

International Development Management Center



International Development Management Center
Division of Agricultural and Life Sciences
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**APPLICATION OF MICROCOMPUTERS
TO PORTUGAL'S AGRICULTURE
MANAGEMENT**

Blending of New and Traditional Technologies

Case Studies

Edited by

A. BHALLA, D. JAMES and Y. STEVENS

Foreword by

FRANCIS BLANCHARD

Director-General, International Labour Office

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CHAPTER THREE

Application of Microcomputers to Portugal's Agricultural Management*

THIS CHAPTER EXAMINES a recent experience with the introduction of microcomputers in conjunction with an integrated effort to improve the management of the national agricultural production programme in Portugal (PROCALFER). This programme represents a rich experience in studying emerging technology transfer issues for several reasons. First, it is a multi-organisational effort that touches on almost every segment of agricultural production activity in rural Portugal. Second, it encompasses three different actors (frequently associated with development programmes) namely, Portuguese public and private sector personnel, United States Agency for International Development (USAID) which finances the programme, and the United States Department of Agriculture (USDA) which provides technical assistance. Third, the microcomputer experiment has been viewed as a research-cum-action effort from the very beginning. Finally, PROCALFER represents an excellent learning setting in so far as substantial human and financial resources have been made available since 1981.

However, one limitation of the case study on the PROCALFER programme may be worth pointing out. The representativeness of this case is perhaps lessened by the continuous changes that are taking place in the microcomputer technology. Therefore, this review provides only interim hypotheses and conclusions for use in further applied research.

I. PORTUGAL'S AGRICULTURAL PRODUCTION PROGRAMME (PROCALFER)

In 1979, a team of three USAID consultants conducted a survey of the Portuguese agricultural sector and recommended a broad development programme designed to address Portugal's key problems. Essentially, the team recommended that the Government of Portugal should undertake:

* Prepared by Marcus Ingle, University of Maryland, and Edwin Connerley, United States Agency for International Development

- a national limestone application programme to tackle the prevalent problem of high soil acidity;
- an accelerated forage and pasture expansion programme to improve soil quality and provide feed for livestock; and
- reorientation and improvement of the national research and extension institutions for improved meeting of farmers' needs.

The USAID report was endorsed at both technical and political levels within the Government. In 1980, the Government of Portugal and the USAID agreed to cooperate on a major development programme, the overall objective of which was to increase domestic food and feed production and reduce dependence on imports. As part of the rationale to increase overall agricultural production thereby raising farmer income, reducing food imports, and improving the balance of payments position, PROCALFER sought to overcome several specific constraints including the unproductive and highly acid soils, inefficient agricultural practices of farmers, and the largely ineffective research and extension services of the Ministry of Agriculture. PROCALFER aimed at overcoming these constraints, initially over a five-year period, through a variety of technical assistance and training inputs. In the design of PROCALFER, priority was given to the generation and transfer of production technologies including limestone and fertiliser use, and forage development. Virtually no attention was paid to the management and implementation of the programme in the Portuguese administrative setting.

II. MICROCOMPUTER TECHNOLOGY APPLICATION

The first microcomputer systems were delivered to PROCALFER in February 1983. The delivery of these systems culminated 18 months of intermittent discussions between American management consultants and their Portuguese counterparts and executives. These discussions concerned the general need to improve the management of PROCALFER, particularly the need for informed decision-making based on timely and accurate programme and financial data, and the role that microcomputers might play in the overall Programme Implementation Management System (PIMS).

The use of microcomputer by PROCALFER was first discussed during a management improvement consultancy which took place in October 1981. The USDA-Lisbon team leader asked the United States management consultants to explore the potential of microcomputers in PROCALFER with Portuguese and American participants. Interest was great and the consultants assembled a long and varied list of potential uses for the microcomputers. In general, American consultants, of whom there were many in various areas of agricultural technology, tended to be more enthusiastic than their Portuguese counterparts.

Perhaps this was because the Portuguese were less informed about what the microcomputer could do. At that time the United States consultants were

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independently conducting a worldwide survey of microcomputer use in agricultural management, and thus were interested in potential benefits of the microcomputer.¹ A proposal was submitted that called for the purchase of one Apple II Plus microcomputer system and appropriate software. Following the departure of the United States consultants, the Coordinating Group (a small body consisting of a chairman and four members selected from the key Ministry of Agriculture, Forests and Food, which operated under the direct supervision of the Minister of Agriculture) allowed this proposal to die by simply not acting on it.

A second attempt to introduce microcomputers in PROCALFER began in February 1982. It was at this time that USDA management consultants presented a report to the Coordinating Group, which recommended the two-year technical assistance and training effort that came to be known as PIMS.² Included in their proposal was a recommendation that PROCALFER should purchase ten Apple II Plus microcomputer systems and appropriate software. The report also recommended that: (i) a survey of PROCALFER's management information needs be conducted; (ii) Portuguese sources for equipment repair and technical assistance should be located, and (iii) the PIMS implementation team should include an individual designated as an information specialist, who would be given training in microcomputers. In accepting this proposal, the Coordinating Group only approved three of the ten microcomputers to be used on an experimental basis in conjunction with PIMS.

