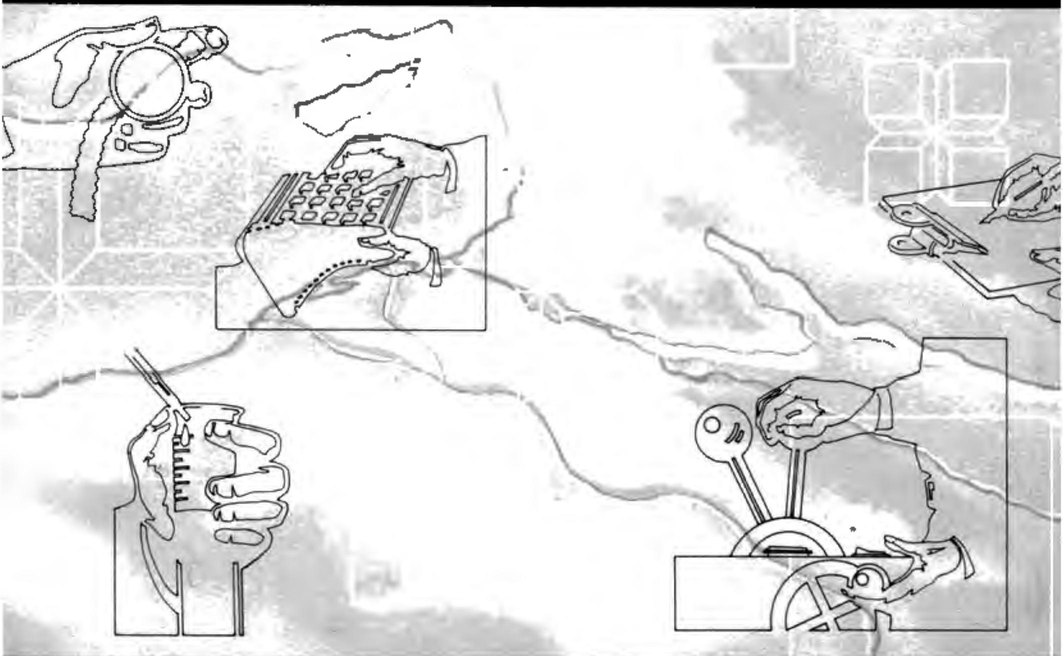
UTILIZATION OF RESEARCH RESULTS



PROCEEDINGS OF A CONFERENCE ORGANIZED BY ALEXANDRIA UNIVERSITY, EGYPT AND IDRC, CANADA

EDITOR

SHERIF KANDIL

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FOREWORD

Since its inception in 1970, The International Development Research Centre (IDRC) has adopted a philosophy of responding to the development needs of Third World Countries as perceived by the indigenous scientific and intellectual communities. This philosophy is best reflected on the Centre's style of operation and the way it selects and develops its research-supported activities.

The Centre supports a variety of research projects, the outputs of which may vary from knowledge and policy recommendations to "hard" technology. In its initial efforts, IDRC has concentrated most of its initial efforts on building research capacity in developing countries and funding research projects. More recently, the Centre moved towards the adoption of a policy that aimed at the promotion of social and economic change through the research it supports. It has been recognized that more attention needs to be paid to complex processes surrounding the utilization of results of research. Utilization in this context implies practical application of research outputs.

As one of several initiatives aimed at developing such a policy, IDRC has initiated a series of regional workshops sponsored by its six regional offices in the developing regions of the world. These workshops concentrated on "universities and application of research results". The rationale behind the conduct of these workshops stemmed from the fact that

While the universities have earned their niche in science and technology and are continuously generating technology research for utilization, they lacked a system that ensures the application of their research results. Thus, these workshops would offer the forum to help the universities define how best they can mobilize their resources to get research outputs disseminated. They ought to develop channels to communicate their research and technology to the rest of the society. It will also help bringing together many insights gained from experiences of universities in technology diffusion/transfer.

In partnership with the University of Alexandria, the IDRC regional office for the Middle East and North Africa in Cairo, has organized a workshop entitled " Universities and Productive Sector Linkages: The Application of Research Results".

The specific objectives of the workshop were as follows:

- To bring together universities and various actors in the productive sectors (e.g. government departments, NGO, private and public sector industry) to identify concerns, discuss problems and propose initiatives for better application of university-based research results;

- To encourage universities in the Middle East and North Africa region to document, in case study form, their experiences in the application of research results; and

- To develop a central set of policy issues for national governments, and if appropriate, universities.

The workshop provided a unique opportunity for participants from seven countries in the region that included: senior university officials, researchers, representations of government and nongovernment organizations, and industrialists from public and private sector, to meet and exchange ideas and experiences on how to strengthen linkages between universities and end-users of research.

It is hoped that such exchange will help the universities of the region plan, develop, and institutionalize the process of commercialization of their research results and strengthen their linkages with end-users, particularly, in the industrial sector. Needless to say that such endeavor could also promote the possibility for new research funding opportunities, something that most universities in the region are very keen on.

Fawzi Kishk

Director,
IDRC Regional Office for
the Middle East and North Africa

ACKNOWLEDGEMENTS

The way towards progress and development (especially in our part of the world) is through the scientific handling of our problems. This involves the creation of a strong scientific base and the raising of technological awareness in our societies.

This book is a documentation of a brain storming session held in Alexandria, Egypt where scientists from different parts of the region tried to look beyond their scientific research and utilize their results for the practical benefit of their societies.

Through this collection of case studies, scientists have shown how they have tried to make a break through, and transform their scientific efforts and intellect into useful applications. They may have lacked a system, but they certainly did not lack enthusiasm and devotion. These efforts need to be studied and analyzed in order to know why some were more successful than others.

If I may include a personal remark, this conference was very rewarding both intellectually and personally-meeting all those distinguished scientists and pioneers was a real enjoyment, particularly working with Professor Abou Akkada (a combination of visionary leader and friend), Professor Fawzi Kishk (an innovator who gives the credit to others), Ms Amira Iskander as well as many others who made this meeting possible.

A special word of thanks to Ms. Nadia El-Sayed for her immaculate preparation of this manuscript, and Mr. Tony Lilley for revising the language.

The Editor

INTRODUCTION

Alexandria University, Egypt and the International Development and Research Centre, Canada jointly organized the conference on Utilization of Research Results. The beautiful city of Alexandria, hosted the conference which was held during the period 5-7 December 1989. The conference was devoted to study the experience of scientists who tried to orient their research to the applied problems and to implement their results.

The meeting was inaugurated by professor Adel Ezz the Minister of Scientific Research who praised the idea of the conference referring to the recent efforts taking place in the region.

The conference was held under the auspices of Prof. Mohamed Saeed Abd El-Fattah, president of Alexandria University, Chaired by Prof. A. Abou Akkada and attended by distinguished scientists from the region. Scientists from Canada, Egypt, Jordan, Kuwait, Pakistan, Sudan, and Turkey, presented their experiences in the form of case studies.

There were five technical sessions for the following areas of research:

1. Modalities and Policies.
2. Management and Training.
3. Agriculture.
4. Industry.
5. Health and Environment.

The Sixth session which provoked very stimulating discussions was devoted to putting forward recommendations. These sessions were chaired by distinguished scientists who have left their marks on the scientific progress of the region.

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IDRC'S EXPERIENCE IN THE UTILIZATION OF RESEARCH RESULTS

JAMES MULLIN

VICE-PRESIDENT, PROGRAM,

THE INTERNATIONAL DEVELOPMENT RESEARCH CENTRE, CANADA

The International Development Research Centre, IDRC, was created by the Parliament of Canada in 1970 to encourage and support applied research on the problems of economic and social development, in the Developing World. Since its creation, IDRC has supported more than three thousand research projects in more than ninety Developing Countries, and currently has an annual budget of more than One Hundred Million Canadian Dollars. Since the Centre sees itself as a Development Agency, which supports research to bring about developmental change, it has in recent years devoted increasing attention to the problem of promoting the utilization of the results of the research which it finances. This paper will therefore seek:

1. To trace the evolution of thinking, within IDRC, on utilization,
2. To review our present, interim conclusions on how to promote improved utilization, and
3. To indicate, in a general way, what the Centre will be doing next.

The Scope of IDRC Activities

IDRC supports research in many fields - from plant breeding to macroeconomic policy, from water and sanitation to microelectronics - and we are concerned to learn how to increase the probability that the results of the research which we finance, on whatever subject, in whatever country, will be used in practice, in ways which will confer benefits on the poorest segments of the global population. It is already clear, from our varied experience, that the appropriate routes to promote utilization vary enormously, depending on the nature of the knowledge or technology <u>and</u> on the nature of the potential user. There are different approaches needed if the proposed user is a Minister or other senior government official, an entrepreneur, or a villager or subsistence farmer. Each operates under her or his own set of constraints and values which act to condition their responses to the possibility of change.

Another variable in this already complex equation of differing disciplines and differing countries is provided by our practice of supporting research in many different kinds of institutions, each with its own mandate. As a result, we are attempting to learn from the experience of universities, such as Alexandria, of Government institutions such as The Pakistan Council for Scientific and Industrial Research, (PCSIR), from private enterprises, from non-governmental organizations and from International Research Centres. We have also sought to exchange our experience with other agencies - Bilateral, Multilateral and Private.

However, since the bulk of IDRC supported activities involve universities, we have focused particular attention on their efforts to promote the practical utilization of the knowledge and technologies which they produce.

Some experience from the Industrialized World

The search for a better understanding of how to promote an improved use of the outputs of scientific research is neither new nor confined to the developing world. In the Industrialized Countries, there is considerable concern about University-Industry linkages, and much experimental policy is being undertaken. The Committee on Science and Technology Policy of The Organization for Economic Cooperation and Development (OECD), has had a committee working on such linkages for close to a decade now, and has published useful comparative studies of some of the experiences of member Countries.[1]

Canada is no exception among the industrialised countries when it comes to concern for University - Industry linkages, and so the decade of the eighties in Canada has seen much policy research[2] and, more importantly, actual experience with innovative approaches, within the universities. Such innovation have ranged from amendments to university regulations designed to create incentives for researchers to have them pursue the practical application of their research output, to the creation of new institutions within the structure of the University to promote utilization. Many universities have had to face up to the redrafting of policies covering such topics as the ownership of intellectual property or the rights of staff members to participate in consulting. One frequent step has been the establishment of on-campus "Innovation Centres". Perhaps one of the most interesting Canadian cases was the creation, by the University of Waterloo, of a private company - wholly owned by the University - to engage in the development and sale of computer software, using Faculty members and students as company employees. The profits generated by this successful enterprise are funnelled back to the University and are used to support further research.

While there is, in the OECD countries, an extensive research literature on responses by the university community to this search for linkages with industry, practically nothing has been written about what, if any thing, is being done by industries, to adjust their behaviour and practices, to improve their links to universities. As a first step, in Canada, IDRC commissioned a short study of the behaviour of a sample of research-intensive industries, to see what kinds of strategies they had evolved to improve their access to the results of university research.(3) This particular study was undertaken as part of an internal IDRC policy review on "utilization", in order to see if lessons could be applied to the relationships among researchers and potential users in the Third World.

It is perhaps no surprise that the key finding of the study was to the effect that the better defined the goals of a partnership, the greater the likelihood of a satisfactory relationship emerging. Beyond this general conclusion, the author of this study, my colleague Dr. Andre Potworowski, has postulated eight working principles which he sets out as advice to industries about to begin a relationship with a university. His advice is as follows:

1. Clearly define the strategic objectives of the linkage -eg short-term problem solving or long-term capacity building;
2. Screen and select partners carefully;
3. Familiarize the university researchers involved with the company's activities and management practices;
4. Clearly define the expected outcome of any contract;
5. Provide incentives for university staff involved (financial rewards, material support, access to unique facilities);
6. Monitor the links closely;
7. Negotiate a fair sharing of any jointly-developed intellectual property;
8. Try to develop longer-term links with the university in area of strategic importance to the enterprise.

As can be seen, these principles are no more than a call to apply good management practices to the relationship.

Recent experience in the Developing World

As an element of a program to increase its attention to questions of utilization, IDRC has been involved, with partner institutions, in a series of Workshops around the world on this topic. We have conducted such exercises in Singapore, in India, in Argentina and now in Egypt, and others are planned in Sub-Saharan Africa. Two common themes have emerged so far. In all parts of the developing world, Universities are struggling with the issue of utilization, but nowhere have they developed a forum within which to exchange ideas and experiences. Some reports on these workshops are already in print.[4,5]

Out of these discussions there are some striking cases, both of good practice and of deep problems. A few examples are:

A. The case study on "Enterprise performance", to be presented at this workshop by Professor Ashour, is an excellent example of the levels of utilization which can be achieved by the careful, and sometimes innovative, involvement of potential users at all stages of the research;

B. Chlang Mal University, in Thailand, has created a Centre to permit close interaction with local entrepreneurs; the Centre sponsors successful residential Weekends at the university, designed to give the local business community, especially those from small scale enterprises, better understanding of what the university has to offer. Such weekends also build up important personal relationships among faculty members and local entrepreneurs;

C. On the negative side, a study of an attempt by India's Council for Scientific and Industrial Research to develop a domestic capacity to produce certain pharmaceutical products demonstrated how Government policies can effectively block attempts to use domestically-generated technologies;

D. In Peru, a group of entrepreneurs and academics have banded together to create a new institute of advanced technological studies, using privately generated funding, and that in a country suffering from hyperinflation;

E. While in most countries it is assumed that, at least in the agricultural sector, the process of utilizing the outputs of research is looked after by the national Agricultural Extension System, this assumption may be over optimistic - the Vice Chancellor of one of India's leading Agricultural Universities said, during a workshop similar to this one, that in Indian agriculture, "There is an alarming gap between knowledge and practice". IDRC hopes to publish the results of a series of workshops on the problems of promoting utilization in India's system of State Agricultural Universities.

A Utilization Framework for Projects

When the Governing Board of IDRC adopted a policy to encourage the utilization of results of IDRC-supported research, it emphasized that concern for utilization must begin with the beginning of planning of the research itself. In addition, the Board argued that, to the maximum extent feasible, some representative potential users should be involved in the planning process from the outset, in order that the research be able to take full account of the constraints under which the users must act.

Going beyond this simple prescription, IDRC initiated a review of the literature on Social Marketing and derived from that exercise a straightforward, eight point, framework of important consideration which the Centre now believes should be addressed in each research proposal.[6] Addressing these matters at the outset of an applied research activity should have a positive effect on the probability that, if the research is successful, the outputs will be both usable and used. The eight elements of the framework are the following:

1. Define clearly the nature of the product or service which is expected to result from the project;

2. Identify the user or adopter of the product or service - i.e. identify who will make the decisions surrounding adoption and use of the research outputs;

3. Attempt to estimate the "Market Potential" for the output - this is particularly important for physical technologies;

4. Define the constraints to use which are likely to be encountered in the economic or political environment within which the users operate.

5. Define the distribution channels through which the outputs will have to pass. In almost every research endeavour the technology has to pass through, and in some cases be transformed by, a number of other organizations, agencies or intermediaries before it reaches the ultimate end-user. "Identifying these actors or agents in the utilization process, understanding their respective roles in the dissemination and implementation process, and developing strategies for better management of these relationships is probably one of the most important components in the development of a (well-conceived applied research) project".[6]

6. Consider how the output can be promoted among larger groups of potential users, beyond those who can have a direct relationship with the project. There may be a need to involve communications researchers to look at this issue in depth.

7. Consider the main features of the behaviour of the users/ adopters who have been identified. This is the step in which culturally determined variables can be extremely important.

8. Consider what price (usually financial, but sometimes political) the user can afford to pay; this will in turn determine what are the limits on the costs of production. In many instances in the developing world, the challenge of introducing new technologies is made much more difficult because of the low level of financial resources accessible by potential users.

This framework was developed as a management tool for use by IDRC staff as they seek to negotiate with researchers the details of future research activities. It is however hoped that it contains some ideas and advice which can be used in many situations.

When one considers the points set out in this framework, it is not difficult to see why so many successful research activities concerned with the practical problems of development are, from the outset, conceived in multidisciplinary terms.

Where next?

Inside IDRC, we will continue to place great emphasis on improving our understanding of the factors which influence the utilization of research results in general, and of those which are produced in the universities of the Third World in particular. In addition, we are considering a "global" workshop, during which we would seek to facilitate a comparison of experiences from all regions of the Third World.

Within IDRC, we have started an internal Newsletter, to allow our staff a medium for rapid exchange of ideas and experiences; this is relatively easy to do so within a large institution and seems to be an effective means of capturing and sharing experiences among busy people.

Finally, we will engage in discussions with our hosts at this workshop, the University of Alexandria, to see what can be done in this region to maintain the dialogue which is now beginning.

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SOME ASPECTS OF UNIVERSITY-INDUSTRY INTERACTION (A REVIEW OF INTERNATIONAL AND LOCAL MODALITIES)

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1. INTRODUCTION

We are living in a new era; the post-industrial society which has quite different characteristics from the preceding industrial age.

One of the distinct features could be exemplified by the fact that nowadays less than 4% of the American work force is producing more food than what used to be produced by 70% in 1820. Mechanized transportation, data handling, information technology and business analysis as well as new disciplines have moved to the focus of interest of both business and education institutions. As with the rest of society, universities are under pressure to adapt to new circumstances. Colleges and Universities started to play an active role in the substitutional system of employee education and training and put a lot of emphasis on human resource development. They also manifested ways of interaction with the productive society around them. However, an accurate survey reveals that there is still a missing link between this array of instructional activities and the present system of higher education. Because of their maturity and tradition, many universities have been slow to adapt. In the manner of endangered societies, they have reacted defensively instead of riding the crest of the wave of change. The situation is more acute in most developing countries, where, to our mind, the concept is not enthusiastically supported but superficially approached to decorate and or satisfy a political set up.

This article is going to review, critically, some of the models and approaches used by various countries and societies and will try to analyze the Egyptian situation.

2. MANAGEMENT OF UNIVERSITY-INDUSTRY INTERACTION

The future will be knowledge-based. Perhaps it has always been, but now the rate of change is so great that new knowledge will rapidly replace old knowledge and the new knowledge itself will wear out or degrade several times in a person's life-time. The "Shelf-life" of knowledge in subjects such as electronics may already be less than five years and in computer science less than two years. Knowledge can no longer be owned; although it can still be bought and sold. As a result, universities will cease to be "Knowledge factories" but rather "Knowledge packing plants".

The application of knowledge is equivalent to the generation and transfer of technology. Technology can be owned and patented. Its "Shelf-life" is still long and it is the principal source of wealth. Technologists are the wealth creators, provided they have access to the corresponding skills. Skills reside largely in people and are transferred only by the movement of people. Knowledgeable people who are also skilled represent the true wealth of the country.

Under these circumstances, universities have an important role to play depending on the tradition of the country of the university. They may be heavily involved in knowledge creation (Research) such as U.K., or in technology transfer (U.S.A.). They may be heavily involved in skills creation (West Germany) or in skills transfer (Japan). In some countries, much of the strategic research (Knowledge creation) is still carried out in academic institutions. These institutions can be either in universities or in separate institutes. In other countries such as Japan, much of the strategic research is carried out in industry.

It is always urged that during times of rapid change, the major investment in research should be investing in new people and new equipment and disinvesting in outmoded people and obsolete methodologies. This constitutes the dynamic of research group or the industry. The biggest investment factor is the coming and going of graduate scientists and technologists. This is easily sustained in universities at little cost. All research organisations therefore benefit greatly by being linked to, or even embedded in, their local university.

To facilitate this linkage, universities will increasingly be required to focus their research in the form of graduate schools, research groups and research units. These must reach a critical mass to be viable and should be targetted at particular industry needs. The result is a technology-transfer bridge from one research group to one or more industries. The resultant blending of industry and academia enriches both. The creation and maintenance of these technology bridges is a new professional skill requiring excellent management.

The dynamic of university-industry links is maintained by the transfer of people along this bridge or by their transfer into or out of the research link into other links or other centres. The vitality of the research component is best maintained by insisting on its financial self-sufficiency. Self-funded units will enjoy great autonomy and higher levels of reward and incentives.

3. Models of University-Industry Links

Technological innovation is critical to the expansion and growth of any country's economy. Various universities have adopted several means for accelerating university-industry cooperation. The ultimate objectives of this cooperation will be making the industry more viable and competitive and strengthening the university systems, i.e. the creation of new knowledge. Modes of university-industry cooperation can be achieved via the following strategies and mechanisms:-

a. Preparing new Graduates

These would be more oriented towards technology via the non-conventional methods of teaching i.e. like the cooperative education and sandwich courses as well as teaching companies models. These graduates who have had first-hand experience in industry would be more able to integrate into the productive world.

b. **Training Courses**

The down-loading of the associated knowledge and skills in technology is a continuous need, and may constitute a considerable income generator. All universities seeking to enlarge their resource base should maximise their capacity to deliver long or short course programmes, in the university, in industry, by long distance learning modes, or by mixtures of these. The university should be aware of the needs of local industries and therefore training courses are tailored to fulfill these requirements. The training courses are normally designed to reveal to industry recent development and to provide a high-level scientifically-based education which is essential for decision-makers in any particular industry. On the other hand, it also reveals the strength of universities and shows their focus of interest. Preparation of these courses is beneficial for university curricula and it helps in creating a common language with industry.

c. **Joint Research Projects**

When the university gains a good reputation for its expertise, the research group will be involved in conducting small or large research projects to meet the needs of the industry. These research projects may be carried out upon the request of a particular industry or by a personal contact of university staff. Generally the projects are not requested according to a definite plan but when the industry faces a production problem. The research contract may include providing the industry with consultancies in some aspects of technology. Inspite of the low costs of these research contracts, they can represent a reasonable source of funds for improving the research facilities in the university. The joint research contracts could also be a good means for a successful university-industry interaction provided they are conducted according to a plan and priorities. In some cases, these projects have led to the creation of new scientific institutes oriented towards a particular industry, funded by industry and run jointly by university and industry scientists (Institute of emulsion polymerization, USA). Or it may be created to satisfy a national need and get a government support (Institute of testing of materials, W. Germany).

d. **Industrial Affiliation Programmes**

This model is adopted by Stanford University, U.S.A. The programmes are proven channels for convenient and direct communication between Stanford University and member company scientists and engineers. Most affiliation programmes assign one of their faculty to act as liason between the programme and one particular company. Each company is asked similarly to designate someone to act as liason between the company and the affiliation programme. The activities of the affiliation programme normally include:

i. Meetings on campus: some of these meetings may concentrate on single broad topics or annual review of research trends; others will be devoted to highly specialized topics.

ii. Visits to company location: most programmes provide for an annual site visit by a faculty member at a company location for a day of lectures, seminars or conferences. These visits provide opportunities for members to discuss company and industry concerns with the faculty.

iii. Publications: most programmes provide copies of all reports and publications originating from their areas.

iv. Problem identification: affiliated members are encouraged to bring technical problems to the attention of faculty members and to outline what they believe to be the key problems in advancing their fields. Thus they may have an influence on future research direction at the university.

v. Campus participation: scientists and engineers in the university are encouraged to be involved in research which will meet the needs of companies in the area.

This participation may be in the form of joint research contracts or consultancies.

All affiliation programmes provide the following special advantages:

i. Industry will have access to basic and applied research of exceptional quality carried out by highly productive researchers. Membership provides a research resource that supplements a company's own activities in many fields of science and technology.

ii. Faculties can be more readily developed through a member company working relationship with the faculty and staff who are experts in industrial problems. In addition to improving the fund resources of the faculty, influences on future research priorities can be exerted by member companies.

e. Innovation Centers

As a means of linking research and development, some universities such as Maryland university have established sophisticated innovation center "Engineering Research Center; ERC" which was established to promote cooperative research projects and focus the university's resources on the needs of the industrial community.

These centers conduct a number of programmes to further the university-industry interaction:

i. The technology Advancement Programme is a small business "Incubator" facility offering space and assistance for start-up companies engaged in the development of technically-oriented products or services. The university colleges of business and management participate with the (ERC) in the programme. An important part of the "incubator" concept is the offering of technical and business support to the participating companies. Such services reduce start-up obligations for a company so it can concentrate its limited resources on developing technical products and bringing them to the market place.

ii. Technology Extension Service (TES): technical assistance to industry is offered from regional offices. The university also participates in this programme by serving as experts for specialized technical problem solving, and in conducting required research. TES sponsors workshop and other educational activities which draw on university resources.

iii. Technology Initiatives Programme: this programme promotes development of research capabilities within the university in technical areas of industrial relevance.

iv. Industrial Partnership: this programme establishes cooperative research projects between industry and university.

f. Productive Units

Production lines within the universities may be created if it proves to be financially beneficial. The early example of the Wolfson Unit in the City University, London, shows how a small group of scientists turned their academic research in oxygen-sensing materials and mechanisms into a product (oxygen sensor). A small production line was established and two offices containing no more than ten people produced a market of more than two million pounds sterling in 1980.

g. Research and Development Companies

This is the sophisticated model of university industry interaction. The university of Strathclyde (U.K.) has established some companies based on technology generated by research which was conducted in the university. Each research group in the university is targeted to one or more companies. The management of the relationship between the university and the companies is undertaken by a well staffed "Research And Development" Center.

This model has been a successful creation of university-industry links. It forms a natural and rewarding connection between the university and industry. It leads to spin-off companies. It induces an excellent culture into the academic life and it can greatly increase the volume and quality of research and improve the teaching at the post-graduate level.

This model has extended elsewhere to form independent companies which have evolved for promoting new inventions and turning ideas into technology (Cambridge consultants and the science parks (U.K.); the silicon valley, and science triangles (U.S.A.).

4. Egypt: Analysis of a Situation

a. Technology evolves outside the third world countries, so it is new to their local universities, even the industry gets the advantage of being aquainted first with these new technological concepts and innovations. Thus confidence in local universities is small and the productive sector is looking for foreign advice, where the technology has been developed. Industrialists are after their investments and have little patience to wait for local universities until they learn to grasp these new technologies and are able to help.

b. Foreign dealers usually work hard on hiding the details of the supplier processes in order to get the user always in need of their services and expertise and spare parts.

c. Some local groups may benefit through keeping the links with foreign dealers and thus they hinder the Egyptian replacement of foreign services, experience or technology.

d. Some leaders in the Public Sector play the safe game; they keep away from the adventures of changes or experiments. The measure of success is the quick return of investments and, to their mind, the investment in scientific research takes too long to be justified.

e. There is no general local plan to integrate facilities and efforts. Although Egypt is a country full of human and natural resources, however, only individual enthusiasm erupts here and there and the lack of a comprehensive scientific leadership is evident. Even the government itself duplicates the efforts and disseminates inadequate budgets among newly generated competing institutes. The situation results in the paralysis of scientific research. Researchers complain of inadequate funds, and government finds little justification in investing in fundamental research.

f. The system of promotion of Egyptian scientists and university staff demands a proof of scientific and scholarly capacities in the form of publications in scientific journals. Each scientist has to create his own research interest which is usually an extension of his Ph.D. studies abroad, and he rarely thinks of directing his research experience towards applied or community problems. There is neither the demand nor a plan directing him towards mission oriented research. The net result is a mismatch and waste of very valuable resources.

g. A general national plan, indicating the priorities in scientific research is lacking. At least it is not properly advertised if it exists. For sure it is not adopted by Universities and Colleges. Every professor is creating his own world of research and there is no plan for research in departments or universities.

h. There are few examples for research institutes which have been successful in creating their own links to industry like the "Central Metallurgy Research and

Development Institute". However, in other examples, companies may ignore institutes which have been created for their specific industrial development. Both models need to be properly studied.

i. The lack of communication among Egyptian scientists has a negative impact on their achievements. They end up by being linked to schools abroad rather than creating integrated and complementary efforts. A mechanism of disseminating knowledge is needed.

j. A positive point is that more awareness of the utilization of research efforts and results has moved Egyptian government institutions and universities to start their own mechanism and take action towards adopting their own models of utilizing their research results.

5. University of Alexandria Efforts Towards Interaction with Community

Since the early sixties, the University of Alexandria has worked for the interaction of scientists of different backgrounds towards solving problems of a multidisciplinary nature. This was reflected in introducing new interdisciplinary courses at its post-graduate level.

The efforts of various faculties, particularly the Institute of Graduate Studies and Research towards establishing post-experience courses oriented towards industrialists and technologists were noted. Various colleges have always given consultancies to industry when needed.

A magazine entitled "University and Industry" was issued. However, it stopped for lack of steady funds and a proper administrative structure.

6. Conclusion

In Alexandria, where 40% of Egyptian industry is located, the university should establish its own integrated mechanism for interaction with community.

A liaison office within the university might be the trigger of this mechanism.

It may execute the following functions:

a. To identify the needs of the local industry.

b. To locate the potential capabilities and strengths of the colleges and individuals within the university.

c. To act to match the needs of the society with the capabilities of the university.

UTILIZATION OF RESEARCH RESULTS. ALEXANDRIA. ed.S.KANDIL.1991

FROM RESEARCH CENTRE TO MARKET PLACE: THE MECHANICS OF EXPLOITING RESEARCH RESULTS (A CASE STUDY FROM KUWAIT)

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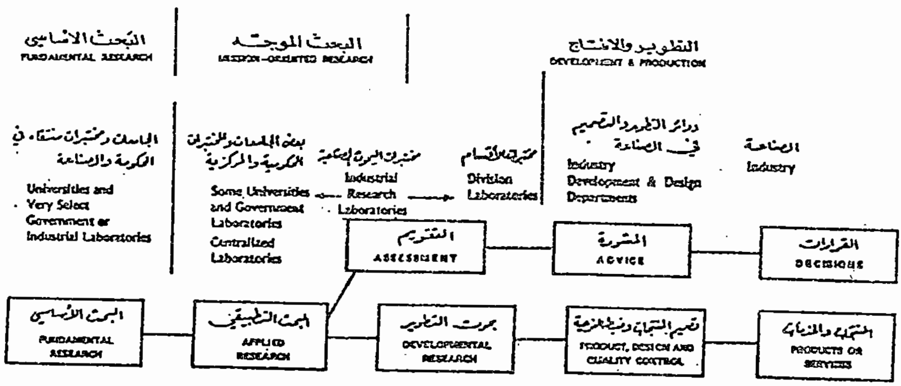
INTRODUCTION

It occurs to me that it would be useful, before reviewing the experience of the Kuwait Institute for Scientific Research (KISR) in linking up with the productive and service sectors, to start by taking a quick look at the manner in which promising research results become goods and services for which there is a market. We should be able, in the light of this general characterization, to do three things: First, we shall identify the gaps in the present set-up of universities, research centres and the productive sector. Secondly, we shall achieve a more realistic assessment of the total cost and effort involved in bringing research results to the market place. Finally, we should hopefully end up with some practical recommendations for establishing at least some of the linkages this workshop is seeking to establish.

We can envisage the process of transforming research results into marketable goods and services as the movement of a complex piece of machinery along an assembly line, where something is added at every station. Fig.(1) is a rough characterization of the various stages through which the results of fundamental research go, as they move along what I call a "conveyor belt", before they end up as products and services.



الحزام الناقل" من البحث الأساسي الى توفير المنتجات والخدمات"

Figure 1. The conveyor belt "From fundamental research to the supply of goods and services."

Fig.(1) shows also the institutions generally involved in industrialized countries at the various stages along the line. It should be possible now to identify where the gaps exist in any particular country, or situation. The figure indicates further three major inputs after achieving success in the stage of applied research. For a closer look at these, we may refer to Fig.(2), where what is involved in the last three stages is shown in some more detail.

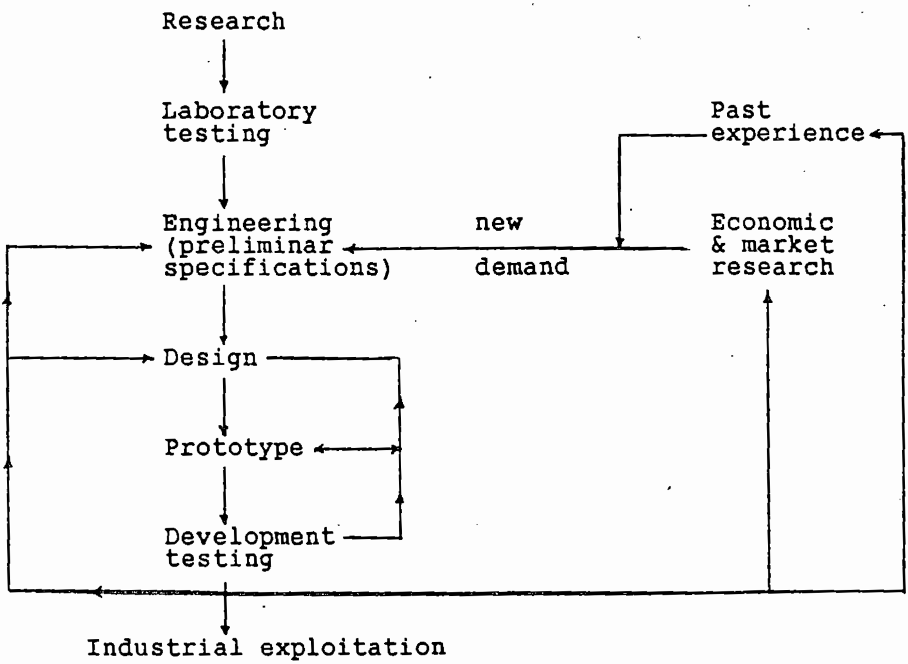


Figure 2: The Process of Innovation

OFFICE OF PROJECT MANAGEMENT

STATEMENT OF KISR/CONTRACT RESEARCH PROJECTS

AS ON 28th JAN. 86.

CLIENTS	DIVISION							
	PRD	RES	PP, MD	ENG	TED	SPP	TS	TOTAL
Kuwait Petroleum Corporation	-	-	1	-	-	-	-	1
Ministry of Public Works	1	-	1	3	-	-	-	5
K.P.A.S.	16	3	11	3	1	2	1	37
Kuwait Municipality	6	-	-	-	-	-	-	6
K.U.P.CO.	1	-	-	-	-	-	-	1
K.P.C.	4	4	-	1	-	-	-	9
K.L.T.T.	1	-	-	-	-	-	-	1
S.A.A.	2	4	-	-	1	2	-	9
Kuwait National Committee for World Food Day	1	-	-	-	-	-	-	1
Miami University	2	-	-	-	-	-	-	2
U.F.K.	4	-	-	-	-	-	-	4
A.A.F.R.A.	1	-	-	-	-	-	-	1
Said Ismail Dashti Co.	1	-	-	-	-	-	-	1
Basara University	1	1	-	-	-	-	-	2
Kuwait University	-	1	2	1	1	-	-	5
Ministry of Oil & Industry	-	2	1	1	1	-	1	6
Ministry of Electricity & Water	-	1	2	6	1	-	-	10
Kuwait Oil Co.	-	-	1	-	-	-	-	1
Kuwait national Petroleum Co.	-	-	2	-	-	-	-	2
Petrochemical Industries Co.	-	-	3	-	-	-	-	3
Kuwait Melamine Industries Co.	-	-	1	-	-	-	-	1
G.K.S.S.	-	-	1	-	-	-	-	1
Kuwait Chemical Mfg. Co.	-	-	1	-	-	-	-	1
Al-Sanaa Chemical Products	-	-	1	-	-	-	-	1
Ministry of Health	-	1	-	-	-	-	1	2
I.B.K.	-	1	-	3	-	-	-	4
Ministry of Interior	-	1	-	1	2	-	-	4
Kuwait Engineers Office	-	1	-	-	-	-	-	1
Quatar Consrd Petroleum Corporation	-	1	-	-	-	-	-	1
R.O.P.M.E.	-	5	-	-	-	-	-	5
Public Ports Authority	-	1	-	-	-	-	-	1
Mistui-Shimizu Consortium	-	1	-	-	-	-	-	1
Kuwait Airforce	-	1	-	-	-	-	-	1
Six Construc Co., Abo-Dhabi	-	1	-	-	-	-	-	1
Dow Chemical Industries	-	-	-	1	-	-	-	1
University of Petroleum and Minerals, Suadi Arabia	-	-	-	1	-	-	-	1
M.B.K.	-	-	-	3	-	-	-	3
Bahrain National Oil Co.	-	-	-	1	-	-	-	1
Gorgia Institute of Technology	-	-	-	2	-	-	-	2
R.S.S.	-	-	1	2	-	-	-	3
M.O.D.	-	-	-	1	-	-	-	1
Fajer Al-Sabita Co.	-	-	-	1	-	-	-	1
Civil Aviation	-	-	-	4	-	-	-	4
Kuwait English School	-	-	-	1	-	-	-	1
National Housing Authority	-	-	-	1	-	-	-	1
N.I.C.	-	-	-	1	3	1	-	5
Ministry of Planning	-	-	-	-	2	-	-	2
Arab Petroleum Training Institute, Iraq	-	-	-	-	1	-	-	1
O.A.P.K.C.	-	-	-	-	1	-	-	1
Amiri Dewan	-	-	-	-	1	-	-	1
Kuwait Banks Committee	-	-	-	-	-	1	-	1
Kuwait Computers Society	-	-	-	-	-	1	-	1
Supreme Housing Council	-	-	-	3	-	-	-	3
AEG-Telefunken, Germany	-	-	-	1	-	-	-	1
TOTAL NUMBER OF RESEARCH CONTRACTS	41	30	29	40	15	7	3	167 54
TOTAL NUMBER OF CLIENTS SUPPORTING RESEARCH IN KISR	36	27	26	39	14	5	3	150
TOTAL NUMBER OF CONTRACTUAT RESEARCH PROJECTS	35	26	21	47	28	-	-	157
TOTAL NUMBER OF KISR FUNDED PROJECTS	71	53	47	86	42	5	3	307

Movement along the conveyor belt is driven by two complementary forces: the "demand pull" from the productive sector end, and the "supply push" from the research end. Demand pull is very weak in the Region, and totally absent in certain productive sectors. The magnitude of demand pull is inversely proportional to the level of technological imports from outside the country, whether these be plant and equipment or products. Supply push exists in the Region and in many fields. However, it lacks the means for putting it through the acid test of market surveys, technoeconomic feasibility and development potential.

At present, and to venture a generalization about the Region that seems to me justified, universities and research institutes are quite familiar with fundamental and applied research. Industry does not have much experience in product design and certainly not in developmental research. It is obvious that if a traditional university, or applied research institute, wants to go beyond mission-oriented applied research it has to set up to the productive sector. Alternatively, the industrial and service sectors need to extend their activities to cover at least product design and development. The issue this workshop has to consider is whether there is a realistic chance to do this within the current organizational set-up of either side and what are the changes needed to achieve the linkages we are seeking.

Without anticipating the proceedings of the workshop, or its recommendations, I would like to conclude these introductory remarks by dwelling a little on development research, and logistic support.

It has been our habit to lump research and development together in the abbreviation (R&D). The distinction between these two very different activities is almost completely blurred. This is mainly due to the fact that our experience in development work, with very few exceptions, is almost totally non-existent. Development work has some very distinctive features which need to be stressed:-

* It is neither scientific, in the true sense of the word, nor completely intuitive. The development engineer is a rare bird who stores a tremendous wealth of practical experience and theoretical knowledge and draws on it, sometimes almost subconsciously. He does not necessarily have a well-defined diagnosis of the causes of a problem or a snag. Sometimes when he manages a technological "fix", he is not very clear why it has solved his problem. This is not to say that his is purely guesswork, or that he has no analytical tools or experimental techniques to guide his efforts.

* The magnitude of development effort is inversely proportional to the level of theoretical knowledge on which the original design is based. This is clearly seen in the field of advanced technology where both the designer and developer are working at the forefront of knowledge and experience in the field.

* Development is more often than not a very costly and long drawnout business, particularly when the product or service is entirely new and not just upgrading of existing ones.

Let me cite two extreme examples that highlight the very special nature of development work. It has been estimated by one of the leading manufacturers of jet engines that the cost of developing a new engine can be as high as ninety times the cost of design. Three leading manufacturers in the USA, Britain and Japan established a joint venture to design and develop a new engine for the next generation of narrow body jet transports. After spending more than US$ 1.5 billion, the engine could not meet the design specifications, nor the delivery dates. Another more down to earth example is the experience of the Rover Group in England with a new 1.5 liter car engine, the K-series engine. After spending 125 million pounds, the product is neither competitive in term of maximum power, nor torque characteristics, and it is not certain whether it will go into mass production.

When we discuss the situation in the Region, we are usually considering much less sophisticated problems. Furthermore, in certain fields, e.g. medicine, pharmaceuticals and agriculture, the linkages have been successfully established, at least in some countries. Several patent medicines on the market have been developed by staff members of the Schools of Pharmacy. However, in my experience, these have been individual efforts brought to fruition by initiatives from the national pharmaceutical industry. In some countries, agricultural extension services are well-developed and some date back to the last century. Again, it is in the industrial field that logistic support for goods based on local designs is a problem. No matter how much prototype testing is carried out, it is the feedback from the consumers that provides the acid test of the products. Inevitably snags will arise and remedies have to be devised and implemented without delay, if the product, its designer and manufacturer, are to maintain their credibility and position in the market place. Unless there is a strong design and development capability in the productive sector, as well as rapid and effective feedback to the research centre, satisfactory logistic support is not possible.

In starting with these scattered remarks I did not intend to be unduly pessimistic, but simply to put the problem in proper perspective.

II. A CASE STUDY

We now consider briefly the experience of the Kuwait Institute for Scientific Research (KISR) in linking up with the productive sector. KISR is an applied research institution with the specific mission, amongst others that need not concern us here, of carrying out research and studies relating to development of national industry and environmental protection, exploration and study of natural resources particularly water and energy, improving agricultural practices, and participation in the study of means of diversifying the national economy through the exploitation of R & D results (my italics). Fulfilling this mission has turned out to be difficult. I shall review here KISR experience with various approaches to achieving effective links with society:-

1. A board of trustees in which all potential beneficiaries of KISR research are represented at a high level:-

At this level of responsibility, the members had little time to ponder over policy issues. One may also add, with all due respect to the members, that their experience in the mechanics of applied research, their appreciation and insight into the problems of applied research institutions in developing countries were not adequate. This is only to be expected in any young developing country.

I believe the situation was aggravated by the absence of a technical secretariat to study the issues to be discussed by the board, analyze the data, and present options for consideration by the board.

2. Drafting a five year strategic programme to guide yearly research plans:-

The idea was that such an overall "strategic" perspective would provide the framework for detailed operational plans for each unit in KISR.

Great care and considerable effort, extending over several months, were exerted in preparing the strategic programme. This involved review of previous work, in-house as well as by an international review panel, contacting a multitude of organizations and personalities for suggestions, submission of the draft for review and comment.

However, because situations in developing countries change rapidly while mobilizing scientific-technological resources takes time, KISR ended up being criticized for not responding, in time and effectively, to national needs. In those cases where KISR could identify an urgent national need and concentrate its efforts to address it, it was very difficult to convince the potential beneficiary of the value of the work. It was usually many years later, when the situation had become critical, that interest was revived. By then KISR would have reduced its activities in the field considerably.

3. Setting targets for various units for self-financing through contract research:-

In 1979, KISR set itself a target of 50% contract research by the end of its 5-year plan (1979-83). Revenue from contract research increased from KD 400,000 in 1981 to KD 2,000,000 in 1986. However, this barely covered 30-40% of the direct cost of the contracted work. Efforts to increase client contributions have not been successful so far. State organizations saw no reason for paying for research carried out by another government organization. Private enterprises found KISR cost too high compared with other national bodies, such as the university, where-unlike KISR which is dedicated to research-costing covers only the extra expenses incurred in carrying out the contracted research obligations.

It is ironical to note here that KISR success in increasing its revenue from contract work five-fold in so many years turned out to be a curse. Several members of parliament, as well as amongst the public, called for turning it into a completely self-financing body.

Contract research brought about some internal problems:-

* It was not meant as a source of financing but rather as a mechanism for addressing real life problems. Consequently, top management insisted that work contracted must have a minimum of scientific merit, and

must not be run-of-the-mill routine.

The unit heads, who had to meet the targets set for them, found it difficult to reconcile the two conflicting considerations of making money and addressing problems of scientific merit. Top management insisted that KISR resources will not be used in competition with less-endowed national bodies, governmental or private, who could do the job.+

* KISR staff, as well as their prospective clients, lacked experience in the mechanics and procedures of negotiating research contracts and monitoring progress. There were disappointments and strained relations on either side that called for considerable effort and patience on the part of top management.

* As most staff came from an academic background, they resented participation in promotional activities and soliciting contracts. In fact, they were very bad promoters of their own talent and services in most cases.

* There were other internal problems relating to implementation of multi-disciplinary work in a "matrix" form of organization, in monitoring progress, and in settling accounts with customers.

4. Establishing an "Office of Business Development":-

This is a new approach that is barely four years old. Although quite young, the office has undertaken a number of useful activities:-

* Pointing out to potential clients those elements in KISR research programme relevant to them.

+ I believe this should prove more of an important consideratior for academic institutions.

* Holding joint meetings of representatives of potential and existing clients and KISR staff to discuss areas of mutual interest and review past experience in cooperation.

* Analyzing systematically KISR experience in contract research, thus proving very useful feedback to top management and scientific personnel.

5. Establishing the "Technology Investment Company (TIC)":-

This company was established in 1982, thanks to KISR's initiative, with the following organizations as shareholders:-
Ministry of Finance - Industrial Bank of Kuwait - Social Insurance Corporation - Kuwait Foreign Trade, Contracting and Investment Co-Kuwait Investment Co.*

The articles of association state that the objectives of the company are:

* Exploitation of the innovations and inventions of Kuwait's scientific bodies as well as their patents and trademarks.

* Assistance in registering patents and industrial and commercial trademarks.

* Investigating investment opportunities to exploit the innovations and inventions of Kuwaiti scientific bodies.

It was intended that TIC play an active role to commercialize Kuwaiti developed technologies. Thus, TIC would work with the developer of the technology to first determine if the technology developed is a suitable candidate for commercialization, and if so, to define the nature of that commercialization. For instance, is an entirely new type of venture to be set up, or is it more

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Kisr could not legally become a shareholder.

simply the transfer of technology and its related rights to a company where existing production processes would be thereby improved?. There are obviously many other possible variations in between.

