult. The easiest method is to put the oil in a tall container, and set it aside until the impure particles settle to the bottom. The oil will become quite clear after 4 or 5 days.

3. In order to clarify the oil more quickly, we recommend that the oil be boiled in water. To do this, you will need a container large enough to hold the oil that you want to clarify and somewhat less than the equivalent amount of water (try one liter of oil to 3/4 liter of water). Put the water and the oil together in the container and bring the mixture to a boil. Add a little bit of salt (about one tablespoon per liter of oil). Let the mixture boil for about ten minutes. Then set it aside to cool. Even before it cools, all the clean oil will have risen to the top, and all the blackish colored water will have settled to the bottom. Slowly pour off the clear oil into another container. (The pouring must be done carefully, especially as you pour off the very last of the oil.)

4. Another technique for clarifying the oil is to use a paper filter.

USING SEED RESIDUE AS ANIMAL FEED

1. Sunflower seed residue is rich in protein, and it makes an excellent feed for cattle and pigs. It is recommended that one part sunflower seed residue be mixed with three parts maize bran, wheat bran, or bean residue.

For more information, please contact:

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