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Extending Agricultural Research Beyond the Farm:
Experiences of IDRC's Postproduction Systems Program¹

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ABSTRACT

This paper provides an overview of the experience gained in project design and management within the postproduction program of Canada's International Development Research Centre (IDRC). Initiated as a program in postharvest technology, the focus of the program has evolved. With experience, the importance of understanding the entire system from food production to consumption has been recognized as being crucial to project success. This progression in thinking was possible at IDRC because a group of program officers worked as a team for most of 15 years and brought together experiences from numerous projects in various parts of the developing world.

This evolution in project design is reviewed and analyzed to highlight the lessons that were learned and to share these experiences with food researchers, rural development practitioners, program officers, and project managers. By improving the design of research projects it is has been possible to address and solve problems shown to be important to communities in developing countries. Research projects that have adopted this revised approach to postproduction research have generated results that have created employment and income in rural communities by addressing constraints that were identified in the food system.

INTRODUCTION

Created in 1970 by an act of the Canadian Parliament, IDRC provides funds and advice for development-related research in Third World countries. This research, which is based on the individual needs and priorities of the countries, is provided by the Centre in seven areas: Agriculture, Food and Nutrition Sciences; Communications; Earth and Engineering Sciences; Fellowships and Awards; Information Sciences; Health Sciences; and Social Sciences.⁴

IDRC is an autonomous organization. Although funded entirely by the Parliament of Canada, IDRC operates under the direction of an international Board of Governors. Seven members of the Board are from developing countries.

The Centre's operations are based on the belief that the best understanding of a country's problems comes from within, and that solutions must be appropriate to the priorities and aspirations of the people and to their resources and culture. For this reason, the projects supported by the Centre are identified, designed, conducted, and managed by researchers in developing countries.

IDRC's mission is to contribute to economic and social development through both research and activities that support research. Emphasizes is

⁴Since this paper was written, IDRC's structure has changed. Information on current programs can be obtained by writing to Corporate Affairs, IDRC, P.O. Box 8500, Ottawa, Canada K1G 3H9.

place on research that is directly relevant to basic human needs and that supports development based on sustainable growth, equity, and participation.

Third World countries are encouraged to draw on the knowledge and experience of their own scientists. In this way, local researchers can enrich their skills, strengthen their professional networks, share common experiences, and expand their ability to contribute to the future of their regions and countries.

To accomplish its mission, the Centre has found it increasingly important to understand the interrelated social and economic factors that are part of the real-life setting in which research outputs of any kind are expected to contribute to development.

It is the purpose of this paper to recount how project design changed within the postproduction systems (PPS) program of IDRC's Agriculture, Food and Nutrition Sciences Division. It retraces the steps that were taken, highlights the conclusions that were reached along the way, and summarizes the lessons learned.

The PPS Program

The PPS program was established to look for ways to help farmers deal with the problems they encountered once their agricultural products were harvested. Specifically, the program has sought to develop and promote

better storage, handling, and drying technologies and to improve the management systems for these processes. Research has been funded to develop, test, and apply better processing methods to extend shelf life; technologies have been introduced to enhance and preserve food using traditional processes and products, and small-scale food enterprises have been established to create income and employment opportunities. As a byproduct of these activities, postproduction research capabilities have been improved and research institutions in many developing countries have been strengthened.

The evolution that has taken place within the PPS program has occurred gradually over more than 15 years, and has drawn on experiences gained from over 270 projects funded in over 50 countries at a cost of more than CAD45 million.

The process was iterative. By building on project experiences from all regions of the developing world, a revised view was constructed of how research projects could be designed. Projects were negotiated and supervised by the same six staff in the PPS program. This was both fortunate and essential because without this continuity, the constant review, integration, and analysis necessary to understand the factors that influence the appropriateness of project results and their relevance to community development would not have been possible.