TIC, in fact, plays its role by working with the technology proprietor to prepare and present the developed technology as an investment opportunity to Kuwaiti and other investors. TIC would in effect be acting as an investment banker for this purpose as well as possibly making a direct TIC investment in any new venture.

Since the start of investment operations in July 1982, one venture placement has been successfully completed and the related investment made, while several potential ventures were under study in various stages of development. For its first venture TIC undertook to raise financing for the commercialization of a technology which had been developed by KISR for the domestic culture of Sobaiti fish (Silvery Black Seabream) in sea cages or ponds. This type of investment represents a typical early phase venture capital investment, where investors finance the commercialization of a product that has been demonstrated by its developers to be feasible on a laboratory scale. In return for their risks the investors get rights to the commercial process.

In the Sobaiti case, TIC carried out a financial feasibility study of the potential for commercialization. Having found the result attractive, TIC arrived at an agreement with KISR to establish a "Joint Venture" to raise investment capital to commercialize the technology, with TIC being responsible for raising the capital and negotiating the venture with potential investors in return for a fixed front end fee plus a share of the royalties to be expected from successful commercialization of the technique.

To carry out its role, TIC prepared a prospectus detailing the uses of the investment funds to be raised, the returns to the investors, and a financial analysis including the development of pro-forma statements showing the additional financial requirements and potential returns to investors if the Sobaiti culture technique was successfully commercialized. Following preliminary contacts to ascertain potential investors interested, the prospectus was presented to 11 potential investors. Two out of the 11 responded with firm indications of interest. Preliminary negotiations with both parties, and detailed negotiations were carried out and successfully concluded with United Fisheries of Kuwait (UFK), with a contract being signed on 1 November 1982 for a KD. 480,000 investment* by UFK in return for the commercialization rights to the Sobiati technology. The contract also had provisions permitting other Kuwaiti investors to join UFK in the contract, within a given time limit, as co-investors with the same rights and obligations.

The original concept was soon expanded to include "Kuwaiti-owned" technologies, and not just "Kuwaiti-developed" ones. The idea was that certain technologies developed abroad are of benefit to Kuwait in very specific situations. Two examples can be cited here. The first is the application of photovoltaic technology in shaving off peak leaks in electricity generating plants. For several hours during daytime in the summer months, nearly one third of the total load is consumed in domestic air conditioning. This also happens to be the period of maximum insolation. Consequently, the basic problem of storage, which has bedevilled solar electricity generation, no longer exists. With the remarkable developments in the efficiency and production techniques of amorphous silicon cells, TIC analysis demonstrated the techno-economic feasibility of such an application. Negotiations were initiated with the Ministry of Electricity and Water to set up a pilot plant using locally-produced panels, to be followed, after field testing and satisfactory development, with a larger

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* KISR investment in developing the technology of Sobaiti and 'elapia culture in the Kuwaiti environment is around one million KD

production facility, wider application and marketing of the panels in the Gulf Region and the Arab States. However as yet, no firm commitment has been forthcoming from the Ministry. The other project presented to Kuwaiti Oil Company (KOC) was that of the use of biosurfactants developed abroad for cleaning oil storage tanks. Field trials are being organized at the expense of TIC, in the hope that KOC may use the technology if proved successful.

TIC had also other interesting, and so far unfamiliar, initiatives such as setting up a Kuwait Technology Fund (KTF), intended to offer Kuwaiti financial institutions the opportunity to make diversified investments, primarily in Kuwait and possibly the Gulf Region, in industries with advanced or developing technologies. This report is not the appropriate place for digressing too far into a discussion of this pioneering idea, since we are basically concerned here with links between R&D institutions and society.

Fate has not been very kind to TIC. Various factors contributed to a drastic reorientation, and even a change of name, a few months ago. Three new shareholders joined the company, viz the:

Kuwait Investment Authority - Kuwait Fund for Arab Economic Development - Industrial Investment Co.

The capital was increased from KD. 650,000 to KD. 5 million. The objectives were broadened to include the study of investment projects in developing countries, promotion of such projects among Kuwaiti investors, rationalizing their investments abroad, implementing projects and concluding agreements with host countries. The company was renamed the "Kuwait Company for Consultations and Investment". The main reasons for this change, which obviously dilutes the original concept which concentrated on investing in technologies rather than production of goods and services, were the under-capitalization of TIC, the need for an advisory/consulting investment arm for the Kuwait Fund and the Investment Authority, that could formulate, promote and launch investment projects abroad as well as the national policy of adapting the structure of existing companies rather than setting up new ones.

Let me hasten to assure you that KISR experience in linking up with the productive and service sectors is far from being disappointing. A glance at the table listing KISR clients up to three years ago should dispel such a pessimistic view. In fact, only last year KISR concluded an agreement with the Ministry of Electricity and Water, whereby the ministry has earmarked no less than KD 2 million for funding KISR research and studies to serve its purposes.

One other point to be borne in mind is that the "Kuwait Fund for the Advancement of Science (KFAS)" has been a main source of funding of KISR contract research. This was done in response to joint applications by the end user and KISR. In other cases KISR, applied for funding by KFAS for projects it considered of national interest.

I hope that, in dwelling on the difficulties in linking up research centres with the productive and service sectors, I have not left you with the impression that this is a hopeless cause. Like all worthwhile causes, it is not easy and needs insight, dedication and a willingness to envisage changes where necessary. We do need some considerable changes and additions in organizational structures, attitudes, corporate culture, as well as a good deal of encouragement from society at large, if we are to achieve the desired linkages.

UTILIZATION OF RESEARCH RESULTS, Alexandria, ed.S.KANDIL,1991.

ON DEMAND DRIVEN HIGHER TECHNOLOGICAL EDUCATION IN EGYPT

(A CASE STUDY)

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INTRODUCTION

When analyzing the strategies of development in Egypt on the verge of the twenty first century, few will disagree that narrowing the widening technological gap between ourselves and the developed countries, and perhaps even between ourselves and some of the less developed countries is a necessity.

The choice of such a course towards narrowing the technological gap will need an overall commitment from the entire nation. The major contributor to such a commitment will have to be the educational and training institutions.

This requires establishing an integrated education and training system covering the education of children below the age of compulsory education up to and including the education of graduates working within their respective professions, as well as specific to job training for graduates of traditional universities in Egypt.

Such a system should interface with the various industrial units in such a manner as to render it compatible with the input requirements of the industrial system. It is evident that the absence of such harmony together with the lack of an adequate feedback mechanism, between the two systems viz. the educational system and the industrial system are among the more important causes of the unemployment of graduates in Egypt with its long term social and economic effects.

Altering the course of the existing system of education by trying to make it more responsive to changing demands in Egypt, requires a large effort because of the inertia of the existing system as well as a number of economic and social factors. But transforming the major part of the educational system to a demand driven technological system is for the same reasons quite impossible within a short time frame. Therefore it was thought to be appropriate at this stage to establish an experimental technological sub-system whose input and output can be controlled with relative ease so that success indicators may be used for its expansion either towards establishing an integrated system, or to generalize the concept of such a sub-system. The great importance of the feedback mechanisms now becomes apparent since without such feedback the level of the system will drop to its lowest common multiple of the original system.

As a result of such analyses the Higher Technological Institute in Ramadan Tenth City was established as a pilot subsystem for the anticipated technological education concept. It will be used here as a case study to present the possibilities of an interface with the industrial setups with an increased emphasis on demonstrating the notion of the feedback mechanisms that is essential in protecting the institute from drifting towards traditional academic education, being of course the easiest way, but would destroy the mission of the institute.

INTRODUCING THE INSTITUTE

A. A Ministerial Decree establishing the Higher Technological Institute in Ramadan Tenth City pursuant to the laws of private higher institutes (Law no.52, year 1970) was issued on October 27, 1988 and the study started on January 21, 1989.

B. The Institute is owned by the non-profit "Foundation for Development of New Communities".

C. At present the Institute consists of four departments:
   1. Department of Production Technology and Energy
   2. Department of Electronics Technology and Computers.
   3. Department of Technology Management and Information Sciences.
   4. Department of Chemical Technology and Polymers.

   The Institute is looking forward to establishing further departments among which are departments for:
   1. Construction and Infrastructure Technology.
   2. Textile Technology and Ready-Made Garments.
   3. Printing, Packaging and Material Handling Technology.
   4. Desert Development Technology.

D. The total number of students now is close to 1500 young men and women, about half of whom reside in the institute's student residence halls.

E. Study in the Institute is based on the credit hour system which combines a large number of elective courses to suit the student's interest; in addition to the compulsory courses. In the technological departments the student obtains a Higher Diploma in Technology after successful completion of 150 units of Bachelor in Engineering and Technology after a further study of 100 units (about two academic years). For the students in the Technology Management Department the student obtains a Higher Diploma in Technology Management and Information science after successful completion of 100 units (about two academic years) and obtains a Bachelor in Technology Management after studying an additional 100 units (about two academic years).

F. The academic year consists of three 14 - weeks Terms. The student spends one complete term each year in industrial training at an industrial facility within the City or abroad. So the practical study represents 60% of the total study hours of the Institute.

G. Annual tuition fees are L.E.2500 (for the students starting 88/1989), L.E.2700 (for the students starting 89/1990), L.E.2940 (for the students starting 90/1991),and L.E.3165 (for students starting 91/1992). These sums represent about 35% of the acual expenses for the year 88/1989 and 70% of the expected expenses for the year 91/1992).

H. The Institute pays attention to teaching languages and general cultural courses. Physical training is a compulsory course.

I. Instruction, which is in English, is for classes of not more than 25 students (except for a general culture course). There is a good contact between students and faculty members through office hours. There are also advisors to the students.

J. The Institute is now in the phase of building its own workshops and laboratories. Although some are already established but the Institute is making use of the workshops and laboratories of the training complex of the Ministry of Industry located in RTC; actually the

Institute rents all its facilities from 3:00 p.m. to 6:30 p.m. every working day.

RELATION WITH INDUSTRY AND THE FEEDBACK MECHANISM

The Institute believes that a coherent relationship must connect the Institute with industry; they must live together, and neither of them can live alone without the other. This relationship that strengthens with time carries the feedback mechanisms between the two bodies for the purpose of establishing the required harmony among them in the different stages of decision making, such as planning, execution, follow up and assessment to create a demand driven technological education. This relation may be summarized in the following:

1. The General Assembly

As previously mentioned, the Institute is owned by the Non-profit Foundation for Development of New Communities, among its members are individuals and some production and service organizations. It is under study now issuing shares for sale to close the gap between tuition-fees paid by the students and their actual expenses.

2. Board of Directors of the Foundation

The board of directors of the Foundation consists of representatives from the sectors of engineering industries; textile industries; construction & development as well as financial institutions. This board represents the owner of the Institute and is concerned mainly with laying of strategies that lead to the growth of the foundation, and dealing with the more serious difficulties it faces in dealing with government authorities.

3. The Board of Directors of the Institute

Among other personnel interested in education are the chief of the Investor's Association in Ramadan Tenth City and two leading members from the factories within the City. The board meets once a month to discuss policies of the Institute and to assign tasks or delegate authorities to the Dean of the Institute who handles day to day affairs relating to students. Discussions of the board represent an important part of feedback mechanisms.

4. Training of Students in the Factories

Students spend 14 weeks every year in industrial training mainly in one of the factories of the City (and may be outside of the City) under the joint supervision of the Institute and the factory. Such training represents an additional feedback mechanism - since students are still in the beginning of their study - specially that the director or one of chief engineers of the factory is a member of the examination board evaluating and discussing with students contents of their reports on the period of training.

Cooperation of industry in this direction reflects its interest in the philosophy underlining the education. The program has increased from about twenty factories in May 1989 to forty five factories in May 1990 to more than seventy five factories in January 1991.

The total number of training opportunities largely exceeds the present need of the Institute.

5. Task Groups

The Institute has formed two working groups comprising faculty members and industry personnel in the fields of textile industry and ready-made garments and in the field of chemical industries and plastics. Such group propose the method of cooperation between the Institute and industries. The two groups concluded establishing two new departments in the Institute, proposed the curricula and promised to take care of the student's industrial training.

The Institute is at present forming additional working groups in the fields of metal work (forming, cutting ..etc) electrical and electronic industries and printing industry, packing and handling. These groups constitute the backbone of the idea of demand-driven technological education.

6. Sharing of Industry Personnel in Teaching at the Institute

Since students are up to now in the early stages of their study, the role of industry personnel is limited to general lectures that are characterized by giving an overall view of certain industries through a "Technological concepts" course, but as students become more specialized some qualified industry personnel will teach narrow specialization courses or application of case studies in some courses in cooperation with the faculty members of the Institute. Engineers from various factories will cooperate in supervising graduation projects of students towards Higher Diploma and Bachelor Degrees.

7. Open Education, Training and Industry Services Center (OTIC)

The institute will establish "The Technological and Management Skills Development Center (TMDC)" in 1990 and "The Small Industry Service Center (SISC)" in 1991. The two centers will act as an "Open-Education, Training and Industry Services Center (OTIC)". There are three members from industry on OTIC's board of directors. It carries out the following activities: a) Open education for higher diploma and bachelor degrees in technology management; b) Free education in technology management, languages and computers; c) Special computer programs to train top executives with an emphasis on Tenth of Ramadan City, d) Arrange workshops and Symposia in certain well defined areas related to industry and environment especially in Tenth of Ramadan City as well as the other new communities in Egypt, e) Tailoring special study and training courses to students and trainees from the different Arab countries. Some of these studies and training are according to the program of Third Country Training, f) Providing various services to industry - particularly small and medium industries in Tenth of Ramadan City. Activities cover the services that every small or medium unit needs but cannot afford alone including: Secretarial (Arabic, English, French and German, word processing, copying, printing etc...), Advanced telecommunications (magnetic cardoperated international phone, Fax, Telex and information unit linked with different computer systems and data banks), computer services (Software house for the field of management systems, Workshops and meeting rooms, laboratories to carry out periodical tests and offer approved certificates of inspection, Applied research and problem solving.

CONCLUSION

This experiment in Egypt, although not the first of its kind, illustrates a new mode of technical education which could create new cadres more to needs of industry. This could be a vital mechanism towards bridging the gap between University and Industry.

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A SUGGESTED PROJECT FOR SCIENTIFIC INTERACTION OF R & D UNITS WITH PRODUCTION AND APPLICATION CENTRES

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1. INTRODUCTION

The following research capacities are noted:-

1. Egypt, with its 52 million population, has established 13 universities with research departments in several disciplines, besides the research facilities and institutions attached to the various ministries & the Academy of Scientific Research & Technology. This exceeded 300.

2. Around 90 scientific societies in various fields & disciplines exist in Egypt.

3. Egypt is a member of 30 international or nongovernmental scientific universities and committees.

4. Egypt has a significant scientific and technological policymaking & planning body. That is the Academy of Scientific research and Technology which is responsible for integrating R & D planning at the national level and has executive, advisory and coordination roles. The academy structure and services are:-
   a. To enhance the contribution of Egyptian scientific capabilities for Development.
   b. To bridge the existing gap between scientific and production sectors.
   c. To support research directed towards solving problems of national interest.
   d. To encourage the application of modern technology.
   e. To define priorities for research in scientific & technological aspects of major development areas.
   f. To formulate polices that strengthen linkages between S&T organizations.
   g. To participate with universities in manpower development for training of researchers in specific areas.

5. The academy plan for the years 87-92 is paying attention to research programmes into certain National Multidisciplinary problems.

6. The Egyptian national 5 years plan includes projects that in their essence require the application of science and technology for achieving the development desired.

Very successful models to transfer the scientific research results to the productive field have been developed performed through National campaigns where the Academy of Scientific Research & Technology, the National Research Centre and the Ministry of Agriculture, cooperated together to raise the production of basic agricultural crops such as citrus, rice, maize and tomatoes.

This year, a three year research plan was formulated by the National Research Centre (NRC), the plan includes profiles for research projects of which the larger number deals with problems of production in several sectors. These problems were identified after field visits and discussions with top officials and managers in production centers.

Moreover, the NRC decided that all postgraduate studies for both M.Sc. or Ph.D. degrees should deal with the aspects of this plan. It is also important to mention that the links between the NRC and production sectors has been improved and a number of R&D contracts were agreed upon.

In spite of this positive picture of the efforts and facilities available in Egypt geared to assure the role of science and technology for development, the production is still suffering insufficient quantity and defficient quality.

The linkages between Research Institutions in Egypt and different Production Centers are rather weak. No centers of research and development are existing to transfer the basic scientific research into a proper effective technology in our practical life. This process is very expensive and needs huge investment. This process is also considered as a basic measure in evaluating development and progress.

2. PROPOSED PROJECT

This situation attracted the Ministry of Scientific Research represented by the Technical & Technological Consulting Studies & Research Fund to formulate the National Project for Formation of Expertise to more effectively contribute to the Development Plan in Egypt. The project depended on the cooperation between Research Institutions and Production Centers for supporting or establishing research and development Units at different Production Centers.

The objectives of this project are the following:

1. Developing and Forming appropriate Technical Cadres specialized in various areas to participate in the implementation of national development plans in Egypt.

2. Strengthening the cooperation between research institutions and R & D Units in both private & public production sectors.

3. Linking the research institutes to the production centers through Human Bridges.

These linkages or pathways will enable the production centres to fulfill their objectives in full adherence to a scientific plan with all its obligations. These objectives are to be achieved through the collaboration and coordination with research centres affiliated to the Ministry of Scientific Research, and with universities as well as with research institutes affiliated to other ministries.

The mode of action of this formulation depends on maximizing the results of human efforts through the implementation of certain programmes serving priority development issues.

The project may ensure the following:

1. The continuous flow of information to and from participating partners.

2. Supporting the scientific research and application of current technology in various fields embodied in programmes of socioeconomic development.

3. Finding the best ways to benefit from the results of research projects and their up-grading to serve the appropriate end-user.

The project's linkage should be on contracting bases as expressed in figure (1).

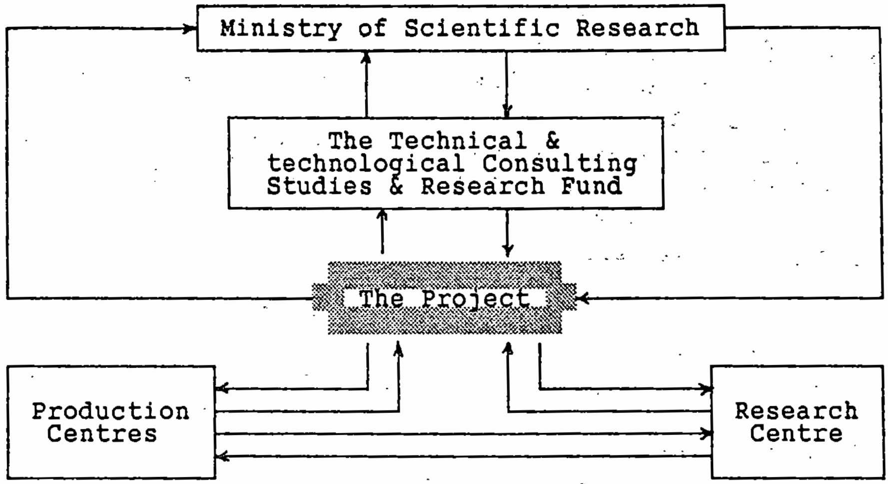

Fig. (1) Project Linkages

The approaches of the project are as follows:

1. Identification of subjects and problems of priorities in the light of the national development plan in different areas such as industry, agriculture, management, energy...etc.

2. Identification of the needs of Production sectors and proper utilization of resources available at the research institutions to fulfill these needs through well-managed projects.

3. Selection of around 300 top-level university graduates, to attend a one year general training programme which may include the following topics:
   a. Science and Technology for Development:
      * Development plans in Egypt.
      * Identification of production problems.
      * Scientific research: tools and processes for development and applications.

b. R & D Management:
   * Planning and scientific management of research projects.
   * Project economics and social aspects.
   * Implementation and evaluation of research projects.

c. Systems analysis.

d. Introduction to computers and computer languages.

e. Means of safety and protection in laboratories and factories.

f. English language: a refresher course and a programme to effectively use the language.

This general training programme will be followed by classifying the candidates into groups to undertake specific specialized field training for a certain period in both private and public production centers. This is required to prepare the candidates for their anticipated R & D careers, and to acquaint them with the whole production experience and related activities.

4. Identification of the research points and formulation of research plans and cooperative research projects between the research institute and the production center concerned. The research projects will be performed with the object to study and to solve the identified production problems.

5. Research will be conducted under the co-supervision of both research institutions and production centers.

6. Research work could be performed in laboratories of both sides and the applications of research results would take place by the beneficial side.

7. Extended work will be carried out to fulfill the legal requirements for M.Sc. & Ph.D. degrees.

8. M.Sc. holders will be allocated to R & D Units of production centers as well as to research institutes.

9. Selection of some candidates to continue their studies to obtain Ph.D. degrees.

10. Enthusiatic and active candidates will be given the chance of training periods and scientific visits abroad, to enhance their absorptive capacity for modern technologies and acquire some actual working experience of these technologies being utilized in advanced communities.

The duration of the project could be for 6-7 years including training and research for the M.Sc. and Ph.D. degrees. Also, the different stages of the project could merge.

The programme will be performed through contracts between the ministry of Scientific Research and the beneficiaries from production centers, as well as the candidates.

Also, the number of candidates could be reduced in light of the available funds, and the whole project can be divided into stages where a micro-scale project of 20-25 candiates could be performed as a pilot model.

A protocol for technical cooperation between the Ministry of industry and the Ministry of scientific Research has been drawn up and a number of industrial factories have expressed interest to join the project activities.

3. COMMENTS AND RECOMMENDATIONS

1. The expected outcomes of this projects could include, in addition to the objectives given before, several scientific proposals and recommendations aimed at solving a number of problems related to the development of the production process.

2. Proper precautionary measures have to be taken to alleviate the following:

   a. Careless or unclear indentification of the needs of the production sectors.

   b. The unavailability of funds at the proper time when they are needed for the application of the research results.

   c. Improper application of outputs.

   d. The prevention of the candidates to participate or to join the R & D units at the benificial production centers, after obtaining their training chances and higher degrees.

3. It is recommended that priorities are set up from the beginning and the attention of concerned partners should be gained.

4. Not all needs and demands to solve production problems in all sectors, can be adressed at the same time. One should identify the priority problems of the industrial sectors and/or subsectors requiring attention and which, out of the many should be tackled first.

A study would be suggested for determining of a small number of these priorities which may give a quick and effective solution of problems of national importance.

It would not be surprising if such a study would identify, out of many, the sectors, sub-sectors of food processing, textiles, foundries, etc... as top priorities.

The study would also pass judgment on the relevance of current R & D in relation to the problems of the chosen industries, the state and quality of the links between the related research institutions and the industries concerned, as well as with the other users of the research results.

There are in Egypt a relatively large number of research institutions. But, very few have succeeded in building the sort of environment which is best suited to participate in bringing solutions to Egyptian problems.

A profitable exercise, as a first step to the reform of the R & D system, would be to find out why research institutions have not been that useful to the needs of the productive establishment of the country.

To conclude, it is essential to:

1. Start with priority setting (of National needs and in light of National Capacities), few but well-chosen priorities at first.

2. Put together resource units, institutional, human and financial resources - as a result of a clear plan for development - to begin tackling through research the problems that each priority sector/sub-sector has revealed.

3. Establish links between the appropriate R & D units with the related productive units and industries, to eventually develop a trouble shooting task force.

SESSION TWO

MANAGEMENT AND TRAINING

1. INTEGRATED FRAMEWORK FOR RENEWABLE ENERGY TECHNOLOGY DEVELOPMENT AND COMMERCIALIZATION (ITDC): A CASE FROM SUDAN.

2. TECHNOLOGICAL CHANGE IN DEVELOPING COUNTRIES; THE ROLE OF UNIVERSITY-INDUSTRY COOPERATION.

3. THE ROLE OF THE UNIVERSITIES AND INDUSTRY IN RELATION TO THE FORMATION OF INDUSTRIAL SKILLS: THE CASE OF TURKEY.

4. RESEARCHERS/END-USERS PLANNED INTERACTION IN UNIVERSITY RESEARCH: A STRATEGY FOR FACILITATING IMPLEMENTATION OF RESEARCH OUTCOMES (A CASE EXAMPLE)

INTEGRATED FRAMEWORK FOR RENEWABLE ENERGY TECHNOLOGY DEVELOPMENT AND COMMERCIALIZATION (ITDC): A CASE FROM SUDAN

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1. GENERAL INTRODUCTION:

Since 1983 the Energy Research Council (ERC) and its executive arm, the Renewable Energy Research Institute (RERI), has made successful strides in the field of renewable energy technology (RET) development and commercialization.

Achievements in this direction covered a wide range of energy policy strategies and a variety of end uses and benificiaries.

In its endeavor to achieve success in utilization of research results and technology transfer, ERC adopted a programme/project approach within an integrated technology development and commercialization framework (ITDC). This framework has evolved, since its inception, to be a strong tool not only as an important ingredient for successful utilization of research results but also as a basis for institutional development for ERC itself. The adoption of this approach coincided with the early phases of ERC and its contribution towards structural formation and streamlining of locally and donor funded programmes was extremely valuable.

This paper attempts to discuss aspects of research results utilization in the context of an integrated concept, and experiences of its implementation in the field of renewables.

2. INTEGRATED FRAMEWORK (ITDC): OVERVIEW:

The basic characteristics of ITDC as shown in Fig.(1) can be summarized as follows:

a. As an integrated approach ITDC is not a sequential process in the traditional relay sense. It allows the flexibility - critical to any technology transfer process - for back and forth movement as one advances towards the final commercialization goal. It is also a rational system, the output from one level becomes the input for another.

b. ITDC calls for an all active participation and interaction with the environment - both horizontal and vertical integration. It provides programming, linkages and relevance to the environment, thus providing systematic feedback on ultimate relevance, adoption and success of the program/project an on going basis, (sustanability dimension).

c. It provides important decision points for progress evaluation, monitoring and corrective action as feedback accumulates.

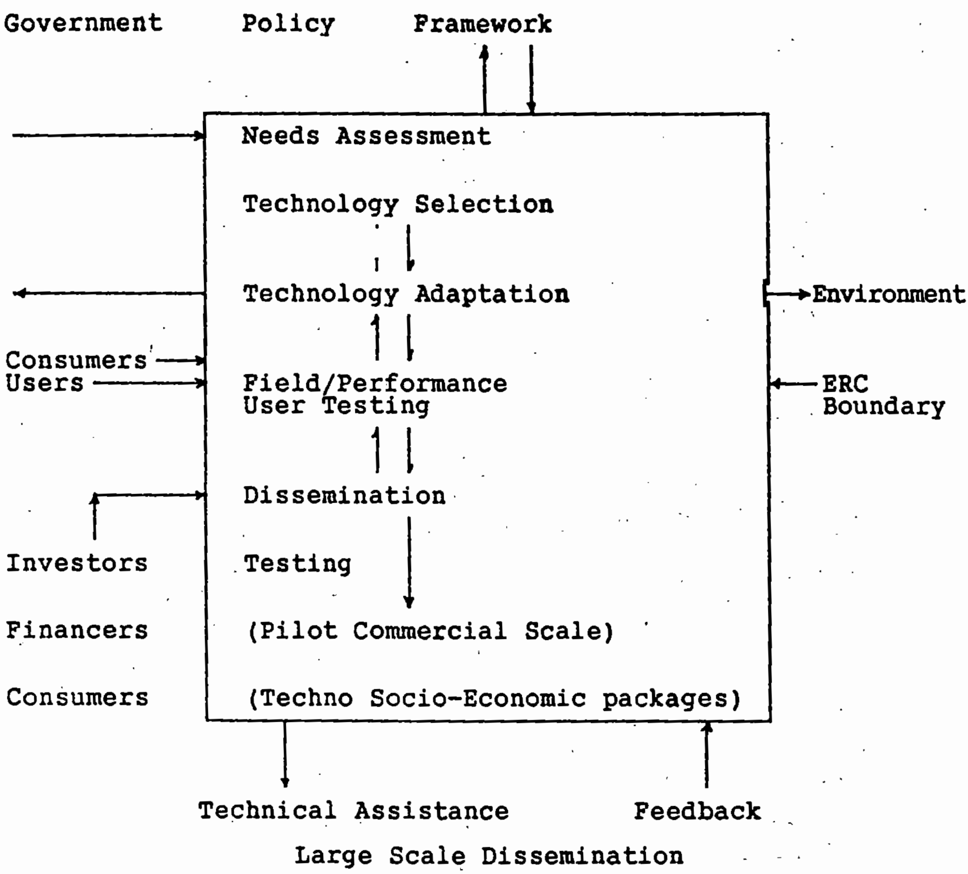

Fig. 1. INTEGRATED DEVELOPMENT AND COMMERCIALIZATION FRAMEWORK

d. It allows the research and development organization to make use of various combinations of technology transfer models.

e. It necessitates a multi-disciplinary team approach in R & D work and exposes technologists to other socio-economic-dimensions, essential to deliver a research product for application.

f. It provides the R&D organization with a basis for structural and manpower development, project selection, design and implementation methodology. It also creates spin-off opportunities for R & D staff and others in a more consistent and coordinated way. It presents a clear and realistic picture of the needs and the staff capability match essential for technology development and commercialization. Such a picture is a valuable bench mark for the manpower training and development planning for the R&D institution.

g. The framework encompasses addressing both the programme/projects concerns and the constraints facing the wide application of the renewable energy technologies. Programme/project concerns focus generally on the attainement of goals or needs set at the national level, maintenance of high scientific standards and the orientation of science to practical goals. Constraints under contemporary conditions of developing countries, and the Sudan in particular, are:
   i) Constraints related to appropriate technology optimization and production.
   ii) Investment constraints in the absence of incentives, banking mechanisms and financial models (Scale problem).
   iii) Promotion and information dissemination constraints.
   iv) Constraints related to policy and manpower aspects.

h. The ITDC as a concept fits very well with the parent organization mission (National Council for Research) which was established, unlike universities - to utilize research as a vehicle for economic development. It has a long standing committement to the slogan "From the lab to the field".

i. ITDC is an expensive process and requires high coordination capabilities.

3. APPLICATION OF ITDC IN SUDAN:

The integrated framework has been applied to a number of technologies, namely the following:

a. Carbonization and briquetting of cotton stalks, an agricultural residue.
b. Improved charcoal stoves in urban areas.
c. Wind for water pumping.
d. Fuelwood resource development.
e. Solar applications (PV and thermal).

Of these applications, those related to biomass have reached the pilot commercial scale. The others are still in the development phases. In the rest of this paper, using some of these applications, three important aspects of research results applications are discussed.

3.1. Overall Impact of ITDC:

Perhaps the most clear impact of ITDC application is the orientation towards dissemination in designing R&D programmes. A quick comparison of programmes/projects in the Energy Research Council with other specialized councils under the umberella of the National Council for Research, indicates such orientation (Table 1).

The overall impact of ITDC application can be summarized as follows:

a. The multi-disciplinary team/project approach provided ERC with an opportunity to evolve as a matrix organization. Such matrix formation allowed effective cross-fertilization in the formation and generation of ideas.

b. It provided ERC with a means for direct and immediate work flow and supervision on a product basis as well as specialization by function. It lent itself to the concept of management by results.

c. It provided formation and implementation of technology development and commercialization objectives to reflect the dual appreciation of long term scientific results and for application of short-term spin offs.

d. It provided ERC with a macro-economic technology interface in terms of technology assimilation ability, adaptation ability and advance ability. Various examples can be cited, The M.Sc. programme in renewables initiated by ERC in cooperation with Khartoum University, Faculty of Engineering is an example of building the assimilation ability. The adaptation ability respresents the bulk of ERC activities in briquetting, stove, solar and wind pumping technologies. The advance abilities are now relatively limited and constrained by lack of facilities.

e. ITDC left a major impact on project/programme design approaches and research strategy. ERC programmes are now need driven (as opposed to technology driven) and its research strategy moved more towards an action-research strategy as opposed to a purely research strategy. More and more ERC programmes strive to:
- Strengthen partners
- Stimulate economic growth and meet needs
- Engage in applied research
- Create and adapt new technologies
- Identify and develop specific projects.

3.2. Partners and Linkages in (ITDC):

Technology development and commercialization is a complex phenomenon and necessitates the involvement of various numerous partners. It is in this respect ITDC has been most effective through its comprehensiveness in determining roles and stages for involvement. The application of ITDC for example in the area of cotton-stalk utilization is a case in point. Table 2 gives details in this respect. It clearly indicates the complixity of partnership in terms of the numerous organizations involved and the spectrum of their structural compositions, mission and interests. The degree of complexity varies from one technology to another, however, the general pattern remains the same eg. stoves or wind mills.

Various points can be raised as to the general issues of partnership and linkages in technology development and commercialization. Of these the following are the most important:

a. Partners' contributions in the process vary significantly, with some sources giving more contribution than others. The nature of partners also shows basic changes as one moves from needs assessment to the pilot commercial scale.

b. The nature of partnership and roles are closely linked to the objectives of ERC as a coordinator and influencer within the ITDC framework. In the case of cotton stalk utilization, improved stove development or wind and solar pumping, ERC objectives are to identify and bring research through the early development and feasiblity stages to the commercialization stage. The commercialization itself will not be performed by ERC but rather by any of the relevant partners - which after an incubation period (intensive ERC technical and may be financial input) continue on their own. The clarification of the objective and mission gave a strong motivation to several partners to participate in the feasibility and development stages and pay mostly in kind towards its costs in selected projects.

c. As seen in the case of cotton stalks (Table 2) and in other cases also, eg. stoves, wind mills, ITDC framework requires early involvement of local industry and users. Such early involvement improved the design cababilities of ERC researchers by embracing much broader design criteria and containing early design failures - duga stove for example - based on purely technical premises, marketing feasibility, reliability, quality, manufacturability and minimization of design changes during large scale production figure as essential design features for new technologies or products. The approach presents a viable medium to deal with performance, production and marketing uncertainities involved in designing or adapting new technologies.

3.3. Technology Transfer Models:

ITDC final goal is to present a viable socio-technoeconomic package for the technologies under consideration. Such a package evolves into its final form through working closely with industry. Any technology transfer model needs to realize the nature of industry within developing countries (RETS) whose markets are not yet well defined. In general, ITDC framework opted for an overall science park or incubator type of transfer model built into it the commercial viability (sustainability) within the short-medium terms. Within that overall frame ITDC transfer model has elements of other models (information dissemination, venture capital, licencing, joint venture models) all brought together in a cooperative venture.

The various models used for different technologies can be seen in details in table (3). This approach was received well by all the partners, donors and bankers. Serious steps are now being taken to initiate banking mechanisms and preferential financing models for renewable energy technologies. Government policy providing incentives however, is still lagging behind.

4. CONCLUSION

ITDC as a tool for renewable energy technology development and commercialization has many of the elements of success necessary for technology transfer under the conditions of developing countries. It helps addressing issues of the application of research results in a consistent and coordinated way. It opens avenues and channels for communication between R&D institutes and the outside environment.

Table 1. Analysis of Research Projects in the National Council for Research

Specialized Council	No.of projects	Driving Motive		Feasibility study	National/ Sector Priorities	application pilot	Relative application
		Technology	Need				
1.Scientific and Technological	6	83%	17%	---	32	50	---
2.Agricultural Council	7	71%	29%	---	86%	14%	57%
3.Energy Council	16	69%	31%	31%	63%	50%	19%
4.Economic and Social Studies	5	---	100%	100%	---	---	---
5.Medical	4	50%	50%	---	75%	---	25%
Average	38	39%	61%	24%	74%	32%	15%

Source: 1987 Gaafar, Research Result Application View Point (Arabic).

Table 2. Patners in Cotton-Stalk Carbonization and Briquetting Technology Development and Commercialization.

Organization	Role	Stage of Involvement
RERI	Technologists	All stages
GTZ/USAID/Dutch	Financing programme	All stages
BTG(Holland)	Technical assistance	Technology adaptation pilot commercial stage
University	Technical assistance	Technology selection
Planning & Finance	Funding agency (local)	All stages
National Energy Administration	Data base policy issues	Needs assessment
Farmers	users, beneficiaries	Field testing/ commercial pilot, large scae dissemination
Households	Users	Field testing
Engineering promotion Unit/Gezera	Extensionist Technical Support	Field testing, large scale dissemination
Rahad and Gezera authorities	Administrative support	Field testing, pilot
Rahad joint Company	Investment	Pilot commercial scale
Islamic Dev.Bank	Financers	Pilot commercial scale
UNIDO	Finding and T.A.	Assessment/pilot commercial scale
Local industry	Production	Technology adaptation/ pilot commercial scale
ERC	Influencers (Coordinators)	All stages

Table 3. Technology Transfer Models Applications in ERC

Technology	Beneficiaries		Transfer Model	Methods or tools Producers	Users	Output/results
	Producers	Users				
1. improved stoves	-informal artisans -Semi formal -formal/ informal sector	Urban house-hold	a) Information Dissemination b) Venture-Capital	a) Contest b) Training c) Grants d) Technical back up & problem shooting e) Loan facility	a) Surveys b) Field testing c) Market demonstrations d) Mass media e) Extension agents	a) 4% market penetration b) Two enterprenuers c) 250-300 artisans
2. Carbonization of cotton stalk self sufficiancy in fuel strategyion b) Financial . Assistance (Venture Capital)				a) Training b) Grants c) Prizes	a) Surveys b) Field testing c) Mass media d) Extension agents	New 15 villages application annualy since 1986
3. Cotton stalk carbonized briquettes (cotton-coal)	a) Farmers & farmers unions b) Scheme authority c) Enter-prenuers or inves-tors	Urban house-holds	a) Information Dissemination b) Venture capital own financing c) Joint venture	a) Evaluation of investors b) Training c) Incentives d) Technical back up & problem shooting e) Company formation f) Incubation during pilot commercial scale	a) Surveys b) Field testing c) Demonstrations d) Mass Media	a) Rahad Company a 800/ton annual plant b) Khartoum Enterprise (investor) total annual production of 100-200 tons of grand nut briquettes
4. Wind mills	a) Indus-trial sector	Rural/ urban irriga-tion & drinking	a) Licencing b) Information dissemination	a) Quotations b) Guaranteed demand c) Incentives d) T.A.	a) Field testing b) Mass media c) Demonstrations	One licenced company to produce CWD machines (Current problems)

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TECHNOLOGICAL CHANGE IN DEVELOPING COUNTRIES; THE ROLE OF UNIVERSITY-INDUSTRY COOPERATION

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By the mid-1970's the international division of labour of the world economy had changed. With the new economic facts occurring in developed countries (the competition between USA, EC and Japan, the crisis of US dollar, the fall of the profit rate), monetarist policies started to be launched. The impact of these policies on the developing countries resulted in the difficulty of obtaining foreign exchange.

This crisis forced the developing countries towards increasing their export and their foreign debt. The export performance of the developing countries was restricted because of their two main features:

a. Most of the developing countries are dependent on the foreign technology.

b. Developing countries have difficulties in facing international competition, especially countries that experienced a very long period of industrialisation through import substitution.

In this paper, the role of the universities and cooperation between universities and industry in developing countries will be analyzed.

The first part will discuss the problems of technology generation and international competition of developing countries, and will focus on the role of the universities regarding the generation of new technologies and encouraging infant industry to enter into international competition.

The second part examines the case of Turkey. In this part, results of a questionnaire which investigates university-industry cooperation in the Turkish clothing industry will be evaluated.

SOME TECHNOLOGICAL PROBLEMS OF DEVELOPING COUNTRIES AND THE ROLE OF THE UNIVERSITIES IN THIS RESPECT

A. Foreign Technology Dependence of Developing Countries

The first wave of developing countries such as South Korea, Brazil, Hong Kong, Singapore, Taiwan[1-6] were able to develop more technology-intensive products requiring more qualified manpower and technological infrastructure in determining competitiveness.

Some developing countries are directing their industrial policies towards upgrading of industrial structures from "downstream" to "upstream" activities. To take the significant example of South Korea, the development of textile machinery exports complements the export of textile products.

However, achieving such upgrading requires considerable effort in developing skills and improving technological capabilities. Therefore, some of the developing countries such as Turkey, Egypt and Tunisia, which are not very successful in developing the necessary technological infrastructure and the capacity to generate new technologies, attached great importance to the acquisition of new technologies; in other words, to the technology transfer.

Table 1. Share of Developed Countries and Developing Countries in the Total World Trade of Engineering Products.[7]

	World*	Developed Countries*	Share of Developed Countries	Developing Countries*
1970	089769	78242	87%	01812
1975	244345	211475	86%	08210
1983	502035	423369	84%	42105
1984	560195	457578	81%	52509
1985	586118	490221	83%	54009

* (millions of USA $).

Table 1 indicates that the position of developing countries in the international market for technology is different from that of developed countries. Developing countries are almost always buyers and only very rarely sellers of technology[8-11]

After the mid 1970's, due to dependence on the foreign technology, the import of technology into developing countries has increased as their exports have increased.

The compensation ratio of exports to imports can be calculated with the formula of revealed comparative advantage (RCA) which describes the trade patterns that have taken place in developing countries[12].

$$RCA = In \left[\frac{Xi}{X} / \frac{Mi}{M} \right] x\ 100$$

where;
X is total export
M is total import

"In" refers to an industry, in our study 1 refers to investment goods sector, 2 refers to electronic goods sector. Revealed comparative advantage of developing countries in the investment and electronic goods sector is compared with those of developed countries in table 2.

Table 2. RCA (1984)

RCA Index in	i=1 Investment Goods	i=2 Electronical Goods
Developed Countries	34	15
Developing Countries	-75	-23

Source: Own calculations based on data of ref (7).

The higher the RCA index is, the more successful is the trade performance of the country in question. In the table 2 RCA index is calculated for 1984. The findings exhibit one main feature: For developing countries RCA values are negative indicating that these countries do not have comparative advantage in the investment and electronic goods sectors.

Thus one of the roles of the universities in developing countries is generating technology where the industry is not capable and not able to finance. Scientific knowledge, produced by research and transmitted mainly through education, is essential for the development and application of new technologies[13].

B. The capacity of Developing Countries to Compete in International markets

Some recent studies are also creating an interest in the relationship between export oriented policies and protection of "infant industries" until they are mature enough for international competitiveness.

After World War II, most of the developing countries have experienced an import substitution period, during which they tried to build up their consumer goods sector*.[1] The main feature of an import substitution period is an overevaluated exchange rate and higher duties on import of consumer goods. Thus import substitution policies are usually paradoxial; undertaken to reduce dependence upon imports for consumer goods, they can increase dependence upon imports of investment goods.

Apart from this, during the import substitution period, developing countries focus on the domestic market and limit the possibilities of using large-scale and efficient techniques. With high duties and import restrictions, developing countries industries have little incentive to carry out production effectively and improve technical change.

I will stress my argument that during the import substitution period, developing countries have built up their consumer goods sector, and experience and skill accumulation occurred via learning by doing. But an internationally competitive industry could not be established. As a matter of fact, this was not the aim of the import substitution period, however, a capacity for international competitiveness is essential in order to launch an export oriented strategy.

Towards the end of the 1970's, while most of the developing countries were trying to increase their exports

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nternational Keynesian policies pursued in developed ountries helped developing countries to follow import ubstitution policies.

in compatibility with the new international division of labour, the argument of selective intervention for infant industries in order to prepare them to the international competition arose.

The objective of the strategy is to build up a comparative advantage in infant industry and to strengthen their technological capability by indirect incentives.

The role of the universities in this context, is to promote infant industry to overcome their problems of effectiveness, and encourage them with some indirect incentives such as acquisition of domestic technology, availability of skilled manpower, formation of an industrial organization which will allow the industry to respond quickly to the evaluation of world market demand.

In developed countries the business sector can expand its spending for research through its own R & D activities. But in developing countries, industry cannot afford to have the most advanced equipment; only a small number of large scale firms and academic institutions are able to finance comparable facilities.

This pooling of research resources and co-ordination of efforts on an interfirm university scale can expand the kind and range of research which can be undertaken by individual firms.

One of the main indirect incentives to strengthen international competition of developing countries, industry, can be affected by fostering university-industry co-operation and funding industrially relevant research. Thus the development of new kinds of institutes which carry out research and transfer the results to industry is very important.

The research that is often most pertinent for industrial needs is of a multidisciplinary and sectorally organised nature. This kind of institution can collaborate in very deep research on a project-by-project basis and can take advantage of the multidisciplinary staff to improve the economic competitiveness of the country.

CO-OPERATION IN RESEARCH BETWEEN UNIVERSITY AND INDUSTRY: THE CASE OF TURKISH CLOTHING INDUSTRY

From the 1950's, the Turkish economy did not need to export in order to earn the necessary foreign exchange. The export/import ratio has continuously decreased until the beginning of 1980's. During these years, the greater part of the imports was intermediate and capital goods, and the foreign exchange necessary for the import of these goods has been provided by foreign aid, foreign debt and workers, remittances.

After the 1980's export-oriented policies have been launched due to the foreign exchange crisis of the Turkish economy. The importance of the clothing industry in Turkey has increased with the export-oriented period. The clothing industry is seen as one of the major sources of foreign exchange earnings for Turkish economy.

The importance of exports in the clothing industry can be seen by comparing the export values of the clothing industry with the manufacturing industry (table 3).

Table 3. The Comparison of Export of Clothing Industry with Manufacturing Industry

	1978	Rank	1985	Rank	1989	Rank
Export of Clo. Ind. / Export of Man. Ind. =	6.19	5	14.82	3	20.74	2
Export of Clo. Ind. / Production of Clo.Ind. =	13.86	3	64.83	1	86.52	1
Export of Man. Ind. / Production of Man.Ind. =	6.10	-	16.11	-	15.94	-

Source: (13) Compiled from SPO (1985) p. 43-49, Planned target.

The export ratio of the clothing industry to the manufacturing industry is 6.19 percent in 1978 and increases up to 14.82 in 1985 and gets the 3rd place in the ranking. The goal in 1989 is to reach 20.74 percent and go up to 2nd place.

Furthermore, when the share of export in the production of clothing and the share of exports in the production of the manufacturing industry are compared, the high share of exports in the clothing attracts attention.

In 1983, the clothing industry occupied the first place among other sectors of the manufacturing industry. The goal for 1989 is to increase the share of clothing industry to 86.52 whereas the goal of manufacturing industry is only 15.94. These comparisons show that much importance is given to clothing industry in the export oriented growth of the manufacturing industry.

International competition has forced this industry to decrease costs and to carry out the production effectively. But it is argued that frequent types of technological change observed in the clothing industry are only the introduction of "ready-made" specifications, requiring only "minor" modifications to existing production facilities and increases in the number of conventional sewing machinery. The entry of microelectronics and an apparent capital embodied change are not realized in the industry.[14]

In this part, some results of a questionnaire investigating the role of the universities in technological change related with the clothing industry will be discussed. Furthermore, the use of university-based research and solving their technological problems through universities will be investigated.

The questionnaire involves 11 questions (see appendix 1), 24 clothing producer firms. The sample is approximately 5% of the population.

In the first three questions, general information on the technological capability of the firms was collected. The following four questions were on the tendencies for R & D departments. The remaining questions were on university industry co-operation.

i) Technological capability of the firms

In this section, the capacity to produce industrial sewing machinery (table 4), the reasons for the low capacity utilization (table 5), and types of technological change pursued in firms (table 6) are examined.

Table 4. The Reasons for not producing Industrial Sewing Machinery

Reasons	Frequency	Relative Frequency
Unavailable Skilled Labour	8	0.31
Infrastructural and Technological Problems	10	0.38
Insufficient Scale of the Market	4	0.15
Nonexistence of the Govenrmental Promotions	4	0.15

The majority of the firms point out that problems may arise with infrastructural and technological problems. The high infrastructural investment required for the production of sewing machinery (specially electronically controlled) causes the enterpreneurs to stay away from the production.

The firms emphasized the fluctuations in the seasonal demand and high product differentiation as being the main external problems related to their capacity utilization. The internal problems such as inadequate labour skill and technical problems take the second place.

Table 5. The Main Reasons Given for Low Capacity Utilization

Reasons	Frequency	Relative Frequency
Factors Associated with Market	13	0.48
Factors Associated with Supply of Raw Materials	8	0.20
Inadequate Labour Skill and Technical Problems	13	0.32

Table 6. Types of Technological Change in the Sample Firms

Types of Technological Change	Frequency	Relative Frequency
Establishment of New Units of Production Capacity	20	0.29
Introduction of "Ready-Made" Changes into the Existing Production System	37	0.54
Implementation of "Active" Changes to Existing Production system	12	0.17

In general the most frequent type of technological change observed was "the introduction of ready-made specifications and requiring only minor modifications to existing production facilities", and "increases in the number of existing machines". The most common type of capacity expansion in this industry is the addition of sewing machinery to the existing system because of high demand. Implementation of "active" change to the existing production system" is rarely seen in the sample firms.

ii) Tendencies for R & D department

In this section, the tendencies of the firms for having R & D departments are investigated. The main outcome of the four questions are summarized below:

One of the sample firms has an R & D department, two of them are willing to have R & D departments. Three of the sample firms declared that a sectoral R & D unit is useful for solving technological problems. All of the sample firms pointed out that there is no governmental subsidy for founding R & D departments.

iii) Responses of the sample firms relating to university industry co-operation

This part of study emphasizes explicit efforts in order to strengthen university-industry co-operation.

Table 7 shows whether industry consults with university for the choice of technology.

Table 7. The Information Source During the Transfer of Technology

The Sources	Frequency	Relative Frequency
Published Information	3	0.11
Fairs	2	0.07
Capital Goods Suppliers	7	0.25
Foreign Customers	10	0.36
Seminars	1	0.04
Research Institutes	1	0.04
Universities	2	0.07
Foreign Consultancy Firms	2	0.07

During the transfer of technology only two firms have consulted the universities. Most of the firms pointed out that they got the information from the foreign customers and capital goods suppliers (Table 8).

Table 8. The existence of University-Industry co-operation in the field of Adaptation/Creation of Technology.

	Frequency	Relative Frequency
Yes	1	0.04
No	23	0.96

Only one firm has co-operated with the university to adapt foreign technology to local conditions and to create new technologies.

Most of the firms inform the importing firms to solve their technological problems. Nine of them were able to solve the problems by themselves. Few of the firms consult with universities or R & D units (Table 9).

Table 9. The Methods to Solve Technological Problems

Methods	Frequency	Relative Frequency
Solve by yourselves	9	0.31
Inform the Producer	4	0.13
Inform the Importing Firm	11	0.38
Consult with the universities	2	0.07
Consult with R & D Units	3	0.10

The sample firms agree that the technological capability in the advanced technology will increase by sending Turkish technicians to the developed countries or having foreign technicians in the plants. They do not think that R & D activities and university-industry co-operation will increase the technological capacity of the industry (Table 10).

Table 10. The Proposed methods of Increasing Technological Capability in Advanced Technology.

Methods	Frequency	Relative Frequency
By having foreign technicians	5	0.33
By sending Turkish technicians Abroad	6	0.40
By R & D activities	2	0.13
By the Co-operation of Industry-University	2	0.13

CONCLUSIONS

Recent development on world trade agreements render the high duties and direct promotions to industry impossible. Developing countries especially those with limited capacity to compete in international markets, have been seriously affected by these agreements.

Developing countries increasingly focus on the indirect promotions in order to improve the industrial competitiveness of their industry especially their infant industries.

One of the main indirect promotions can be university-industry co-operation in order to adapt transferred technologies to the local conditions, to strengthen the capacity to generate new technologies, to increase the productivity and the number of skilled man-power.

The structure of Universities and the system of higher education are not flexible enough to collaborate with industry. Therefore, multidisciplinary R & D centers organised on a sectoral basis are necessary. They should be organized on a sectoral basis since the co-ordination of efforts on an interfirm scale can expand the kind and the range of research which can be undertaken by individual firms. They should also be multidisciplinary since the research that is often most pertinent for industrial needs is of a multidisciplinary nature.

Turkey, after the 1980's has adopted export oriented policies in order to earn the necessary foreign exchange. This attempt has forced industry to accumulate knowledge and expertise for international competition. Universities have lost a large part of their monopoly on this subject. The reason for that is not only the push created by the international competition but also the insufficient structure of the universities which could influence the development of "big science" and "high technologies".

As a matter of fact, in this paper it is shown that the university-industry co-operation of the Turkish clothing industry is not very strong.

The results of the questionnaire indicate that the main problems of the sector are technological and infrastructural problems, low capacity utilization and the dependence on foreign technology.

The conclusion which can be drawn from the questionnaire is that there is no university-industry co-operation for the choice of technology, for generating domestic technology and resolving technological problems.

The industry believes that existing R & D center and university-industry co-ordination are insufficient for solving their problems.

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APPENDIX 1

1) What are the reasons for not producing industrial sewing machinery in Turkey?
   ( ) Unavailable skilled labour
   ( ) Infrastructural and technological problems
   ( ) Insufficient scale of the market
   ( ) Inexistence of the governmental promotions

2) What are the main reasons for the capacity utilization?
   ( ) Factors associated with market
   ( ) Factors associated with supply of raw material
   ( ) Inadequate labour skill and technical problems

3) Which type of technological change is pursued in your firm?
   ( ) Establishment of new units of production capacity
   ( ) Introduction of "Ready-Made" changes into the existing production system.
   ( ) Implementation of "Active" changes to existing production system.

4) Do you have an R & D department?
   ( ) Yes
   ( ) No

5) Are you willing to have an R & D department
   ( ) Yes
   ( ) No

6) Is there a need for sectoral R & D department for solving technological problems?
   ( ) Yes
   ( ) No

7) Do you get any governmental promotions for founding R & D departments
   ( ) Yes
   ( ) No

8) What are the information source during the transfer of technology?
   ( ) Published information
   ( ) Fairs
   ( ) Capital goods suppliers
   ( ) Foreign customers
   ( ) Seminars
   ( ) Research institutes
   ( ) Universities
   ( ) Foreign consultancy firms

9) Is there any university-industry co-operation to adapt foreign technology to local conditions and to create new technologies?
   ( ) Yes
   ( ) No

10) How do you solve your technological problems
- ( ) Solve by yourselves
- ( ) Inform the producer
- ( ) Inform the importing firm
- ( ) Consult with the universities
- ( ) Consult with R & D units

11) How can the technological capability of advanced technology increase?
- ( ) By having foreign technicians
- ( ) By sending Turkish technicians abroad
- ( ) By R & D activities
- ( ) By the co-operation of university-industry.

THE ROLE OF THE UNIVERSITIES AND INDUSTRY IN RELATION TO THE FORMATION OF INDUSTRIAL SKILLS: THE CASE OF TURKEY

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The aim of this paper is to examine the formation of industrial skills in a developing country through formal education, training activities, local R & D centres and consulting firms. The cooperation of these bodies and the productive sectors will be evaluated from a specific industry's point of view. I hope the case study will throw some light on other Turkish and developing country sectors in increasing their technological capability. This specific sector is the Turkish clothing industry and the reference points are taken from our research funded by IDRC entitled "Technological and Structural Change in the Turkish Clothing Industry".(1)

The clothing industry is seen as one of major sources of foreign exchange earnings for the Turkish economy. Recent developments in the clothing industry, such as changing international division of labour and radical technical changes taking place with the entry of microelectronics, have brought a new dynamism to the industry.

Our research indicates that Turkish industry should improve its competitiveness by investing in newer technologies, more productive/conventional techniques, upgrading quality and achieving improvement in efficiency.

The capital goods sector of the clothing industry is not developed in Turkey yet. The technology used is imported from industrialized countries. Besides the direct cost of the machinery transferred, there are very important indirect costs as R & D expenditures to adapt the new technology, the low productivity of unskilled workers, the cost of low quality products and the cost of a foreign consultancy.

The significance of university-industry cooperation will be argued in the context of this paper.

THE SKILL REQUIREMENTS FOR THE TECHNOLOGIES

In our research, most of the difficulties related to the electronically controlled machines were said to be arising as a result of wrong usage of advanced machinery or inappropriate technology. Moreover, the diffusion of these systems was declared to be low as a result of unavailable skilled labour, abundance of cheap unqualified labour and scepticism of the user related to the maintenance and spare part problems (see appendix, question 1).

The main point to stress here is that knowledge and expertise is not transferred so that the local personnel would be able to use the machines efficiently, and could repair and develop the machines.

Quantitative assessment of scientific manpower and technological potential is very important for technological development. The number of engineers and technicians and the distribution of labour according to skill levels of clothing industries in selected countries are displayed in the table below.

Table 1
Distribution of Technical Manpower
in Selected Countries %, 1972*

Countries	Qualification of Labour (Clothing Industry %)			Stock of Scientists and Engineers per 10000 Population
	Skilled	Semi-skilled	Unskilled	
Belgium	26	46	29	073
Italy	33	49	18	120
France	28	49	23	198
Germany	17	63	20	178
Hong Kong	20	--	80	102
Turkey	07	--	93	040

* Source: OECD (1983) p.74, SPO (1985), Frobel, F. et al. (1979), UNESCO (1980).

However, qualitative analysis of science careers as affected by the nature of their training and the wider industrial environment are likely to become an important feature of the mapping of national indigenous technological capability.

In our survey, the departments in which the engineers, technicians and skilled personnel are employed has been specified. The data shows that the largest number of technical personnel are working in the quality control departments, then comes the maintenance, production and control functions. Mostly in the small scale firms, production planning and control are done by the owners or "the old skilled workers". The range of technical personnel for product design is very narrow. In large scale firms the engineers are working as general managers in administrative work (question 2).

For most developing countries, there is likely to be a relatively shortage of trained technicians and engineers, especially those capable of undertaking basic design and development work. This will lead to a slower rate of minor innovations, in given conditions than in developed countries.

The Turkish clothing industry is based largely on re-using the existing stock of local technical knowledge and expertise as a result of the duplication of the production system for many years. The use of dedicated machinery did not help in the generation of new knowledge. The pattern of industrial expansion in this sector involved growth on the basis of a "close" structure of knowledge rather than steps in technological learning process. Only some of the large export firms were open to the acquisition of new technical knowledge and expertise related to the advanced technology (questions 3-4).

The main sources for the acquisition of technical knowledge used by the sample firms are the capital goods suppliers and published information. Some of the large scale clothing manufacturers interested in the development of the technological frontier visit international and national textile machinery fairs each year. Some of the small exporting and subcontracting firms acquire technical knowledge from their foreign customers and from similar firms in the industry. The research institutes and universities do not play any role in the acquisition. Only Ege University in Ismir had an influence on the choice technology of in one sample firm (question 5).

The level of embodied knowledge related to conventional sewing mechinery, dedicated and electronically controlled machinery is an important component of technological capability of the sample firms. All of the firms declared that they have the information about the way the machines were operated. As mentioned earlier, the long history of conventional machinery in the Turkish clothing industry resulted in the acquisition of knowledge through "learning-by-doing". During this period, the number of technicians for the maintenance of the conventional machinery increased, and they developed the capacity to generate some small changes in the machinery. But, the firms have made no efforts to increase their knowledge of dedicated or electronically controlled machinery. Only three of the 12 firms owning dedicated units embodied maintenance knowledge. Two of them also added that they could change some parts of the units. The firms owning electrically controlled units declared that they did not have any idea about the maintenance or detailed technical specifications of the systems. One of the firms bought machinery this year and still does not know how to operate it yet. The machinery has been put into the inventory (question 6).

PATTERNS OF TRAINING ACTIVITIES IN THE FIRMS

A number of studies in the literature suggest that various kinds of formalised training were often far more important as sources of technological capability than were forms of doing-based learning.[3]

During industrial development when existing expertise in these technologies is limited, both the efficiency of newly established firms themselves and many of the "spread effect" and externalities expected from the industrialization probably depend mainly on the nature of the explicit training efforts undertaken.[4]

The majority of the sample firms in our research had undertaken no training at all to develop their capacity for the functions related to technical change (R & D). Similarly, a large proportion has undertaken no "significant" training activities to develop their capacities to carry out quality control or product design. The small number of firms having undertaken "significant" training were large scale exporting firms which have good contacts with the European markets (question 7).

The training provided in the firms for "skilled workers" and "technicians" does not include the generation of any product or process changes and improvements. In most of the firms the objectives of any training were only concerned with acquiring skills and knowledge to operate and maintain the existing technical system of the firms. The minority of the firms has some training activities marginally concerned with technical change. These are large-scale export firms owning dedicated sewing machinery. The technology is new in the market and there is no available skilled labour so the firms have to train their own personnel. Some of the firms sent their technicians to capital goods suppliers in Europe (question 8).

In order to determine the extent to which training was used to accumulate "deeper" layers of knowledge about the firms technology, initial training, duration of training and the manner in which the training was organized is examined. The majority of the firms specified that skilled workers did not have to have any academic qualifications above elementary, but in 38 percent of the sample firms technicians were required to possess a higher academic qualification of at least junior high school education. The majority of the firms started production with a "skilled" workforce and technicians that had previous related work experience. The firms draw significantly on the existing stock of industrial skills for both categories (question 9)

The on-job training programmes provide opportunities for access to underlying "know-why" and technical principles as well as the procedures required for ongoing operations.(4)

The empirical research in the industry shows that on-the-job training activities are very limited in duration and concerned with acquiring the minimum knowledge needed to operate the changed production system, rather than being part of continuing programme of investment in human capital.

THE CHARACTERISTICS OF THE FORMAL EDUCATION SYSTEM IN RELATION TO THE DEVELOPMENT OF TECHNOLOGICAL CAPABILITY

The education system plays an important role in the accumulation of knowledge for the development of technological capability.

When the government expenditures and numbers enrolled in higher education in Middle East and some selected countries are examined, it is seen that Turkey is not investing much in human capital.

Table 2

Expenditures on education and the percentage of enrolled in higher education in some selected countries*

	Expenditures on Education/ Government Expenditures		Number Enrolled in Higher Education as Percentage of Age Group
	1971	1985	1984
Sudan	09.3	----	2
Yemen,PDR.	---	-----	-
Yemen,AR.	---	20.6	1
Morocco	19.2	19.2	8
Egypt	---	10.6	21
Turkey	18.1	10.0	9
Tunisia	30.5	14.3	6
Jordan	---	11.3	37
Syrian,AR.	11.3	-----	16
Lebanon	---	----	--
Algeria	---	-----	--
Israel	07.1	07.1	34
Iran,IR.	10.4	16.2	4
Iraq	---	----	10
Libyan,AJ.	---	----	11
Saudi	---	----	10
Arabi	15.0	11.6	16
Kuwait	16.5	09.7	8
U.Arab			
Emi.			

* Source: World Bank (1987).

Our research indicates that the formal education in textiles is very limited. There are only seven technical colleges related to this industry. The teachers are graduates of the Technical Education Faculty of Marmara University. Seventy percent of the graduates of the colleges are working in the industry. However, the problems of these schools are high in number and can be summarized as the curriculum being focussed on basic science, insufficient laboratory equipment, limited practical education.

There are three universities where textile education takes place; however, they do not have a section on clothing. In Egean University, a Textile Education Center has been established for training and research by the German-Turkish Technical Association Agreement. This center also aims at consulting and preparing seminars. Our interviews in the area have indicated that this center has had positive influence on the clothing producers, approach towards the new efficient technologies.

Apart from the formal education, there are technical sandwich courses by specialized training centers. For example, ISO (Istanbul Chamber of Commerce) trains 1200 personnel per year in these courses. However, it is very hard to say that there are any strong associated activities between the industries and the universities. The first move was made by the Textile Education Faculty of Marmara University, where the students were sent to factories for applied education.

For example, in Korea, KAIS was established with recognition of the anticipated growth of high calibre manpower. In his paper,(5) Chong-Ouk explains that KAIS is a mission-oriented post-graduate school complementing existing universities and college, producing high level scientist and engineers needed for the fast growing Korean Industry, and at the same time, KAIS undertakes research projects of interest to Korean industries so that the students can encounter practical problems in the course of their education.

Science and technology form the basis of industrialisation; the fact that they can be used as such effective instruments and vehicles of development means that the entire population must be associated with scientific and technological advance, that they must be given pride of place in education.[2,6]

In developed countries, universities have become more entrepreneurial as the demand for their research and education has grown. The greater demand results primarily from the increasing need of scientific knowledge for the development of advanced technologies and associated education and training for applying the technologies in business and industry.[6]

The active marketing of university services is becoming widespread in developed countries. This includes the provision of short training courses and longer special educational programmes to meet the requirements of particular companies and business sectors as well as the modification of curricula to reflect greater industrial relevance. These efforts, like those regarding research, are stimulated by the need to increase the income of academic institutions and by the growing industrial demand for education and training. The latter has increased sharply in recent years as industry and business more widely recognise the importance of investment in human capital for enhancing performance and competitiveness. A major contributing factor to the rising demand is the rapid pace of technological change which increases the needed for special training courses to update the knowledge and skill of the workforce.[6,7]

R & D ACTIVITIES IN CREATION AND ACCUMULATION OF TECHNICAL KNOWLEDGE

In developed countries, the business sector expanded its spending for research during 1980 in two main ways: through its own R & D activities and through its support of research in academic institutions.

The total expenditures on R & D as a percentage of GNP in Turkey is relatively low among the Middle East and selected countries.

Table 3: Total Expenditures on R & D as % of GNP*

Country	% of R + D to GNP
Morocco (76)	0.01
Egypt (76)	0.70
Turkey (72)	0.20
Tunisia (77)	0.50
Jordan (76)	0.50
Syrian, AR. (76)	0.10
Israel (75)	1.00
Iran, IR. (72)	0.20
Iraq (74)	0.20
Libyan, AJ. (76)	0.50
Kuwait (76)	0.50

* Source: UNESCO (1980)[8]

Moreover, the R & D expenditures of the universities are getting less and less every year (0-6.4 in 1984 to 0-4.9% in 1986).[9,10]

One of the main policy implication of our research was the need for establishing a sectorial R & D unit and information flow between this unit and inter-firm R & D activities must start working efficiently for the accumulation of technological capability. The promotion for establishing a technology information center is mentioned in the development plans. However, the existing research center is far away from both following the technical changes in the frontiers and generating technology.

The policies pursued in Turkey do not correspond with the planning targets in the Five Year Development plans. When the sections of the development plans on science and technology policy, the incentives for the investments, and exports are examined it is seen that the following points are emphasized; priorities to R & D activities, establishment of a documentation center, encouragement of domestic technology generation, building of the industrial infrastructure, promoting the export of manufacturing goods, and simplifying the export procedures. However, neither the planned targets nor the policy option for increasing the technological capability discussed in the research done in developing countries, are pursued in Turkey. This conclusion was reached after the evaluation of science and technology policies pursued before and after 1980, and comparisons between Turkey and some other developing countries on the basis of some indicators of technological capability.

The government should play a major role in orienting research and education towards meeting industrial needs. It should encourage or even induce academic and research institutes to increase their collaboration with industry, to orient their research and education towards the need of business and industry and to provide services to these sectors.

Government policies and priorities should focus on the promotion of research which is most directly and immediately relevant to new technologies and associating higher education system with the industrial sector.

THE CONSULTANCY AS A KEY INSTITUTION INVOLVED IN THE SELECTION AND MODIFICATION OF FOREIGN TECHNOLOGY

It is argued in the literature that the concentration of the most talented and experienced engineering manpower provides the basis for an indigenous capability to "unpackage" foreign technology. The ability to utilize local engineering manpower in this way can lead to considerable cost saving by making greater use of raw materials, reducing reliance on proprietorial technology and dispensing with payment of often substantial foreign consultancy fees.[9, 10]

In Turkey, the number of local consulting firms are very limited. Especially, conservative sectors, such as clothing are not interested in utilizing the existing local or foreign consulting firms. Only some of the large-scale textile firms are concerned with training programs offered by some consulting firms. As a result of very low payments in the universities, the academic personnel had started to work in these consulting firms besides their lectures and research. The consequences are promising from industry's point of view, but the impact of the university education and research should be taken into consideration very seriously in developing countries.

CONCLUSION

- The research indicates that knowledge and expertise should be transferred to developing countries besides the machinery in order to adapt the new technology to local conditions, to start producing efficiently and to generate change.

- Besides the significance of the quantitative assessment of scientific manpower and technological potential, the qualitative analysis of these careers as well as the nature of their training and work they are undertaking in the firms is very important in developing technological capability.

- The universities and research institutions do not play any role in the acquisition of technology for the Turkish clothing industry.

- The training activities of the firms are mainly concerned with acquiring skills and knowledge to operate and maintain the existing production techniques, not with technical change.

- The on-the-job training activities for developing skills provides opportunities for access to underlying "know-why".

- The Turkish formal education system is far away from developing industrial skills for the accumulation of knowledge of the industry and increasing their technological capability.

- There is a need for establishing sectoral R & D units and a technology information center. Government and industry should take an important step towards orienting these institutions towards the needs of the productive sectors.

- Local consulting firms should be involved in the selection and modification of foreign technology.

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APPENDIX

1) What are the reasons for the low diffusion of electronically controlled systems?
   - ( ) Unavailable skilled labour
   - ( ) High capital cost
   - ( ) Infrastructural problems
   - ( ) Maintenance and spare part problems
   - ( ) Cheap labour
   - ( ) Conservatism of the industry

2) Fill in the table below

Department people specifically linked to	Unskilled labour	Skilled labour	Technician	Engineers
Ind.engineering Produc. control				
R & D				
Quality control				
Maintenance				
Design				
Total direct labour				

3) The diffusion period of dedicated machinery mainly coincides with:
   - ( ) The last 2-3 years
   - ( ) The last 4-5 years
   - ( ) The last 5-6 years

4) The main factors determining the choice of dedicated machinery
   - ( ) The scale of the firm
   - ( ) The exporting condition
   - ( ) Increase in the sale of the firm

5) What are your information source for innovations?
- ( ) Published information
- ( ) Fairs
- ( ) Capital goods suppliers
- ( ) Foreign customers
- ( ) Seminars
- ( ) Research institutes
- ( ) Foreign consultancy firms
- ( ) Universities

6) The firm embodies

(for non-electronic)		(for electronic)
( )	The knowledge of operation	( )
( )	The knowledge of maintenance	( )
( )	The knowledge of design	( )
( )	The knowledge of production	( )

7) Fill in the table below

	No Training carried out	Marginal training undertaken	Significant training undertaken as part of initial inv.	Training undertaken subs.
Product related R & D				
Process related R & D				
Product design				
Product quality control				
Process maintenance				
Production engi.				

8) What was the purpose of training?

	For skilled workers	For technicians
Explicit concern with technical change and improvement		
Marginal concern with technical change		
Exclusive concern with operation and maintenance		

9) Fill in the table below

Initial training/experience	For skilled workers	For technicians
No specific education level required, nor prior work exp.		
School education levels required, but not prior work experience		
High level education but not prior work experience		
Technical high school training and prior work experience relevant to firm's operations education level		
Prior work experience relevant to firm's operations		

UTILIZATION OF RESEARCH RESULTS, ALEXANDRIA, ed.S.KANDIL,1991

RESEARCHERS/ END-USERS PLANNED INTERACTION IN UNIVERSITY RESEARCH: A STRATEGY FOR FACILITATING IMPLEMENTATION OF RESEARCH OUTCOMES (A CASE EXAMPLE)

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1. INTRODUCTION

The case example reported here represents a situation in which the practical relevance and applicability of the results of a scientific research project were enhanced through planned interaction and active participation of end-users/practitioners in the project. The strategy used

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to involve end-users in the research was a solution to problems concerning the implementation of the research design and outcomes. Furthermore, it represents a vehicle by which scientific academic research could be, under certain conditions, transformed into action research.

2. A BRIEF DESCRIPTION OF THE ENTERPRISE PERFORMANCE PROJECT

The Enterprise Performance Project (EPP) was a multi-facet multi-disciplinary research housed at Alexandria University and supported by a grant from the International Development Research Centre of Canada (1982-1986). The research aimed at explaining variations in performance effectiveness among public manufacturing enterprises in Egypt. It sought to identify managerial and contextual factors contributing to the performance effectiveness of these enterprises. Although a wealth of research results exists on this issue, the body of knowledge and research findings consist mostly of fragmented and partial explanations. No comprehensive research was done to examine the relative contribution of different groups of managerial and contextual variables. Furthermore, theory and research evidence was derived mostly from manufacturing organizations operating in developed western economies.

The conceptual underpinnings of the research were based on a comprehensive framework of factors contributing to performance effectiveness. The framework modified and redefined the existing body of theory and research evidence from the standpoint of management practitioners. The framework was developed to reflect the state of scientific knowledge as well as local conditions in which Egyptian manufacturing firms operate. Effectiveness criteria were defined to include end-result financial indicies as well as productivity measures defined in real terms. Managerial variables included formal (Institutional) management systems as well as informal (Individual) practices of top and middle managers. Contextual variables included long term attributes of the firm (e.g., size, age and technology) as well as conditions of the market in which it operates.

Data on managerial and contextual variables were gathered via a battery of questionnaires which were adapted and developed to suit the research strategy of the project. Data on the dependent variables (effectiveness) were extracted from the annual reports of the company, covering a period from 1979 to 1985/1986. The main sample consisted of 48 companies. The companies represented different manufacturing sectors belonging mainly to the Ministry of Industry.

3. FORMULATION OF THE RESEARCH PROBLEM

The problem chosen for research in the EPP, represented a link between policy makers' concerns and academic researchers' interests. Defining the research issue in terms of end result and performance consequences (dependent variables) rather than independent parameters, directed the focus of research to aspects which are most important to practitioners and policy makers. The body of theory, research evidence and methodology were employed to answer two practical questions:

1. What makes the difference between less profitable, less productive companies, and more profitable, more productive ones?

2. How could the difference in management and other attributes be translated into an action program of improving the performance effectiveness of public manufacturing enterprises in Egypt?

The researchers resisted the temptation of defining the research problem in terms of independent variables and/or some intermediate processes which have no link to the outcome parameters of profit, cost, revenue, productivity and resource utilization. The choice of independent variables was guided by the same criteria (i.e., the potential impact on the outcome parameters).

Additional considerations helped to add practical relevance to the research issue. The manufacturing companies represented important vehicles for industrialization and development in Egypt and in most less developed countries. The choice of public enterprises was justified on the basis that they were a major instrument of public policy in Egypt. In addition, the effectiveness and management system of the public enterprises have been a subject of heated debate for the last two decades. Inspite of this, no comprehensive or systematic research on that issue has been attempted in Egypt.

In order to limit the end users efforts' for collecting and generating new data on the effectiveness indices, and to minimize the costs associated with these efforts, a decision was made by the research team to confine the data sources for financial and productivity indices of effectiveness to the annual performance reports of the companies. Such a decision not only served to facilitate the collection of the performance data but also to minimize new data gathering costs on the companies, an area which they have been already overburdened with. The research aimed at providing methods and analytical techniques for calculating financial performance and real productivity indices using the data structure and sources which the companies already had.

4. RESEARCH DESIGN

The interests of the end-user policy makers were represented in the research design by various means:

1. The variables incorporated in the design were defined in a less abstract and more practical (pragmatic) way. Variables which represented purely abstract concepts or could not be meaningful to management practitioners

were modified or deleted from the design. This was achieved by assuring the representation of two types of researchers in the research team:

- Academics who had practical experience via applied consulting;
- Practitioners who possessed academic/research abilities.

2. Concerted effort was directed toward assuring the meaningfulness of the measures incorporated in the questionnaire battery. After the initial formulation of the battery was completed, it was pretested to identify potential problems of implementation, including lack of meaningfulness of the questionnaire items. The interviewers were sensitized about the meaningfulness of the items from the respondents' standpoint.

3. Interaction with the top government policy makers in the planning/design phase regarding the research strategy resulted in modifying the research design in important aspects. Because the food manufacturing sector was of great importance, the Minister of Industry requested that a complete coverage of the sector companies be included in the report of that study over other reports. Although this caused a change in the research plan and schedule, this request was looked at as an opportunity to fulfil the policy makers' needs and to tailor-make subsequent reports based on the feedback coming from the food manufacturing report. The Minister of Cabinet Affairs and Management Development indicated an additional request which proved to be useful in accentuating further the practical relevance of the findings. He requested that, in the financial analysis aspect of the project, particular emphasis be given to profitability indices and that companies be compared in pairs. Each pair should consist of a relatively high performing company and a low performing one. Such comparisons proved useful not only in analyzing

aspects contributing to the differences in performance, but also to the design of the sample. Consequently, the sample design was modified to include companies representing different sectors and also constrasting levels of performance in each sector and activity type.

5. FIELD DATA COLLECTION

Planned interaction of end-user organizations with University researchers in the EPP data gathering phase was a way to achieve three objectives: a) To facilitate and accelerate the data gathering process; b) to give the top executives of the Ministry of Industry, who facilitated the gathering of the annual financial reports, a sense of contribution in the research; c) to use the practitioners who participated in field data collection as a vital source of feedback on the respondents' reaction to the questionnaires. They also acted as a link between the research team and the practicing managers who responded to the questionnaire. Their participation and involvement in this phase took various forms:

1. Membership of the data-gathering teams was augmented by practitioners from public sector companies. This aimed at facilitating interaction between the researchers and the data-gathering practitioners. This was further insured by the participation of practitioners and researchers in the same data-gathering teams and the regular follow up meeting for data-gathering problems which involved members of both groups.

2. A number of top level practitioners who possessed extensive experience and wide contacts served as liaison between the research team and the companies under study. They helped in informing the research team about the history of certain companies and facilitated decision on the comparability of companies considered for potential pairing in the financial and productivity studies of the project. They also helped,

through their contacts, provide entry to and acceptance of companies selected in the sample.

3. Formal sponsorships from the Ministry of Industry and the Minister of Cabinet Affairs and Management Development were solicited and obtained prior to the data collection phase. The sponsorship of these ministries was crucial in obtaining the cooperation of the companies in providing the required financial data and in responding to the elaborate battery of questionnaires. From the standpoint of end-users' participation, it was a check point at which the usefulness, the practical relevance of the research, and the anticipated practical outcomes were assured. The sponsorship served to develop a sense of ownership of the research and motivation in its outcomes on the part of the ministries. Thus, with the participation of the senior researchers, the Ministry of Industry served as a steering body throughout the data collection phase.

DATA ANALYSIS AND REPORT WRITING

Three types of data analysis were conducted in the EPP. Data extracted from the annual performance reports were subjected to analysis of profitability and the financial indices contributing to it. The same data were partially used to calculate and analyze productivity indicators measured in real terms. Data on the management and contextual variables (the independent variables) were correlated with profitability and productivity indices. Special arrangements were applied to the analysis of financial indicators because they had the greatest practical content and represented the dimension which the policy makers gave highest priority in relevance and importance. A team consisting of the principal investigator, academics specialized in the area of finance, and a practicing financial manager from a public manufacturing company was formed. The responsibility of this team was to develop the data analytical approach, conduct the analysis and diagnosis for each company. After having completed the latter, the team did the report writing as well. The participation of the practicing manager in data analysis and report writing was a major contribution to the accentuation of the applied and practical content of the final reports. These reports were to be submitted to top policy makers and executives of the ministries and the manufacturing public sectors. In addition, the participating manager shed light on common accounting and financial practices of the companies relevant to the analysis made. The financial manager possessed special qualities which enabled him to understand research issues in his specialty. A large group of University junior researchers and company practitioners assisted the team. The practitioners, in turn provided counselling and interpretation of common practices used by the companies in preparing the data and the different indices used in the annual performance reports.

The early report on the food manufacturing sector was submitted to the ministries and their reaction and feedback were obtained. Subsequent reports were adjusted accordingly. The productivity analysis and the correlation of managerial and contextual variables with the effectiveness variables were done primarily by the academic researchers. However, the reports prepared based on these results were geared to top management practitioners and policy makers, and were primarily practitioner oriented.

The reports submitted to the Ministries and the Public Sector Authorities included an action program and policy recommendations which aimed at improving the management and performance effectiveness of public manufacturing companies in Egypt. The reports included detailed analytical diagnosis of effectiveness indices and their related management practices. The content and language of the reports were aimed at the practitioners and policy makers without compromising on the research rigor. They were written more in a professional-practitioner's language than academic-researchers' language. This came about as a result of the intensive interaction which took place between researchers and practitioners in the report writing team. Drafts of the reports were read and revised by researchers and practitioners to assure both rigor and practicality. Collaborative report writing between researchers and practitioners was an effective means by which the implementation of the research results was assured.

DISSEMINATING THE FINDINGS AND FORMULATING THE IMPLEMENTATION PROGRAMME

In order to disseminate the research findings among the end-users and to formulate an implementation programme, a symposium was held. Top level executives from the ministries, public authorities, and the companies, along with the researchers participated in the symposium. The findings and policy recommendations which resulted from the project were presented. A management reform plan which aimed at improving the effectiveness of the public manufacturing companies was prepared by the principal investigator. The plan constituted a synthesis of the overall findings and practical recommendations of the project. The reform plan focused on the policies and steps to be followed at each of the following levels: the company, the public authority, and the Ministry of Industry. The proposed reform plan was confined to what lies within the sovereignty of management and its areas of freedom. It differed from previous reform recommendations in a number of aspects:

a. It was based on the findings of a comprehensive and systematic research project. The research rigor of that project was maintained by University researchers. Its practicality was assured via the involvement of end-users/practitioners.

b. It did not require a change in the network of laws governing the work of public enterprises in Egypt, nor did it call for major strategic shifts in public policy, structure or framework within which the enterprises operate. For example, it did not call for the adoption of a privitization policy or a change in government strategy towards public enterprises. The reform plan was confined to what management can do.

c. It offered programmatic steps which should be carried out at the company, public authority, and ministry levels and identified the order of such steps. A prerequisite and first step for management reform requires changing the criteria by which the performance of the cooporation is evaluated.

The symposium resulted in the adoption of most of the reform plan by the Ministry of Industry. The following steps were taken by the Ministry of Industry to put the recommended reform policies into implementation:

1. Indices and information included in the annual reports reflecting performance of the companies were changed to include additional criteria and measures of effectiveness recommended in the reform plan (e.g., Rate of Return on Equity).

2. The companies (especially those showing losses) were asked to present performance improvement and loss reduction plans.

3. Steps were taken to establish a data base on managerial talent in the manufacturing sectors. Such data was needed to facilitate and improve selection and placement decisions of top managerial personnel in the manufacturing public sectors.

4. The diagnostic analysis of the companies and the management reform recommendation of the EPP reports, were further used by the Ministry of Industry as a basis for evaluation of company performance which is carried out by the company's general assembly (headed by the Minister).

5. Currently, negotiation is taking place between Alexandria University and the Ministry of Industry to establish a Centre of Industrial Productivity Analysis and Development. This centre is to be manned by both University researchers and industrial practitioners. This was an explicit recommendation included in the principal investigator's reform plan submitted to the symposium.

SESSION THREE

AGRICULTURE

1. UNIVERSITY PRODUCTIVE SECTOR LINKAGES APPLICATION OF RESEARCH RESULTS: A CASE STUDY ON PAKISTAN.

2. FOOD LEGUME IMPROVMENT PROJECT-UNIVERSITY OF JORDAN: A CASE STUDY.

3. THE INTRODUCTION OF ROUGHAGES TO THE INDUSTRY OF ANIMAL FEEDS IN EGYPT.

4. DEVELOPMENT OF THE LIVESTOCK - GRASS - LEGUME SYSTEMS IN IRRIGATED AGRICULTURE IN EGYPT.

UNIVERSITY PRODUCTIVE SECTOR LINKAGES APPLICATION OF RESEARCH RESULTS: A CASE STUDY ON PAKISTAN

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INTRODUCTION

1. This paper on the topic of "University-Productive Sector linkages: Application of Research Results", has been written in the context of Agricultural Universities in Pakistan and with particular reference to NWEP University of Agriculture, Peshawar.

2. There are three agricultural unuversities in the country, located at Faisalabad, Tandojam and Peshawar established in 1962, 1977 and 1981 respectively (Fig.1). These are financed by the Federal Government through the University Grants Commission. It would be appropriate to mention at the very outset that in the process of their genesis, these Universities became detached from the mainstream of agricultural research in the country through

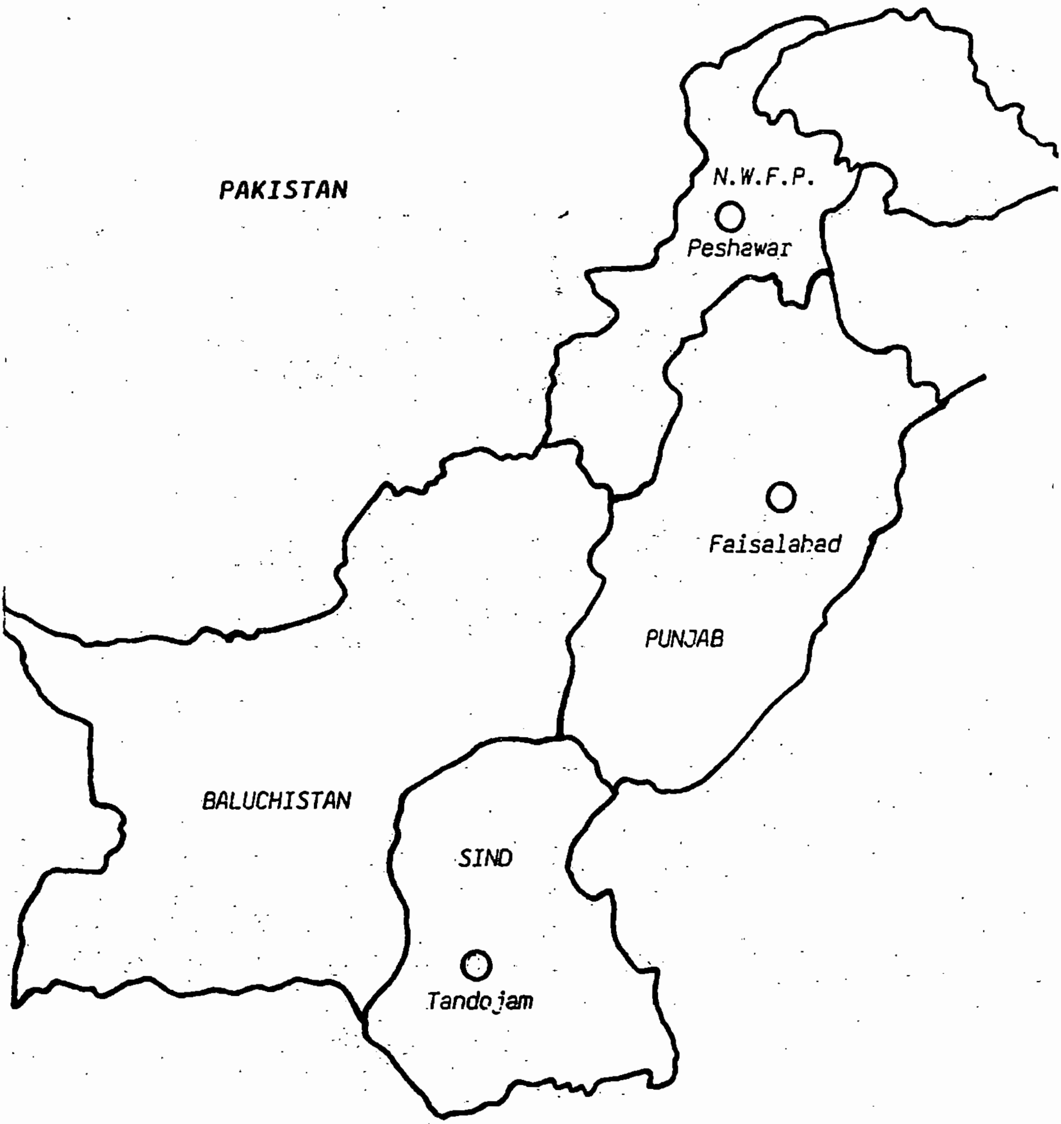

Figure 1. Agricultural Universities.

the establishment of separate and administratively independent agricultural research institutes in the provinces. The universities, by design, were required to provide agricultural education to keep up a regular supply of trained manpower to meet a wide variety of needs for scientists, experts and extension workers in a rapidly growing agricultural sector, allied trades and industries. These were also expected to conduct some basic/fundamental research primarily through post-graduate student theses. Research for technology generation thus became the responsibility of the Provincial Agricultural Research Institutes.

3. The "PRODUCTIVE SECTOR" for the purposes of this paper has been defined as consisting of:

i. The large farming community of the country, operating different crop and/or livestock farming systems on a wide range of farm sizes in a number of diverse agro-ecological environments and with various levels of farm resources. They are the direct recipients of technologies generated by the university research.

ii. The whole range of input manufacturing and supply organizations in the public as well as the private sector including fertilizers, pesticides, farm machinery, seed and various other types of planting materials, agricultural services etc.

iii. Agro-based processing industries, such as food processing.

iv. Planners and policy makers in the public sector.

UNIVERSITY OF AGRICULTURE, FAISALABAD

1. The university of Agriculture, Faisalabad, (Punjab), is the oldest of the three universities and is also the largest in terms of size of the faculty, and student enrolement. It was established in 1962, with the up-gradation of the prestigious Punjab Agricultural College and Research Institute, Lyallpur (now Faisalabad). This

college had been setup in 1908 and through its accomplishments in agricultural education and research had established a sound reputation in the Indo-Pakistan Sub-Continent. The university has an academic staff of 438, of which about one-third possess the Ph.D degree.

2. Organizationally the university consists of six Faculties viz, Agriculture, Animal Husbandry, Veterinary Medicine, Agriculture Economics and Rural Sociology, Agriculture Engineering and Technology, and Basic Sciences. In addition there is a Division of Agricultural Education and Extension.

3. At the undergraduate level the University offers courses leading to the degrees of B.Sc. (Honours), Agriculture; B.Sc.(Honours) Animal Husbandry, B.Sc. (Ag. Engineering), and Doctor of Veterinary Medicine (DVM). At the post-graduate level Masters, M.Phil and Ph.D. programmes exist in a number of disciplines. The University has a total student enrolement of close to five thousand. Sufficient farm area is available for field experimentation. The post-graduate teaching and wsearch are coordinated at the University level separately by the Directorates of Advanced Studies and Research, respectively.

4. The University has so far concentrated on training of extension personnel for field, for executive and planning agencies and for some extension research organizations. Because of limited facilities it has only sparingly involved itself in providing extension services to the Community. Some research on extension methodology is also conducted.

5. In view of the fast development taking place in the fields of Science and Technology and also to keep pace with the national requirements of development, the courses of studies offered at the University are constantly reviewed and updated by the various statutory bodies viz: Boards of Studies, Boards of Faculty, Advance Studies and Research

Board, Academic Council and Syndicate. The University is placing increasing emphasis on combining theory with practice.

6. A large multi-disciplinary agricultural research institute (The Ayub Agricultural Research Institute-AARI) is located at Faisalabad. This is the premier research institute of the Punjab Province, with the responsibility of applied research for technology generation for the province. In addition, there is a "Nuclear Institute for Agriculture and Biology (NIAB) located adjacent to AARI under the administrative control of the Pakistan Atomic Energy Commission. NIAB is working on the use of nuclear energy in agriculture. The linkages of the university with these institutes are rather casual. Occasionally student thesis research is conducted at one of these institutes and one of their concerned scientists is recognized as the co-supervisor. More recently a Provincial Research Coordination Board has been setup to coordinate the research efforts of the university and the research institutes in the Province. The fact that both the University of agriculture and Ayub Agricultural Research Institute are administratively linked to the Provincial Department of Agriculture, makes this sort of coordination possible. However, so far there have been few collaborative research programmes planned and implemented jointly.