Food production and postharvest activities in most developing

countries involve a large number of small enterprises that prepare, process, store, distribute, and market food products as well as supply other goods and services that are inputs to the production process. These enterprises provide jobs for more than half the industrial labour force in most developing countries. Emphasis in the PPS program is therefore placed on improvements in processes and technologies for existing enterprises and on the search for effective ways to establish and sustain new enterprises. More efficient use of available labour, higher return on investment, improvement in product quality, reduced drudgery in the workplace, and new product development and introduction are among the program's research objectives.

It is important to place the activities normally associated with the postharvest and market system in a total food-system perspective. A very simple illustration is shown in Figure 1. The postproduction and market system occupies a key position between producer and consumer. Messages about consumer demand and producer supply are transmitted through this system. The system also provides a range of services to both producers and consumers and, through the processing of raw agricultural commodities, produces modified products with characteristics often vastly different from the initial material. These activities and their underlying technologies indicate major groups of postproduction functions. The lower box indicates some of the many criteria that products produced by the postproduction system must meet to satisfy consumers. These same criteria must also be

reflected back to producers to determine what raw materials are required.

Of course, this system is not totally efficient even in very integrated economies. In most developing countries there are discontinuities, lack of communication and infrastructure, incomplete information, and very local markets. Nevertheless, the model helps put things in perspective. This is important because research and development related to the food system is still so dominated by the commodity-production perspective that the essential role of the postproduction sector is often ignored or assumed away by agricultural researchers concerned with food problems.

There is one more essential aspect of the food-system picture that bears emphasis. The whole postproduction and market system does not operate in a vacuum, it operates within an environment of national and international policies. Decisions that are made and pressures brought to bare at this level have a great deal to do with who in society will benefit most, what prices will be paid, and what products can viably be produced, manufactured, and distributed locally, regionally, and nationally. Imports, exports, subsidies, urban versus rural demands, and a host of other more political decisions impinge on the consumer -- postproduction market -- producer system.

The processing, culling, and distribution of agricultural commodities often produces large quantities of by-products and low-quality materials not suitable for human consumption but quite adequate as is, or with modification, for animal feed and other uses. This additional value that

producers can obtain from the use of the total biomass is frequently overlooked when research priorities are established to improve production technology. In some cases, the by-product may be more valuable than what is considered the principle product for human food.

Technology Focus

Projects 10 to 15 years ago looked mostly at improving specific drying, storage, and processing problems. IDRC staff visited institutions to identify researchers willing and able to carry out research and together research ideas were developed. The projects were generally designed to answer questions that were defined by researchers based on their understanding of the problems that were affecting the postharvest system or on specific scientific problems of interest to them, e.g. the design and evaluation of equipment. Although the intended beneficiaries were almost always the rural poor, these people were only superficially consulted when the problems were being defined, and they were seldom included when the output of the research activities were being assessed.

For example, in West Africa, drying projects involved the development of solar dryers for specific commodities (fish in Mali, onions in Niger), while storage projects compared various storage systems or studied the characteristics of stored grains. In most of these projects, field work was a weakness because the research teams, generally biochemists or engineers,

had little experience conducting on-farm or market research. Instead, most of the research was based on laboratory work, and extension staff were expected to introduce and promote the resulting technical solutions.

Using this approach, the solutions were often not used, not because they were necessarily technically flawed but because they had been developed taking only the scientists' criteria into account and in isolation from the needs of the people.

Some of the projects did include socioeconomic components to define the storage and drying problems and to evaluate the acceptability of potential solutions, but they tended to be poorly carried out or ignored either because the researchers lacked experience in these areas or because the social scientists hired to carry out these tasks were isolated from the main project and thus their input was not integrated with the technical aspects of the research.

As a result, the farmers could not afford to buy the dryers and some of the dryers, even if affordable, were not suitable because that they could only dry a small amount of produce, could not fit with traditional work patterns, were difficult to control under rural conditions, had too high operating costs, or produced no apparent benefits for the farmers.

Technology with Socioeconomics

PPS-supported projects from around the world ran into similar

problems. Ongoing reviews of these projects suggested that the usefulness of various interventions could only be determined if appropriate operational field work to identify the real needs and wants of farmers, processors, marketers, and consumers became an integral component of the design of future projects.