SIND AGRICULTURAL UNIVERSITY, TANDOJAM

1. The Sind Agricultural University at Tandojam came into being in 1977 with the up-gradation of the Sind Agricultural College, which had earlier been established at Sakrand in 1925 Faculties viz: Crop Production, Crop Protection, Agricultural Social Sciences, Animal Husbandry & Veterinary Sciences, and Agriculture Engineering. The University has both under-graduate and post-graduate degree programmes in a number of subjects. At the undergraduate level it offers courses leading to B.Sc. (Honours) Agriculture, & B.Sc. (Ag.Engineering). Programmes leading to M.Sc. and Ph.D. degrees are offered in a number of subjects. The academic staff of the University number about

250 with a student enrolement of two thousand five hundred. The Director of Advanced Studies and Research coordinates the post-graduate teaching and research at the University level. The outreach research and extension related activities are performed by the faculty of Agricultural Social Sciences. The Boards of Studies and Academic council of the University are responssible for setting the academic contents and standards of various degree programmes.

2. A multidisciplinary Agricultural Research Institute for the Sind Province is located within the campus of the university, although the two belong to different departments. The University is administratively attached to the Education Department whereas the Agricultural Research Institute is under the control of the Department of Agriculture. This dichotomy of administrative control poses serious problems of coordination between the two institutions. An "Atomic Energy in agricultural development. The only mode of collaboration that has existed between the university and other institutions at Tando-Jam is occasional help in post-graduate thesis research.

NWFP UNIVERSITY OF AGRICULTURE

The NWFP University of Agriculture at Peshawar was established in 1981 with the up-gradation of the Faculty of Agriculture of the University of Peshawar. Out of the three agricultural universities in the country, this is the youngest in age, and is also the smallest in size when judged by faculty size and student enrollment. As the study had been further developed with a particular focus on this university, more details about it are provided in the latter part of this paper.

THE UNIVERSITY'S ROLE

1. As already stated, the three agricultural universities of Pakistan have primarly been engaged in agricultural education at the under-graduate and post-grasuate level in order to train manpower for the

agricultural research and development services in the provinces and at the federal level, as well as, whatever little requirement exists in the private sector. In most cases research is done only as part of the post-graduate thesis but this research is seldom relevant to the solution of the problems of the farmers, thus making little impact on production. There is no formal mechanism in the university operation for the academic staff to get feed back about the real farm problems. The funds provided for research in the Universities are negligible. It is pity the services of a large mass of highly qualified staff are not being fully utilized. Because of this funding constraint, most of the faculty members do not have any worth while on-going research programmes of their own. The problems assigned to the post-graduate students are therefore often based on their personal thinking or liking,without much continuity of the research programmes. Usually universities operate on a project basis, which means short-term, more specific but scattered studies. The tendency is towards less applied and more theoretical research. Links with the national institutes are frequently weak, and their relationships are often competitive. Univerity administration is continually challenged by student activities. Such confrontation seldom promotes excellence.

2. The capturing and distilling of acquired knowledge and transmitting the wisdom for future thought and usefulness through an efficient process of teaching will remain the primary function of an Agricultural University. As agriculture becomes more technical, and as its problems become more intricate, the demand for more advanced education increases. The ways of doing things in agriculture are also changing at an accelerated rate. The "half-life" of most technology is short. There is greater realization that the education that is given should be both practical and sound in principle and theory. Only with basic training and good reading ability can young men and women keep their education upto date as conditions change. This traditional role of the university of making knowledge useful and of helping people use it in making decisions

must, therefore, be sustained.

3. However, Agricultural University in a developing country like Pakistan has to be given the additional urgent role of serving the rural community in teaching skills, generating and transfering technology. This can happen only through the provision of adequate funding and would require a change in policy attitude. Higher education, particularly in agriculture, is far more than mere training for jobs. The research scientist must look at science both deeply and broadly. The current trends in science raise serious problems of scope and choice for most agricultural universities. Rarely would the facilities and funds be available for faculty of high excellence in all aspects of the broad field of agriculture. Choices must be made and the vital choice would be for survival between considerable general mediocrity on the one hand, and high excellence in the selected fields on the other.

4. With changing emphasis on the mission or tasks they program, the agricultural universities in the decades ahead will be more complex institutions. The knowledge centred in them will be devoted to more varied uses than in the past. As instruments of progress and public service, they will have a widened clientele and will participate more fully in the advance of theoretical knowledge in the natural sciences. They will be concerned not only with technology per se but also with how it affects people and their institutions.

CONTRACTS, CONSULTANCIES AND CONFLICTS

Only in a few areas like policy studies in resource management, food and feed processing and agricultural machinery manufacture, university experts are involved in contractual research or consultancy services. However, there is every likelihood of University Scientists to be more dependent upon contract research with funding from both private, public and international donor sources. Short term and long term consultancies will be available to capture the experties of outstanding faculty members in areas like bio-technology, bio-fertilizers, bio-pesticides etc... Experience overseas has indicated potential conflicts as a result of pressure in an accelerated campaign to modernize agricultural technology in the developing countries. The traditional role of teaching as of the foremost importance of the Agricultural University will need to be monitored and preserved. Some faculties can be lured to sacrifice teaching students for more remunerative grants and consultancies.

A RESPONSIVE CURRICULUM

Both undergraduate and postgraduate training to remain relevant will require regular assessment of curriculum and University training. The nation requires young men and women who possess not only theoretical knowledge of the physical, biological, earth and Social Sciences but also the ability to relate this knowledge to everyday problems that people face in the real world. Industries must have educated people to produce the things used in modern farming. Educated people are needed to manage farm enterprises and the industries that process agricultural products. System research and training with an inter-disciplinary thrust will need more attention. A related issue is the availability of suitable text-books. To a large extent, the Agricultural University students are taught with foreign published text-books. They contain the basic scientific information but no examples specific to Pakistan; often their focus is irrelevant to Pakistan conditions. This problem can be alleviated somewhat by the planned production of text-books by the University staff.

PROVINCIAL AGRICULTURAL RESEARCH INSTITUTES

1. According to the present setup the research for technology generation in agriculture is primarily the responsibility of the agricultural research institutes which are under the administrative control of Provincial Agriculture Departments. Each province in the country has one major multi-disciplinary agricultural research institute, some mono-commodity institutes and a large

number of research stations and sub-stations located in different production environments throughout the province. The research set up in each province is headed by a Director-General.

2. The dissemination of technology, thus generated, is done by the extension services of the Department of Agriculture, under the charge of a Director-General Extension. The extension service has various categories of staff at the Headquarters and also at the Divisional, District and Tehsil level. The Tehsil Officer has a number of Extension Agents each covering 8-10 villages. The farmers are occasionally approached by the Extension Agents through their visits, meetings, discussions apart from using the mass media of newspapers, pamphlets, posters, T.V. and Radio. Each province has also one or more institutes for the training of middle level technicians in agricultural extension and also for in-service training of higher level agricultural extension officers.

INPUT SUPPLY SERVICES

1. The provision of inputs and services is the responsibility of other organizations, like Agricultural Services and Supply Corporations, Provincial Seed Corporations, Plant Protection Departments, Agriculture Workshops and Agricultural Development Banks. A number of other special types of programmes have been and are being implemented with certain success and failures. These programmes include District Agricultural Advisory Work; Village Agricultural and Industrial Development Programmes; Integrated Rural Development; Crop Maximization Programmes; Training and Visit System, and commercial extension services, controlled by financial and commercial/Industrial Institutions. The agricultural research system in each province, and the agriculture extension services, administratively merge at the level of Secretary to the Provincial Government in the Department of Agriculture.

2. During the past several years, World Bank funded Projects on Adaptive Research have been implemented in the

Provinces of Pubjab and Sind and, more recently, in Baluchistan. Under this programme Adaptive Research Farms have been established in various agro-ecological zones of the respective provinces, where the subject matter specialists try to adapt technologies developed by the research institutes. These are then disseminated to the target farmers through the Training and Visit (T & V) system, in collaboration with the agricultural extension services. The basic concept underlying this system is to motivate farmers to do simple things that could increase the output immediately, are less risk prone, require little cash outlay and which extension workers could be easily taught to carry to the farmers. These programmes operate as a component of the Directorates-General of Agricultural Extension in the Provinces.

3. One major weakness of the T & V system is that its basic institution is a small group of fellow farmers at village level, centred around a leader farmer. Other types of grouping may be more acceptable than T & V group and may be more effective. Lack of interdepartmental cooperation and coordination is also a serious threat to the real spirit and objectives of the programmes.

4. The Provincial Seed Councils in Punjab and Sind are responsible for the multiplication of seed of improved varieties released either by agricultural research institutes or Agricultural Universities. These seeds are certified by the Directorate of Seed Certification and then sold through a network of sale depots of agricultural services and supply corporations.

SYSTEMS APPROACH AND SUSTAINABILITY

1. Three new challenges are now before the development community as increasingly important issues. These are: (i) to sustain past increases in food production in line with the needs of increasing population, (ii) the improved productivity of cropping and resource systems in less favoured environments and, (iii) the development of production technologies that do not pollute the environment.

2. To meet these challenges, a new and more encompassing research strategy needs to be developed, one that focuses on more efficient use of existing resources, through better management. There are significant differences between the kind of research that must be carried out under this strategy and that which has been pursued over the past three decades. The new strategy requries a "whole system" approach rather than a more limited focus on the system components. Research necessarily needs to be multi-disciplinary in future, since both socio economic and technical issues need to be considered. Research needs to be more adaptive than strategic, and for that reason must be carried out in operating systems, whether they be land, water, or coastal systems, in addition to research carried out on experiment stations. And, associated with the last issue, research must be carried out in collaboration with the agencies or institutions that manage these systems, and therefore, must have strong institution - building components.

3. The pragmatic - and farmer - orientated approach characteristic of Farming System Research (FSR) has been followed in Pakistan and this has encouraged multi-disciplinary studies. Through this partnership the research process is better able to meet the needs of the farmers. Agricultural research becomes more relevant to solving production and management constraints. Farmers become partners in testing improved technology. Policy makers and planners benefit from on-farm generated data as a basis for important policy decisions. Coordination between extension, research, and education is advanced, while feedback to scientists is swift, dynamic, and effective.

CONSTRAINTS ON ADOPTION OF IMPROVED TECHNOLOGIES

Farmers generally adopt technologies that increase the productivity of their total farming systems. "Improved" technologies that are not adopted usually turn out to require either higher prices, unaviable inputs, additional knowledge, lumpy capital, a non-existent marketing system or some other requirement beyond farmers means. Where infrastructure, knowledge, capital or markets are not limiting, their development will likely induce farmers to use new technologies if such are available. Determining whether such technologies offer profit or productivity gains requires economic evaluation of agronomic research conducted under farmer's conditions.

NWFP UNIVERSITY OF AGRICULTURE REVISITED

The NWFP University of Agriculture, as already mentioned, was established in 1981 with the upgradation of the Faculty of Agriculture of the University of Peshawar. This University has been chosen as the focus of this paper because, starting 1983 a comprehensive institutional development project TRANSFORMATION AND INTEGRATION OF THE PROVINCIAL AGRICULTURAL NETWORK (TIPAN), funded through USAID, is under implementation at this University. As a result a unified system of agricultural research, education and extension has been established in the North-West Frontier Province.

2. The primary goal of the project is to increase NWFP's agricultural yields, agricultural production; farm income and rural employment. The secondary goal is to transform the agricultural technology transfer network in the NWFP. While the TIPAN Project focuses on the NWFP, it is likely to serve as a model for eventual adaptation and replication in other parts of Pakistan for the merger of agricultural research with agricultural education.

3. This project has aimed at integrating agricultural research which consisted of twelve research institutes, stations and substation for crop research and three for animal husbandry, located in various parts of the Province, with agricultural education at the university level (FIG.2). The objective is to raise the productivity, economic well-being, health and general welfare of the agriculture sector of the province. The means to achieve the objective was through improving the quality of

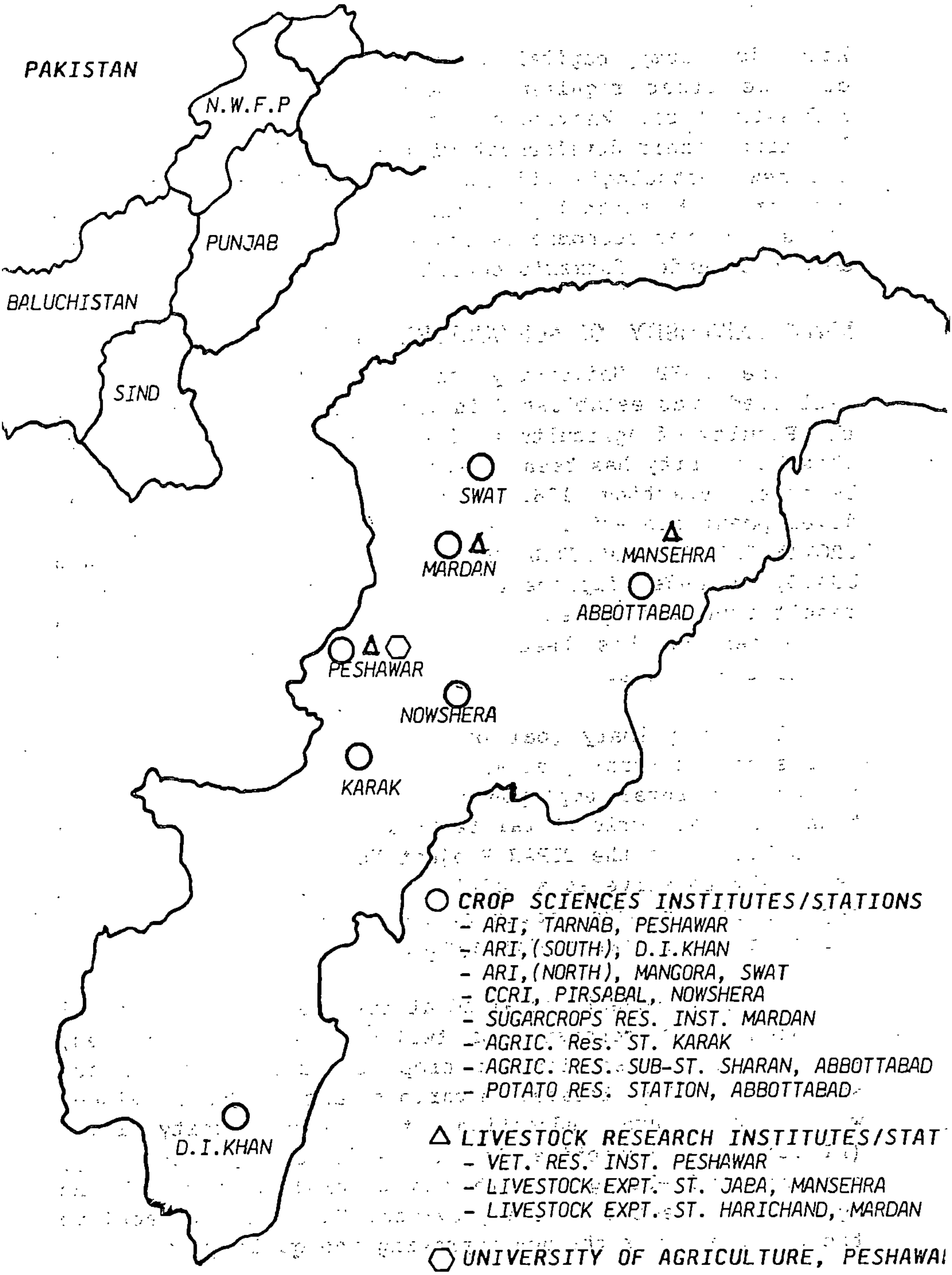

Figure 2. Agricultural Research System of N.W.F.P., Pakistan

education and research programme and strengthening the linkages with agricultural extension through problem solving, farmer-oriented research and outreach programme at the university. To achieve this goal the essential institutional milestones fixed were as follows:

i) The university will completely revise its education programme to prepare students to fill job opportunities in both private and public sectors for the agricultural development of the province.

ii) The Government of the North West Frontier Province and the Agricultural University will develop a Problem solving research programme to be planned and implemented by the newly merged provincial agricultural research system and the Peshawar campus research personnel.

iii) The University will develop an outreach programme to link the campus and its merged research capability with the NWFP agriculture extension services and other agencies working directly with farmer, women and youth. To accomplish this, the University will provide leadership in the development and equipping of an Outreach Programme Division, a Communication Services Division and Continuing Education/Training Division.

iv) To implement the new role and orientation of the University a system of governance will be instituted involving professional and student representation in a committee structure representing critical areas where wide based professional and student support are needed to be successful.

v) The University will establish firm linkages with other universities within and outside of Pakistan, international agricultural research centers and other research organizations through interaction, joint research projects, presentation of papers at conferences, seminar visits and other communications.

4. The project achievement will be demonstrated by existence of the following conditions:

i) University as a dynamic force for improved agricultural development of the NWFP.

ii) University producing high quality graduates to staff the public and private agriculture sector.

iii) University directed Provincial research programme generating improved technology packages which are relevant to NWFP farmers and their problems; and

iv) University outreach activities well integrated with provincial extension efforts, and new technologies being effectively delivered to potential users and other client groups.

PROJECT PROGRESS

1. The merger of provincial research system and Peshawar campus has been done. A beginning has been made in projectizing the research programmes and in organizing a merged provincial research system with the Peshawar campus into one university research programme. An administrative restructuring is in progress and Peshawar based professionals are being organized into five academic Faculties viz: Animal Husbandry, Food Nutritional Sciences, Plant Protection Sciences, Plant Science and Social Sciences. Positions of Director of Teaching, Director of Research and Director of Out-reach, have been established to coordinate teaching, research and extension at the University level.

2. A massive staff-training programme is under implementation. Over 70 advanced degree participants have gone to the United States for Training and have already started returning with completed M.Sc. & Ph.D. degree. The University Professional staff (research system and campus combined) is targeted to reach four hundred and twenty.

3. Linkages with the productive sector are being strengthened through:

i) An improved grading system to better prepare students for postgraduate employment and service.

ii) An internship programme to provide a minimum of three months of continuous practical training in the student, major field and all course work will have a practical orientation throughout the degree programme.

iii) A placement programme aiming at placement of 90 percent of all graduates, 25 percent of these in private industry.

iv) Implementation of a fully-integrated problem solving research programme conducted by on-and off-campus faculty working together in multi-disiclinary teams.

v) An effective programme of mass media technology using radio, television and newspapers.

4. The outreach programming is evolving. Linkages have been established with extension and other provincial organizations for dissemination of research information to farmers and other citizens of NWFP. Outreach programme for women has also been initiated. The university has established numerous linkages with US universities through degree participant programmes. These linkages are being strengthened by cooperative programmes between Agricultural University and these institutions.

RESEARCH PLAN

1. Research stations are being upgraded to enable them to carry out the integrated programs of research, outreach and teaching. Livestock is being included on several stations which have hitherto been devoted to only crops research. Hostels will be built to facilitate student internship, teacher and outreach training. Seed storage and processing units for pre-basic and basic seed will be

established at two stations to support an emerging private sector seed industry. A provincial long term research plan will be developed outlining research goals and priorities. The plan will focus on research by University faculty and researchers as well as trainee participants.

PRIVATE SECTOR EMPHASIS

As the University increases its ability to influence the development of the rural areas, there will be more need to help the private sector provide services to the farming community. The university will serve as the catalyst for private sector involvement in the seed industry, fertilizer, feed and other areas by staging symposia, meetings, farmers days etc. It will also be providing entrepreneurial graduates who recognize and seek out opportunities to make a living serving farmers. This new focus will help to overcome the current problem of unemployment among university graduates.

PLANNING MONITORING AND EVALUATION

The University needs to assume a more vigorous role in providing relevant data to decision makers in the province to ensure that more effective rural policies are formulated to raise living standards. For this purpose a planning, Monitoring and Evaluation Cell will be established within the Vice-Chancellor's office of the University. This cell will be equipped with needed computer hard-and soft ware and will be supported by all Departments.

UNIVERSITY OUTREACH PROGRAMME

1. Outreach is generally thought of as the process of extending knowledge from a centre of learning and research to people of an area to be served. Under the new NWFP Agricultural University, research will create knowledge and based on this research and outreach together will work closely to develop new technology. In this way the university will reach out in all directions to help rural families of the NWFP. Most of the discipline-oriented, basic and applied research will be involved in later stages

of technology development, mostly with on-farm work.

2. A primary role of outreach is to develop the capabilities of the University to serve extension workers of the provincial government as they provide assistance to the majority of small and medium farmers. Figure 3 shows the relationship among research, outreach and extension.

OUTREACH

<-------	RESEARCH -------------->		EXTENSION
Basic and applied research	Adaptive research	Verification trials	Demonstration
On station --------->	On farm ------->	On farm -------->	On farm -------->

Figure 3. Working relationships among research, out reach and extension.

TECHNOLOGY DEVELOPMENT AND TRANSFER

Discipline-oriented, basic and applied research will be done on the University farm and outlying research/outreach stations. Adaptive research will be carried out on farmers' land and is designed to determine recommendations suitable for specific areas. When practices are decided upon, they are to be carried out on farmers' fields through verification trials to be sure they work. Once tested and proven, technology can be promoted through large-scale demonstrations. Outreach personnel will provide the link to tie research and extension together.

FLOW OF INFORMATION

Another major concept of outreach is that it must facilitate a two-way flow of information. Not only will the technology go from the University to the farmers, but equally important, information must flow up through the system from the farmers to the researchers who can work on the problems. Figure 4 illustrates this two-way flow of information for outreach to be effective

RESEARCH	----TECHNOLOGY---> OUTREACH/EXTENSION <----PROBLEMS----	FARM FAMILIES

Figure 4. Two-way flow of information through outreach

AUDIENCES TO BE SERVED

1. Many audiences are to be served by University Outreach. Most importantly, a strong linkage is being developed with the Extension Wing and the Department of Animal husbandry of the NWFP Department of Agriculture. A Memorandum of Understanding has been signed between each of those two units and the University to formalize the relationships. University Outreach will now have on-going contact with extension personnel at all levels, from provincial officers to Field Assistants. Outreach will also support and work with Veterinary Officers and Stock Assistants of Animal Husbandry.

2. A second very important audience will be farmers and farm families. Whereas the Extension Wing of the NWFP Department of Agriculture is charged with the responsibility of working with the majority of small to medium farmers, as appropriate, University outreach will contact directly and serve the larger, more progressive farmers.

3. A third type of audience will be people from the private agricultural sector. These include agricultural credit banks, suppliers of agricultural inputs and food processing industries. Training in this sector will be provided as appropriate. They may also be involved in needs assessment, as well as the planning and implementation of programs. University Outreach Personnel will also maintain contact and work with related agricultural government organizations and agencies.

4. Another very important audience, which up to now has received far too little attention, is the rural household, including women and youth. University Outreach will play a role in improving conditions of people living in rural areas. The greatest immediate impact may come by giving attention to better human nutrition. Another important area will be a special effort to reach rural women with information on the care and feeding of livestock. Eventually, an agricultural education program for rural youth will be established.

PERSONNEL TO SUPPORT OUTREACH

Outreach personnel both full - and part - time are located on campus and the various outlying stations throughout the province. A Director of Outreach gives the overall administrative and programmatic leadership to the University outreach efforts and also coordinates programming with Director Teaching and Research. An Associate Director of Research has been hired as in charge of all training and continuing education programmes. There are five on-campus Outreach Programme Leaders who help develop and implement identifiable programmes within their broad fields and aggressively seek cooperation in interdisciplinary programming with various departments as appropriate. The real backbone of the university Outreach Programme is be the various department Outreach Specialists. These individuals provide the subject expertise to support all programmes. The Regional Outreach Programme Leaders coordinate all outreach activities within the region of the province. They work in close cooperation with the on-campus programmes and department Outreach Specialists.

AREAS OF WORK

The following five areas of work have been proposed for the new outreach programme.

i) Technology Development: A major method of outreach will be the development of technologies for specific crops, livestock, agricultural systems and subjects related to women and rural families. Within this area three major tasks are being carried out: (a) The development and continual up-dating of situational information, (b) The synthesis, in a useful form, of all existing relevant research; and (c) adaptive research and verification trials.

ii) Integrated village Demonstration Programme: The major components of this programme include selection of a village or villages, farmer involvement, survey of needs, problem identification, priority setting and the selection of key elements for demonstration. The farmer and farm family training form essential parts of the programme.

iii) Training and Continuing Education: The new University will have a major training and continuing education function. Currently, all farmer and in-service training of Extension Personnel is being carried out by the Agricultural Training Institute (ATI) of the Extension Wing. Gradually, NWFP Agricultural University, in cooperation with ATI, will assume more responsibility in this area.

iv) Communication Support: A large Communication Services Unit will be developed and maintained at the University. A professional Communication Staff will be trained to provide support in the areas of editorial services, photography, art work and graphic design, print media, mass media and instruction resources. These include bulletin, fact sheets, pamphlets, video and audio tapes, and slide sets. The materials will be designed to be used by Agricultural Officers and Field Assistants as resource information or to be handed out by Extension staff directly to farmers. Mobile communication vans will be placed in service to support joint Outreach and Extension activities in the field.

v) Technical Backstopping: Technical backstopping refers to the act of responding to information requests and answers to questions. With a highly trained staff, the new University will become the primary source of subject matter expertise in the province. Agricultural professionals and farmers alike should begin to look to the University for expert advice and for help in solving their critical problems.

ISSUES HIGHLIGHTED

i) By design, the Universities of Agriculture have been kept out of the mainstream of agricultural research in the country. Therefore, these have not been able to support any significant level of basic or applied research in spite of the presence of large well trained faculty. The Government agencies need to expand their vision of the role of the University and with the provision of adequate resources should assign them a major responsibility of serving the rural community in teaching skills generating and disseminating technology.

ii) The Agricultural Universities have not been involved in significant extension roles, because government line agencies have tended to guard this function for themselves.

iii) The linkages of Agricultural Universities with specialized research institutions are very casual. There are hardly any collaborative research programmes even among institutions located next door to each other. University linkages with external constituencies and policy arenas are also weak.

iv) As agriculture becomes more technical and as its problems become more intricate, the demand for more advanced education increases. There is need for a constant effort by the Universities to conform curricula to the changing needs of agricultural production systems. Related to this issue is the non-availability of locally published textbooks written with a focus on Pakistani agriculture.

v) The demand for agricultural graduates in the public sector is not expanding and there is little prospect of any major increases ill the demand from the private sector. The Agricultural Universities will, therefore, need to adapt their educational programmes to new markets including designing non-degree programmes for specialized skill development including entrepreneurial skills. The University needs to provide effective placement counselling for its graduates.

vi) In some cases the agricultural universities and agricultural research institutes belong to different line departments and this makes institutional collaboration difficult.

vii) Due to the absence of any formal feed back mechanism to the university, research carried out by scientists, particularly the post-graduate thesis research is not relevant to the real problems of the farmer.

viii) To enhance linkages and relevance of their activities the universities must strive for contractual research and consultancy services with the productive sector both public and private.

ix) The Productive Sector should be represented at the appropriate committees of the agricultural universities to provide feed back for research planning in the universities.

x) Future research in universities need to focus on more efficient use of available production resources through better management. The new strategy requires a "Whole System" approach rather than a more limited focus on the system components.

xi) The a doption of improved technology, generated by the Universities is sometimes constrained by its high cost, non-availability of required inputs and lack of supportive markets.

xii). University activities are continually challenged by student activities which hinder promotion of excellence in academic standards as well as research achievements.

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FOOD LEGUME IMPROVEMENT PROJECT- UNIVERSITY OF JORDAN A CASE STUDY

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BACKGROUND

Until 1979, the research work on the improvment of food legumes, namely lentil and chickpeas, was very limited and there was no technology available to be transferred to the farmers. A systemic research work on the two crops started in 1979 with the financial support of the faculty of agriculture, University of Jordan. In 1980 a comprehensive project was established in the faculty of agriculture financially supported by international development research center (IDRC), aiming to improve the production technology of lentil and chickpeas. The project bojectives were:-

a) To develop through breeding, improved chickpea and lentil cultivats.

b) To develop cultural practices suitable for different ecological conditions.

c) To improve the contribution of legumes within the cereal-legume-cereal rotation.

d) To test and adapt harvesting machinery.

e) To identify limiting on-farm problems with existing and improved lentil and chickpea cultivats and production technology.

Phase 1 of the project started with a duration of three years and was extended for a second phase with a duration of three more years. By the end of a second phase, new lentil and chickpea cultivats and proper production technologies were identified and tested on farmers'fields. Then a third phase started with a major emphasis on technology transfer to farmers.

Before discussing the project structure and the links that were developped between the project and the productive sector in the country and in particular the Minstry of Agriculture (MOA) and the Jordan Cooperative Organisation (JCO), I would like to briefly discuss the research structure at the University of Jordan (UOJ) that allows and enhances such linkages to be developed.

AGRICULTURAL RESEARCH AND EXTENSION IN JORDAN

Research and extension in agriculture is carried out by several agencies and institutions in Jordan. These are the following:

1. The National Center for Agricultural Research and Technology Transfer (NCARTT)

This center is a part of the Ministry of Agriculture; the center has the responsibility of conducting the rasearch and trasferring the identified technology to the farmers in the different parts of the country. The center has been recently restructured where five regional centers in Ramthe (north), mshaggar (center), Rabba (south), Shawbak (far south) and Deiralla (Jordan Valley) were established and connected to the main NCARTT headquarters in Amman. Subject matter specialists in the different disciplines are stationed at the regional centers.

The center was originally established to act as a national center where different scientists in the country can carry their research. However, until now, it is still working within the framework of the Ministry of Agriculture. There were attempts to make the center autonomous and connect it to the higher Council of Science and Technology.

The center has access to the extensions which are located in Agriculture Directorates in the different provinces.

2. Faculties of Agriculture

The faculties of agriculture in the university of Jordan (UOJ) and the university of science and technology (JUST) conduct research in the different areas of Jordan. However, as was indicated earlier, the faculty of agriculture does not have its own extension system and depends on the faculty members' initative. Faculty members are considered as subject matter specialists in their free time.

3. Jordan Cooperative Organisation (JCO)

The Jordon Cooperative Organisation has no research resposibilities but it does have extension activities through the service that it provides to farmers in Jordan.

The major services are production and distribution of certified seeds, provision of inputs of machinery services including plows, seed drills, chemical sprayers... etc.

The JCO has extension personel who have direct contacts with farmers especially those who are engaged in cooperatives. Moreover the JCO participates in the excution of some agricultural projects in cooperation with the Ministry of Agriculture and Faculties of Agriculture such as the certified seed production, the Jordan - Australia project for the improvement of the farming system.

SCIENTIFIC RESEARCH IN THE UNIVERSITY OF JORDAN

Scientific research is a major concern of the university of Jordan. The University is keen to encourage faculty members to conduct research and puplish their results to become accessible to the largest clientele. In fact, the promotion system requires that faculty members should publish a certain number of research papers in distinguished journals. This usually encourages them to do research and to publish their results.

One of the major objectives of the university of Jordan is to strengthen the interaction with the total community which particularly could be achieved by transferring research results to the community and to get it involved in the research activities.

In the following we will try to describe briefly the scientific research structure in the university of Jordan with a special focus on the Faculty of Agriculture. This will assist our understanding of the available facilities and flexibility in the university of Jordan and the Faculty of Agriculture that allow for better interaction and linkages achieved with other institutions and productive sectors in the country.

1. Deanship of Research

The deanship of scientific research is responsible for research activities in the University. It has a budget, from the university core budget, to support research proposals. The amount of support for a single project is rather small. However, the deanship seeks funds from inside the country and from other funding agencies outside to support projects beyound its capability.

Nevertheless, foreign funding is usual: achieved by researchers through the direct contacts of their Departments. The Deanship of research has a technical committee that reviews and discusses research projects and approves, rejects, or requests modifications

2. Faculty of Agriculture

The major objective of the faculty of Agriculture as established in 1973, is to carry the responsibility of teaching, research and extension.

The faculty of Agriculture consists of six departments; these are: Plant production, plant protection, animal production, nutrition, soil and irrigation and agriculture economics and extension. In each of these departments there is a scientific research committee, which reviews research project proposals and when approved, it will be sent to the committee on the faculty level. The committee discusses the proposal and either approves, rejects or requests modifications. If approved, then it will be sent to the Deanship for scientific research for approval and support as was described earlier.

The scientific research committee in the Faculty of Agriculture consists of one member from each department, whereas that in the Deanship of Research consists of one member from each Faculty. This last committee is appointed by the Dean's council each calender year.

3. **University Farm**

The university farm is located in the Jordan valleyin the middle of the most important irrigated area in Jordan, where high investment in agriculture is practiced and the private sector is heavily involved, especially in the areas of fertilizer products, irrigation equipment and chemicals.

The farm was established for student training and for conducting research by faculty members. It has a major function of serving the agriculture community in the Jordan valley.

The farm is considered as an extension center for Jordan valley farmers. In the farm, seminars and workshops are held and attended by farmers, technicians and agricultural company agents. In these meetings, research results are presented by faculty members.

The farm links the Faculty of Agriculture to the productive sector in Jordan valley. As a training center, fourth year students spend one full semester (4 months) in the farm. During this period they are trained on practical aspects of agriculture production technology under the Jordan valley conditions. One step taken by the Faculty of Agiculture, to improve the student training and to stengthen the interaction with the farmers in the valley, is the "outreach" program. The program was sponored by the agency for International Development (AID). It involves both students and faculty members. In this program students were trained in private farms in the Jordan valley. They spend three days per week outside the university farm in this private farm, where they live and participate in the farm activities. Faculty members on the other hand, visit students in the field and meet with the farmers, discuss problems and provide advices. Faculty members return with some ideas and problems that would be suitable for research.

The outside program provided the needed facilities for the faculty members to conduct demonstrations in farmers' fields to show and demonstrate the new technology they achieved, with full participation of the farmers. The program continued for one year, it was unique and successful.

4. Graduate Student Program

The graduate program in the university of Jordan is an important program for carrying research activities. In the Faculty of Agriculture an M.Sc. is availiable where a thesis is part of the requirements. Students are either self supported or sponsored by the faculty of Graduate Studies on a competetive basis. Scholarships from Ministry of Agiculture, (JCO), private sector as well as from research projects are available.

Students' research work aim to solve problems that are facing farmers. Research is usually conducted at the university farm or on compus. Some work is also conducted in the ministry of agriculture research stations. The program links Faculty of Agriculture to Ministry of Agriculture (JCO) and private sector. The graduates in the program return to work either in the government or in the private sector. Those graduates are highly qualified to take the lead in the development of agricultural sectors. The university has a good policy of keeping the contacts with its graduates and this usually strengthens the interaction.

5. Training

The university on Jordan, Faculty of Agriculture, is considered as an important training center for JOrdan and the region. This is due to the diversity of specialization, the highly qualified faculty members as well as facilities available at the faculty level and at the level of university.

Several training courses were conducted by the Faculty of Agriculture and attended by technicians of the Ministry of Agriculture and JCO. Other courses were conducted for participiants from arab countries, such as Yemen, Saudi

Arabia, Syria, Iraq, United Arab Emirates and others.

The training program is an important mechanism for increasing the interaction between the Faculty of Agriculture and the production sector.

6. Publications and Extension Bulletins

Research projects are published in specialised Journals either in English or in Arabic. 'Dirasat' is the University Journal and is made available to interested people in Jordan. Moreover, the agricultural Documentation center'AGRIS' is located in the Faculty of Agriculture and provides services to all Agriculture workers in Jordan. This center provides additional links between the Faculty and the Agricultural sector.

The faculty of Agriculture has an extension committee that discusses and approves extension bulletins. Faculty members are encouraged to prepare their research results in a simple language addressed to farmers. Several bulletins were produced and distributed to interested farmers.

APPLICATION OF RESEARCH RESULTS BY THE UNIVERSITY

As might be expected, the university of Jordan and the Faculty of Agriculture do not have the extension staff who can promote the identified technology. However, faculty members in each speciality are considerded as subject matter specialists in thier field of research. Faculty members through their personal initiative can assist in the application of their results by farmers or end users through the following channels.

1. Direct Contact

Faculty members have direct contact with farmers by visiting them in their farms.

2. Radio and Television Programs

A daily radio program and a weekly TV program are available for agriculture information. In these programs there is an active role of faculty members where they present their research in a simple way addressed to farmers and end users.

3. Extension Bulletins

The Faculty of Agriculture produces its own extension bulletins which are prepared by the specialists and reviewed by technical committee. These bulletins are distributed to interested people by different means among which is the extension section of the Ministry of Agriculture. The university Press has good facilities to produce a high quality bulletin.

4. Video Films

The educational technology center at the University of Jordan has the facillity to produce teaching video films that can be broadcast through the extension system or through the agricultural program on the national TV. Several agricutural films have been produced.

5. Training Courses

Special training courses were developed and conducted to qualify research assistants and extension agents. This activity stengthens the cooperation between the Faculty of Agriculture and its staff on the one hand and with the staff of other agricultural organisation on the other.

6. Seminars and Workshops

This is a continuous activity where the faculty of agriculture is very active in organising national and regional workshops in different areas of agriculture. These workshops are attended by technicians and extension agents from the Ministry of Agriculture and JCO and by some selected farmers. Moreover, specialised seminars are usually presented in the Faculty of Agriculture by faculty members or by invited speakers. These seminars are attended by interested people in the agricultural sector.

FOOD LEGUME IMPROVEMENT PROJECT

The food legume improvement project at the university of Jordan, Faculty of agriculture, is considered as a successeful example of the proper linkage that was developed between the university and the productive sector.

The food legume improvement project started in 1980 as mentioned earlier. The work was focussing on identifying proper technology for lentil and chickpeas to improve crop yield and increase farmer net return. However, the project is also concerned with the training aspect to qualify technicians and researchers to work on lentil and chickpeas. This will assure the continuity of the work. The food legume project was implemented in three phases as follows:

1. Managed Research (Phase I and II)

The research work in the project started from scratch since no information was available in the country about the two crops. Therefore the research was needed in the different aspects of crop production, the areas that were covered are the following :

1.1. Agronomy : to identify proper culture practices for the production of lentil and chickpeas which include : Planting date, seeding rates, fertilization, seed innoculation, weed control, method of sowing.

1.2. Breeding : this include collection of local plant races, evaluation of these germplasms along with introduced ones from ICARDA and elsewhere, hybridisation program in order to select and develop new varieties that are high yielding, good quality and suitable for mechanical harvesting.

1.3. Mechanical harvesting of lentil and chickpeas through the evaluation of the available machinery and modify the proper prototype that was first developed in University of Jordan.

1.4. Socioeconomical studies : to achieve better understanding of social constraints and their possible solutions.

Laying down these activities we decided that part of the work should be done by graduate students who have received scholarships from the project. This will serve two purposes; on the one hand we will be able to find answers to some of the questions and on the other hand we will train the student who will eventually be the specialist in the area that will carry on the work in the future.

The other important point is that the research work should be conducted at the Ministry of Agriculture research station. This will allow for better interaction between our team and the stations team, and will lay the basis for the future cooperation.

2. Results of Phase I and II

The results obtained during the two phases of the project were satisfactory to the project objectives and can be summarized as follows :

Objective a) : to develop through breeding improved chickpeas and lentil cultivats.

Results

i)Two lentil cultivatesare now at the release stage. These are UJL 176, a yellow cotyledon type (proposed name Jordan 1), and UJ 81L, superior to UJ 176 have been made and are coming on stream for release within the coming two years. Emphasis on selection is put on plant height, grain and straw yield and seed quality.

ii) Two chickpeas cultivats have been developed : UJC 107 for spring sowing (Jubeiha 1) and ILC 482 for winter sowing (Jubeiha 2)

Objective b) : to develop agricultural practices suitable for new cultivats adapted to different ecological conditions. Recommendation for cultural practices developed by the project include the following:

Lentil

i) Seedbed preparation and seeding equipment : the equipment used for cereals, already available in the country through the Jordan Cooperative Organisation or contractor services, can be used for lentil, with only minor adjustments.

ii) Seedbed preparation : Chisel plow or sweep, followed by smoothing with a spike harrow.

iii) Seeding rate : 120 kg per hectare of medium size lentil seeds for high rainfall areas (over 300 mm) and 80 kg per hectare for low rainfall areas (250 - 300).

iv) Planting date : early sowing is recommended, with one or two hand weedings when necessary.

v) Fertiliser application : 20 kg and 40 kg per hectare, equivalent to 100 kg per hectare of locally manufactured Diammonium Phosphate (DAP). Fertilizer application at planting, with the seed.

Chickpeas

i) Seedbed preparation with chisel plow or sweep followed by spike tooth harrow. If disk plows are used, the operation should be followed by a disk harrow or chisel plow for the achievment of a level seedbed which will allow successful harvest mechanisation. Here again available machinery for cereals can be used .

ii) Seeding : with regular wheat seed drills after adjustment for seeding rate.

iii) Seeding rate : 100 kg per ha of the medium seed size varaities.

iv) Fertilisation : same as for lentils.

v) Planting time :
Winter sowing : high yielding. Ascochyta blight

tolerance cultivats should be used and weeds controlled. Planting time October or November variety Jubeiha 2. Spring sowing : Planting in January, as compared to March, resulted in significant field increases with no danger of Ascochyta and low weed infestation. Variety : Jubeiha 1.

Objective c): to assess the contribution of legumes within the cereal-legume-cereal rotations.

Rotation trials have been carried out locations by one M.Sc. student during two years, in two locations. Treatments include chickpeas, with and without N and P type fertilizers, followed by wheat, additionally, a large(3 ha) non-replicated trial on a farmer's field was used including summer vegetables as an additional treatment in the rotation . Results from the two trials indicated significant increases in wheat yields following fertilized lentil and chickpeas , as compared to fallow or summer vegetables. Yields of wheat were superior in rotations which included fertilized or unfertilized lentil and chickpeas, to those in continuous wheat rotations. Economic analysis of these trials will be reported in the technical report of the supplemental year.

Objective d): to test and adapt haresting machinery.
Direct combining and harvesting with the ICARDA double blade cutter bar on both lentil and chickpeas have been evaluated with the following conclusions:

Lentil

i) A smooth seedbed is essential for harvest mechanization. Rolling after sowing is recommended to smooth the seedbed and push stones down into the soil. Rollers can be attached behind the seed drill, thus eliminating extra operating costs.

ii) Harvesting with a double blade cutter bar mounted on a tractor : cutting should be performed when plants are yellow but moist and when the pods have turned golden yellow but are not dry. Cutting should be performed early in the morning and discoutinued duriong the hot part of the day. Immediately after cutting, lentil should be collected. Threshing can be performed with the stationary threshers currently available in Jordan. If combines with a suitable pick-up mechnism are available, lentil can be dried in wind rows and combined directly. Regular wheat combines can be used after proper adjustment of the drum speed and the distance between the drum and the concave. Direct combining of the crop is possible, although more losses occur.

iii) The double blade cutter bar is very efficient on smooth stoneless soils. For optimum efficiency the blades need to be sharpened regularly. Modification of the cutter bar by the addition of plant lifters should further increase its performance.

Chickpeas:

Rolling is not necessary and direct combining posses no problem. Cutter bars can also be used.

Objective e): To identify limiting on - farm problems with existing and improved lentil and chickpeas cultivats and production technology.

Most work on constraint evaluation was performed during the 1987/88 season and is described in the following section.

3. Project Extension

1) The extension year started on November 1st,1987 and continued until October 31st,1988. The main objective of this additional year was to involve researchers and additional specialists from the University of Jordan and the Ministry of Agriculture in larger scale demonstration and verification trials as a preparatory learning step towards the preparation of the third phase of this project. Agronomic and socio-economic evaluation of trial results will be presented at the end of the current season.

2) Nine demonstration/verification trials on farmers' field have been conducted (six for lentil and three for chickpeas). Field size ranged between one and two hectars. The whole area was split up into two parts, 75 to 80% of the area was managed by researchers and included whole package demonstration of recommendations, and the remaining 20-25% was farmer managed using traditional practices. Results so far indicate the superiority of the improved practice to those of the farmers.

3) Seven tons of UJL 176 lentil seed and three tons of UJC 107 chickpea seed have been produced for use in future demonstration/verification trials and for commercial stock multiplication.

4) Preliminary analysis of cost/benefit data from on-farm trail indicated the following: Mechnical harvesting is highly economic despite some grain losses. Fertilizer application economics needs to take into consideration yield increases in both food and legumes and following cereal crop. Herbicide application appears to be non-economic due to the high cost of the product, the costs of the aplications and unpredictability of the results.

5) A key constraint to adoption of technologies by farmers was found to be the lack of awareness and knowledge of available technologies, inaccurate preceptions of risk and economic returns associated with new technologies (mainly as regards seed losses with mechanical harvesting and fertilizer application), lack of timely availability of inputs and support services and inadequate extension methods and/or knowledge.

6) All four new varieties were found to have high acceptibility in terms of taste and cooking time.

7) Two field days for farmers were held in April 1988. The farmers' responsible were very positive and several expressed interest in obtaining seeds. Some farmers indicated willingness to collaborate with the project

during the coming season.

8) Several visits to demonstation sites were organised for technicians and extension agents of the Ministry of Agriculture (MOA) and the Jordan Cooperative Organisation (JCO).

9) Two extension bulletins were published in Arabic, one on lentil and the second on chickpeas. The bulletins were addressed to extension technicians and farmers and described the recommended practices for lentil and chickpeas production. 500 copies of each were distributed in the country. The bulletins are now in the process of being reprinted.

10) For the purpose of future extension activities, the project has started to develop a video tape in cooperation with the Communications Department in the University of Jordan. The 20 minute film will be oriented to technicians and farmers and will illustrate project recommendations for mechanized lentil and chickpea production. It is hoped that the video will be completed before the beginning of the next growing season for presentation on television. The video will be utilized during field days and village visits during the coming growing season.

11) An M.Sc. student in extension, from the Ministry of Agriculture was to start his first year during the suplemented year. However , this activity did not take place due to the late identification of a promising candidate. The M.Sc. training will now be transferred to phase III.