A fundamental change in project design was introduced in the early 1980s. Initial assessment studies were included in projects to determine the nature of the problem and identify who faced it. It became clear that the characteristics of the "hoped for solution" from the projects had to be spelled out. Factors such as the scale of the intervention, its costs, its ability to compete with what was currently being done, and the opportunities to market the idea or product became part of the array of questions asked during project development.

This change in project design meant that multidisciplinary teams were needed to manage the range of technical, economic, and social questions that had to be addressed. As well, research projects needed followup field studies to assess the acceptability of the interventions. This integration of new ideas into projects placed additional demands on the project leaders and placed even greater importance on their enthusiasm, skill, and resilience. Training for project leaders and project staff in the management of multidisciplinary research that often involved several institutions became increasingly important for projects within the PPS program.

Deliberate changes were made in the way in which projects were developed. No longer were funds provided to support isolated technological research. When program officers were approached with projects of this type, where good ideas were being suggested for important problems, they negotiated changes in the structure and methodology of project proposals to incorporate a much wider range of activities. In particular, initial needs assessment studies were promoted -- often as a small project to clearly identify problems, opportunities, and approaches to solve and implement solutions and to encourage participation of intended beneficiaries in the research process. The appropriateness of the technological research identified in this way was then verified during the life of the project by periodically checking project assumptions with the intended beneficiaries.

As experience was gained with these projects, the importance of developing rural food enterprises as part of the overall development plan surrounding the research project became apparent. One of the most important advantages of these enterprises was that they could create employment and income opportunities in the rural areas that were the target of most of the development projects. However, there were also practical advantages to locating postharvest activities in rural areas. Because the processing steps were close to the agricultural activity, loss resulting from transportation could be reduced, and because only the processed or partly processed products had to be shipped to urban centres, transportation cost

were lowered.

The value of understanding the entire food system is underscored by experiences with research on grain drying in Asia. Although drying is a crucial step to maintain grain quality and avoid spoilage, and many earlier projects had developed dryers that could reduce the moisture of rice so that it could be stored without deterioration, these "improved" dryers were often not accepted by the farmers.

A project supported to analyze the rice handling and marketing system showed that to be acceptable a dryer had to produce a profit for the farmer. The only way this could occur was if the rice fetched a higher price and thus covered the investment and operating costs. Without this price incentive, farmers, quite reasonably, would not make the investment in a dryer. When commercial producers found that they could command a higher price for better quality rice, things changed. Premium quality rice could be produced only if the rice was dried on the farm immediately after harvest. By working with the farmers, the commercial processors were able to link consumer demands for quality rice with farm production and drying. This linkage produced greater efficiency and increased profits for both farmers and processors. Dryers then became a necessary and profitable input into the farmers' production system and they were adopted and used.

Projects supported during this period were encouraging because they showed evidence that some of the earlier constraints to adoption of the

results of the projects were being overcome. Specifically, the initial needs assessment studies that had become part of project design showed great potential. However, reviews of project activities also pointed out that researchers, unfamiliar with the necessary techniques, needed training in project management and additional input from specialists in other disciplines. Groups of specialists working together on market research, participatory research methods, enterprise development, and technical disciplines became the norm in project design.

A cassava-processing project in Latin America exemplifies the approach and its potential. A team from an international agricultural research centre and two local institutions was assembled to attack the many-sided problem of how and under what conditions a new product, cassava flour, could be incorporated into the existing wheat-flour milling system and accepted by the baking industry. Some of the disciplines involved were agricultural economics, marketing, agronomy, food science, and chemical and mechanical engineering. Many of the basic technologies had already been developed independently and were incorporated or adapted to meet specific requirements defined by preliminary analysis and feasibility studies.

A preliminary macro analysis of the local wheat market was paralleled by compilation of information on cassava production, a wheat mill survey, and a baker and consumer survey. Separately, but oriented by earlier findings of the above study, a village cooperative processing plant was

designed and developed. Washing, peeling, and cutting equipment, drying systems, milling equipment, and storage conditions were evaluated and modified before they were combined into pilot plant studies. Bakery product development looked at cassava variety and harvest-age trials, flour production, optimization of bakery procedures, and quality control and acceptability studies.

The knowledge and hardware generated through this process was finally combined in a feasibility study that involved on-farm trials, composite-flour production determinations, and assessments of baker and consumer acceptance of the final products. The whole system is presently being pilot-tested with a farmers' association and with millers, bakers, and food industry. This project and several other similar ones showed that flexibility and special management skills on the part of the project leader were essential. Because all of the skills and experience required are unlikely to be found in a single institution, working relationships with specialists at local universities and with private consultants are beneficial and effective.

Technological research thus became much more focused and appropriate in projects that included initial needs assessments, such as rapid rural appraisal and market research, and incorporated economics and acceptability activities. The projects succeeded in producing results at the pilot level, but dissemination for wider use was limited by the existing agricultural and industrial extension systems.

In most countries, it was found that there were no real extension services for off-farm technologies or for enterprise development. For projects to produce positive changes, other organizations that had more experience working in community activities and could assist in ensuring the appropriateness and implementation of results had to be found. As more experience was gained, the PPS program worked with several nongovernmental organizations (NGOs), which although limited in research capabilities had much experience in organizing and working within rural communities.

Further dissemination of results was also hampered by poor written communications. Often the reports that described the work and results were of poor quality. Others were in a technical style that made them of limited use to development workers. Language differences among researchers also made reports of work from different parts of the world inaccessible.

To help overcome these concerns, and to reduce the isolation that researchers often felt, project staff were supported by project funds to present their findings at conferences, seminars, and workshops. This wider dissemination of their results provided opportunities for reviews of methods and future plans and created links with other researchers working on related projects. Out of these informal links grew the idea of establishing networks of projects that shared similar objectives and could benefit from interactions among project staff. This networking concept has become an increasingly

important part of program design and management.

Systems and Multicomponent Projects

Much more emphasis is now placed on the dissemination and promotion of the results of the research and on the evaluation of the commercial feasibility of pilot enterprises, especially those that can be established and run in rural areas.

Projects now are designed to address a wide range of concerns within the food system from harvest to consumption (see Figure 2). Researchers are encouraged to investigate competing products or services, understand government policies, investigate marketing and distribution systems, and consider community organization as well as technology options. To identify the necessary research agenda to develop rural enterprises, technology and management issues such as product and process development, the procurement of raw materials at agreed prices, the development of process and quality control measures, the use of appropriate management techniques, and the management of credit and cash flow are all considered.

Collaboration with NGOs often improves project links to local concerns and priorities. However, NGOs frequently need support from specialists in universities or research institutions or other outside consultants to ensure access to the diverse range of technical skills and knowledge considered essential for successful project management. Active PPS projects in Latin

America and Africa illustrate this approach to project design.

Through a series of grain milling projects in Africa, technical development of a dehuller for sorghum and millet has been guided by feedback from users on various iterations of the design, its cost, and the quality of dehulled products produced. Using this approach, it was possible to adapt and modify a machine, which was designed in Canada, to suit local needs in Africa. Researchers produced the initial design. But NGOs in Botswana were instrumental in determining the type of dehuller consumers wanted and in modifying the dehuller so that it responded to consumer needs. After modification, the machine could dehull batches as small as 2 kg, which matched the daily and weekly needs of rural households, while retaining the ability to dehull large amounts in a continuous stream. The work soon attracted the attention of rural households, potential entrepreneurs, ministries, and development agencies.

NGOs also played an important role in developing strategies to promote the technology and to help establish and support commercial mills in rural areas. But it was only when collaborative links were developed among research organizations, government agencies, and NGOs that the projects achieved success in commercial application of the milling technology in rural areas. Between 1980 and 1883, more than 20 small-scale milling systems became established in Botswana. A mill owners' association was formed, and the industry matured. The next several years of drought brought

about successive crop failures. Farm households had no grain supplies of their own, and several of the more successful millers imported bulk stocks from neighbouring countries. From service milling, they converted to small factories that marketed sorghum meal in attractively labelled bags. Each brand competed for consumer attention and loyalty.