4. Technology Transfer (phase III)

The third phase is an integrated phase where FA/UOJ and NCARTT/MOA are jointly implementing the project. The phase is a technology transfer and, therefore, extension is a major component in it. Extension agents in the MOa along with researchers in tha MOA and in the FA/UOJ are working together on the implementation of this phase. Only the budget is directed by the UOJ because of the better flexibility of the UOJ system. Workshops, field days and training are organised and conducted jointly by both institutions.

The annual report is jointly prepared and daily contacts beteen scientists are available. The results of the first year cooperation are excellent and it is now considered as a unique example for other projects to follow.

In the present phase, new varieties of lentil and chickpeas have been released, the suggested name for those are related to Jordan and not to the Ministry of Agriculture or to the University of Jordan.

COOPERATION APPROACH IN THE FOOD LEGUME PROJECT

From the start of the project an approach was taken to strengthen the cooperation between the project, the researchers and the extension agents in the Ministry of Agriculture and JCO. This was achieved through the following means.

1. Ministry of Agriculture Research Stations

The project used the Ministry of Agriculture Research Stations as sites to conduct the trials, after having the permission of the MOA. The station supervisors were aware of the activities and they participated in the implementation of some trials. During the season, the technicians of the project and those in the stations visited together the trials and recorded their observations, thus feeling that they were part of the work.

When needed, the JCO machinery was used in planting large plots and also the JCO became acquainted with the project activities.

2. Project annual reports

The projects produce a regular annual report containing the results of the project activities and a workplan for the following growing season. In this report there is always an acknowledgement to the Ministry of Agriculture and to the research station supervisors and technicians who assisted in the project. The report has a summary in Arabic where major finding are presented for those who do not read English. The report is usually distributed to NCARTT and JCO and to the stations as individual technicians and researchers in these stations. This usually results in better cooperation and warmer relationships. This does not happen in other projects.

3. Workshops

The project organised several workshops where all researchers and technicians from the major centers of NCARTT and JCO were invited. In these workshops, a review of the project activities is presented and a work plan for the next growing season is developed. This usually makes people feel that they are part of the activity as they know about it and participate in the planning stage. This results in more cooperaton and involvement during the growing season.

4. On-Farm Trial and Demonstration

On-farm research started towards the end of the second phase and was managed by the project researchers. In this activity the project researcher consults with MOA and JCO extension agents on the areas and the farmers to be selected. They participate together in this activity which results in good cooperation between them. The JCO Machinery was hired to do the planting and therefore JCO personnel were involved in the activity from the beginning. The project took into consideration that this machinery should be used by the project.

5. Field Days

The food legume project organised its field day at the same time as the MOA had its field days for cereal and forage crops. The project requested the Ministry to include the food legume in its field days program, this enhanced cooperation and reduced the cost and increased farmers benefits. The costs were shared with the MOA and project specialists and were available to answer any questions.

6. M.Sc. Training

The food legume project emphasizes that training is needed in order to build up manpower in the area of food legumes that can be used by Jordan and the region. Seven M.Sc. students submitted their M.Sc. in the area of food legumes. After Graduation they worked in the following areas:

2 graduates in the MDA
2 graduates in JUST
1 graduate in FA/UOJ
1 graduate in ICARDA
1 graduate in the west bank of Jordan.

UTILIZATION OF RESEARCH RESULTS, ALEXANDRIA, ed.S.KANDIL,1991

THE INTRODUCTION OF ROUGHAGES TO THE INDUSTRY OF ANIMAL FEEDS IN EGYPT

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INTRODUCTION

Literature on animal nutrition puplished in Nothern-America and Western-Europe recommends the inclusion of high percentages of grains and oil cakes in animal feeds. This information is taught in many schools in the developing countries. Animals in the developing countries are of modest productive levels. Careful revision of the requirements of the third world's animals may indicate that they can do well with just roughages, provided it is properly processed and nutritionally balanced.

This presentation describes the research and application efforts achieved within the joint project "by-products, Egypt III" Between the IDRC of Canada and the University of Alexandria during the period 1984-1987.

ANIMAL FEEDING PRACTICES IN EGYPT 1984

The Egyptian animal wealth could be distributed into three major groups. The first group is the largest (75%) and it is in the hands of the small-scale farmers. It is mainly working animals. These animals are heavily infested with parasites because they graze on the weeds on the banks of water canals. No veterinary care is given to animals of this group. Their feeding is irregular and mostly insufficient due to the shortage of cash. They are in small ownership patterns of 1-4 heads per farmer. Small scale farmers cannot join the animal insurance system because the number of animals they own is small. This system allows an amount of manufactured concentrates at a subsidized price. The small scale farmers can sometimes manage to obtain the maufactured concentrates from the black market for almost double its subsidised price.

The second group of animals (20 %) is in the hands of milk and meat provision producers. The contribution of this group to the Egyptian milk and meat market is significant. Members of this group of owners are relatively rich and their ownership suits the regulations of the animal insurance system. Therefore, they receive the subsidized manufactured concentrates allowed to their animals. Horeover, many of them misuse the heavy subsidy given by the government to the prices of wheat, flour, bread and macaroni. It was established by some authorities that about half the wheat and wheat products specified for human consumption, was illegally siphoned off drained to animal feeding. The misuse of the subsidy was encouraged by the pricing policy (at the year 1984) which obligated selling the ton of wheat against L.E. 80 at the time the ton of manufactured concentrates was sold against L.E. 140. Wheat straw which was not governmentally priced, was sold against L.E. 150-200, depending on the season.

The third group (5%) is in the hands of public sector agricultural companies. These companies recieve considerable amounts of the manufactured concentrates. This group of animals was slaughtered and sold at relatively low prices to compensate for the high prices of meat of the private sector.

If the non-subsidized prices of grains (wheat & corn) and manufactured concentrates were added to the sum price of berseem and wheat straw offered to Egypt in the year 1984 besides the costs of labour, veterinary care, transportation... etc., the grand inputs value equal the total price (at the year, 1984) of outputs (milk and meat). This is shown in Table 1 and indicates that any profit that may be earned under such conditions would be the governmental subsidy. The animal prodction industry under the policy and practice dominating in the year 1984 was not really profitable.

Table 1. The prices of the inputs and outputs of the Egyptian animal production industry for the year 1984 with and without the grain subsidy.

Item	Inputs		Item	Outputs	
	Million tons	Real cost L.E.		Million tons	Real cost L.E.
Grains	3	840	Milk	1.8	1260
Berseem	57	1425	Meat	0.5	3500
Bran and cake	1.3	250	Animals	5%/year	175
Straws	3	450			
Real cost of feed		2965			
Vet.cave & labour.etc		2200			
Total real inputs 1984		5165			
Subsidized feed price		2080			
Vet.care & labour.etc		2200			
		4280			4935
Real price, 1989		7830			7800

RESEARCH RESULTS SUPPORTING THE ROUGHAGE BASED DIETS AS PROPER FEED FOR EGYPTIAN ANIMALS.

The comparison between the voluntary roughaged consumption of cattle, (buffaloes), sheep and goats (table 2) indicated that large animals (cattle and baffaloes) can do well on a whole roughage diet (Table 3). Sheep and goats failed to get even their maintenance requirements on a whole roughage diet.

Table 2. Comparing the ad lib. consumption of whole roughage by cattle, buffaloes, sheep and goats.

Animal species	Avg. body weight		ad lib. consumption	
	kg	$W^{.75}$	gm DM / Head / day	gm Dm/ $W^{.75}$/day
Cattle	259	46.5	7800	121
Baafaloes	230	59	8900	151
Sheep	40	15.9	607	038
Goats	42.3	11.1	420	37.8

Table 3. The adequacy of freely consumed TDN by cattle , buffaloes, sheep and goats feed a whole roughage diet.

Animal spieces	kg TDN / Head / Day		
	Standard requirements	consumed	Daily body weight change (Kg/head)
Cattle	3.95	4.1	+ 0.58
Buffaloes	4.20	4.6	+ 0.65
sheep	0.67	0.32	- 0.03
goats	0.55	0.22	- 0.04

The nutritive value of the roughage based diet was improved to the utmost when it was consolidated with 20-30 concentrates (Table 4 and 5).

Table 4. The voluntary feed consumption by sheep fed choped corn stalks with differnt additives or treatments.

Item	Corn stalks based diets			
	Raw	With urea, salt and Vitamin A	With 24% bran and cottonseed cake	treated with ammonia
Consumption (gm/Head/Day)	564	706	1094	815
TDN %	54.1	54.7	55.8	84.6

Table 5. The gained associative effect of in diets of different roughage/concentrate ratios.

Item	Percent of roughage in the diet			
	100	75	50	25
TDN:				
Calculated	40.9	47.2	52.5	53.5
actual	48.5	62.7	60.7	59.8
The associative effect %	18.6	32.8	12.7	11.8

The roughage based diet was compared with the traditionally practiced feeding regimes for raising male calves for meat production (Table 6). The roughage based diet was cheaper by about 26%. Milk production at levels between 6-9 kg/head/day was more economic than the roughage based diet containing 15% concentrates (Tale 7).

Table 6. Comparison between the roughage based diet and the concentrate based diet for raising male calves for meat production.

Item.	Roughage based diet (75 %)	Concentrate based diet (75 %)
Feed consumption (Kg/h/d)	9.5	9.3
Price (L.E)/Kg feed	0.11	0.2
Daily bodywt. gain (Kg/h)	0.81	1.06
Kg feed/Kg body wt.gain	11.73	8.77
Feed cost (L.E)Kg body wt.gain	1.29	1.76

Table 7. Effect of different roughage/concentrate ratios on the economics of milk production from native cattle and baffaloes.

Item	Roughage: concentrate ratio			
	1 : 1.5	1 : 0	1 : 1	5.7 : 1
Kg Feed/H./D.	20	20	15	18
Kg milk/H./D.	7.02	5.66	6.34	7.16
Fat %	4.94	4.96	4.58	4.76
Fat corrected milk (Kg/H./D.)	8.01	6.47	6.89	7.98
Daily bodywt. change (Kg/H.)	0.33	0.40	0.38	0.53
Daily Feed cost (L.E)	3.40	1.01	2.24	1.51
Cost of Feed/Kg milk	0.30	0.16	0.33	0.19

The nutritive value of the roughage based diet was much improved by adding urea (1.5 %) and locally formulated mineral mixture.If the forementioned results were utilised and Egyptian animals were fed a recommended roughage based diet supplemented with less than 20% bran, molasses and cotton seed cake, then the industry of animal production in Egypt would give about 17% profit without subsidy (and without grains). Table 8 presents the inputs-outputs prices according to the 1989 market prices. This will be the only way for such industry to survive and even flourish in Egypt in the foreseeable future.

Table 8. Prices (1989) of the inputs and outputs of the animal production industry in Egypt when the diet contains no grain.

Item	Inputs		Item	Outputs	
	Million tons	Million L.E		Million tons	Million L.E
Bran and Cake	1.5	375	Milk	1.8	1800
Straws	7.0	850	Meat	0.5	4500
Corn stalks	4.0	320	Animals	5%/year	0175
Berseem hay	5.5	1650			
		3195			
Vet., labour...etc.		2300			
		5495			6475

EFFORTS MADE TO POPULARIZE THE FOREMENTIONED INFORMATION:

Efforts to extend the project's experience were made on three different levels:

a) Contacts were made with the Minister of Agiculture, the under secretary of statl for animal Production in the Ministry of Agriculture and the Head of the Institute of Animal and Poultry Research of the Minsterial resolution No.75 Of the year 1967 controlling the production and distribution of manufactured concentrates. A new resolution was requested to recognize roughages as feed ingredients that could be manufactured either alone to produce whole roughage manufactured feed or mixed with concentrates to produce a complete manufactured diet. A committee of researchers intrested in these topic was invited and the issue was carfully studied and the Minister of Agriculture supported their recommendation by the ministerial resolution No. 554 of the year 1984 .

The above mentioned committee took the point of view of the project constructively. In developping countries where the proper know-how on animal nutritionwould be lacking to great extent, it is not enough to produce well balanced concentrates. The farmer or herdsman may loose this balance by non calculated addition of poor straws. The well balanced complete diet would be more convinient (economic) for those who keep animals for meat and/or milk production.

b) Directors of the department of Agricuture at the villages Komel-berka and Sedi Ghazi in Behira Governorate and at Abo-Greda in the governorate of Domieta were contacted. They were asked to recommend farmers in their areas who would represent some sort of leadership between their colleagues. The team of the project was introduced to these nominated farmers by the director of the Department of Agriculture at each village. The team suggested to the farmers to process his field by-products and formulate a well balanced ration for his animals. Productivity of the.

animals before these treatments was compared to levels after feeding the properly formulated diet. This period lasted for about 8 months, at each site. The farmers were cooperating during the presence of the team on the site. Unfortunately, the farmers did not continue on their own after the team left.

The situation was much better with herdsmen. They got intrested in the information. Some of them argued some concepts and showed their preference for their inherited experience, especially when the price of wheat was heavily subsidised. They became more broad-minded by the correction of the pricing policy and when the prohibition of using wheat for animal feeding was seriously applied by the government. A good precentage of contacted hedsmen were very cooperative. This last group enhanced active members of the general society of the Development of Animal Wealth in Cairo. Their interest was expressed by purchasing choppers or choppers plus mixers for processing roughages further connection with other businessmen, it was possible to convince four groups to establish feed mills for manufacturing complete diets or roughages alone. These four feed mills were the first private animal feed mills in Egypt that have been established since 1952. A fifth mill was constructed by the governorate (Matrouh). All of these mills were located in the neighbouhood of Alexandria.

The first years of experience of these mills were not fruitful. The main reason was the difficulty of marketing the product. The whole concentrated manufacture diet produced by the government contained cotton seed cake and yellow corn, and was heavily subsidised. The new feed mills were allowed by the government to produce whatever they wanted but without obtaining any governmentally subsidised concentrate ingredient. Consequently, the feed of these new mills reduced contained roughages which was a very strange component. The market was not prepared to accept it, and at the same time it was more expensive than the manufactured concentrate. The only chance was in producing special orders for milk-producers who have friesians of high level productivity. The government hesitated to stop the subsidy policy up to the year 1988. The industry of manufacturing roughages was about to vanish. Investors stopped investing any more in this new industry.

c) Approaching the public sector manufacturing concentrates in Egypt to share in producing the complete manufactured feed (1987-1988) was the most successful step towards the goal of the project. Farmers and herdsmen accepted the presence of the roughages in the governmental manufactured feed because of its subsidised price and the presence of cottonseed cake and yellow corn. Now(1989) roughages in the governmental manufactured feed do not exceed 25% to the utmost. This percentage should increase by time. The public sector feed factories obtain the roughage portion in a peletted form because all their feed mills were designed for manufacturing concentrates. These mills do not have any means to deal with roughages unless it is recieved in a granulated form. The newly established roughage mills prepare roughage in the form suitable for the public sector mills in a sort of integration between the traditional and the new technologies. The existing manufacturing capacity of the public sector plants is around 3.7 million tons per year. The total concentrate ingredients that could be furnished annually do not exceed 2.1 million tons. The integration between the new and the traditional feed mills was good for both sides.

When the government stops subsidizing the price of its production of animal feed and let the concentrate ingredient be freely sold at market price, the private sector feed mills will be able to produce complete feeds at competing prices with the public sector. At that time the farmers and herdsmen will be used to the presence of roughage in the manufactured feed.

This step was induced through demonstrations conducted at some feed mills in the public sector, and these trials were reported to the Head of the General Authority of Food Industries (GAF1) belonging to the Ministry of Industry.

Then the topic was studied in meetings between representatives of the GAF1 and the Central Directory of the Animal And Poultry Wealth belonging to the Ministry of Agriculture. The two sides agreed upon the inclusion of roughages (purchased in a pre-industrialised form) into the governmental manufactured feed. It is hoped that the full manufacturing capacity of the public sector feed plants will be employed through increasing the available ingriedients by the pre-industrialised roughage.

Producing manufactured roughage based feed is economically feasible. One ton of yellow corn containing 800 kg of TDN costs L.E. 500. The ton of wheat bran (600 kg TDN) costs L.E.250. This show that the kg TDN in concentrate ingredients costs betwwen L.E. 0.416 and L.E. 0.625. Low price straw, bean straw, corn stalks and berseem hay could be purchased now (1989) at L.E. 45, 60 70 and 180 per ton, respectively. The TDN content per ton of this ingredient is 440, 380, 450 and 480 kg, respectively. The price of kg TDN in roughages costs between L.E. 0.102, L.E. 0.158, L.E. 0.155 and 0.375, with an average of L.E. 0.197 per kg TDN. The cost of pelleting a ton of roughage may be L.E. 35 which adds L.E. 0.035 per kg TDN. Then the kg of TDN in pelletized roughage mixture would cost L.E. 0.232 which is still cheaper than the cost of kg TDN in raw wheat bran.

DEVELOPMENT OF THE LIVESTOCK-GRASS-LEGUME SYSTEMS IN IRRIGATED AGRICULTURE IN EGYPT

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ABSTRACT

Berseem is the main animal feed and is grown in the same winter cropping rotation with wheat. The great area (about 3 million feddans) cultivated with berseem limits the land committed to wheat; thus it competes with food production in Egypt. Research for several years in the Faculty of Agriculture has generated a feasible technology of growing barley + berseem mixture. The technology has improved the nutritive values and the yield of the green fodder; therefore increases the potential area for wheat production without affecting the amounts of forages available for the national herd.

The technology of barley+berseem mixture was promoted through three main channels:- (1) On farm trials with farmers in a number of cooperatives in neighbouring rural areas of Alexandria. The trials showed that the technology was easy to be adopted by farmers. (2) Beheira Rural Development project: The technology was utilized by farmers in 45 villages with the help of a good network of agricultural extension in the project. The research team provides consultancies to the project in the field of animal and animal feeds. The project granted the farmers some incentives in the form of barley seeds. The benefits furnished by the technology encouraged the farmers to participate in the implementation of this agricultural practice. (3) National Agricultural Research Center: The results of the application of the technology of barley+berseem mixture was presented to the board of the National Agricultural Research Center for evaluation. After evaluation, the technology was recommended by the Ministry of Agriculture through the extension service.

The financial and economic analysis indicated that the technology of barely+berseem mixture has generated considerable benefits to the farmers, country and rural society. In addition to the potential increase in the land available for wheat production, the technology secured an additional amount of water for irrigation.

The present case-study provides concrete evidence that the cooperation and coordination between the Faculties of Agriculture with the Ministry of Agriculture is of great value. Links between the University and Ministry should be established through an efficient system of agricultural extension. The benefits generated by this simple technology also suggests that efforts should be made for the utilization of University research through the appropriate channels.

INTRODUCTION

Mixed farms, those that have crop and livestock components, are dominant in Egypt and interactions between these components often have a major impact on the productivity and efficiency of the mixed farming systems. Some interactions are indirect, resulting from competition between crop and livestock enterprises for land, labour and capital. Direct interactions both competitive and complementary also occur; for example when crop residues are fed to animals, animal power is used for cropping activities; animal manure is used as fertilizer and forage crops are combined with food or cash crops. Relatively little research has been done on the interactions among soil, crop and livestock in the mixed farming systems in Egypt. Farming systems research can be oriented towards improving crop production, animal production, or crop-livestock production systems (soil is a vital component in each system). Research stratewes in Egypt should not ignore the fact that the farmer will reject any research recommendation that entails low financial returns or a financial loss. Research must also provide answers that offer explicit gain for the country. The present research was therefore conducted in an attempt to improve efficiency of the crop-livestock system in mixed farms in Egypt.

IDENTIFICATION OF THE PROBLEM:

Forage legumes such as Berseem (Trifolilum alexandrinum) are very often planted to restore soil fertility before a crop is planted. Berseem is also the most widely used legume forage for feeding in Egypt. It is estimated that the area cultivated with Berseem is in the order of three million feddans. Berseem and crops such as cereals are parts of the same cropping system. Berseem therefore, limits the proportion of land committed to the production of cereals, mainly wheat. In Egypt, the majority of the country's needs for wheat is imported and thus the improvement of wheat production should be given priority.

Previous research had indicated that Berseem is low in dry matter contents and is high in the protein contents. Animals fed on Berseem (1st cut) could therefore suffer from bloat. It was also indicated that the nutritive value of Berseem could be greatly improved when it is grown in a mixture with grasses or cereals. Under these circumstances, research should be oriented towards the improvement of the production of Berseem dry matter. This trend will generate two benefits:

1. The improvement of livestock productivity as a result of the improvement in the nutritive value of Berseem in terms of total digestible nutrients (TDN). The improvement of Berseem dry matter will also reduce the hazards of bloat.

2. The improvement of Berseem production will help in increasing the proportion of land committed to cereals planted in the same cropping system such as wheat. This situation will lead to the increase of wheat production with no adverse effects on the amounts of Berseem now available for livestock production.

PRODUCT/SERVICE

A series of experiments was carried out during the period 1972-1984 in an attempt to introduce a simple and effective technology to improve the yield and the nutritive value of Berseem. The technology should be acceptable at the village level as long as the main user of the technology will be the small farmer.

Research conducted in the experimental station of Alexandria University together with on farm studies indicated that the yield of Berseem + Rygrass; Berseem+Sudan grass or Berseem + barley mixtures were greater than that of Berseem alone. This trend was observed in the fresh yield, dry matter and the total digestible nutrients (TDN). The percentage of improvement was in the order of 29-30%. The technology of growing a barley + Berseem mixture was simple and within the ability of small farmers. The technology included sowing berseem followed by barley. Effective nodulation with rhizobium strain was made. A bonus of nitrogen was provided by adding urea fertilizer.

PROMOTION:

The technology of barley+Berseem was transferred to the end-user (small farmer) through the following channels:-

A. On-Farm Trials:

When the station-level work was complete, the implementation began. The researchers carried out the work on a number of farms with the farmer's consent in newly reclaimed areas in the neighbourhood of Alexandria and Beheira Governorates. The farmers were members of agricultural cooperatives; therefore they had potential for success of the implementation of the technology of growing a barley-berseem mixture. Evening meetings with the selected farmers were made in order to explain the implementation and benefits of the proposed technology. The results of the impact of the technology, as obtained by a number of selected farmers, are included in Table 1.

Table 1: The Yield of berseem and Barley+Berseem mixture in on-farm trials.

Cuts	Yield (tons)*	
	Berseem	Berseem+Barley mixture
1st cut	11.6	14.9
2nd cut	10.9	14.5
3rd cut	10.8	14.0
Total	33.3	43.4

*. The number of farmers participating in the on-farm trials was 469 (1985)

The improvements in the yield and nutritive value of berseem obtained in the on-farm trials allowed for the direct evaluation, in actual farms, of the new technology of the barley+legume mixture and thus helped in the large-scale adoption by farmers. These trials had also indicated that the practice of barley + legume mixture was easy for farmers to adopt.

B. Beheira Rural Development Project

The project belongs to the Ministry of Agriculture and is funded by the amount of $22 million from the African Development Bank. The project is oriented towards transferring simple agricultural technologies to small holders in 45 villages in three locations namely Kafr El-Dawar, Abou Hommous and Mahmoudia. The project also aims at encouraging farmers to participate in income generating (self-reliance) projects through utilizing agricultural technologies. The researchers provide consultancies in various aspects of agricultural development including improving animal feed resources. The researchers made use of the services of a good network of agricultural extension provided by the project.

The implementation of the technology of barley+berseem mixtures in the Beheira project proceeded as follows. A farmer was identified who was willing to participate, had resources (land, animal, family labour and some capital) and had potential for success. Only part of the farmer's land was used in the research and he was provided by the project with barley seeds as an incentive. The research team used to monitor the implementation progress. The advantages in this approach were:

(i) The farmer learns first-hand.
(ii) The farmer is encouraged to consider expanding the implementation of the proposed technology.
(iii) The farmer is motivated to consider committing additional land to growing wheat as a result of the improvement in the yield of green forage.
(iv) The farmer is encouraged to conserve the green forage for use during periods of scarcity.
(v) The farmer experiences the pride of participating in the work of the government and university.

(vi) Neighbouring farmers become aware to the progress and become eager to participate and improve the yield of the green fodder.

(vii) Problems at the farm level were fed back for further investigation by the research team.

This approach has been successfully executed in the 45 villages of the Beheira project during the period 1985-1988. Frequent meetings with the extension officers and the researchers and Video films processed by Beheira project helped the farmers greatly to disseminate the results of the implementation of the Barley + Berseem technology.

The results of implementing the technology of barley+Berseem mixture are included in Table 2. The data that were collected were analyzed by the research team to evaluate the response of the farmers and determine the possible economic benefits of the technology.

Table 2: The effect of barley+berseem mixtures on the yield of green forage in three counties of Beheira Governorate (averages of 4 cuts)*

Counties	Yield (tons)	
	Berseem	Berseem+Barley mixture
Kafr El-Dawar	47.2	55.5
Abou Hommous	44.0	50.1
Mahmoudia	46.2	52.9

* The technology was implemented in 4135 feddans by 2532 farmers in 1987-1988.

C. National Agricultural Research Center, Ministry of Agriculture

After three years of the implementation of the barley+berseem mixture in the Beheira project, the results were presented to the board of the National Agricultural Centre, Ministry of Agriculture. This board is headed by the Minister of Agriculture and consists of the highest ranks of researchers and executives in the Ministry of Agriculture. The board evaluated the technology through the following parameters:

i) The technology is technically feasible. This means that the barley+berseem mixture can be easily utilized by masses of small holders at the village level. The technology should be used and applied in several ways.

ii) Financial and economic profitability: Profitability refers to the comparison of costs with benefits. A technology is profitable if the benefits are higher than the costs.

The board of the National Agricultural center examined the financial profitability of the barley + berseem mixture by determining the net returns generated for the farmers when the technology is used as compared with conventional practices.

The economic profitability was determined by evaluating the added productivity that is generated by the technology for the country and the rural community. The economic value of the technology is also considered in the light of the increase in the potential land committed to wheat if the barley+berseem mixtures is applied at a national scale.

After the evaluation of the barley+berseem technology by the board of the National Agricultural Center, it was decided that the technology should be applied in the Beheira and Menia Governorates of Egypt. The application of the technology was undertaken in perfect cooperation between the research team and the extension service of the Ministry of Agriculture. The cooperation and coordination between the University research team and Ministry of Agriculture has helped greatly in the promotion of the barley+berseem mixture in 20,000 feddans cultivated by farmers in Beheira Governorate during the winter season of 1988/1989. It is planned that the technology will be a common practice that will be recommended by the Ministry of Agriculture in Beheira Governorate through a good network of agricultural extension.

FINANCIAL AND ECONOMIC EVALUATION:

The financial analysis has indicated that the financial net returns of barley-berseem mixture was higher than that of berseem (Table 3).

Table 3: Financial and Economic Evaluation of Berseem + Barley mixture.

	Cost of Production		Income Pounds/fed.		Net Return Pounds/fed.	
	Berseem	Berseem +Barley	Berseem	Berseem +Barley	Berseem	Berseem +Barley
Kafr El-Dawar	250.0	260.8	1134.2	1553.0	884.2	1292.2
Abou Hommous	250.0	260.8	0970.4	1302.7	720.4	1041.9
Mahmoudia	250.0	260.8	1031.9	1482.3	781.9	1221.5
Av.	250.0	260.0	1066.5	1440.3	816.5	1179.5

The economic analysis indicated that the technology of barley+berseem mixture has improved significantly the nutritive value and the yield of the green fodder available for the national herd in Egypt. As berseem is grown in the same cropping rotation as wheat, the technology has increased the area committed to wheat. Because of the lower water requirements of wheat, the technology of barley+berseem mixture has resulted in the reduction of irrigation water consumed by crops of the winter rotation in Beheira Governorate. Similar economic benefits are expected if the technology is implemented at the national level as indicated in tables 4 & 5.

able 4: The economic benefits of the barley+berseem mixture in Beheira Governorate (1988/1989)

1	Expected Increase of Green Fodder (Tons)	2,461,037
2	Expected Increase in Area Available for Wheat Production (Feddan)	46,140
3	Expected Additional Wheat Production (Ton)	93,041
4	Values of Wheat Production ($ million)	18.61
5	Surplus of irrigated Water (million M^3)	113.51

Table 5: The National Economic Benefits of Barley + Berseem Mixture

1	Expected Increase of Green Fodder (Million tons)	16.74
2	Expected Increase in Area Available For Wheat Production (Feddan)	313,853
3	Additional Wheat Production (Ton)	615,704
4	Value of Wheat Production ($ million)	130,340
5	Surplus of Irrigated water (M^3 million)	382,900

The economic benefits of the technology of barley+berseem mixture supports the strategy of the Ministry of Agriculture which involves greater land for cereal production at the expense of the area committed for berseem production. It is noteworthy that the application of the technology of barley+berseem mixture will increase the land for wheat without affecting the amount of green fodder available for livestock production.

CONCLUSIONS

In spite of the simplicity of the present case study, it reveals some important guide-lines pertaining to the transfer of the university technologies to agriculture:

1. The university colleges should provide an integrated extension and technology transfer service to agriculture. The combination of teaching, extension and research services within one institution is of great value. It provides the vital link between "the university laboratory bench" and users of practical developments by operating teaching, research and technology transfer services together. For instance, in new agricultural projects, researchers are guided in the needs of agriculture by their technology transfer colleagues. In turn, new technologies are rapidly available to teachers and to growers/ farmers via technology transfer. The proposed system is now a common practice in colleges of agriculture in univesities of the U.S.A. and Scotland. The subject matter specialist stimulates better links between the University researchers and the field extensionists in

the Ministry of Agriculture. Modification in the scientific programmes of colleges of agriculture in Universities of Egypt should be made in order to accommodate "the subject matter specialist" systems in order to develop the links between the researchers and the farmers.

2. The role played by person-to-person contact, group meetings and short training programmes in the technology transfer, cannot be ignored. Invariably, the transfer of technology depends greatly upon the personal efforts of the researchers. Unfortunately, it is assumed that good researchers are bad communicators! Efforts should therefore be made to encourage the personal interest of some researchers to link with the agriculturists.

3. The successful creation of technology transfer highways is within the reach of most of the universities of Egypt. They form a natural and rewarding connection between these universities and agriculture. They induce a new culture into academic life. They can greatly increase the volume and quality of research and improve the teaching at the post-graduate level.

4. All universities seeking to develop their links with agriculture should maximise their capacity to deliver long or short course programmes, in the university, in the field or by mixtures of both.

SESSION FOUR

INDUSTRY

1. DEVELOPMENT OF A NEW DOBBY MECHANISM AS A P CSIR-IDRC JOINT PROJECT.

2. DEVELOPMENT OF SIZE BASE MATERIALS FOR TEXTILE WARP SIZING

3. LOCALLY MANUFACTURED FILTER BAGS USED IN THE STEEL INDUSTRY FOR ENVIRONMENTAL POLLUTION CONTROL: A CASE STUDY.

4. A CASE STUDY FOR THE APPLICATION OF AN INHIBITOR FOR THE POLYMERISATION OF ACRYLIC ACID.

DEVELOPMENT OF A NEW DOBBY MECHANISM AS A P CSIR-IDRC JOINT PROJECT

MUMTAZ HASAN MALIK

PAKISTAN COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH, PAKISTAN.

The Pakistan Council of Scientific and Industrial Research, shortly known as P CSIR, was established in the year 1953 as an autonomous body by the Government of Pakistan. Its main objective was to undertake scientific research for the utilization of the country's indigenous resources and raw materials, and for solving the problems of industries. Soon after its establishment, the Council embarked upon plans for setting up multifunctional laboratories in various parts of the country which comprised a number of research divisions in the fields of national importance. P CSIR has now a network of laboratories spread in four provinces of the country. Three multipurpose laboratories are situated at Karachi, Lahore and Peshawar, while special purpose units comprise a

National Physical and Standards Laboratory at Islamabad, a Fuel Research Centre and a Leather Research Centre at Karachi, a Solar Energy Research Centre at Hyderabad and a Camp Office at Quetta. The total manpower is over 2500, of which there are 766 scientists, engineers and technologists, including 140 Ph.Ds. The organizational set-up of P CSIR is as follows:

Chairman

Council of P CSIR — Governing Body

Science Wing	Technology Wing	Establishment & Administration Wing	Finance Wing
Member Science	Member Technology	Secretary	Member Finance
T&DDirectorate	Technology Directorate	Establishment Directorate	Auditand Accounts.
Trainingand International Liaison Directorate.	Industrial liaison Directorate.	Administration Directorate	Finance and Budget Directorate
Scientific Information Directorate.	CivilWorks Directorate. Pilot Plant Directorate. Extension Services Directorate.	Legal Affairs Directorate. Supply and Procurement Directorate.	Laboratories Accounts Officers.

P CSIR	FRC	LRC	SRC	P CSIR	NPSL	PSTC	P CSIR	P CS
Karachi	Karachi	Karachi	Hydra-	Lahore	I lamabad	Karachi	Peshawar	Quet

Since 1969, the reorganization of Research and Development activity in Pakistan has come repeatedly under review, the objective being to raise the level of Research and Development to ensure expansion of scientific activity in the country. P CSIR programmes have also been under critical review. After its re-constitution in 1973 under an act of the National Assembly, the present scope of activities may broadly be classified as follows:

i. Systematic evaluation, development and utilization of indigenous materials leading to the development of new processes/products or adaptation of known processes to local raw materials and conditions.

ii. To conduct Research and Development work on problems that are being faced by the industrial sector, to associate the industries concerned in the working of the laboratories/institutes of the P CSIR.

iii. To plan the establishment of new science-based and oriented industry which would help in improving the export performance of the country and in creating a self-reliant and self-sustaining industrial infrastructure.

iv. To adopt measures for the application and utilization of research results.

v. To develop indigenous technology through adaptation, modification and to improve the existing technologies to the local conditions.

vi. To test bench scale findings on a pilot plant and collect data for commercial plant design.

The present complexion of the P CSIR is that under the P CSIR Act of 1973 it has been reorganized mostly into disciplines such as Applied Chemistry, Polymer Science, Pharmaceutical and Fine Chemicals, Food Science, Mineral and Metallurgy, Glass and Ceramics, Instrumentation and Standards, Solar Energy, Leather Technology, Precision Engineering, Rural Technology, Marine Food, Applied Biology and Design Engineering. The research programmes of P CSIR are divided into the following categories:

1. In-house Projects:

Research divisions of various laboratories/institutes submit research proposals which are aimed at creating new products/processes and the Management Committee of the concerned laboratory, after evaluating the submitted proposals, provides funds for carrying out work on the projects.

2. ADP Projects:

Under this category, Government of Pakistan provides funds to P CSIR for pilot plant studies or prototypes of industrial processes/products which are of national importance.

3. Sponsored Projects:

P CSIR prepares a preliminary report upon completion of the laboratory work and circulates it widely in the local industry through Chambers of Commerce and Industry, the State and Foreign Agencies etc. in order to find willing parties to finance pilot plant/prototype development or take the development direct to the utilization stage.

Efforts Towards Utilization of Research Results

In order to ensure utilization of research results two points are of utmost importance:

i. That dissemination of research is a full time and continuing activity.

ii. Identification and establishment of links with the industry and end-users is necessary.

Keeping in view these important points P CSIR established a Scientific and Technological Development Corporation (STEDEC). The main objective of STEDEC is to promote the products, processes and technologies of P CSIR and market them directly in the early stages if necessary. Industrial processes/products developed by P CSIR are leased-out on the bases of input of capital/efforts in the development of these processes/products. The publicity of the P CSIR's developments is made through newspapers, monthly news letter of the P CSIR, liaison with various Chambers of Commerce and Industry and is projected sometimes through electronic media. After leasing-out of P CSIR technology, quality is controlled by P CSIR for at least two years on payment.

Pakistan is one of the largest producers of cotton fibers in the world. It produces annually more than 8.0 million bales of cotton fibers, out of which about 50% is exported and the rest is processed into yarn within the country. Out of this yarn more than 50% is exported as a semi raw material and the rest is processed into cloth in Pakistan. The country's annual production of cloth is more than 2.5 billion square meters, which produced both in mill and non mill sector. A large quantity of this cloth is exported.

Due to the sophistication of export market demands and the high production of cotton fibers in the country during the last few years, it has become imperative to improve the quality of cloth and increase its production. Keeping in view these points, Government of Pakistan has liberalized the policy of the import of textile machinery and has given many incentives to mill and non mill sectors including a credit facility. Due to these facilities, the import of textile machinery has increased considerably.

Since the designed woven cloth is produced by means of mechanical device called a "Dobby" which is used with the weaving loom and since the existing local manufactured dobbins are not able to produce cloth upto the international standards, this machine is being imported by the mill sector in large quantities and at high cost. Even the non mill sector has to replace the present installed dobbins either by imported ones or by a new locally made dobby which can produce good quality cloth to survive.

The imported modern dobby mechanism is presently sold in Pakistan for about Rs. 125,000/-per unit. The high price of the imported dobby mechanisms puts them out of the reach of the non mill sector which normally use locally manufactured power looms at an average price of about Rs. 70,000/-. In order to lower the cost of dobby mechanisms and increase their accessibility to the textile industry, scientists at the Pakistan Council of Scientific and Industrial Research have been working for a number of years toward the development of a new dobby.

The said project was one of the in-house projects of P CSIR- Lahore. In 1987 Government of Pakistan released funds for its development under the ADP Scheme. Two types of dobbins i.e. 1) Linear Dobby and 2) Swing-Lever Dobby were invented by Mr. Wasey Omar upto 1983. IDRC became interested in the Swing-Lever type, and P CSIR and IRDC signed an agreement for the collaborative development of the project in September 1986. The main objectives of this project are:

i. To design and manufacture two new refined prototype dobbins based on the dobby developed in P CSIR,

ii. To assess the performance of these dobbins at the laboratory level and select one for manufacturing.

iii. To determine the manufacturing techniques necessary for the preproduction of a dobby mechanism,

iv. To fabricate 35 dobby units in the local engineering industry of Pakistan,

v. To market and field test the units in the local textile industry,

vi. To prepare a promotion and marketing plan for the new dobby,

vii. To prepare operation and installation manuals for the new dobby, and

viii. To prepare a production plan and manufacturing procedures for potential local dobby manufactures.

In cooperation with the Manitoba Research Council, Canada, the first prototype dobby was manufactured in December 1987 with the help of CAD/CAM Technology. This prototype was tested in P CSIR-Lahore and, on the basis of its merits and demerits, a second prototype was developed by the Manitoba Research Council.

Thirty-five dobby units are being manufactured under contract by local engineering concerns. To prepare a production plan, manufacturing problems at this stage are strictly monitored. Manufacturing costs will also be carefully monitored to permit the analysis of bulk production costs and unit cost. When these units are ready, the dobbins will be distributed in the industry especially in the non-mill sector for field trials. The field test will last six months and the data collected during the testing will be used to exploit the dobby mechanism at the national and international level.

DEVELOPMENT OF SIZE BASE MATERIALS FOR TEXTILE WARP SIZING

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ABSTRACT

Within a framework of a project aiming at development of sizing agents and sizing operations, research and development (R&D) work was designed to establish appropriate conditions for synthesis of polysacharide based sizes and synthetic vinyls. For example, carboxymethyl starch, syanoethyl starch, poly (methacrylic acid) - starch graft copolymers, vinyl polymer-starch composites, carboxymethyl cellulose and polyacrylic acid have been synthesized. Parallel to this, trials have been made to transfer some of the R&D results to the production units. The recovery of water soluble sizes and their re-use in a textile mill was also studied.

INTRODUCTION

Processing of modern fabric is intricate and complex. It requires much thought and much planning. It is the end-product of an ability to bring into focus a body of knowledge which involves the proper use of men, materials and machinery. Of all of the decisions made in a textile operation nothing is more important than the decision of how, the warp of textile yarns are to be sized.

The principal aim of sizing is to improve the weaveability of the warps by providing the individual yarn with some form of protection in order to enable it to withstand the action of heads and reeds and the rubbing of chafing caused by adjacent yarns. This is accomplished by selecting sizing materials which are the most suitable for the yarn being slashed (sized) and applying the size properly to the warp.

A satisfactory size should possess good film forming properties, good adhesive properties, and impart strength, elasticity, resilience, flexing resistance and lubrication to the yarn. Commercial sizes usually contain, therefore, a film forming material (size base material) and a lubricant. The main criteria for lubricants used in conjunction with the size base materials are satisfactory lubricating properties, easy emulsifiability, good compatibility and ready removability from woven fabrics along with the size base material by normal desizing and scouring processes.

It is convenient to classify size base materials into three main chemical groups:

1. Polysaccharides such as starch, modified starches and water soluble cellulose derivatives.
2. Proteins such as those derived from gelatin and casein.
3. Synthetic vinyls such as polyvinyl alcohol, poly-acrylic acid.

Starch requires fairly prolonged desizing and scouring treatment for its removal from yarns. It can be used successfully as a size for cotton warps since vigorous methods are employed to remove the natural impurities from cotton and hence of starch based sizes from cotton wraps offers no major difficulties. Yarns spun from man-fibres are of high purity compared with yarns from the natural fibres like cotton. For this reason, it will be highly desirable to use readily removable water soluble sizes such as water soluble modified starches and synthetic vinyls.

Current Status of Sizing Agents in Egypt

Textile manufacture in Egypt is one of the oldest and biggest industries including both public and private plants. The total amount of fibre utilized by these plants in 1983 was 311,600 tons of which 262,000 tons of cotton were used.

Total textiles production (80% of which is produced by the public sector and 20% by the private sector) represents 30%wf the production of the whole industry in Egypt. The Textile industry is responsible for more than 50% of industrial exports. The textile sector exports 13% of its production. Half the total manpower working in Egyptian industry are in the textile industry.

Starch is the main sizing agent used in Egyptian textile plants. Different kinds of starch are used, namely, rice starch and maize starch. Nevertheless, rich starch is by far the most commonly used as starch size. In 1985, the public sector consumed 5,690 tons of starch. This is against 470 tons of modified starches and synthetic sizes.

Experience has shown that the native Egyptian starches, particularly rice and maize starches, have good adhesive and film forming properties. However, their very high molecular size, retrograde by fluctuation of temperature and the susceptibility of these starches to microorganisms are considered as drawbacks. The first two drawbacks have been reduced by the oxidation of starch either in the starch producing companies (Starch and Yeast Co., Alexandria and Starch and Glucose Co., Cairo) or during the sizing operation in the textile mills by using oxidizing degrading agents; while antiseptic additives have been used to overcome susceptibility toward microorganisms. The starch and Yeast Co., Alexandria has produced etherified starches, particularly, carboxymethyl starch (CMS) with improved properties for sizing of high quality cotton yarns or polyester/cotton blend yarns. The CMS was used in combination with native starch. The need for CMS production depends upon the availability of imported sizing agents, such as PVA, acrylate, CMC, and CMS.

Egyptian R and D Activities in the Field of Sizing Agents:

During the years 1969-1972, the Textiles Research Division at the National Research Centre, Cairo, has given much attention to implement research results concerning the oxidation of starch with sodium hybocholorite or potasium persulphate to textile mills. Despite the promise of the established conditions, they are only used whenever there is a shortage of imported sizing agents.

In 1984, the Academy of Scientific Research and Technology agreed upon financing a national project dealing with "development of sizes and sizing operations". National Research Centre, Misr Company for Spinning and Weaving, Mehalla El-Kobra and Starch and Glucose Company, Cairo, are the main agencies responsible for the implementation of this project which has four objectives:

1. Improving the properties of starch via chemical modification such as oxidation, partial carboxymethylation, carbamaylethylation, cyanoethylation and grafting with carboxyl - containing polymers.
2. Preparation of CMC from agricultural wastes: cotton stalks, rice straw, sugar-cane bagasse, etc.
3. Preparation of synthetic sizes based on poly(acrylic acid)
4. Recovery of water soluble sizes with a view of improving the quality of the environment.

Experiments were designed to discover optimal conditions for each objective. Furthermore, conditions were established to suit the chemical modification of starch in the textile mill as well as in a Chemical Factory such as Starch and Yeast Co., Alexandria, and Starch and Glucose Co., Cairo.

Detailed analysis of the results obtained from these studies were compiled in 1987 in the form of final report for the first phase of the project. This report was submitted to the Academy of Scientific Research and Technology. In addition, three semiannual technical reports for the period March 1988 - September 1989 covering, in part, the second phase of the project were also submitted to the Academy. Major finding obtained from the studies are summarized below.

1. STARCH SIZES:

1.1. Hypochlorite Oxidation Starch

Sodium hypochlorite was used along with starch sizing formulation in a textile mill. Cotton warps were sized with this size and compared with those sized with a similar sizing formulation but in the absence of the hypochlorite. Warp performance on the loom showed an average breakage/hour of 2.44 and 2.89 for warp yarns sized in presence and absence of sodium hypochlorite, respectively.

1.2. Persulphate Oxidized Starch

The use of potassium persulphate instead of the hypochlorite in the oxidation of starch during the sizing operation in a textile mill was found more apporpriate from both the technical as well as the economic point of view. Wrap yarns sized in the presence of persulphate exhibited greater abrasion resistance and tensile strength.

1.3. Carboxymethyl Starch

Maize starch was reacted with monochloroacetic acid in the presence of sodium hydroxide. The reaction involved is known as carboxymethylation. The latter was carried out

under a variety of conditions. For every set of conditions, carboxymethylation was studied with respect to the extent of reaction expressed as degree of substitution (D.S.) and reaction efficiency (R.E.). Results obtained indicated that starch: water ratio of 1:2.5 constitutes the optimal material to liquor ratio; below or above a liquor ration of 2.5, the D.S. and R.E. decrease. (Figure 1). Increasing sodium hydroxide concentration up to 8 N causes significant enhancement in D.S. and R.E. while higher concentrations bring about sharp decrement (Figure 2). The D.S. increases as the monochloroacetic acid concentration increases; opposite trend was observed with respect to R.E. (Figure 3). Increasing duration (0.5-3 hours) and temperature (60-70°C) acts in favour of both D.S. and R.E. (Figure 4). The D.S. is also governed by the reaction medium. Water and organic solvents were used independently as well as in admixture of solvent/water. It was found that the highest D.S. is achieved with isopropyl alcohol and the least with water, the D.S. follows the order:
isopropyl alcohol > cyclohexane > dimethyl formamide > methyl alcohol > acetone > water.
Isoptopyl alcohol: water mixture (80:20) constitutes the most favourable medium for the carboxymethylation reaction under the conditions used (Table 1).

Table 1. Variation of the extent of carboxymethylation expressed as D.S. with the reaction medium.

Water ml	Solvent ml	D. S.				
		Isopropyl alcohol	Dimethyl formamide	Cyclo-hexane	Acetone	Methyl alcohol
0	100	0.41	0.17	0.20	0.15	0.16
20	80	0.53	0.27	0.29	0.19	0.17
40	60	0.32	0.23	0.22	0.19	0.15
60	40	0.22	0.21	0.20	0.15	0.11
80	20	0.13	0.13	0.11	0.10	0.09
100	00	0.08	0.08	0.08	0.08	0.08

Starch, 4g; monochloroacetic acid, 4g; sodium hydroxide, 3.2g; reaction temperature, 60°C; reaction time 2, hours; total volume, 100 ml.

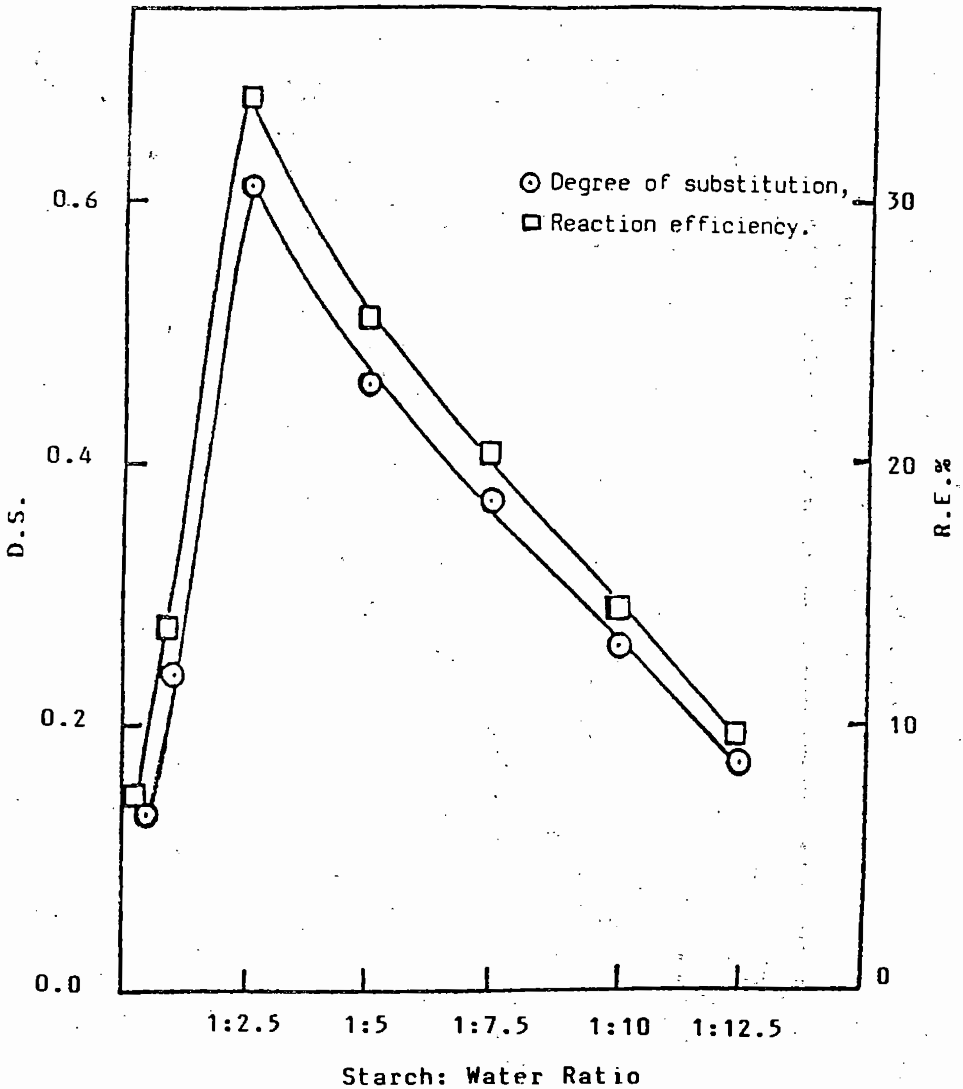

Figure 1. Effect of liquor ratio on the degree of substitution (D.S.) and the reaction efficiency (R.E.); Starch, 4g.; monochloroacetic acid, 4 g; sodium hydroxide, 3.5 g; reaction temperature, 60°C; reaction time, 2 hours.

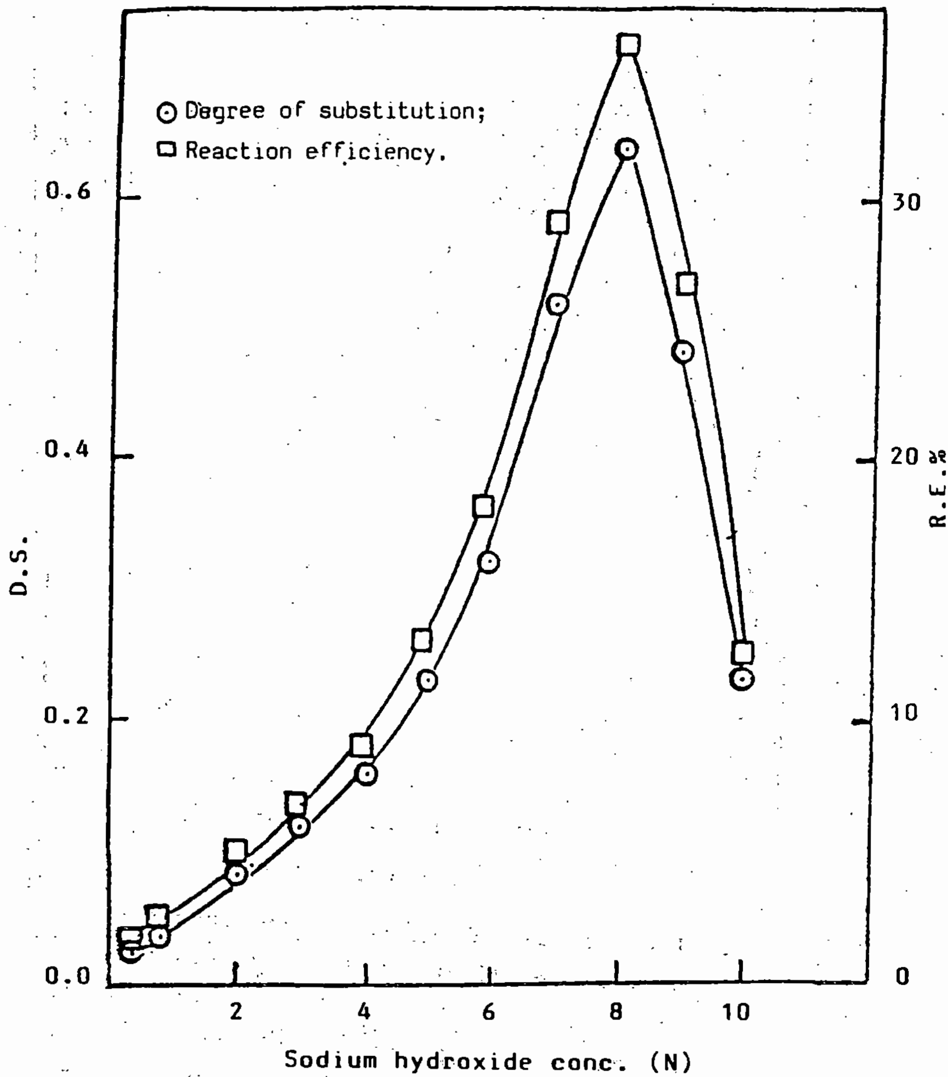

Figure 2. Effect of sodium hydroxide concentration on the degree of substitution (D.S.) and reaction efficiency (R.E.).; Starch, 4 g; reaction temperature, 60°C; reaction time 2 hours; starch: liquor ratio 1:2.5.

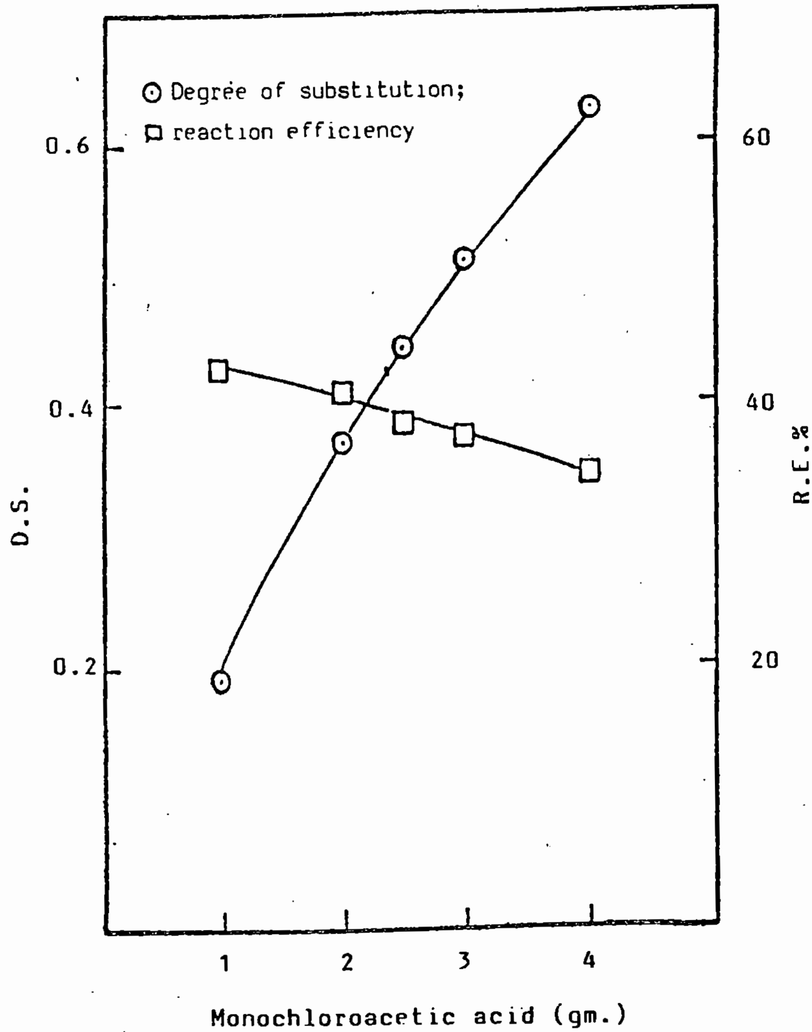

Figure 3. Effect of monochloroacetic acid conc. on degree of substitution (D.S.) and reaction efficiency (R.E.); Starch, 4g; sodium hydroxide, 3.2 g; reaction temperature, 60°C; reaction time, 2 hours, starch: liquor ration 1:2.5.

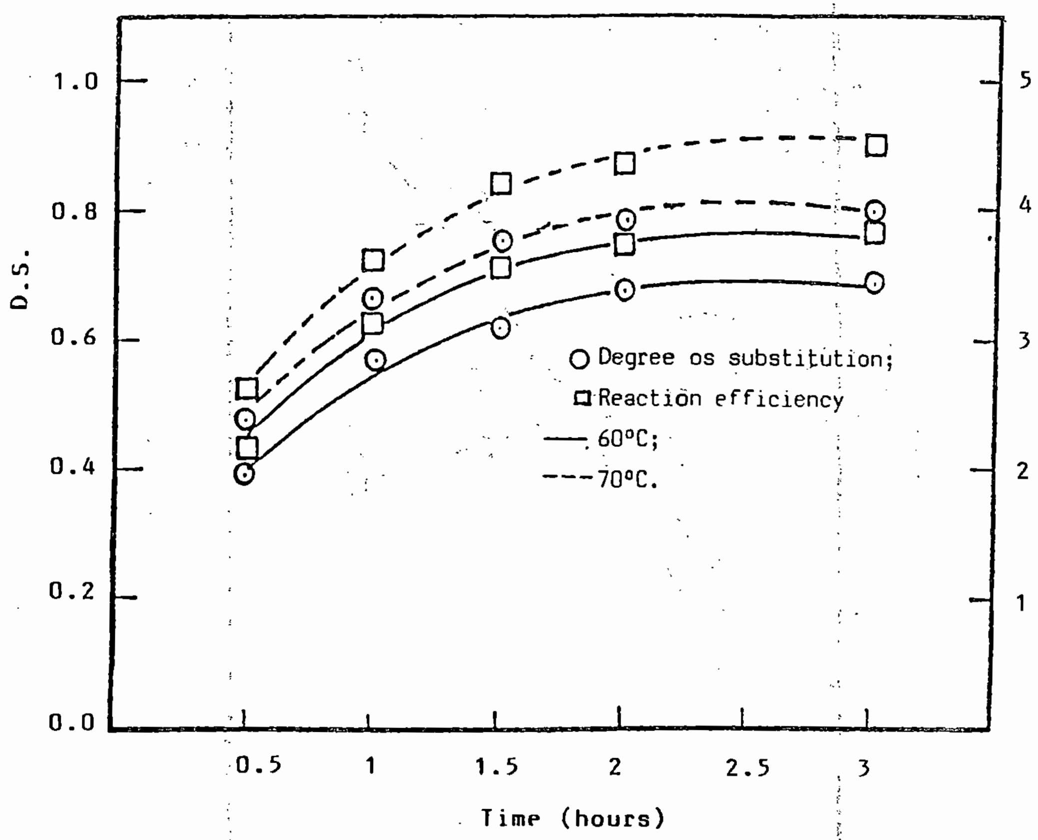

Figure 4. Dependence of the extent and efficiency of carboxymethylation on time and temperature of the reaction.
Starch, 4g; monochloroacetic acid 4g; sodium hydroxide, 3.2 g.; starch: liquor ratio 1:2.5

Further efforts have been made to optimize the reaction conditions of the carboxymethylation of starch. Table 2. shows the combined effect of increasing the monochloroacetic acid and sodium hydroxide concentration at 50 and 60°C on the D.S. and R.E. when the reaction was carried out for 3h using 6g starch and 15 ml water. The results indicate that the D.S. of carboxymethyl starch increases while R.E. of the carboxymethylation reaction decreases by the concurrent increase in monochloroacetic acid and sodium hydroxide concentrations. They also indicate that raising the reaction temperature from 50 to 60°C enhances both the D.S. and R.E.

Table 2. Combined Effect of Increasing Concentration of Monochloroacetic Acid and Sodium Hydroxide on D.S. and R.E. when Carboxymethylation Reaction was carried out at 50°C and 60°C.

Monochloroacetic acid (g)	Sodium hydroxide (g)	50°C		60°C	
		R.E.	D.S.	R.E.	D.S.
1	1	67.5	0.192	68.2	0.194
2	2	45.7	0.260	54.6	0.310
3	3	31.93	0.272	41.8	0.356
4	4	29.8	0.338	39.2	0.445
6	6	25.6	0.434	29.3	0.498

Reaction conditions: Starch 6g; water 15 ml; reaction time 3h.

Table 3 shows the same effect when the carboxymethylation reaction was carried out at 80°C for 2hr. and at room temperature (ca. 25°C) for 16hr. Here too, the combined effect of increasing the concentrations of both monochloroacetic acid and sodium hydroxide is to bring about enhancement in the D.S. and decrement in the R.E. Nevertheless, carboxymethylation at room temperature for a longer time appears advantageous in terms of higher values of both D.S. and R.E.

Table 3. Combined Effect of Increasing Monochloroacetic Acid and Sodium Hydroxide Concentrations on D.S. and R.E. when Carboxymethylation Reaction was Carried out at 80°C for 2h and Room Temperature for 16h.

Monochloroacetic acid (g)	Sodium hydroxide (g)	Room temperature (25°) for 16h		80°C for 2h	
		R.E. (%)	D.S.	R.E. (%)	D.S.
10	10	52.6	0.224	46.6	0.198
20	20	46.6	0.398	42.6	0.362
30	30	38.0	0.486	34.0	0.436
40	40	33.4	0.569	27.0	0.458

Reaction conditions: Starch 40g; water 200 ml.

Table 4. shows variation of the D.S. of carboxymethyl starch and the R.E. of the carboxymethylation reaction when the latter was conducted at 100°C for 1hr. using 6g starch along with different amounts of monochloroacetic acid and sodium hydroxide in 10ml water. Obviously, carboxymethyl starch of 0.436 D.S. could be achieved with R.E. of ca. 79% if the carboxymethylation is performed under these conditions.

Table 4. Variation of D.S. and R.E. with Monochloroacetic Acid and Sodium Hydroxide Concentration when Carboxymethylation Reaction was carried out at 100°C for 1h.

Monochloroacetic (g)	Sodium hydroxide (g)	R.E. (%)	D.S.
2	2	78.9	0.436
4	4	43.0	0.488
6	6	31.3	0.532

Reaction conditions: Starch 6g; water 10ml; reaction temperature 100°C; reaction time 1h.

1.3.1. Pilot Scale Production of Carboxymethyl Starch (CMS)

The major difficulty in preparation of CMS is the drying operation. For this reason experiments were designed to carry out the carboxymethylation reaction of starch and monochloroacetic acid in the presence of sodium hydroxide using the least amount of water. The amount of water used ranged from 30 to 50% based on weight of the starch.

Although the amount of water appears to be very little, yet it was found that it is enough for dissolution of monochloroacetic acid and sodium hydroxide without gel formation in the reaction medium provided that the carboxymethylation conditions and the sequence of its ingredients are controlled.

It has been possible to establish conditions under which a batchwise method could be employed to prepare 2Kg of CMS at a time. The method is reproducible and CMS sample of 2Kg has been produced at a time.

1.4. Cyanoethyl Starch (CES)

Reaction of starch with acrylonitrile in the presence of sodium hydroxide as a catalyst results in CES. Experiments were designed to study factors affecting this reaction. The extent of the latter, expressed as nitrogen content, was found to increase by increasing the material to liquor ratio, as well as acrylonirile concentration. On the other hand, the extent of the cyanoethylation reaction decreases by increasing the sodium hydroxide concentration; 0.5 N NaOH proved to be the optimal concentration. The extent of the reaction; the highest nitrogen content was obtained at 40°C, after 4 hours cyanoethylation.

In another study, attempts have been made to tailor polymeric materials with certain properties through controlling the molecular structure of starch. This could be achieved by the oxidation of starch to affect variation in molecular size and cyanoethylation to replace some of the starch hydroxyls by cyanoethyl groups as described below.

Egyptian rice and maize starches were treated with sodium hypochlorite at different concentrations. The oxidized starches so obtained were monitored for carboxyl content and rheological properties. In addition, the extent and rate of the oxidation reaction was assessed by investigating the chlorine consumption. Results obtained indicated that the extent and rate of oxidation of rice starch, expressed as chlorine consumption, are much higher than those of maize starch. The opposite holds true for the carboxyl content. Plates of rice and maize starches before and after oxidation exhibit non-Newtonian thixotropic behaviour but their apparent viscosity decreases by increasing the hypochlorite concentration. In any event, the apparent viscosity of rice starch is substantially higher than that of maize starch. Storing the pastes for 24 hr. adversely affect the apparent viscosity, particularly with oxidized starches prepared using higher hypochlorite concentration.

Starch of different molecular sizes brought about by the oxidation of maize and rice starches were cyanoethylated under identical conditions. The degree of cyanoethylation, expressed as %N, was found to depend mainly on the molecular size of starch irrespective of its kind. As the molecular size decreases the degree of cyanoethylation increases (Table 5). Cyanoethyl starches are water soluble and can be precipitated by ethyl alcohol. It was also found that the rheological properties are determined by the nitrogen content of cyanoethyl starch. When the latter acquires low nitrogen content, it exhibits non-Newtonian pseudoplastic behaviour. On the other hand, cyanoethyl starches with higher nitrogen content are characterized by non-Newtonian pseudoplastic behaviour. On the other hand, cyanoethyl starches with higher nitrogen content are characterized by non-Newtonian thixotropic (Figures 5 and 6). At constant rate of shear the apparent viscosity of cyanoethyl starches is directly related to this molecular size. (Table 6 and 7).

Table 5. Dependence of the extent of cyanoethylation on molecular size of starch.

Hypochlorite concentration (g/l)	Carboxyl content*		Apparent viscosity at a rate of shear of 11.160 sec^{-1}		Extent of cyano-ethylation (% N)	
	Maize starch	Rice starch	Maize starch	Rice starch	Maize starch	Rice starch
Original starch	9.36	3.64	264.0	626.9	1.88	1.63
0.5	15.01	4.50	202.4	451.9	1.91	1.70
1	21.05	6.50	176.9	310.3	2.12	2.42
2	29.00	10.00	098.6	120.5	2.71	2.58
3	34.58	18.90	033.3	102.5	4.56	4.69
4	41.50	20.50	-----	055.0	---	4.97

* ml equivalent/100 g starch.

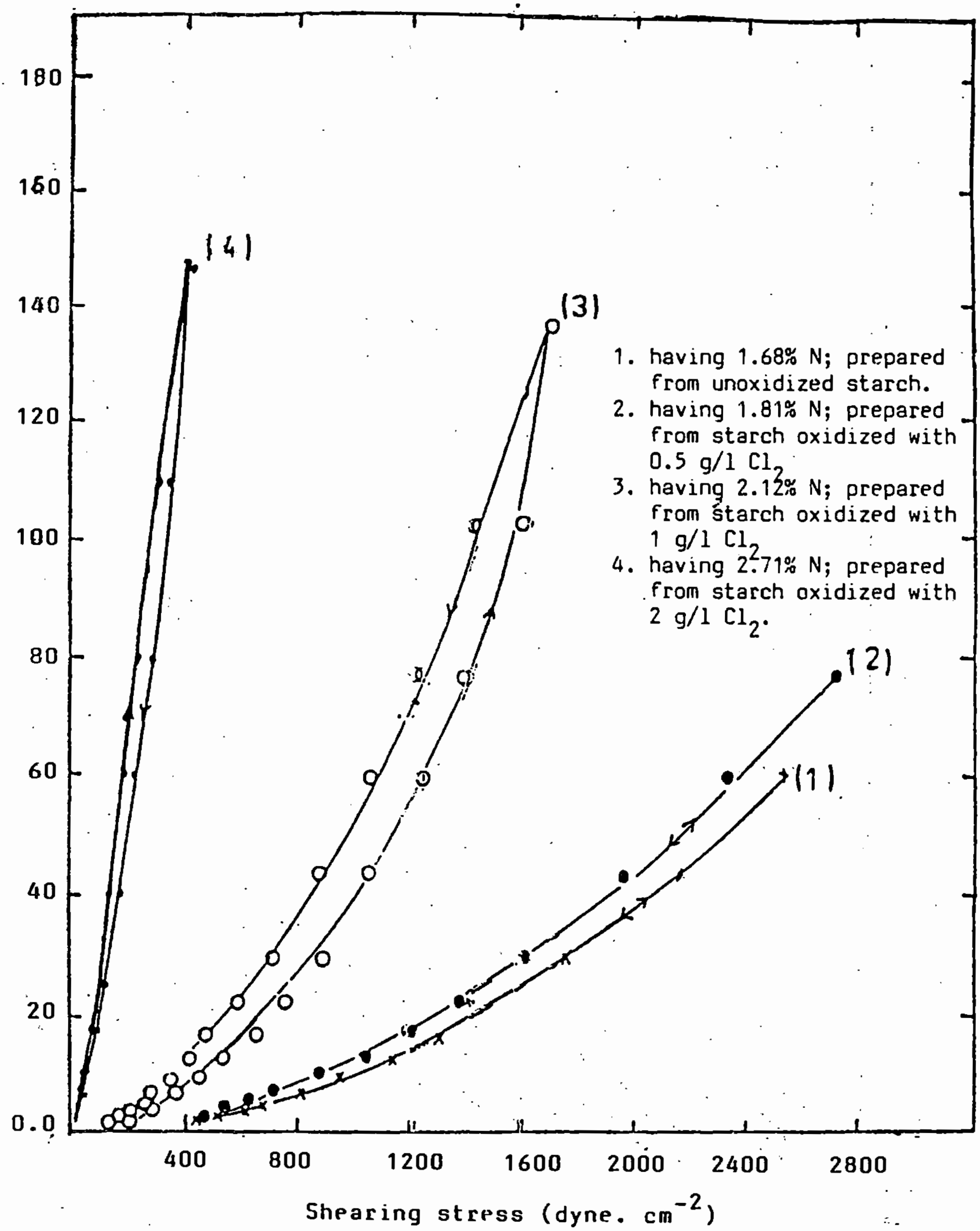

Figure 5. Rheograms of cyanoethyl starches prepared from different oxidized maize starches.

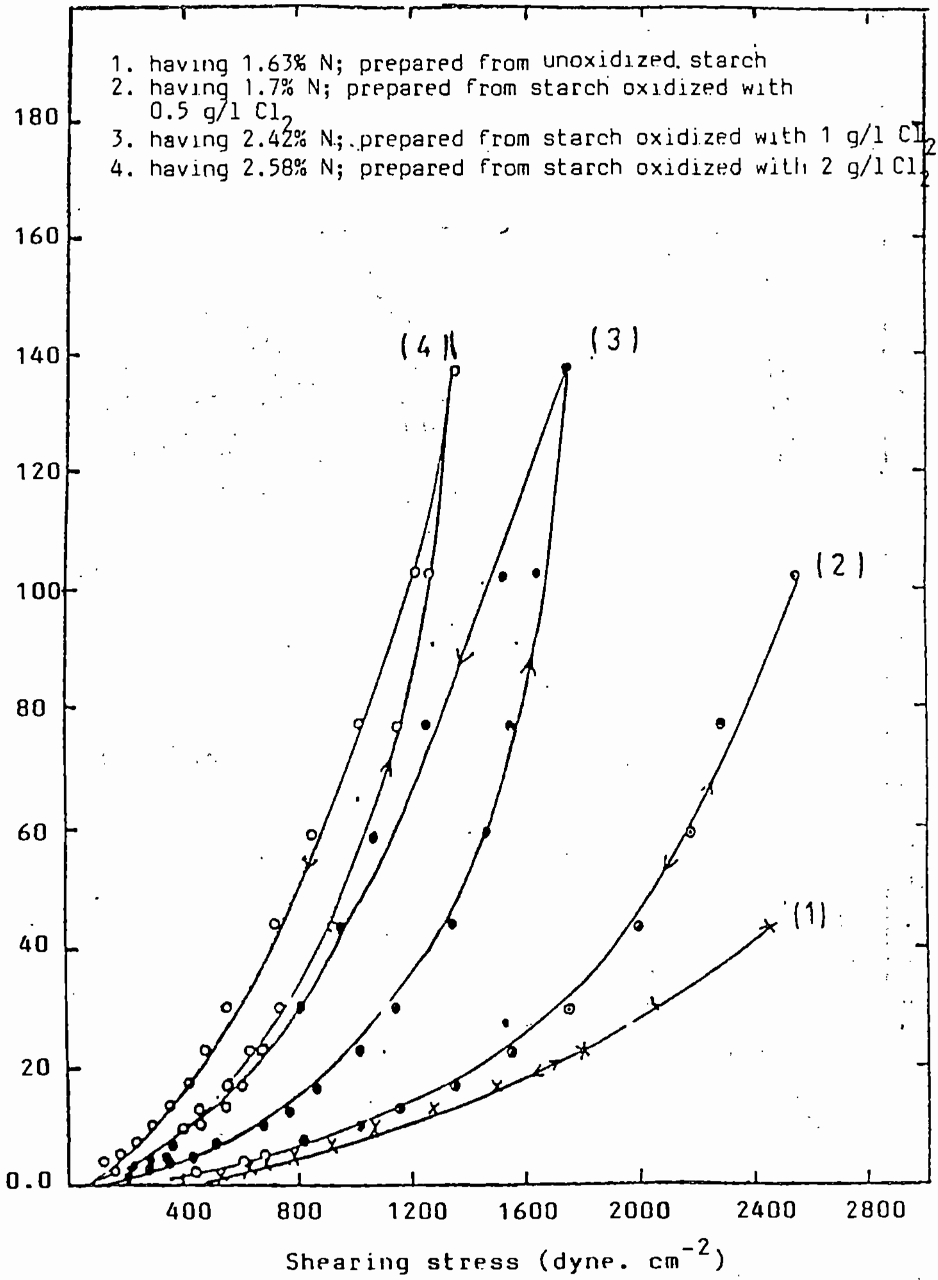

Figure 6. Rheograms of cyanoethyl starches prepared from different oxidized rice starches.

Table 6. Apparent viscosity of cyanoethyl starch prepared from oxidized rice starch by different concentrations of sodium hypochlorite.

Rate of shear (sec^{-1})	Apparent viscosity in poise				Rate of shear (sec^{-1})	Apparent viscosity sample (5)
	Sample (1)	Sample (2)	Sample (3)	Sample (4)		
2.180	238.6	200.9	125.6	87.9	11.16	0.59
2.927	205.8	168.4	112.3	74.8	14.99	0.57
3.851	186.2	156.4	99.5	58.6	19.72	0.55
5.139	154.5	133.2	95.6	56.5	26.32	0.51
6.779	133.3	121.2	76.7	47.6	34.72	0.49
9.771	112.1	103.7	67.3	41.7	50.04	0.48
13.120	98.1	89.7	58.4	34.9	67.18	0.46
17.260	77.3	79.3	50.8	29.7	88.41	0.44
23.030	67.6	67.8	43.9	27.0	117.90	0.42
30.380	55.9	56.8	37.9	21.7	155.60	0.39
44.100	----	45.3	30.4	18.5	225.90	0.36
59.220	----	36.9	24.9	14.8	303.30	0.35
77.920	----	29.5	20.0	12.4	399.00	----
103.900	----	24.5	15.8	9.9	532.10	----
137.100	----	----	12.8	----	702.30	----

Sample No.1 having 1.63% N; prepared from unoxidized starch.
Sample No.2 having 1.70% N; prepared from starch oxidized with 0.5 g/l Cl_2.
Sample No.3 having 2.42% N; prepared from starch oxidized with 1 g/l Cl_2.
Sample No.4 having 2.58% N; prepared from starch oxidized with 2 g/l Cl_2.
Sample No.5 having 4.69% N; prepared from starch oxidized with 3 g/l Cl_2.

Table 7. Apparent viscosity of cyanoethyl starches prepared from different oxidized starches.

Rate of shear (sec^{-1})	Apparent viscosity in poise			Rate of shear (sec^{-1})	Apparent viscosity sample (4)	Rate of shear (sec^{-1})	Apparent viscosity sample (5)
	sample (1)	sample (2)	sample (3)				
2.180	200.9	198.2	100.5	3.111	9.5	11.16	---
2.927	177.7	175.0	84.2	4.177	9.1	14.99	---
3.851	156.4	149.3	63.9	5.495	8.5	19.72	---
5.139	133.2	130.5	56.5	7.333	7.5	26.32	---
6.779	121.2	113.1	41.7	9.673	6.6	34.72	---
9.771	98.1	92.5	38.1	13.940	6.1	50.04	---
13.120	87.6	79.3	33.3	18.720	5.6	67.18	0.20
17.260	78.1	69.8	29.7	24.630	4.9	88.41	0.19
23.030	60.6	60.6	24.2	32.860	4.6	117.90	0.19
30.380	58.6	54.1	21.3	43.350	4.2	155.60	0.17
44.100	49.7	44.7	17.9	62.930	3.8	225.60	0.15
59.220	43.5	39.3	15.5	84.500	3.4	303.30	0.13
77.920	----	34.8	12.8	111.200	3.0	399.00	0.01
103.90	----	----	----	148.300	2.8	532.10	---
137.10	----	----	----	195.700	---	702.30	---

Sample No.1 having 1.88% N; prepared from unoxidized starch.
Sample No.2 having 1.91% N; prepared from starch oxidized with 0.5 g/l Cl_2.
Sample No.3 having 2.12% N; prepared from starch oxidized with 1 g/l Cl_2.
Sample No.4 having 2.71% N; prepared from starch oxidized with 2 g/l Cl_2.
Sample No.5 having 4.56% N; prepared from starch oxidized with 3 g/l Cl_2.

1.5. Starch Graft Copolymers

Graft copolymerization of acrylamide into rice starch was investigated under different conditions using potasium persulphate, benzoyl peroxide or potassium permanganate as initiators. This has led to the establishment of the appropriate grafting conditions for each of these initiators. Under these conditions grafting was characterized by two rates regardless of the initiator used. The first rate occurred during the initial stages of polymerization while the second during the later stages. The first rates of grafting for the three initiators were very close, indicating the insignificant effect of the nature of the initiator on grafting during the initial stages of the reaction. On the other hand, the second rates of grafting exhibited the order: potassium persulphate > benzoyl peroxide > potassium permanganate, reflecting the role played by the nature of the initiator during the later stages of the reaction. With respect to some critical properties substantial differences in solubility were observed between poly(acrylamide) - starch graft copolymers and the unmodified starch as well as among copolymers prepared using the three initiators. Although the copolymers acquired higher solubility percent than the unmodified starch, yet the nature of the initiator, graft yield, structural changes in the copolymer occurring during grafting and the temperature of solubility measurement determined the solubility percent. Copolymers prepared using benzoyl peroxide or potassium persulphate showed lower viscosity than the unmodified starch. The opposite was the case with respect to the copolymer prepared using potassium permanganate.

Synthesis of poly(methacrylic acid)-starch graft copolymers using Mn^{IV}-acid system was also studied. Results indicated that when starch was treated with MnO_4 solution, MnO_2 was deposited overall the starch. The amount of MnO_2 deposited relied on the $KMnO_4$ concentration. Subjecting the MnO_2 containing starch to a solution consisting of monomer (methacrylic acid, MAA) and acid (citric, tartaric, oxalic or sulphuric acid) resulted in the formation of poly(MAA) starch graft copolymer. The magnitude of grafting, expressed as m.eq.-COOH/100 g starch, was determined by the amount of MnO_2 deposited, MAA concentration, temperature and duration of polymerization as well as kind and concentration of the acid. Incorporation of cations such as Fe^{+3}, Cu^{+2} and Li^{+1} has a significant effect on grafting. The highest extent and rate of grafting were obtained with citric acid and the least with sulphuric acid; tartaric acid stood in mid-way position. The magnitude of grafting increased as the acid concentration increased till a certain concentration beyond which grafting levelled off. A similar trend was observed when the magnitude of grafting was related to the amount of MnO_2 deposited. The extent and rate of grafting increased by raising the polymerization temperature from 30 to 50°C then decreased by raising the temperature further from 60 to 70°C.

On the other hand, grafting enhanced significantly by the addition of Fe^{+3}, Cu^{+2} or Li^{+1} and followed the order Fe^{+3} Cu^{+2} Li^{+1}. A tentative mechanism for the grafting of starch with MAA using MnO_2-acid system was elucidated.

1.6. Polyacrylic Acid-Starch Composite

When $K_2S_2O_8$ was used as initiator, the polymerization reaction of acrylic acid with starch is much affected by:

(a) Alteration of temperature,
(b) 3 hrs is needed for complete conversion
(c) the composite could not be stored with neutralization
(d) samples sized with unneutralized composite is difficult to remove under the washing conditions used.

On the other hand, when $KMnO_4$/ citric was used as initiator, it was found that;

(a) the polymerization could be carried at a temperature range of 30-50°C,
(b) the composite could be stored without neutralization at the end of polymerization,

(c) samples sized with unneutralized composite were easily washed and

(d) the stirring should not exceed (350 round/min). When the polymerization was carried at 30°C.

2. CARBOXYMETHYL CELLULOSE (CMC)

Different agriculture wastes were used as starting materials for the preparation of CMC. These include sugar cane bagasse, cotton stalk, rice straw and wood manufacturing waste. After being subjected to a pulping process, the cellulosic material obtained from each of these wastes was reacted with monochloroacetic acid in the presence of sodium hydroxide in a nonaqueous medium. Results obtained signified that the most reactive cellulose pulp was that produced from rice straw. The presence of large amount of impurities in the pulp did adversely affect the reactivity of the cellulose pulp. Examination of the rheological properties of the CMC - prepared from these different sources of cellulose - revealed that they were non-Newtonian-thixotropic irrespective of the starting pulp. The apparent viscosity of CMC samples, prepared from the cotton stalk pulp, was equal to that of the sugar cane bagasse but lower than that of the wood pulp.

CMC was also prepared using cotton stalk as it is without pulping. The stalk was ground then treated with monochloroacetic acid and sodium hydroxide under certain conditions. The reaction products were dissolved in water and filtered. The addition of ethyl alcohol to the filtrate resulted in precipitation of CMC. The yield of CMC and its degree of substitution increased by increasing the concentrations of monochloroacetic acid and sodium hydroxide. The opposite was the case with respect to the apparent viscosity.

In addition, a simple, practical and different technique for the preparation of CMC from the pulp of sugar cane beggasse and rice straw was developed. The technique is reproducible and no solvent is involved in the reaction. The CMC so obtained acquires good properties which enable it to serve as a satisfactory size base material.

3. SYNTHETIC VINYLS

Poly(acrylic acid) and poly(methacrylic acid) were synthesized using the corresponding monomer. Polymerization of the latter was carried out under different conditions including time and temperature of the reaction, concentration of the monomer and concentration of the redox components. The redox system used was ammonium persulphate/ sodium sulphate. The effect of the degree of neutralization of the monomer before commencing polymerization on the polymer yield and polymer viscosity was also examined. Based on these studies it was possible to prepare a solution containing 10% polymer. The viscosity of this solution was very close to that of a similar commercial product used as a size base material.

4. RECOVERY OF WATER SOLUBLE SIZE

Within the framework of the project, polyester/cotton blend (67 : 33) yarns were sized using PVA/CMC mixture (60:40) in a textile mill. These yarns were used as wraps for a fabric which was desized on a continuous open-width bleaching line after insertion of certain modifications in the machinery and conditions of desizing. The latter was performed using hot water (90°C) which ran at a specific rate with a certain pressure to ensure removal of the size from the fabric as much as possible. The concentration of the liquor (washing) containing the removed size (ca.54%) was readjusted and used for sizing again.

It was shown that weavability increases by 12% when the conventional size of the mill based on native starch/PVA mixture) was replaced by PVA/CMC mixture used in current work. Quality of the fabric was also better. It was shown further that the difference in price is not much, particularly after considering the reuse of the recovered size. The recovery of sizes is also expected to act in favour of improving the quality of environment. It is acknowledged that the consumption of oxygen in water by sizes adversely affects the growth of living organisms such as fish in water.

LOCALLY MANUFACTURED FILTER BAGS USED IN THE STEEL INDUSTRY FOR ENVIRONMENTAL POLLUTION CONTROL: A CASE STUDY

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GENERAL

There is a strict system applied at the Alexandria National Iron and Steel Co. (ANSDK) for environmental pollution control, which stipulates the anti-pollution measures and activities to be taken to maintain a clean environment inside and outside the plant.

The company is an integrated plant for producing reinforced steel bars, or rods with annual nominal capacity of 750,000 tons. It is composed of a) direct reduction plant, b) steel making plant, 1. four electric arc furnaces 2. three continuous casting machines, 3. lime calcining plant as well as, c) Rolling Mill - for production of bars and rods.

Main features of the anti pollution system:

- Filter bags used mainly for prevention of air pollution from exhaust gases, dust from raw material during handling and by-products such as burnt lime...etc.
- For water.
- Filter cloth dehydrator - for sludge at Direct Reduction Plant
- 3 water treatment stations.

Phenomena faced:

The filter bags used at S.M.P. fume Extraction system, and dust collector system, and at the lime calcining plant as well as the filtering cloth at D.R.P suffer damage, which is reflected in a financial burden to the company and national economy due to high costs of replacement paid in foreign currencies to import such filters of ready made cloth.

Measures taken:

A team from the Department of Materials Science, Institute of Graduate Studies and Research, Alexandria University and ANSDK was nominated on Feb.1989 to tackle the problem.

Aim of Work:

- The team aimed at assessing the design requirements.
- To simulate separation conditions by designing a set of experiments to represent the different conditions in the laboratory of the actual operation.
- To define the specification and technical evaluation of the physical properties of the material already used in the plant.

- To form a laboratory pattern to be a base for comparing the several types of material used.
- To survey the local market, and evaluate feasibility of producing several types on pilot plant bases in the textile field.
- To run laboratory tests to identify the locally manufactured material which is compatible and most suitable to operation conditions.
- In the final evaluation, to select the best out of the suitable materials.
- To design a pattern for site trials.
- To develop the locally manufactured filters by reviewing site trial results by user and supplier.

This study has taken place on contractual basis with the Institute of Graduate Studies and Research IGSAR, Alexandria University and financed by ANSDK.

Why IGSAR was selected for such study:

IGSAR has a well established Department for Materials Science, with well equipped laboratories, instrumentation, and qualified personnel to satisfy the requirements of such research. It was therefore selected

Procedure:

As it needs long time to demonstrate the results for several types, so we concentrated here on one type of filter which is already used in the actual field trial and which has been running smoothly for more than five months without trouble i.e filter bags for the Lime Calcining Plant (L.C.P).

- Bag Function:

The filter bags used in L.C.P consist of a cell unit that comprises a group of filter elements mounted in a steel frame. The elements are slotted side by side into the frame and the individual element sealing arrangement effectively separates the dirty "inlet" side of the filter from the clean outlet side.

- Bag Description:

Two kinds of bags used at L.C.P both are similar in type of cloth-chemical specification but differ in shape, specific gravity and thickness.

a. The 1st is cylindrical with dead bottom end. It is suspended and held to the venture sheet together with the cage and the venture. The total number of this type is 406 bags mounted at different points.

b. The 2nd is of the Dalamatic type:
These are of rectangular form and consist of a slim mesh frame insert for the filter pad, to which is welded a shaped steel outlet header with sealing flange, the filter pad itself consists of a rectangular bag incorporating a resilient sealing ring at the open end, the bag is pulled over the wire portion of the insert until the sealing ring presses against the sealing flange, thus effectively isolating the dirty side of the filter from the clean one when the elements are clamped into the steel frame. This enables the filter to operate at a constant heat and so maintains a uniform pressure drop and serves to maintain optimum filtering efficiency at all times.

The Test Procedures:

- Identification of the thermal, mechanical and physical properties of imported material already in use.
- Characterization of the thermal, mechanical and physical properties of the local material.

A. Material Tested:

This was divided into six types:

- Two imported of (550, 600 g/m) non-woven, taken as a reference.
- 4 types of locally manufactured (non-woven)
  1. Two types (550 g/m, 600 g/m) surface treated by spraying.
  2. Two types (550 g/m, 600 g/m) surface treated by impregnation.

Each of 1 and 2 was divided into two types of different physical characteristics.

B. Thermal Analysis:

Thermogravimetery, T.G, was performed using a Schimadzu DT-30/TG-30 Thermobalance. Conditions used were: weight=25 mg; Sensitivity=25 Mv/cm; heating note 10 K/min.

C. Mechanical Test

- General, sampling was performed according to JISL 1096
- Tests of effect of operating media. with ageing factors indicated (Tensile JISR 3420)

Air Permeability (JISL 1996)

Air permeability was determined by allowing a flow of air specified to pass through a certain area diaphragm, then compared with the pressure required to force the same amount of air, having same flow rate, to pass through the material covering the diaphragm (standard). The instrument used was an AVK type ALT2, with the kind permission of the textile department at the faculty of Engineering, Alexandria University.

FINAL RESULTS:

The study has succeeded in defining the local textile material which could substitute the imported one and which is suitable for the operation conditions. It has been used successfully in the field and produced similar results as for the other filters. For the new dust collectors, it was planned to start site trials for the dehydrator cloth, and the fume extraction filter bags before the end of 1989.

This case represents the fruitful results of co-operation between the industry and the university and research centers which have been developed for the sake of national economy and establishing our own technology.

Note: The results have been presented to the ministry of Industry, cement factories; the Association of Environment Protection as a model ready to be applied with some modifications to suit the exsisting conditions.

Table 1. Filter Bags, L.C.F., Operation Conditions

FILTER BAG RO.	UNIT	L.C 11	L.C 12	L.C 13	L.C 330	L.C 331	L.C 332	L.C 333
1.Capacity, Suction	m^3/min.	370	470	510	95	45	95	95
2.Filtering Area	m^2	214	391	285	45	18	45	45
3.Gas Velocity (Filtering Speed)	Cm/S	3.09	2.64	3.2	3.8	4.74	3.3	3.3
4.Dust Concentra-tion (Inlet)	Av.: g/Nm^3	0.3	0.6	0.3	0.3	0.3	0.3	0.3
5.Dust Carry-Over (Outlet)	less than: g/Km^3	0.03	0.03	0.03	0.03	0.03	0.03	0.03
6.Dust Type		$CaCO_3$	$CaCO_3$+CaO	CaO	CaO	CaO	CaO	CaO
7.Dust Temperature	°C		70-100					
8.Pressure Drop	Approx: mmag	150	150	150	150	150	150	150

Table 2. Bag filter specification and locally manufactured quantify needed for field trial at LCP

PLANT NAME	BAG FILTER SPECIFICATION						
	Size	Material	Weight (gm/m^2)	Thick-ness(mm)	T.Strength (Kg/mm)	Permeability (cm^3/cm^2/sec) at ½ E_2O	Max. temp. (°C)
LCP - LC 1112,LC1218 LC 1327	127 x3620mm	Polyester	600	Aprx. 2.2	1.8	11	150
- LC 1330,LC1333	490x1510mm	Felt	550	Aprox. 1.7	1.8	11	150

A CASE STUDY FOR THE APPLICATION OF AN INHIBITOR FOR THE POLYMERIZATION OF ACRYLIC ACID.