Throughout this period, the NGO and the mill owners' association together developed a self-sustaining system of delivering the technology to rural areas: manufacturing the dehullers; training the rural entrepreneurs in maintenance, operation, and management; delivering the hardware required for a full small-scale mill; arranging sources of credit for the entrepreneurs; and providing after-sales advice and service. This experience has been applied and adapted in several other African countries.

In Latin America, recent efforts have focused on the development of rural agroindustries in collaboration with NGOs. One project began by looking at the possibilities of generating a regular source of income for small farms from the wild fruit found on their small holdings. Local markets and the potential for local employment and income generation were assessed as part of the project's design. The NGO did not have the necessary expertise in food technology, engineering, or marketing, so these services were obtained through consultants and collaboration with the nearby university. As a result of this project, a fruit juice plant, a soyabean milk plant, and a bakery are now operating. As well, a product distribution network using local stores and

schools has been developed. The project has promoted this experience in other areas, so that now another six satellite rural processing plants have been established with technical and training support from the project.

In these projects, continuity of support through to development of pilot enterprises was essential. Only once the projects reached this stage could researchers obtain first-hand knowledge on how their results were being used and learn of new research questions that needed to be answered before the enterprise could become successful. There is also a need to carefully document these experiences. This has been addressed in some cases by attaching experienced writers to the projects.

Experiences to date have shown that much still must be learned about how to establish new food enterprises that will be viable in rural areas. Some expertise has been drawn from small enterprise development approaches in urban areas, but rural projects must often work with personnel that lack rural experience and adapt to less dense markets and the seasonality of raw materials. They are particularly limited in the technical and management services available to them. There is, therefore, a need for research on appropriate ways to develop sustainable rural agroindustries.

Lessons Learned

After 15 years of project experience, there is still much to be learned; however, a number of observations can be made that may provide valuable

lessons to others undertaking or supporting postproduction research.

(1) The effective identification of relevant research problems and needs requires a well-designed and executed diagnostic study in the field and an appropriate review of existing literature. This study may need to be carried out by a different research group than those proposing the technological research. Ideally, it should be carried out jointly. Rapid rural appraisal techniques are a good place to start. In new areas, a strategic overall study of the food and market system may be required to identify research entry points.

(2) National postharvest programs are weak or nonexistent and lack experience in technological, economic, and marketing problems in rural areas. Research planning and management skills need to be developed and creatively encouraged.

(3) Outside funding and support must be flexible and be able to adjust to different needs and research problems as they arise. This is true for research methodologies as well as for a wide range of activities related to small enterprises.

(4) Opportunities to implement or improve rural agroindustries must be considered in project design. However, it is very unusual to find a research team in one institution that can deal effectively with all the necessary topics. Whereas researchers can be expected to expand the boundaries of their interests, there are limits beyond which they become ineffective. Researchers

therefore need to recognize when to seek assistance from other agencies and disciplines to help define and answer evolving questions. Some of this input can come from private firms specializing in food technology, market research, commercialization and enterprise development, group organization, engineering design, plant design, and machinery construction.

(5) Applying the results of technology research at various scales of operation in rural, village, and peri-urban settings requires creativity to seek market and product niches not presently or adequately filled or recognized. Some options to be examined include: partial processing in near-farm locations to provide more uniform and stable raw materials to urban plants and to leave more by-products and waste materials in rural areas for animal feed or other uses; franchising small-scale processing plants in rural areas with marketing, technical backstopping, and quality control managed by a specialized core group; contract processing and joint venture arrangements with urban-based commercial plants; and hiring of professionals to operate and manage rural plants on behalf of rural associations.