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Acrylic acid is one of the most important chemicals used for the production of polymers. The great chemical reactivity combined with the water solubility of its polymerisation product, polyacrylic acid, are responsible for the wide range of its industrial applications, and are the main causes of the steady increase in the quantities produced of the acid monomer. However, great difficulties are known to be associated with the purification and storage of the acid monomer. Thus when purification is effected by distillation, the process should be carried out at reduced pressure. Even at low pressures, the distillation of the monomer is difficult because the polymer forms readily. For this reason, during distillation the still pot should contain a non volatile inhibitor (eg, salts of copper) and the column and condenser should be packed with copper helixes, or else a volatile inhibitor such as nitric oxide should be introduced with the monomer.

On the other hand, the safe storage of large quantities of the glacial acid is not usually fully guaranteed even in the presence of inhibitors. The problem arises from the fact that the readiness with which the undiluted monomer polymerises, and the large amounts of heat evolved during polymerisation, make the uncontrolled polymerization of the acid to be frequently associated with potential danger and the reaction in many cases can be violent and explosive. For this reason, bulk storage should be at a temperature just above the melting point (18-20°C) to avoid local overheating and uncontrolled polymerisation during thawing. Laboratory samples can be stored frozen but partial thawing of the solid acid should obviously be carried out with care otherwise the inhibitor may not be distributed uniformly between the solid and liquid phases so that either phase may be depleted of inhibitor. Withdrawal of acid from a partially thawed sample could leave behind material which, upon further liquifaction, contains insufficient inhibitor for safe storage. Frozen acid must, therefore, be thawed cautiously and completely before removal of material.

The third problem which is usually encountered with acrylic acid, is that of its dimerisation. It is known that acrylic acid undergoes spontaneous dimerisation to β-acryloyloxy propionic acid. The rate of dimerisation increases with temperature. The reaction is probably ionic rather than free radical, which is why the commonly used polymerisation inhibitors are ineffective in suppressing the dimerisation process. It is estimated that the dimerisation might lead to the loss of 2-3% of the acid monomer as a dimer product.

From our previous work with polymerisation inhibitors and with dicyandiamide as a material of potential chemical reactivity, it became known that, under certain conditions, the above-mentioned material reacts with formaldehyde to form water-soluble cationic resins. The cationic nature acquired by the resin molecules results from their ability to be protonated on dissolution in water or in acids. The greater the acidity of the medium, the greater is the extent of protonation. It became thus of great importance to get benefit of this unique property of these resins to solve the above-mentioned difficulties encountered with acrylic acid taking into account the prevailing concept that inhibition of vinyl polymerisation involves electron transfer from the growing chains to the inhibitor molecules, and that the greater the electron affinity of the inhibitor, the higher the efficiency of inhibition.

The ability of the resin molecule to acquire a cationic nature on reaction with acrylic acid implies in situ creation of a potentional inhibitor for the self polymerisation of the acid. As the formation of the inhibitor in this case is the result of a chemical reaction between the acid and the resin molecules, the inhibitor will be found usually uniformly distributed between the solid and liquid phases of the acid irrespective of the number of the freeze/thaw cycles. Accordingly, portions can be withdrawn safely from partially thawed frozen acid samples. Moreover, as the in situ formed inhibitor is ionic in nature, it can therefore intervene with the ionic dimerisation reaction which implies that an inhibitor has been found, for the first time, that can suppress this side reaction.

Still another advantage of the mentioned resins, is that on distilling the acid at normal pressure in their presence, they decompose to give formaldehyde and a mixture of nitrogeneous gaseous substances. The evolved gases have proved to be very effective gas phase inhibitors for the self polymerisation of the acid, so that the use of only 0.5% of the resin, relative to the weight of the acid, affords the possibility of safe distillation of the acid at normal pressure without the necessity for additional liquid or gas phase inhibitors.

It is surprising that although the mentioned product was developed ten years ago and provides effective and reliable solutions for major problems encountered in the manufacture of acrylic acid, the product has not yet found its way to industrial application up till now, neither on the national level nor internationally. Although the product aroused great interest when the outlines of the idea of its action became available, no actual steps were undertaken to introduce it to industry and application.

When the first announcement of the developed product appeared in "Chemistry and Industry", an immediate response came from two American companies, namely Polysciences, Inc. and the Ansul Company, Weslaco Technical Center. Both companies showed interest and asked for further information about the product and the possibility of its technical applications. Unfortunately, the lack of experience in dealing with the productive sector in general and foriegn companies in particular concerning the application of a university-based research has limited the probability of any possible cooperation with both companies. The lack of knowledge of the regulations govering the royalties and disclosure of information has led to the creation of a state of mistrust which prevented us from going on a step further. For this reason, the establishment of an office for technology development and transfer to act as the linkage between universities and research institutions on one side, and the productive sector on the other side, is a vital requirement for marketing research-based inventions and introducing them to industry if we are keen to get the benefits of the useful results of our research. Unfortunately, our unsuccessful trials to find any kind of cooperation with the productive sector have proved that the development of a useful product is a story which totally differs from its marketing, and it seems difficult, if not impossible, for the researcher to do both jobs by himself.

Many useful university-based research results are now available, and will be stored simply as useful results, of probable value, until they could be introduced somehow into practice for the welfare and benefit of man.

SESSION FIVE

HEALTH AND ENVIRONMENT

1. MANAGEMENT OF THE POLLUTION OF ALEXANDRIA BEACHES DUE TO SEWAGE DISCHARGE: A CASE STUDY.

2. SYNTHESIS AND STUDIES ON THE USE OF POLYMERIC MOLLUCICIDES FOR COMBATING THE DISEASE BILHARZIA

3. A CASE STUDY ON ANALYSIS OF RENAL CALCULI

MANAGEMENT OF THE POLLUTION OF ALEXANDRIA BEACHES DUE TO SEWAGE DISCHARGE: A CASE STUDY

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ABSTRACT

Alexandria is the main resort of Egypt. The population of the city is about 4 million and in summer it receives more than half a million tourists who come to its beaches for recreation. Part of the city sewage is discharged into the sea through some outfalls along the coast. A coastal line of about 20 Kms in length was monitored in order to study the pollution of the recreational waters. Also, a retrospective epidemiological study was carried out to find if there was a relation between the state of pollution and

the occurrence of typhoid among bathers. The results of this study showed that there was a significant risk of contracting typhoid from bathing in the heavily polluted water and the most affected was the young age group.

Therefore it was recommended that the minor outfalls, should be closed immediately to protect the public health, and to save the aesthetic value and tourist industry. So an emergency plan was initiated by Alexandria General Organization for Sanitary Drainage (AGOSD) to divert all the sewage flows from these minor outfalls to the internal sewerage system. Thus these outfalls were completely closed by the summer of 1986.

INTRODUCTION

Alexandria is the second largest city in Egypt and its main summer resort. The population of the city is about 4 million, and in summer it receives about half a million tourists who come to its beaches for recreation.

A major outfall, 735 meters long and 16 meters deep is located at Kait-Bay and it discharges on average about 200,000 cubic meters/day. There are also 18 minor outfalls that serve as an emergency relief of the sewerage system along the coast, as shown on Fig.1. They were primarily designed for water disposal during the rainy season in winter, but due to the overloaded conditions of the sewerage system, these minor outfalls discharge raw sewage in summer also, to prevent the flooding of streets. This direct discharge of raw sewage into the sea water of beaches resulted in the direct contact of bathers with heavily polluted sea water.

A coastal line of about 20 Kms in length was monitored in order to study the pollution of the recreational beach waters and the hazard to human health.

Samples from 20 Beaches along the Alexandria coast were collected weekly to determine the total coliforms,

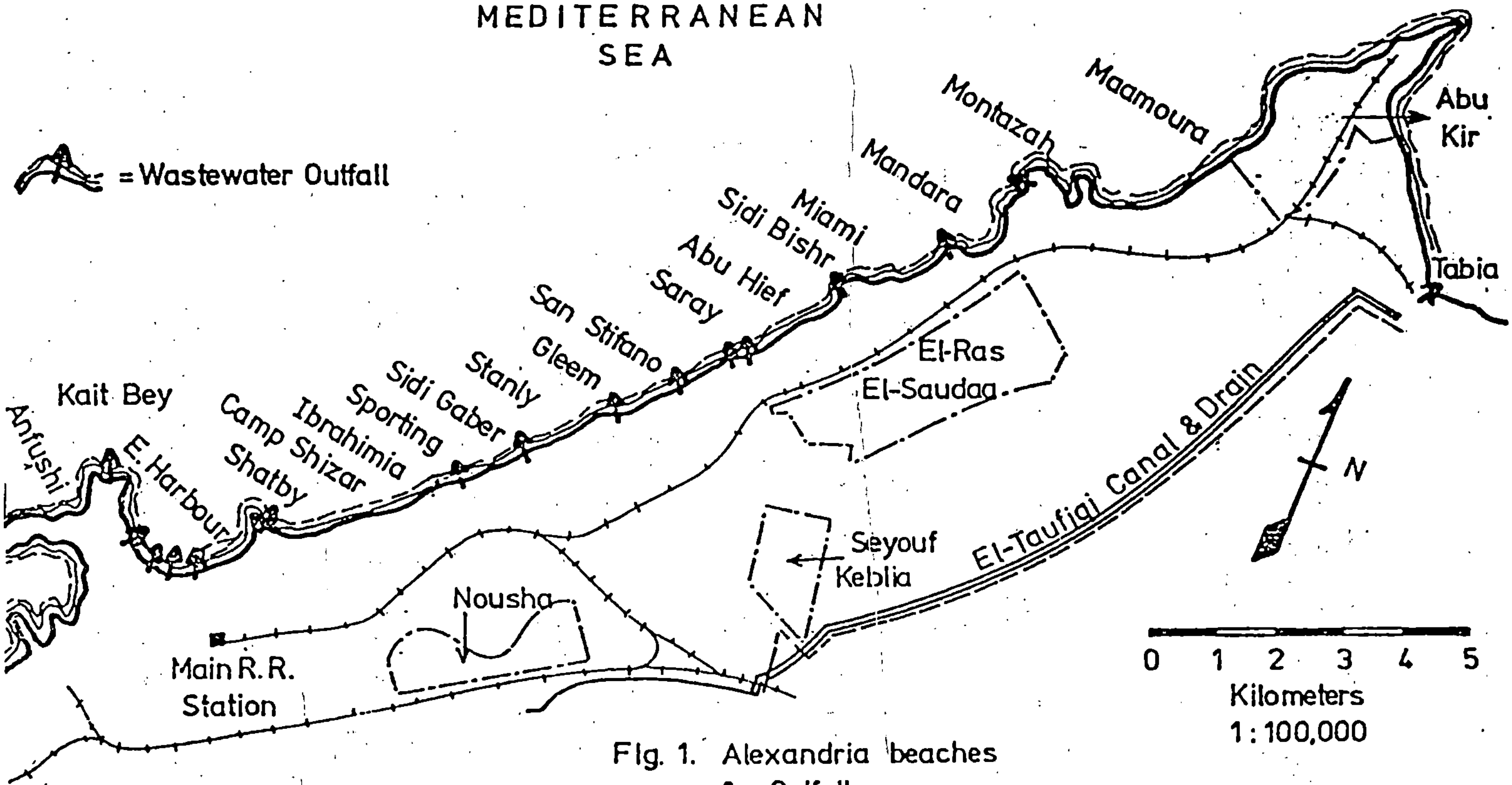

Fig. 1. Alexandria beaches & Outfalls

F.EL-SHARKAWY

faecal coliforms (E.Coli) and faecal streptococci. The methods used for this purpose are those recommended in the Quality "WHO", Copenhagen 1977. The sewage discharge, quantity and characteristics were determined for each outfall.

RESULTS

Table 1 shows the average quantity of sewage discharged from each outfall and the corresponding diameter and length.

Table (1) Quality of sewage and length of outfalls (1980)

Outfall	Flow (m^3/day)	Length (m)
Montaza	1500	40
Mandara	5000	50
Beer-Masoud	4000	30
San Stefano	1000	20
Gleem	6000	40
Sporting	5000	40
Selsela	10,000	5
Eastern Harbour (8 out falls)	10,000	-
Kait Bay	200,000	735

Most of the monitored beaches showed high coliform and high streptococci counts which indicate heavily polluted sea water as shown in Table 2. The table gives the mean bacterial counts in summer and winter.

EPIDEMIOLOGICAL STUDIES

A retrospective study was done to find out if there was a relation between the state of pollution of the beaches and the occurrence of typhoid among bathers. All cases entering Alexandria's communicable diseases hospital and diagnosed clinically and bacteriologically as enteric were obtained, a history of bathing within two to three weeks before the onset of the disease was asked carefully, and the beach visited was observed. Those cases with a history of bathing and swallowing sea-water were considered as "complete bathers".

Table (2) Mean for Bacteriological Results in Winter and Summer 1980

Beach	Winter		Summer	
	Coliform MPN / % Fecal strep	Fecal strep / % confirmed	Coliform MPN / % Fecal Strep	Fecal strep / % confirmed
El-Anfouchi	2660 / 57	2884 / 78	3445 / 66	4266 / 79
El-shatby	3230 / 63	2818 / 69	2630 / 68	2778 / 78
Camp cesar	2148 / 48	2630 / 74	2690 / 74	3090 / 79
Sporting	25119 / 57	117490 / 85	11481 / 79	22387 / 89
Sidi Gaber	2884 / 62	4467 / 81	1349 / 62	3981 / 87
Stanley	891 / 76	661 / 52	323 / 54	1412 / 57
Gleem	25710 / 38	10000 / 85	27542 / 67	58884 / 78
San-Stefano	2175 / 49	3388 / 68	1288 / 57	4169 / 81
Sidi-Bisher	3020 / 44	1660 / 71	2138 / 59	2128 / 91
Miami	1900 / 28	1259 / 54	3510 / 82	4169 / 93
Mandara	8128 / 35	17378 / 47	26303 / 62	21380 / 83
Montaza	460 / 18	407 / 54	616 / 36	933 / 79
Maamoura	460 / 50	245 / 40	850 / 50	871 / 60

Table 3 shows the percentage distribution of "complete bathers" among typhoid cases according to sex and date of onset of the disease. The highest percentage (77.7%) was among men during the month of August which is five times more than that during June (15.5%). The highest percentage among women (44.3%) was in September which is five times more than in June (8.1%).

Table 3. The Distribution of Bathers Among Typhoid Cases According to Their Sex and Date of Onset of the Disease

Month	Men			Women			Both		
	Bathers	All	%	Bathers	All	%	Bathers	All	%
June	16	82	15.5	5	62	8.1	21	144	14.5
July	47	124	37.9	17	87	19.5	64	211	30.3
Aug.	115	148	77.7	40	98	40.8	155	246	63.0
Sept.	72	113	63.7	27	61	44.3	99	174	56.8
Total	250	467	53.5	89	308	28.9	339	775	43.7

This might be explained by the fact that women usually prefer to bathe when the crowds on the beaches decrease during the month of September. In general, the percentage of bathers among men is much higher than among women because women prefer wading at the beaches to bathing and they usually bathe for shorter periods than men.

The study of the percentage distribution of the "complete bathers" according to their age is shown in Table 4. It is clear that the highest percentage was among the age group ten to nineteen years (57.7%). This is the most active group who likes to stay in the water for long periods of time and therefore with greater chances of swallowing more sea water than the older age groups. The percentage is smaller between the ages of one to about ten (32.9%) as they do not stay in the water for long periods and prefer playing on the edge of the water. The percentage is also smaller in the age group between twenty and thirty, and between thirty and forty (40.5% and 32.6% respectively) as they usually prefer staying in the water for a shorter time and do not swallow the water.

Table 4. The Distribution of Bathers Among Typhoid Cases According to their Age.

Age Group	Bathers	All	%
01-09 years	70	217	32.9
10-19 years	182	315	57.7
20-29 years	70	173	40.5
30-39 years	15	46	32.6
40 and over	02	24	08.3

Figure 2 demonstrates the distribution of the typhoid cases with a positive history of bathing according to different beaches. It is apparent that beaches with sewage outfalls like the Anfoushi and Mandara contributed more cases than those beaches without sewage outfalls.

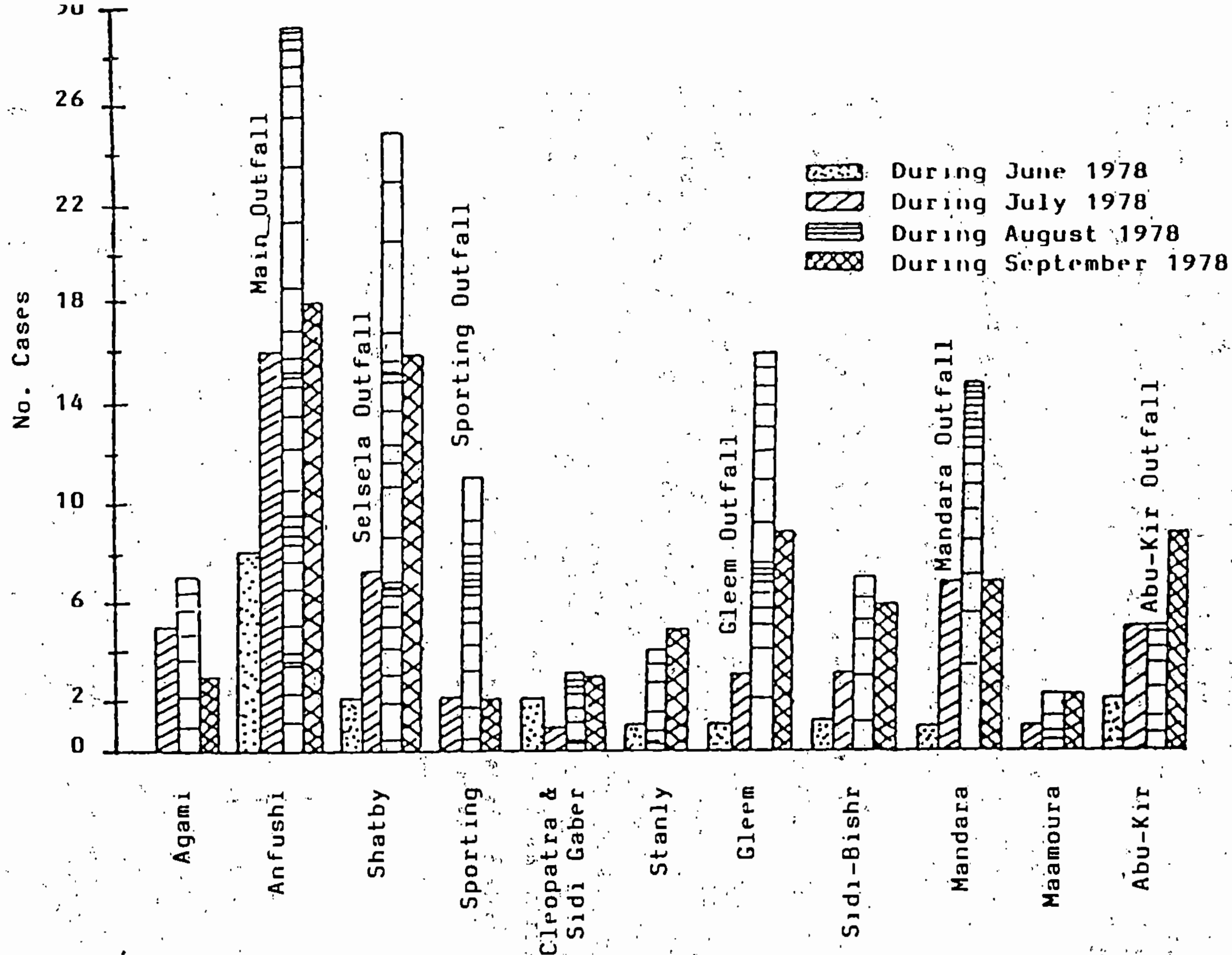

Fig.2. Typhoid cases in Alexandria according to swimming beaches during 21 days before symptoms appear.

This study proved that the risk of contracting typhoid was significantly higher among bathers at beaches with outfalls than at beaches without outfalls. It was noticed that most of the cases were among young ages, especially among men, who usually stayed longer in the water and thus had more chances of swallowing larger amounts of sea water. This can be attributed to the close contact between the bathers and the faecal matter from these very short outfalls which discharge only a few meters away from the beach.

These short outfalls are real hazards to the health of those frequenting the beaches. Therefore they should be closed immediately to protect public health and to save the aesthetic values and tourist industry.

The research explained the ways of diverting the sewage flows from these minor outfalls to the internal sewerage system.

So an emergency plan was initiated by Alexandria General Organizations for Sanitary Drainage (AGOSD) to start construction of the necessary diversion works and to close those minor outfalls from Sporting to Montazah. The work was completed by summer 1986. The monitoring of the beaches continued and showed the improvement in water quality as shown in table (5).

Table 5. The Mean Facel Coliform/100 ml During Summer in the Different Swimming Beaches in Alexandria.

Beach	Faecal Coliform during Summer 100/ml 1981	Sewage Outfall	Faecal coliform during Summer 100/ml		Sewage Outfall
			1987	1988	
Anfoushi	4675	Present	3400	2600	Present
Shatby	4404	Present	2100	1800	Present
Camp-Chizar & Ibrahimia	2998	---	1200	1000	---
Sporting	96108	Present	800	800	---
Sidi Gaber & Cleopatra	3000	---	680	620	---
Stanley	1131	---	600	620	---
Gleem	16550	Present	460	460	---
Sen-Stifano	2909	---	400	420	---
Sidi Bisher	2901	---	530	520	---
Miami	2737	---	380	420	---
Mandara	108593	Present	320	360	---
Montaza	1440	---	300	300	---
Maamoura	421	---	400	380	---

It is hoped that after implementing the Sewerage Master Plan and the completion and commissioning of the two sewage treatment plants (East and west plants), more improvement in beach water quality will be obtained and safer bathing conditions and cleaner water along the beaches can be secured.

From this quick survey of the research project, it can be seen that after adopting and implementing the recommendations and the suggested solutions to the problem of beach pollution, the outcome was very encouraging, and Alexandria beaches have regained their attraction with a positive effect on the economic situation of the city through the increase in the number of summer tourists.

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SYNTHESIS AND STUDIES ON THE USE OF POLYMERIC MOLLUSCICIDES FOR COMBATING THE DISEASE BILHARZIA

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Organization and Financing of the Project:

The financial resources of the research project were provided by the Egyptian Supreme Council of Universities and US Agency for International Development (AID), Grant No 831010.

Application of the Results:

The organization which has shown interest in applying the obtained scientific results of the project is National Development Consultancy Services Ltd, Harare, Zimbabwe (see the attached letters).

Background:

Bilharzia is one of the most widespread trematode, endemic diseases in tropical countries with the increasing spread of cultivated areas. In Egypt, the allocation of large areas to perennial irrigation has increased the infection rate since new areas are added as suitable habitats for the snails, which are the intermediate vectors of the parasite. Thus fight against bilharzia represents one of the important areas of Egyptian national needs for health and economic development.

The molluscs do not directly harm mammals but are alternate hosts for the schistosoma parasites, the causal agent for the debilitating human disease bilharzia. Molluscicides are chemicals specifically designed to combat various mollusc and their application for the eradication of snails has opened up the way for combating bilharzia through interrupting the cycles of transmission of snail borne trematode parasites. Hence great quantities of these chemicals are necessary for any substantial increase in control and eradication of the schistosoma snails.

An active molluscicide, Baylucide has been introduced by Bayer Co. and applied in Egypt for combating the disease by the extermination of various molluscs. Pentachlorophenol (PCP) has also been chosen in this study because it is extensively used as a general pesticide. However, the widespread use of great amounts of these molluscicides that are often used in multiple applications to achieve effective distribution, is accompanied by problems of contamination of the surrounding environment and economic cost. Thus the demand for utilizing decreased amounts of these molluscicides with no detrimental effect on the surrounding environment but with a high biological activity is necessary in the fight against bilharzia.

Aim and Advantages of the Project:

The aim of the project is concerned with the production and use of polymeric molluscicides under the principle of the controlled release technique. This offers a great promise for increasing the efficiency of Baylücide and PCP through enhancing the desirable increase in their persistence by eliminating the environmental and toxicological problems associated with their use. The objectives of the use of polymeric molluscicides are:

i. to allow automatic release of the molluscicide to the snails at controlled rates,

ii. to protect the supply of the molluscicide and

iii. to maintain the concentration of the molluscicide within the optimum limits over a specified period of time.

This technique offers some advantages, which are attractive from the aspects of health, environmental pollution control, and economic development, such as:

1. Prolongation of activity: it allows much lower amounts of Baulucide and PCP to be used since it releases the required amount over a long period.

2. Reduction of number of applications through achieving a long period of duration of activity by a single application.

3. Reduction of cost: it eliminates the time and cost of repeated and over application because smaller amounts are needed.

4. Environmental pollution control: it eliminates the need for wide-spread distribution of large amounts of molluscicide at one time, thereby reducing the excess of toxicity levels in the surrounding environment.

Disadvantage

The additional time and cost of synthesizing the active polymers used as carriers for the Baylucide and PCP is the main disadvantage of this technique, which may well be offset by the above potential advantages.

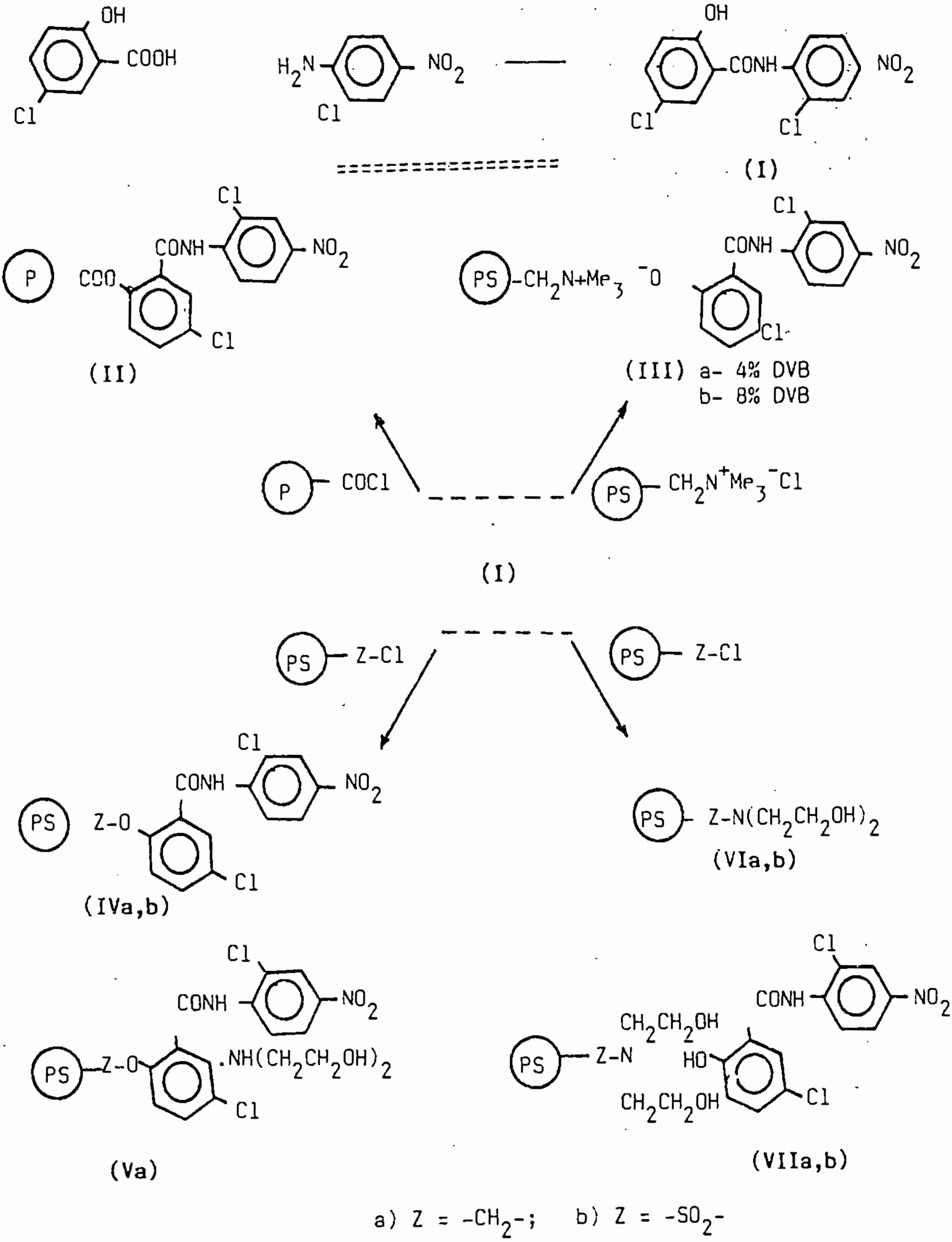
Preparation of Molluscicide Polymers:

The Baylucide and PCP polymers were prepared by two general methods, either by free radical homo-/ co-polymerization technique of the corresponding monomeric molluscicide or by chemical modifications of preformed functionalized polymers with Baylucide/PCP via simple reactions.

A. Baylucide Polymers:

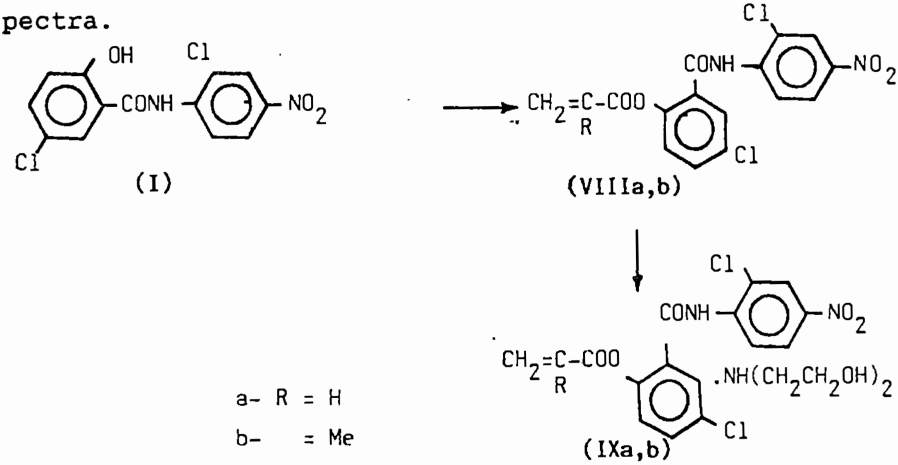
Baylucide is 5,2'-dichloro-4'-nitrosalicylanilide-ethanolamine (also known as Bayer 73 or Niclosamide-ethanolamine). It is effective at very low concentrations against both snails and snail eggs giving a total kill of Australotbis glabratus at 0.3 pw. It was prepared in 62% yield by treatment of a mixture of 5-chlorosalicylic acid and 2-chloro-4-nitroaniline in xylene with phosphorous tricaworide as a catalyst.

The Baylucide polymers were firstly prepared by chemical modifications of preformed polymers with Baylucide, (I), as shown in Scheme 1. The polymeric molluscicide II contains the Baylucide as pendant substituents via ester bonds and had been prepared by treatment of poly(acryloyl chloride) with Baylucide in the presence of a base as triethylamine or anhydrous sodium carbonate. Polymeric molluscicides containing Baylucide as counter ion moiety associated with pendant ammonium salt group, IIIa, b, have also been prepared by treatment of the commercial strongly anion exchange resins, Amberlite IRA-401 (4% DVB), and IRA-400 (8% DVB). In addition, polymers having Baulucide via ether bonds, IVa, Va, VIIa, and sulfonate bonds, IVb, VIIb have been prepared by chemical modifications of poly(chloromethyl-styrene) (2% DVB) and Amberlite IR-120 (8% DVB) with Baylucide, as shown in Scheme 1. The structures of all the Baylucide polymers were identified by microanalysis and IR spectra.



Scheme 1: Preparation of Baylucide Polymers by Chemical Modifications.

In an attempt to obtain Baylucide polymers having the maximum loadings, the synthesis of the polymers by polymerization technique has been carried out. Treatment of Niclosamide with acryloyl and methacryloyl chlorides gave the Niclosamide monomers, 2-acryloyloxy VIIIa, and 2-methacryloyloxy-5, 2'-dichloro-4'-nitrobenzanilide, VIIIb, respectively, as shown in Scheme 2. The monomeric Baylucide IXa,b, were also obtained in high yields by treatment of the monomers, VIII,b, with diethanolamine. The structures of all monomers were confirmed by microanalysis, NMR and IR spectra.

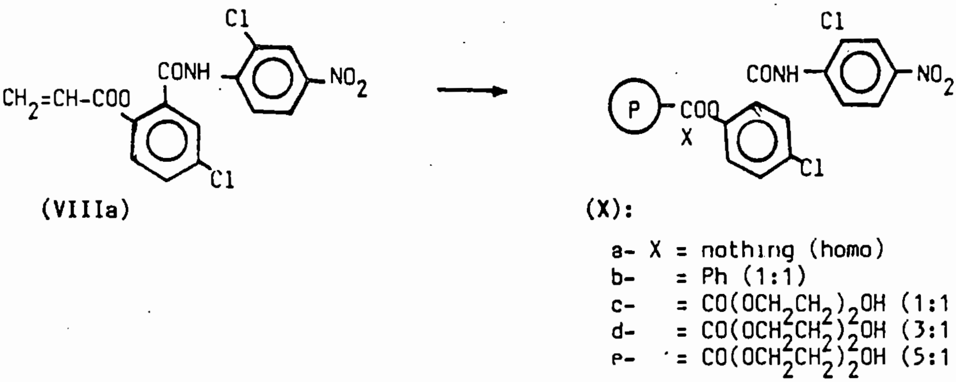


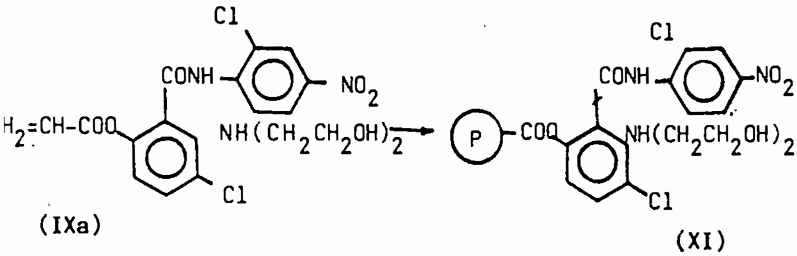
a- R = H

b- = Me

Scheme 2. Preparation of Baylucide Monomers.

The Niclosamide monomer, VIIIa, has been successfully homopolymerized by a solution free radical technique, according to Scheme 3, to afford the homopolymer XA. This monomer has also been copolymerized with styrene and oligoioxyethylene monomers in different ratios by a free radical solution technique to induce different properties to the Baylucide polymers. These structural factors have affected the rates of release of the active ingredient. However, the incorporation of comonomer residues along the polymer backbone was determined by the chlorine and nitrogen analysis of the resultant copolymers, as shown in Table 1. In addition, the monomeric Baylucide salt IXa has been homopolymerized to give the polymeric Baylucide salt XI.





ʖcheme 3. Preparation of Baylucide Polymers by Polymerization

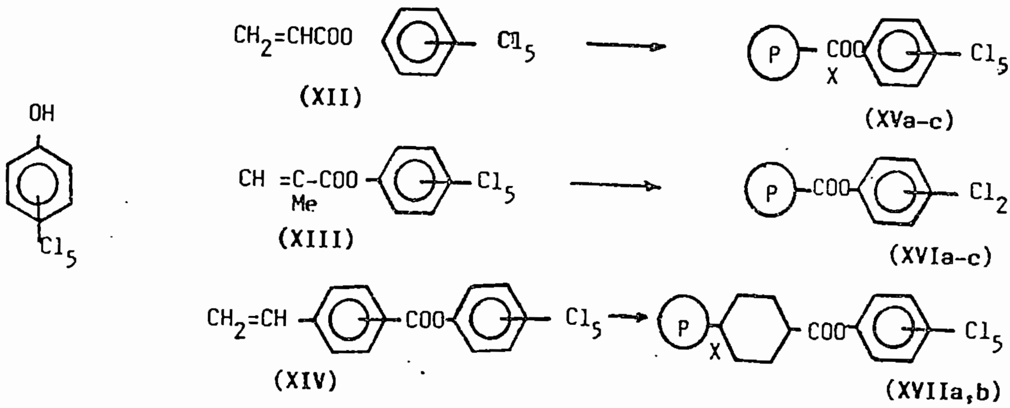
Table 1. Baylucide Polymers Composition and Analysis

Polymer	Comonomer a	Comonomer:Monomer ratio	Anal. Found Cl%	N%
Xa	---	----	18.7	7.3
Xb	Styrene	1 : 1	14.7	5.2
Xc	PE 90	1 : 1	12.6	4.9
Xd	PE 200	3 : 1	15.0	6.0
Xe	PE 350	5 : 1	15.2	6.1
XI	---	----	14.5	8.6

a PE 90, 200 and 350 (Nippon Oil & Fats Co. Ltd., Japan)

B. Pentachlorophenol Polymers:

A series of vinyl monomers containing PCP via an ester linkage unit has also been prepared by direct reactions of acryloyl-, methacryloyl and p-vinylbenzoyl chloride with PCP as shown in Scheme 4. The obtained monomers, XII, XIII, XIV, were successfully free radical homopolymerized by bulk and solution techniques to yield the polymers XVa, XVIa, and XVIIa, respectively. The bulk polymerization gave the highest molecular weight materials, i.e. afforded polymers with the highest inherent viscosities. The monomers were also solution copolymerized with different ratios of styrene and 4-vinylpyridene as shown in Scheme 4, to induce hydrophobic and hydrophilic nature to the polymers. The polymerization conditions and the elemental analysis of the resulting polymers are listed in Table 2.



a) X=nothing; b) X=Ph; c) X= $-C_5H_4N-P$

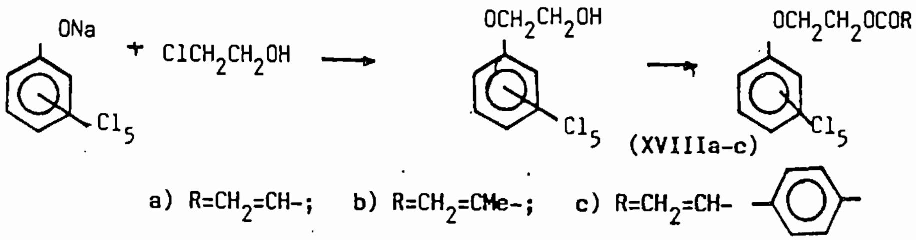
Scheme 4. Preparation of Pentachlorophenol Monomers and their Polymers.

Table 2. Polymerization Conditions and PCP-Polymers Analysis

Polymer	Comonomer	Comonomer:Monomer ratio	a rel	Analysis, % Calcd	Found
XVa	---	----		Cl:55.4	55.8
XVIa	---	----	1.0135	Cl:53.06	53.5
XVIIa	---	----	1.0576	Cl:44.77	45.0
XVb	Styrene	1 : 5	1.1070	Cl:21.21	28.8
XVIb	Styrene	1 : 1	1.0165	Cl:40.48	40.1
XVIIb	Styrene	1 : 1	1.0905	Cl:35.46	39.8
XVc	4-vinyl-pyridine	1 : 1		Cl:41.72 N : 3.29	42.0 03.0
XVIc	4-vinyl-pyridine	1 : 1		Cl:40.39 N : 3.19	40.2 02.9

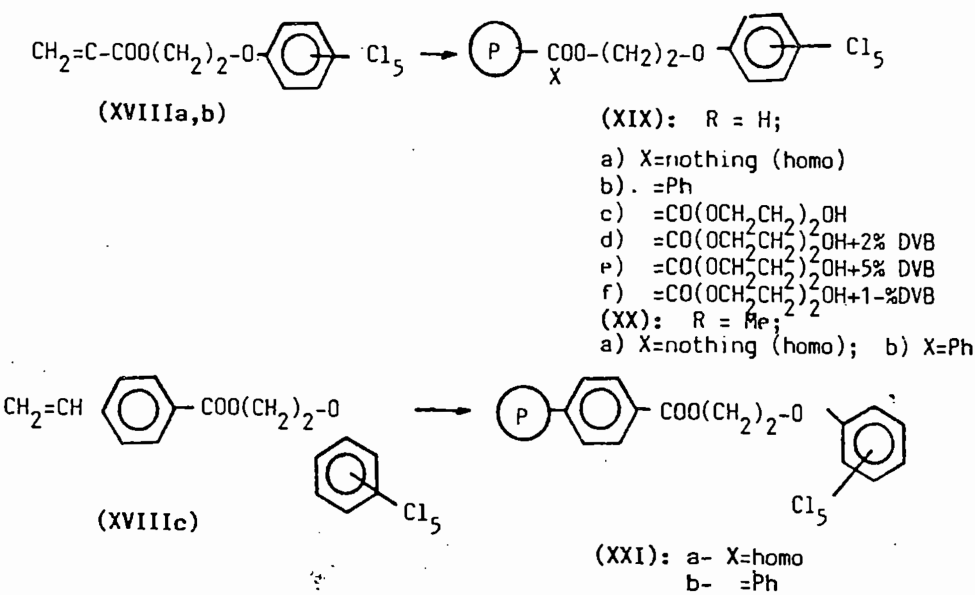
a 1.13%, benzene, 26°C

In addition, a series of chain-extended monomers, XVIIIa-c, were prepared by introducing an oxyethylene moiety via the ester group between the PCP and the polymerizable vinyl groups. Their synthesis was accomplished by reacting pentachlorophenoxide anion with 2-chloroethanol to generate 2-pentachlorophenoxyethanol, which on treatment with acryloyl, methacryloyl and p-vinylbenzoyl chlorides gave the corresponding chain extended monomer as shown in Scheme 5.



Scheme 5. Preparation of Pentachlorophenol Monomers.

The PCP monomers XVIIIa-c were homo-/copolymerized with styrene and 2-(2-hydroxyethoxy)ethyl methacrylate to give the corresponding polymer XIX, XX and XXI, as shown in Scheme 6. The copolymerization conditions and the elemental analysis of the polymers are shown in Table 3.



Scheme 6. Polymerization of Pentachlorophenol Monomers

Table 3. Polymerization Conditions and PCP-Oxyethylene Polymers Analysis

Polymer	Monomer	Comonomer	Mon:Comon	DVB,%	+ rel	Cl%, Anal Calcd	Found
XIXa	XVIIIa	----	----	---	1.0165	48.70	48.5
XIXb	XVIIIa	Styrene	1 : 10	---	1.1276	07.51	07.5
XIXc	XVIIIa	HEEM [a]	1 : 1	---		33.84	32.8
XIXd	XVIIIa	HEEM	1 : 1	2			31.6
XIXe	XVIIIa	HEEM	1 : 1	5			31.5
XIXf	XVIIIa	HEEM	1 : 1	10			30.4
XXa	XVIIIb	----	----	---	1.0082	46.90	45.8
XXb	XVIIIb	Styrene	1 : 10	---	1.1235	12.51	1w6
XXIa	XVIIIc	----	----	---	1.0062	40.30	40.1
XXIb	XVIIIc	Styrene	1 : 10	---	1.0864	11.99	12.0

[a] HEEM: 2-(hydroxyethoxy)ethyl methacrylate.

+ 1.13%, benzene, 26°C.

Crosslinked copolymers XIXd-F were also prepared by the free radical copolymerization of XVIIIa and 2-(2-hydroxyethoxy)ethyl methacrylate with different ratios of technical divinylbenzene (DVB). The ratios of DVB chosen were 2, 5 and 10%, which led to rigid, saleable polymers.

Hydrolytic Release of Baylucide and Pentachlorophenol:

The hydrolytic releases of Baylucide and PCP from the polymers were studied in different media; water, dioxane-water, pH=4 and 10; in which the amounts released were determined periodically by UV spectrophotometric analysis. In general, the linear and crosslinked polymers are insolúble in the hydrolyzing media and have been used as powders in stagnant conditions.

Whereas an increase in the degree of crosslinking results in a slight decrease in the rate of exchange, the type of binding group appears to be an important factor in the Baylucide exchange as shown in Fig.1. The polymeric Baylucide IIIa undergoes exchange with a slight increase in the rate than the higher crosslinked polymer IIIb. The slower hydrolysis of II than IIIa may be attributed to the nature of the covalently bound ester groups, which are more stable towards hydrolysis than the ionically bound ammonium salt groups. However, the hydrophilicity of the ammonium salt and carboxylic groups is the major factor in the release of Baylucide. The high rate of release from these resins is attributed to the intramolecular interactions of the neighboring groups which are not modified or generated during the hydrolysis.

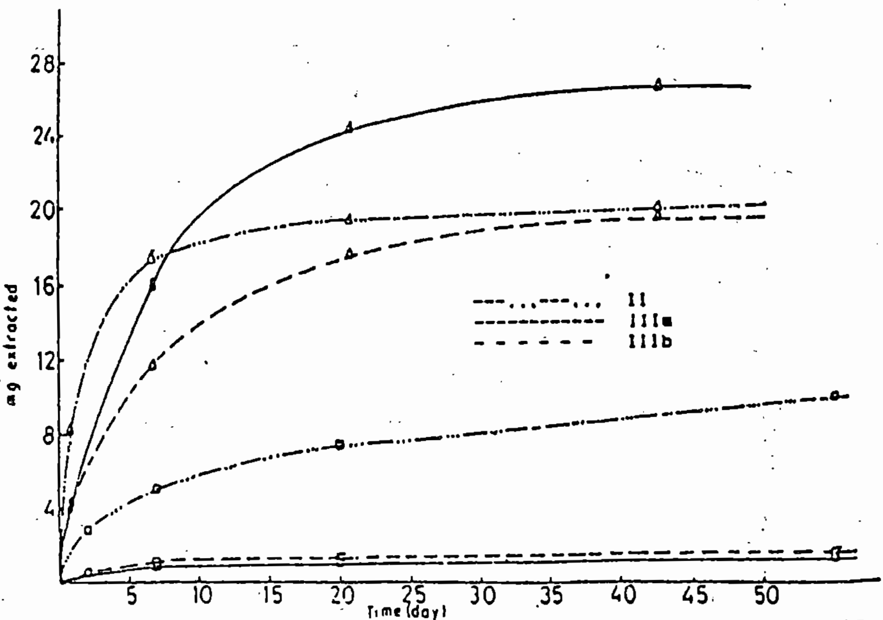


Fig.1. Niclosamide released from 0.1g of polymers II and IIIa,b

The hydrolytic release of Baylucide from the polymers were studied in dioxane-water and a buffeted aqueous medium of pH=10, in which all polymeric systems showed significantly higher release than in water or acidic media. The concentrations of Baylucide delivered from the polymers Xa-e and XI were measured directly from the filtrate using UV spectrophotometer as shown in Figs 2 and 3.

Although all polymers were characterized by a slight initial release in the first few days followed by a more gradual release as can be seen in Fig.2, the higher hydrophilic polymers had much higher release rates. Whereas a change in the type and nature of hydrophilic group may result in a slight increase in the rate of release. The nature of the medium appears to be an important factor in

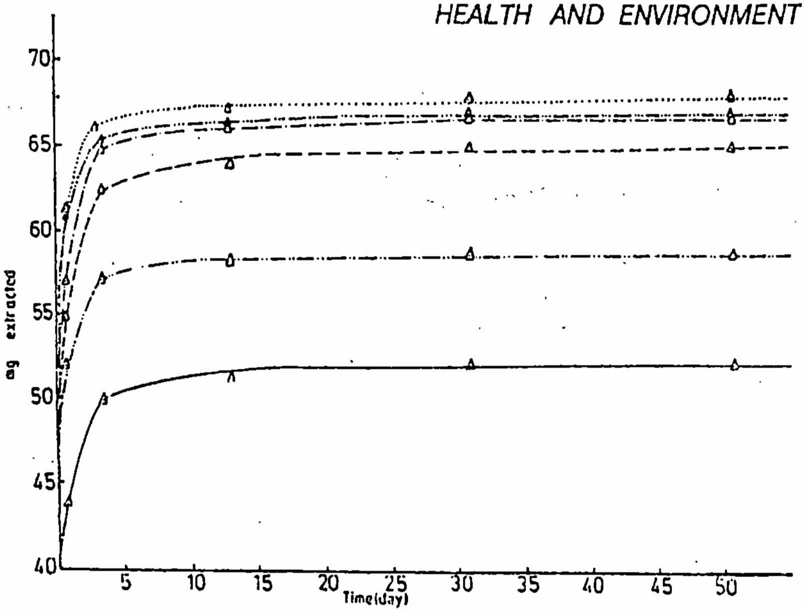


Fig.2. Baylucide released from 0.1g of polymers Xa-c and XI.

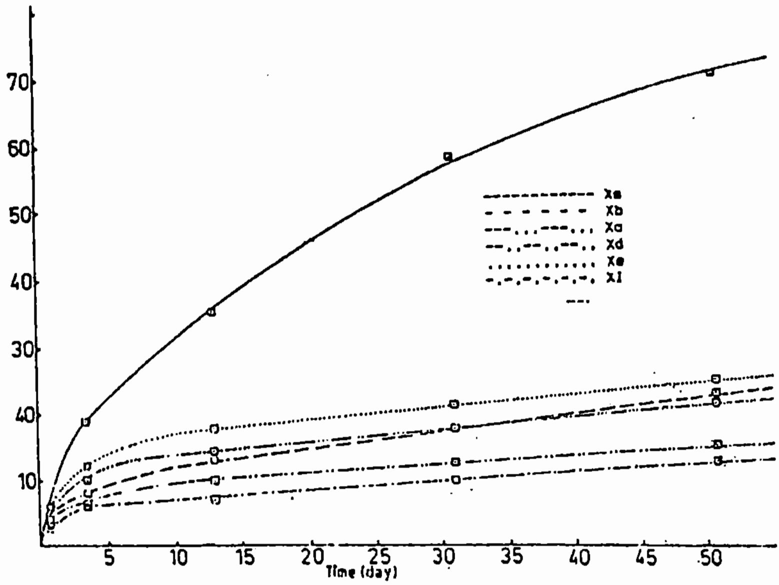


Fig.3. Baylucide released from 0.1g of polymers Xa-e and XI.

the Baylucide release as shown in Fig.3. The polymeric Baylucide Xa undergoes release with a slight decrease in the rate than the higher hydrophilic polymers Xc-e. The slower hydrolysis of Xb than Xc-e may be due to the nature of the phenyl rings which decrease the compatibility between the medium and the active sites. However, the higher release of Baulucide from hydrophilic polymers may be attributed to the intramolecular interactions of the neighbouring polyethylene glycol. These groups can be regraded as protic solvents with aprotic sites, which accelerate the hydrolysis reactions. However, in a medium of pH=10 the homopolymers appear to have the higher release rates, Fig.3, which may also be attributed to the hydrophilicity effect of the carboxylic groups generated during the initial hydrolysis.

The hydrolysis data indicate that the release rates are strongly dependent upon the nature of the hydrolyzing medium and the polymer structure and properties such as the type of binding group, the degree of crosslinking and the nature of the hydrophilicity of the polymer.

In general, all PCP-polymers showed significantly fast release because resonance of charge in the phenyl ring stabilizes the phenoxy anion making it a good leaving group in ester hydrolysis. The hydrolysis data of poly(pentachlorophenol acrylate), XVa, and its copolymers with styrene, XVb, and 4-vinylpyridine, XVc, showed an increase in release rates in dioxane-water as well as in the basic media. However, the rates in water and acidic medium were quite similar and slightly lower than in basic medium. Comparison between the release rates of the homo- and copolymers suggests that the rates increase with increase in the degree of hydrophilicity. Copolymer XVc hydrolyses more than twice as fast as the homopolymer XVa, which has considerably higher rates than the hydrophobic copolymer XVb, as shown in Fig.4. The increase in the rate of hydrolysis of XVc can be attributed to its higher pyridine content, while the decrease in the rates of XVb can be attributed to its higher hydrophobic phenyl rings. Thus, the hydrophilicity as determined by the comonomer type and composition appears to be a major factor governing the rate of hydrolysis.

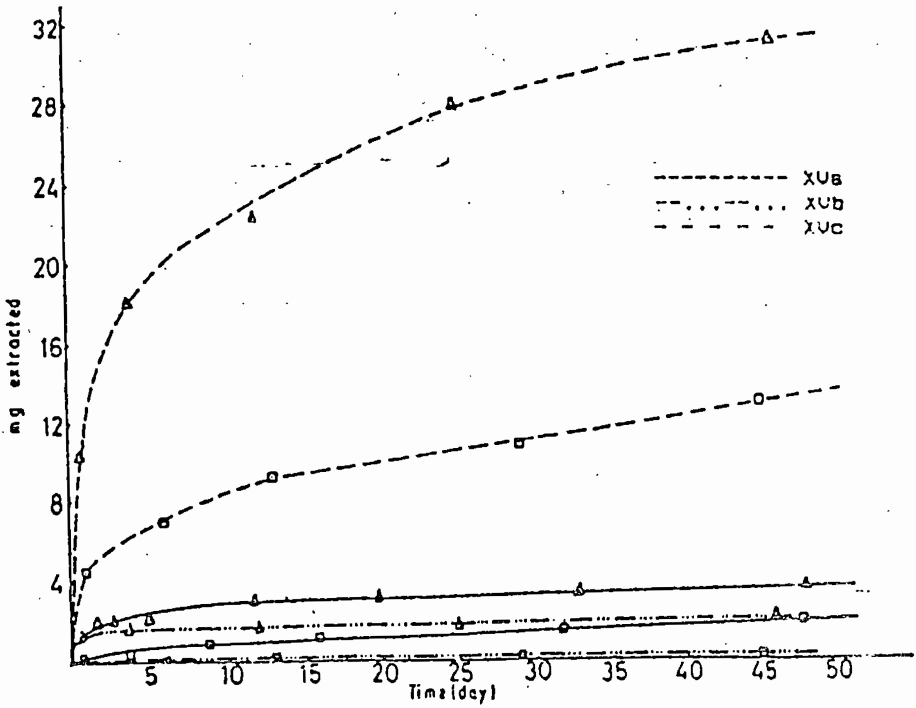


Fig.4. Pentachlorophenol released from 0.1g of homopolymer XVa, and copolymers XVb and XVc.

Additional examples of the overriding effect of the comonomer type and composition can be found by comparing homopolymers XVIa, XVIIa and their copolymers with styrene XVIb, XVIIB and with pyridine XVIc. The copolymer with pyridine residue XVIc delivered a higher amount of PCP, while the copolymers with styrene XVIb and XVIIb released a lower percentage of PCP than the homopolymer XVIa and XVIIa.

The effect of the temperature on the release rates of PCP from all polymers indicates that the release rates are enhanced by increasing the temperature from 30 to 60°C.

Although the first example has shown the effect of the hydrolyzing media and the hydrophilicity of the polymers on the release rates of PCP, however, there are some other structural properties which appear to be major factors affecting the rate of PCP hydrolysis. The PCP polymers XIX, XX and XXI were chosen as other examples for studying the effect of the spacer oxyethylene units and the degree of crosslinking, as well as the effect of the hydrolyzing media and the nature of the comonomers on the release rates.

The rates of hydrolysis for the homopolymer XIXa, XXa, and XXIa are faster than the corresponding homopolymer XVa, XVIa and XVIIa. The release rates are also dependent on the degree and the nature of the comonomer units. The incorporation of hydrophobic styrene residues along the backbone of the copolymers XIXb, XXb and XXIb, results in slower hydrolysis of ester linkages than the corresponding homopolymer. However, the rates of PCP release can be increased dramatically by incorporating oxyethylene comonomer units along the polymer backbone XIXc. These groups are very effective in catalyzing the hydrolysis of the PCP-polymer ester bonds. The structural picture provides a satisfying explanation for the hydrolytic release data in Fig.5, since the more hydrolytic copolymer can be expected to hydrolyze at a faster rate than the more hydrophobic copolymer.

The linear polymer XIXc is characterized by a rapid initial release in the first days followed by a more gradual rate lasting several days. The crosslinked systems XIXd-f have much lower release rates with little initial release. This could be predicted by the time required for the swelling of the hydrophilic polymer, so that hydrolysis and diffusion could occur. After swelling, slight concentration increases were noted. Plots of solution concentrations versus time (Fig.6) indicate that the linear polymer XIXc releases PCP much more rapidly than the crosslinked systems. Although the presence of the hydrophilicity may result in an increase in the rate of

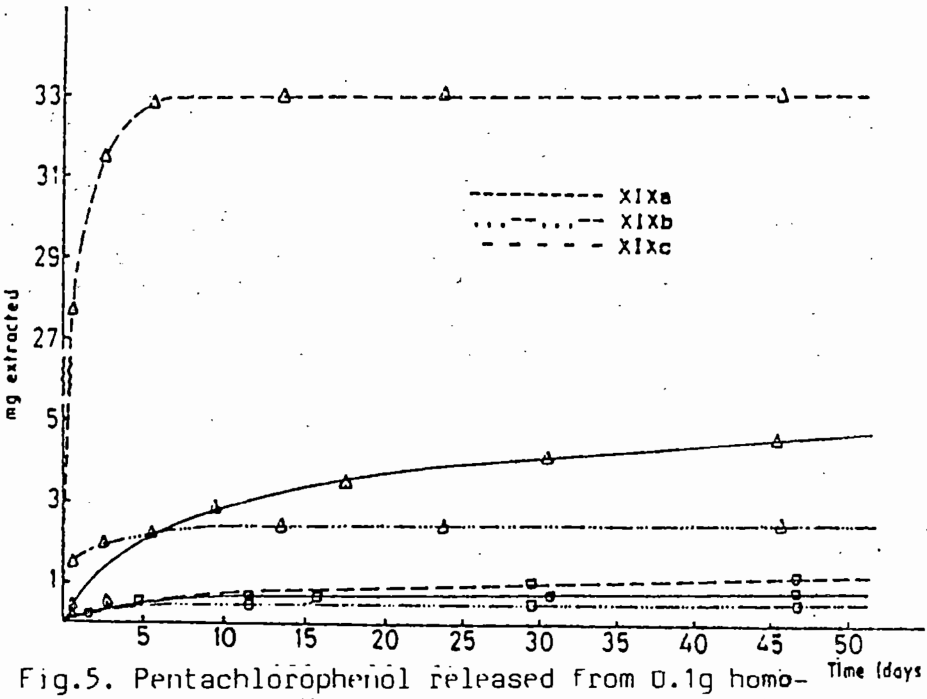


Fig.5. Pentachlorophenol released from 0.1g homopolymer XIXa and copolymers XIXb and XIXc.

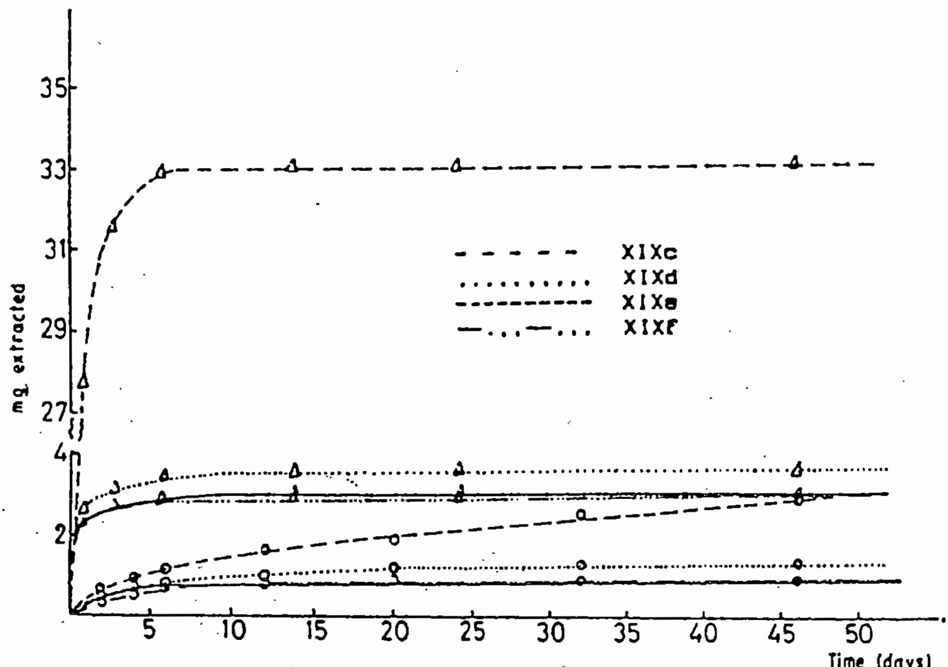


Fig.6. Pentachlorophenol released from 0.1g of linear XIXc and crosslinked polymers XIXd, XIXe and XIXf

hydrolysis, the degree of crosslinking appears to be the major factor governing the rate at which a given copolymer undergoes hydrolysis. For example a linear copolymer XIXc hydrolyzed more than six times as fast as the linear homopolymer XIXa which can be attributed to its higher 2-(2-hydroxyethoxy)ethyl methacrylate content. However, the crosslinked copolymer XIXa releases PCP at nearly constant rates. This can be attributed to the hydrophilic groups which autoaccelerate the hydrolysis despite increasing the degree of crosslinking. The costs for the production of 1 Kg of pure Baylucide polymers are listed in table 4.

Table 4. Costs of produced polymers depending on the prices of fine chemicals catalog (Aldrich, 1989/1990):

Product Loading	Price* $/Kg	Starting Materials for producing 1 Kg	Weight	Price* $
Baylucide	75	S-chlorosalicylic acid 2-chloro-4-nitroaniline phosphoroustrichloride xylene diethanolamine	751g 751g 154ml 1.5L 165g	36 20.5 3 6 1.5
II (50%)	122	Amberlite 1RC-50 Niclosamide thionyl chloride base and solvent	306g 694g 600ml	8 57.5 10 46.5
IIIa 83%	75	Amberlite IRA-401 Niclosamide base and solvent	423g 543g	17 45 8
IIIb 68%	62	Amberlite IRA-400 Niclosamide base and solvent	423g 445g	17 37 8

* U.S. Dollars.

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748315
Telex : 92925
ASICA UN.

34 TALAT HARB STREET . CAIRO - EGYPT.

Date : 8 March, 1988.

Dear Dr. Okela,

We are the National Bureau of Tips which is a United Nations project to promote exchange of technology between the developing countries. Technological information is gathered and distriputed between the participating countries. We just announce the new ideas, but terms of exchange remain according to agreement between the owner and the interested parties. Enclosed is a pamphlet about our project.

We read about your discovery of molluscicide. We want to announce about it in our daily pamphlet South Tech. They wanted to know some information about it. Please send us some details about it e.g Ch. grouping, methods of application.

With best regards,

Dr. Esmat Ezz.

D. E. Ezz

N B Director.

TIPS, a network for the exchange of technology and trade information among developing countries, is being implemented by DEVNET under contract with the United Nations Development Programme.

A. AKELAH

NATIONAL DEVELOPMENT CONSULTANCY SERVICES (PVT.) LTD.

NADECS

3rd Floor, Zambia House
Cnr Union Ave/Julius Nyerere Way
Harare

P.O. Box 2013
Harare Zimbabwe
Telephones: 729559
729550
Telex: 4666 PCO ZW

1 September 1988

Ahmed M. Akela
Faculty of Science
Tanta University
Tanta
EGYPT

Dear Sir

RE: BILHARZIAL SNAIL MOLLUSCIDE

I write to introduce our company, National Development Consultancy Services (Pvt) Ltd. We are a private sector organisation funded from our own sources.

We are a leading indigenous consultancy company rich in experience in the policies, priorities and future prospects of our Government and the sub-region.

Our primary purpose is to identify projects and then identify partners from the developed or developing countries which can provide transfer of technology to our Companies which are prepared to promote the projects.

We need the technical and cost information so that we can assist in writing up the project, assist in negotiating agreement, obtain our Government approval and arrange for financing where necessary.

My organisation seeks to have more information on the above project so that we can find an appropriate partner in our country.

I have enclosed our brochure.

Yours sincerely

M.A. Mawema (Dr.)
MARKETING DIRECTOR

WHO ARE WE?

SADECS is an indigenous Consultancy Company rich in experience in the policies, priorities and future prospects of the Zimbabwe Government.

SADECS is managed by economists, accountants and administrative experts who themselves have had wide and varied experiences in developmental matters in Zimbabwe and have close association with SADCC and PTA Governments.

OUR OBJECTIVES

- to assist indigenous businessmen in project formulation.
- to identify projects which promote a national balanced economic growth.
- to identify import-substitution oriented projects.

SERVICES ASSISTED AND OFFERED BY SADECS

- We develop ideas into concrete fundable projects
- Industrial Project Allocation applications
- Commercial Allocation Applications
- Loan applications to banks, finance houses, NGO and Government institutions.
- Project appraisal, feasibility studies
- Market Surveys and farm budgets.
- Customs clearance, import and export licences
- Tarrif protection, barter deals and counter trade agreements.
- Formation and registration of companies agreements of sale.
- SADCC and PTA transactions Export promotions and Export Revolving Fund applications.
- Technology transfer - coupling Zimbabwe business with foreign investors.
- Identification of bankable projects and raising of capital funds.

Directors :

M.	Nesangano	(Managing) B.Sc, M.Sc. (Econs)
B.	Mafodze	B.Sc. (Econs)
Dr. M.A. Mazema		ED-D, FBIM, M Inst. Mktg.

A. AKELAH

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Ref: TT/1/15

27 September 1988

Prof. Dr Ahmed Akelah
Chemistry Department
Faculty of Science
Tanta University
TANTA
Egypt

Dear Prof. Akelah,

re: BILHARZIA SNAIL MOLLUSCICIDE

I acknowledge receipt of your letter dated 20th of September 1988 concerning the above.

We are interested in the project. We have understood how the polymeric molluscicides work. We are interested in knowing what the total cost will be in US dollars of establishing a plant to prepare the polymeric molluscicides. We welcome the idea of sending us some samples of the polymeric molluscicides.

We are also interested in the research project concerning the production of reactive polymers for dual application of agriculture.

Can you kindly advise us if all these projects are only results of research or they have been developed into production. If they have been developed into production, we need to know the following:-

i. Brief description of manufacturing process;
ii. Estimated capital of manufacturing process;
iii. Estimated annual operating costs of project;
iv. Estimated output of plant;
v. Estimated employment; and
vi. Cost build up of product.

We need to know this information for the two projects so that we are able to make a decision of investment. The plant we are having in mind should be small or medium size.

Thank you.

Yours sincerely,

Dr M.A. Mawema
MARKETING DIRECTOR

HEALTH AND ENVIRONMENT

Southern Company Services, Inc
Post Office Box 2625
Birmingham, Alabama 35202
Telephone 205 870-6011

Southern Company Servic
the southern electric syst

August 9, 1988

Dr. A. Akelah
Chemistry Department
Tanta University
Tanta
Egypt

Dear Dr. Akelah:

I have recently evaluated several molluscicides and would like to reference your own work in the forthcoming paper. Although my study determined the effectiveness of several nonoxidizing biocides on the freshwater clam Corbicula fluminea, any information you have concerning the use of molluscicides in freshwater or saltwater would be greatly appreciated. In return, I will gladly send you a copy of my finished paper.

Thank you for your help.

Sincerely,

George Ramsay

George G. Ramsay
Research Engineer

fmb:2364o

cc: D. W. Morris
R. E. Rush
J. H. Tackett

A. AKELAH

Department of Pharmacy

CHAIRMAN:
Professor T. E. Chagwedera
B.Sc. (S. Leone), M.Sc. (McGill),
Ph.D. (Université Laval)

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FACULTY OF MEDICINE UNIVERSITY OF ZIMBABWE

#i

15th August 1988

Ahmed M. Akela
Faculty of Science
Tanta University
Tanta
EGYPT

Dear Sir

Please send me further information and any other relevant details on Bilharzial Snail Molluscicide.

Thank you

Professor T E Chagwedera
CHAIRMAN
DEPARMENT OF PHARMACY

/mk

Dr. Kruse zum Honorarprofessor ernannt

Dr. Joseph A. Kruse, Ltd. Direktor des Heinrich-Heine-Instituts der Stadt Düsseldorf, erhielt am 24. Juli 1986 von Rektor Prof. Dr. Gert Kaiser die Ernennungsurkunde zum Honorarprofessor.

Dr. Kruse, 1944 in Dingden Kreis Borken geboren, schloß sein Studium an der Universität Bonn 1969 mit der Ersten Staatsprüfung in Deutsch und Katholischer Religion ab. Das anschließende Promotionsstudium absolvierte Dr. Kruse an der Universität Düsseldorf (1969–1972). Hier fertigte er seine Doktorarbeit über „Heines Hamburger Zeit" bei Prof. Dr. Manfred Windfuhr an und legte an der Phi- losophischen Fakultät der Univ- 1972 sein Doktorexam- er wissensch- ne-

einen größeren Leserkreis anzusprechen vermag.

Dr. Kruse betätigt sich auch erfolgreich als Herausgeber mit Heine-Forschung. So gibt er seit 1977 jährlich das „Heine-Jahrbuch" und seit 1978 in loser Folge die „Heine-Studien" heraus. Es ist mit sein Verdienst, daß Düsseldorf zu einem der Zentren der internationalen Heine-Forschung geworden ist. Erwähnt werden muß auch, daß Dr. Kruse üb- zialgebiet hinaus nach - Themenbere- ha-

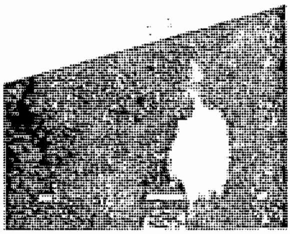
DÜSSELDORFER UNI-ZEITUNG 5

Oktober 19-

15. Jahrgang, Nr. 5

-ommen. S- der institutionali- si- -vermittlung, verbunden mit str- Solidität der wissenschaftlichen Arbeit, zeichnet sich u.a. auch dadurch aus, daß er über den Rahmen der Fachkollegen hinaus

-ort, mit -veranstaltungen -en. Durch die Lehraufträge, -ruse kontinuierlich in der Germanistik der Universität Düsseldorf übernommen hat, gewannen die Studenten einen zusätzlichen Zugang zur literarischen Öffentlichkeit, zur Arbeitsweise eines Literaturmuseums, zur Heine-Forschung, zu Heine-Forschern aus aller Welt und zur gesamten Heine-Literatur bis hin zum Einblick in Handschriften.



Die Ernennungsurkunde zum Honorarprofessor für Dr. Kruse überreichte Rektor Prof. Dr. Kaiser.

Chemiker aus Ägypten: Prof. Akelah

Düsseldorfer Know-how für Ägyptens Landwirtschaft

Selbst weitgereiste Wissenschaftler zucken, wenn man sie nach dem Sitz der „Tanta Universität" fragt, ratlos mit den Schultern. Könnte vielleicht in Afrika liegen? Richtig, in Ägypten, wo sie mit 15000 Studenten im Reigen der 17 einheimischen Hochschulen durchaus nicht die kleinste ist. Einer ihrer Professoren, der Chemiker Dr. Ahmed Akelah, hielt sich als Stipendiat des DAAD jetzt drei Monate zu Forschungszwecken bei Prof. Dr. Wulff am Institut für Organische Chemie II auf, wobei er mit glänzenden Kenntnissen der deutschen Hochschulszene aufwarten konnte. Kein Wunder, hatte er doch fünf Jahre in Bonn studiert und bei dem seinerzeit dort tätigen Prof. Wulff auch seine Doktorprüfung abgelegt.

Der 40jährige Wissenschaftler, Vater dreier Töchter, erhielt für seine Forschungsarbeiten in Ägypten auch Zuschüsse aus Mitteln der amerikanischen Entwicklungshilfe. Der Grund wird klar, wenn er auf sein Spezialgebiet zu sprechen kommt. Er beschäftigt sich nämlich mit funktionell reaktiven Polymeren, organischen Verbindungen, denen in Form von Pestiziden und Herbiziden besonders in der Landwirtschaft große Bedeutung zukommt. Vorteil: Die Pflanzen brauchen nur noch im Abstand von etwa zehn Jahren damit behandelt zu werden, was die teure Herstellung ausgleicht. Und die entstandenen Abfälle können – kleingehäckselt – sogar als Dünger verwendet werden. Diese Forschung ist in Ägypten noch relativ neu, doch eminent wichtig für die Entwicklung als Agrarland. Zu seinem Bedauern muß sich Prof. Akelah an seiner Universität wesentlich mehr der Ausbildung der Studenten widmen, als ihm lieb ist.

Zur Forschung und Weiterbildung bleibt jungen Wissenschaftlern wie ihm dann nur der Weg ins Ausland. Zwei Jahre forschte er an der Strathclyde University in Glasgow und drei Monate in den USA. Ein Buch „Reaktive funktionelle Polymere" steht kurz vor dem Erscheinen.

فقدت البلهارسيا بشاعتها

... كواحده من اكبر الدول ... الواردات الالمانية ؛ حيث انه كان ... بتحقيق الدعم ... المستقبل ؛ | مجالات عديدة مثل استخراج البترول ...

UTILIZATION OF RESEARCH RESULTS, ALEXANDRIA, ed.S.KANDIL,1991

A CASE STUDY ON ANALYSIS OF RENAL CALCULI

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INSTITUTE OF GRADUATE STUDIES & RESEARCH,
AND
TOUSSON E. ABOUL-AZM
DEPARTMENT OF UROLOGY, FACULTY OF MEDICINE,
ALEXANDRIA UNIVERSITY, ALEXANDRIA, EGYPT.

ABSTRACT

Infrared spectroscopy has proved to be advantageous to wet chemical analysis in identifying the chemical constituents of renal calculi. The constituents of the core of the calculi, which were difficult to characterize using the wet chemical analysis, were easily identified using the infrared method.

A computer programme was established where reference data were filed to be compared with the sample and the identification process was fully computerized.

The research results were applied and offered a unique service to the leading Urologists in Alexandria University. The improved quality of analysis insured proper and accurate management. This has reflected in the enhancement of the health service offerred to the Egyptian public.

BACKGROUND

This case study presents a piece of research, which was done purely for academic curiosity with possible clinical application in the way of prevention of reformation of renal stone calculi. It was not funded by any external agencies. Only the facilities of both the Institute of Graduate Studies and Research and the Faculty of Medicine of Alexandria University were the assets of this research. Two students from the faculty of Medicine have accomplished this work through their M.Sc. studies[1,2] which were jointly supervised by members of staff from the Urology Department of the Faculty of Medicine and the Department of Materials Science, Institute of Graduate Studies and Research of Alexandria University. This research which demonstrates an interdisciplinary example has been reported in the open Literature[3,4].

INTRODUCTION

The importance of accurate knowledge concerning the chemical composition of urinary calculi is unquestioned. Techniques for analysis include X-ray diffraction[5,6] polarized microscopy[6,7] thermal analysis[8-10]infrared spectroscopy (IR)[8,11,12] as well as wet chemical methods[5,8,13]. The last method has been the most widely used one. However, it is time-consuming and a relatively large sample is required to analyse all of its components. Moreover, it is subject to error. The other procedures involve the use of sophisticated and expensive equipment and demand high operator skill. X-ray methods and optical crystallography are beyond the reach of most clinical laboratories and thus the infrared method has become increasingly important as a diagnostic tool.[5,7,14] It has proved to be the most practical method in the clinical environment. It is simple to perform and the identification is relatively easy even when a mixture of compounds is present. The required sample size is small and this factor is especially important in analyzing the core and shell of a stone separately. The core, often present in such minute amounts as to make chemical analysis difficult, is the most important target in indicating the primary cause of stone formation.

This research has aimed at investigating the accuracy of the infrared analysis technique as it should give a unique finger print spectrum which is characteristic of the chemical constituents of the renal calculi. Also it was aimed at investigating the posibility of identifying the core of these stones as the infrared method needs only few milligrams to prepare a fully identifiable sample. A comparison of these results with those obtained via the conventional wet chemical analysis method would assess the advantage of one of the techniques relative to the other. The infrared techniques when proved advantageous could be applied for routine analysis.

MATERIALS AND METHODS

One hundred and fifty five calculi were surgically extracted from one hundred and fifty-five patients admitted to the Urology Department, Faculty of Medicine, University of Alexandria and were used in this research work.

Samples were subjected to wet chemical analysis using the conventionally reported methods[13,15,16] as well as infrared spectroscopic analysis.[3] The characteristic spectra of authentic and accurately identified samples were collected and a computer data base was built-up. This data base was filed in a library and was used afterwards to identify unknown samples.[4] Figures 1, 2 and 3 show the

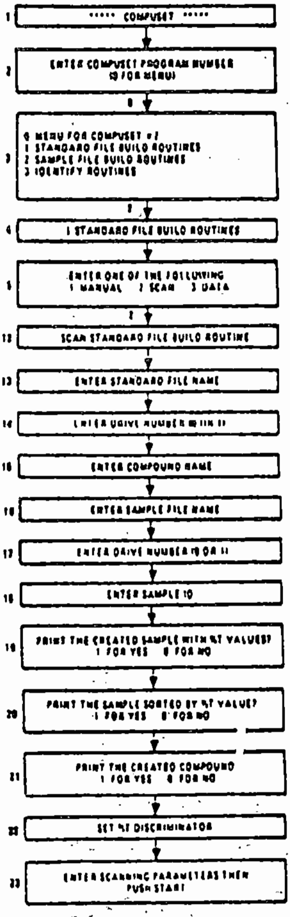

Figure 1. Standard file build routine.

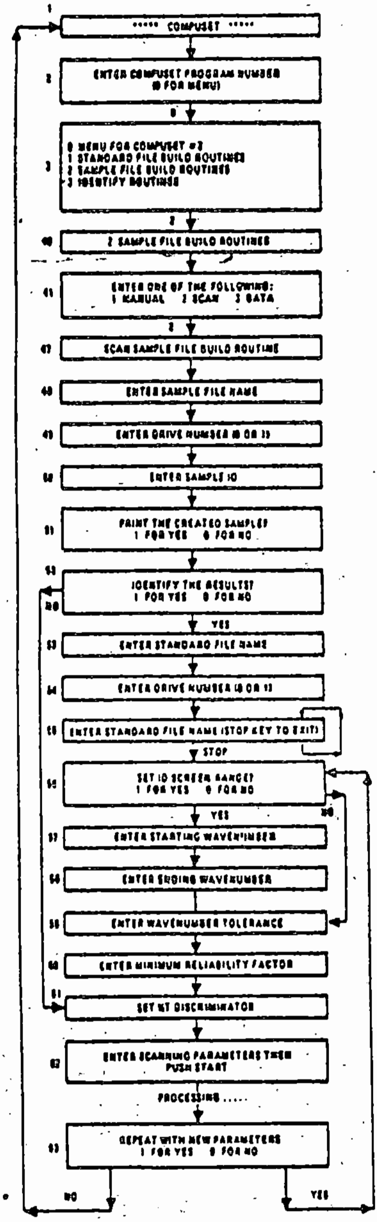

Figure 2. Sample file build routine.

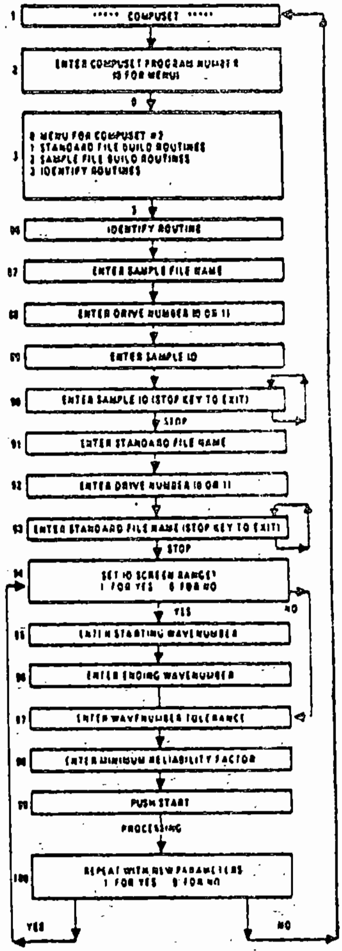

Figure 3. Identity routine.

basic flow sheets used to build the soft-ware needed to store the reference spectra, sample spectra and the identification routine respectively.

RESEARCH RESULTS

Results of this research showed the superiority of the infrared to the wet chemical analysis method. The former method identified about 50% more compositions which were not revealed applying the latter method. Tables 1 and 2 show clearly that the efficiency of characterization was highly enhanced using the infrared technique.

Table 1. Composition of stones by chemical analysis

Group	Composition of stone	Number
1	Calcium oxalate	82
2	Uric acid	11
3	Calcium phosphate	3
4	Calcium oxalate + Calcium phosphate	37
5	Calcium oxalate + Uric acid	4
6	MAP + Calcium carbonate	11
7	MAP + calcium carbonate + calcium oxalate	5
8	MAP	2
Total		155

MAP = Magnesium ammonium phosphate.

Table 2. Composition of stones by infrared analysis

Group	Composition	Number
1	Calcium oxalate monohydrate (COM)	26
2	Calcium oxalate dihydrate (COD)	7
3	Uric acid dihydrate	8
4	Ammonium acid urate	3
5	COM + COD	8
6	COD + phosphate	30
7	COM + phosphate	32
8	Calcium oxalate + uric acid	15
9	COM + calcium hydrogen phosphate (CHP)	5
10	TP + magnesium hydrogen phosphate	3
11	MAP + calcium carbonate (CC)	11
12	Calcium oxalate + MAP + calcium carbonate	5
13	Magnesium ammonium phosphate hexahydrate	2
Total		155

TP = Tricalcium phosphate.

MAP = Magnesium ammonium phosphate.

Most importantly, the nuclei of the calculi which are most vital to be correctly identified, were characterized and in many cases proved to be different from the outer-shell (table 3). This has influenced the management and therapy and ensured that it was directed to the right path.

When the produced spectra were stored in a computer memory, the unknown samples were identified without having any possibility for human interference, and hence the major source of errors in the identification process was successfully avoided. Figure (4) shows the characteristic spectra while table (4) reports the peak assignments.

APPLICATION OF RESEARCH RESULTS

This research has caught the interest of leading practicing urologists in Alexandria, and they were eager to see such a service offered to the public, particularly for those cases which needed confirmation of analysis. The department of materials science has decided to offer such service for a reasonable price which could partially pay

Table 3. The composition of nuclei of stones and its outer shell.

Composition of nuclei	Composition of its outer shell	No.
Calcium oxalate monohydrate (COM)	COM + phosphate	3
COM	Uric acid dihydrate	1
COM	COM + uric acid	1
COM	COD	1
COO + phosphate	Calcium oxalate + MAP + CC	2
COO + phosphate	MAP + CC	1
COM + phosphate	COD + phosphate	1
COM + phosphate	COM + CHP	1
Calcium oxalate + uric acid	COD + phosphate	1
Calcium oxalate + uric acid	MAP + CC	1
MAP + CC	COM + phosphate	1
		14

The rest of 55 samples showed identical composition of the nucleus and outer shell of the renal calculi.

COM = Calcium oxalate monohydrate.

COD = Calcium oxalate dihydrate.

CC = Calcium carbonate.

MAP = Magnesium ammonium phosphate.

Table 4. The characteristic infrared absorptions of the constituents of renal stones

Compound	Characteristic absorptions	Compound	Characteristic absorptions
Calcium oxalate monohydrate	At 1620, 1360, 1320, 940, 870, 770 and 660 cm^{-1}. The band at 1620 cm^{-1}(strong)is assigned to the stretching frequency of the carbonyl band. Absorptions around 1380 cm^{-1} (shoulder),1320 cm^{-1}(strong) are due to O—C stretch. There is broad absorption at 3500-2800 cm^{-1} by the vibration of water molecules (hydroxyl stretch and different modes of hydrogen bonding).	Magnesium ammonium phosphate hexahydrate	Showed absorption maxima at 1470 and 1445 cm^{-1}, and a P=O band showed maxima at 995 cm^{-1}. There is a further absorption band at 770 cm^{-1},the bands at 1470 and 1445 $cm^{-1}$are attributed to the vibrations inside the NH group.The dislocation of PO maximum to the wave numbers nearer to 1000 cm^{-1} differentiates this compound from other phosphate compounds
Calcium oxalate dihydrate	There are significant differences between this compound and calcium oxalate monohydrate in the 3500-2800 cm^{-1} region. This difference is attributed to the difference in hydrogen bonding caused by the increase of the water molecules. The bands at 940 and 870 $cm^{-1}$are absent. The band at 770 $cm^{-1}$is slightly broader in the dihydrate	Calcium hydrogen phosphate dihydrate	Weak absorptions at 1120, 1030 and 990 cm^{-1} which may be attributed to vibrations of P—O and P=O bands
		Tricalcium phosphate	Bands at 1440(medium)and 1030(strong)cm^{-1} are assigned to different bending modes associated wi P—O and P=O stretches.
Uric acid dihydrate	At 1660, 1300, 1200, 1035, and 995 cm^{-1}. The band at 1660 cm^{-1} (strong)is due to the carbonyl group. The absorption at 1120 cm^{-1} is assigned to the C—N stretch. A broad band in the region 3600-2300 cm^{-1} is assigned to various N—H stretches as well as the hydroxyl stretch of the water.	Magnesium hydrogen phosphate trihydrate	Absorption bands at 1240 and 1160 cm^{-1} and a broad PO absorption with maxima at 1060 and 1020 cm^{-1}. There is a further band at 890 cm^{-1}.
		Calcium carbonate	A broad absorption maximum at 1420 cm^{-1}, a sharp bifid peak at 880 and 860 cm^{-1}, and a further sharp peak at 720 cm^{-1}

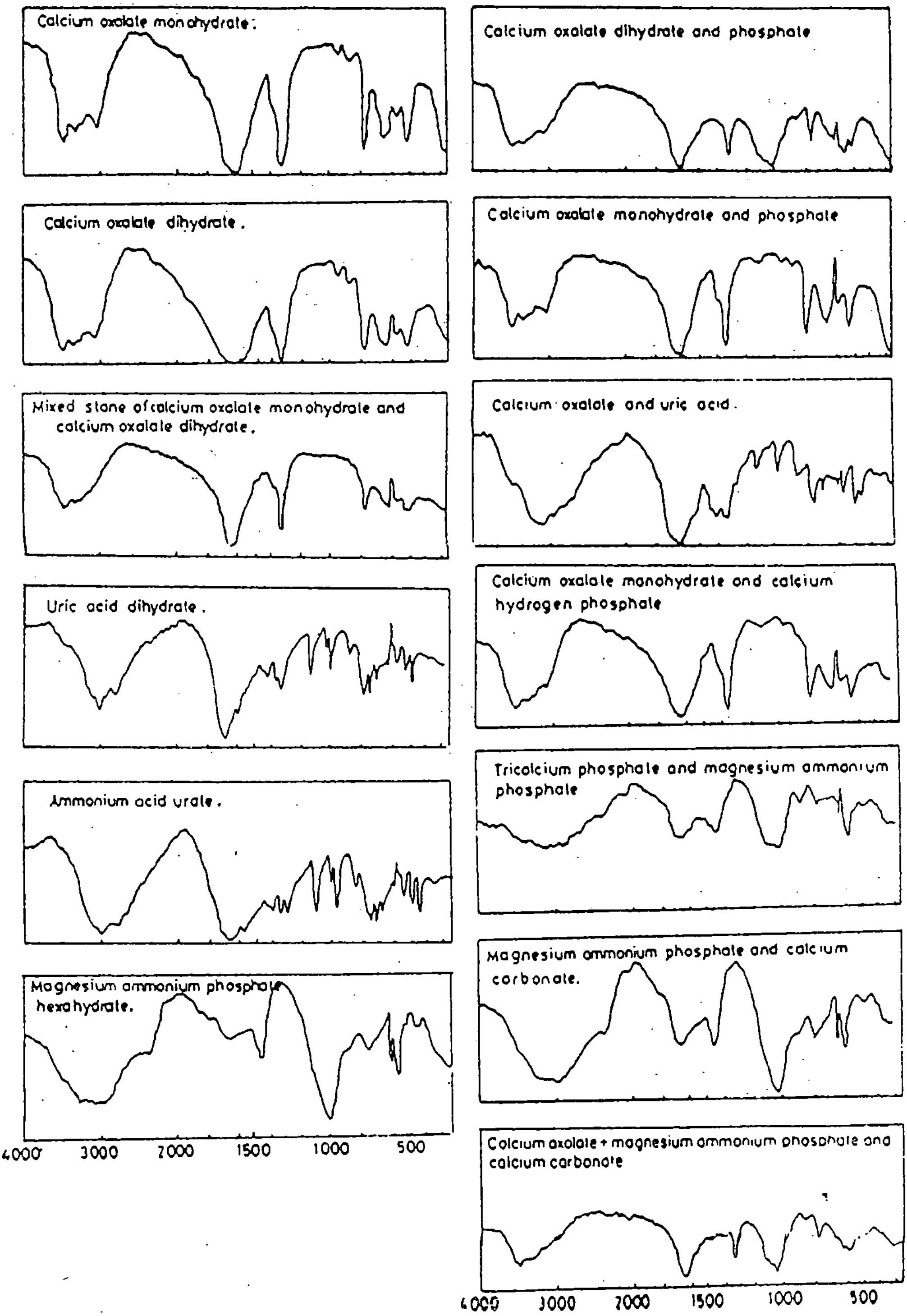

Figure 4, Representative spectra of renal stones.

for the maintenance, supply of essential materials and the time of personnel involved.

Although this service has not been advertized or publicized, over seven urologists of the faculty of medicine at Alexandria University have made use of it. It was reported, at least in one case, that as the nucleus was identified to be different from the previous wet chemical analysis results, the course of management has completely changed and the patient health condition has greatly improved as he did not suffer recurrency of stone formation, or more accurately less frequent recurrence than was expected.

Most interestingly, other private clinical laboratories (at least we know of one) started to offer this service using our published data.

Another future application is the possible identification of mono-and dihydrate calcium oxalate crystals among those obtained by centrifugation of urine samples (24 hours collection). This will lead to the choice of new methods of treatment such as ultrasonic disintegration of stone or electric-shock wave lethotripthy.

CONCLUSION

This piece of research gives an example of the application of research results in the health service area. It gives reliable and accurate results of analysis of renal calculi, a service which is badly needed in the medical profession. It could be reflecting on the health of the public by rectifying the path of management and treatment. It could also be a resource of funds for the university.

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SESSION SIX

RECOMMENDATIONS

RECOMMENDATIONS OF THE WORKSHOP ON "UTILIZATION OF RESEARCH RESULTS"

ALEXANDRIA 5-7 DECEMBER 1989

(1) This workshop notes the need for the implementation of a strategic and tactical grand national plan for scientific research. This plan should be disseminated via the various disciplines of each university and should make good use of the creativity of scientists in universities and research centers.

(2) The workshop recommends that each university seeks to strengthen its research in areas which reflects well on its community in order to be a focal reference point for society. In this context attention should be paid to pre-structured and integrated research of post-graduate students. Also specialized workshops for specific local industries and products should be organized.

(3) The need for enhancing the national scientific and technical capabilities through:

a. Conducting training in research, development and technology management.
b. Encouraging young scientists to spend lengthy periods in the productive sector.
c. Encouraging multidisciplinary research and the blending of social and natural sciences.

(4) The promotion and evaluation of university staff should include, in part, the impact of their research on community service and their role in extension services.

(5) This workshop recommends the establishment of mechanisms for the utilization of research results via:-

a. Establishment of centres for technical and consultative services that will organize, mobilize and market research results.
b. Establishing centres in the universities to liaise between potential clients and users and the research scientists, and ensure early planning of research and compatibility with the socioeconomic requirements.
c. Supporting the technical development concerning the translation of research results to the proto-type level.
d. Establishing companies to develop, manufacture and market the output of research.

(6) The workshop notes the urgent need of coordination between the various information centres within the society.

(7) Enhancement of technical and scientific awareness within the society is needed. This could be achieved via providing the media with suitable and appropriate scientific information.

(8) The workshop notes the need of encouraging and adopting the new and emerging technologies.

(9) This workshop looks upon Alexandria University to set a model for implementing some of these recommendations via establishing a liaison centre to create a dialogue between the university and the productive sector and community in general. The workshop calls upon international organizations and funding agents to support the realization of this model.

LIST OF PARTICIPANTS