(6) Research on rural small-scale industries is complex because it represents a combination of many technologies and management skills. PPS support focused initially on the technological aspects because these were the areas in which most researchers and their institutions felt comfortable and thus they provided a common starting point. Nevertheless, it is evident that technological components are not always the limiting factor. For this reason,

considerable emphasis is now placed on methodology development, diagnostics, and awareness of rural realities.

(7) Research institutions may not be the appropriate leaders to establish and encourage small food enterprises. Their input is essential but private commercial operations, NGOs, or individual entrepreneurs have a much closer feel for day-to-day operations and market demands, penalties, and rewards.

(8) Project management becomes a crucial factor in complex agroindustry research and development projects. The leader must be creative, flexible, able to handle people well, and understand and integrate a wide range of disciplines. A non-researching director may be required to oversee progress in the many components, according to a planned timetable and budget, and to promote productive interaction among team members.

(9) Researchers must be able to share experiences and methodologies. Therefore, experiences, methodologies, approaches, and results must be documented and published. As well, opportunities for workshops and seminars to encourage interactions among project staff from different locations should become part of project design. Formal research networks should also be created to share results and encourage collaboration.

Conclusion

Fifteen years of experience in the postproduction sector has shown that technologies alone do not solve development problems. Research that is to produce results that will be used must be designed in collaboration with the people expected to benefit from the research. Research should also be extended to the development of pilot plants and the establishment of rural agroindustries, which offer considerable potential for the introduction of innovations while providing employment and income opportunities in rural communities.

Projects must consider the broader food system, including the production and postproduction systems and the surrounding environment. This makes projects more complex, but is essential to identify appropriate interventions that employ research innovations in postproduction technology, markets, or enterprises to produce positive changes in the food system. In future, this will mean that more attention will need to be given to postproduction or policy research rather than to production research.

The time lag between research and the successful application of the results has been reduced to 5 to 6 years in some of the projects supported by the PPS program in IDRC. The challenge for the future is to further reduce the time needed to offer appropriate solutions to rural people through postproduction research.

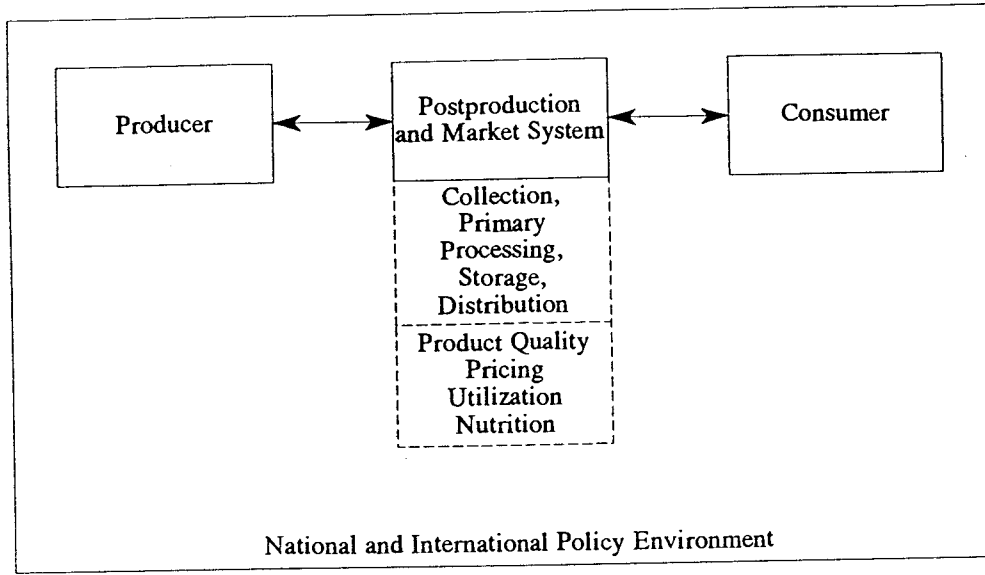


Figure 1. The food production and utilization system.

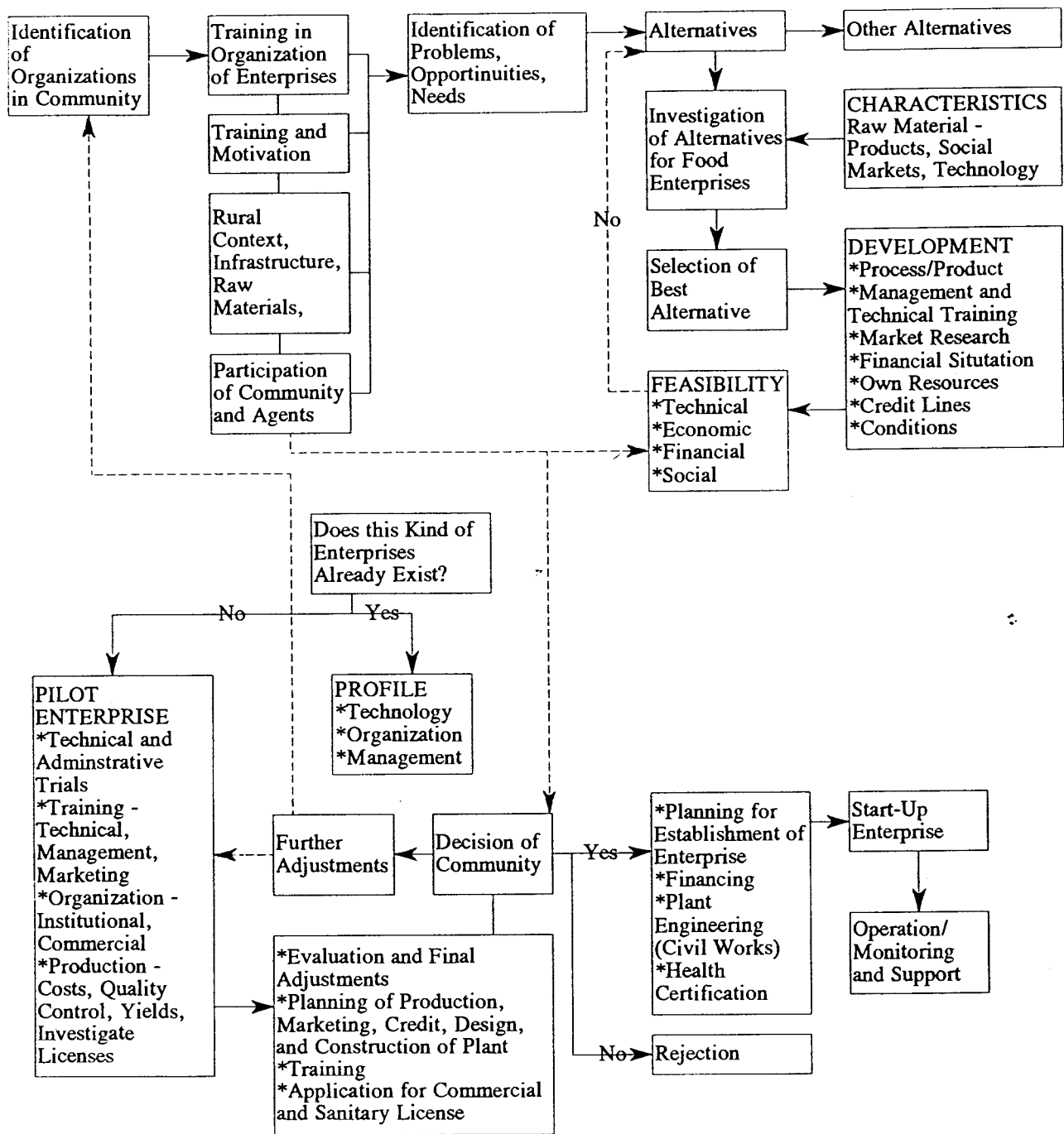


Figure 2. Flowchart of steps to establish a rural food enterprise. Solid lines are principal flow lines; dashed lines represent community participation.