While there was relatively widespread interest in the acquisition and use of microcomputers, support was strongest among regional implementors and the United States technicians. The regional staff tended to see microcomputers as an opportunity to acquire equipment for use both in PROCALFER and non-PROCALFER activities. The Coordinating Group was intrigued with the possibilities for using this technology, knowing the dangers of providing the regions with an expensive technology that would, in their opinion, be diverted largely to non-PROCALFER use or, worse yet, stand idle for lack of trained users. The USDA team leader and the USAID representatives in Lisbon were very supportive of the acquisition, but they were also concerned about spending US\$30,000, the estimated cost of the hardware and software for the three systems, without a more detailed analysis. In authorising the two-year PIMS effort, therefore, the Coordinating Group delayed purchase of the microcomputers until an in-depth assessment of PROCALFER's needs for the microcomputers was carried out. During July-August 1982, the PIMS consultant conducted a brief assessment of the potential uses of microcomputers in PROCALFER at the regional and central levels. At the headquarters level, clear justification for microcomputer use in financial management, project planning and control, wordprocessing and statistical research analysis, was identified. It was also noted that these separate applications should, in the intermediate future, be merged into a comprehensive management information system.

At the regional level, the need for financial management and project planning and control, were strongly supported. This proposal recommended the purchase of three Apple Europlus microcomputer systems and appropriate word processing, electronic spreadsheet, and data-base management software. Initially, modest three systems were proposed, which would grow to eight to ten systems or more, if the first

ones proved to be cost-effective. The applications chosen for initial computerisation also involved relatively long time periods, thus giving time for learning from one cycle to the next. Software using the Apple Disc Operating System (DOS) was initially selected because it was easier to learn than the more powerful CP/M operating system. Standard software packages for word processing, spreadsheet analysis and data-based management, were purchased. Use of the CP/M software was to be on an "as needed" basis only after individual users had reached the limits of the capabilities of the DOS software.

One microcomputer system was proposed for the permanent use of the Coordinating Group and its staff, including the PIMS team. The other two systems were scheduled for use by the PIMS team to train regional PROCALFER staff in microcomputer use and to develop a computerised version of the cost estimation and budget preparation methodology. Training of regional participants and development of the cost estimation and budget preparation procedure were estimated to require six to nine months. The second and third computer systems were to be turned over to selected regional users as soon as this work was completed. In the meantime, regional interest and capability in applying microcomputers to PROCALFER's work could be assessed. The proposal assumed that the regions would prove capable and willing to use microcomputers in PROCALFER work, and noted the probability that five or more additional systems would eventually be needed.

In September 1982 the PIMS team participated in a two-day training programme on "Introduction to Microcomputers" held in Washington, DC. This system was used by PIMS team members for self-learning. The Coordinating Group approved the purchase of three microcomputer systems in December 1982. The first system was delivered in February 1983, approximately 16 months after the initial recommendation for the purchase of microcomputers.

The microcomputer technology has evolved to better fit the specific PROCALFER context. The pressures for adaptation have come from a number of sources. Prime reasons for the high degree of evolutionary change are a deliberate PIMS emphasis on learning by doing, and adherence to a participative, iterative process rather than single-minded, blueprint pursuit of planned products. Other generalised sources of adaptive pressures are the need to adjust facets of the technologies to Portuguese management culture, and to involve Portuguese participants in the design and implementation in order that they might "own" the outcomes.

The microcomputer hardware used by PROCALFER was purchased from a Lisbon Apple dealer to ensure service and technical support. The software was purchased in the United States and sent to Lisbon because it was hard to justify, under United States government regulations, the foreign purchase of such easily transported items. Purchasing the hardware locally has resulted in more timely service, and compatibility with the Portuguese electrical system. It has also meant that the equipment was delivered piece-by-piece over a period of several months, rather than being delivered all at once. Protracted delivery caused some problems in introducing the systems. At times, the PIMS team had to make do with fewer computers because vital components were missing. At other times, training of operators was made more difficult because of the fact that computers that appeared to be identical operated

differently because of the missing internal "add-on" capabilities.

The infrastructure required to support the use of microcomputers is reasonably well-developed in Lisbon but problematic in other areas of Portugal. Infrastructure includes retail microcomputer dealers capable of servicing the products that they sell, a stable and "clean" source of electrical power, experienced microcomputer users and a telephone system capable of transmitting microcomputer data. No serious problems with any aspect of infrastructure other than staff experience have been encountered in the Lisbon metropolitan area, but every aspect of infrastructure is questionable in some of the more remote regional locations. There are 10 to 15 Apple dealers in Lisbon, one in Porto and none in most cities where regional offices are located. Electrical power problems are minimal in Lisbon, and the use of voltage surge protectors for relatively tolerant electrical devices such as televisions and stereos is common in other parts of the country.

Should infrastructural problems prove insurmountable in certain parts of the country, alternative support arrangements will be made. Microcomputers might have to be shipped to Lisbon for repairs. Data discs may be mailed back and forth rather than having data sent via the telephone system. Ultimately, the microcomputer-based information system may operate with response times measured in days rather than nanoseconds, but it will be far superior to what PROCALFER has at the moment.

Alternative Technologies

Specific consideration of alternative technologies was very limited. In a sense, one could say that two alternatives were considered: (i) traditional Portuguese public sector management practices; and (ii) a version of the PIMS that did not include the use of microcomputers. The first "alternative" was clearly unsatisfactory. All concerned were convinced that there were serious deficiencies in the traditional public sector management practices. The need to improve management was dramatically demonstrated by low levels of productivity and accomplishment. The traditional management technology, which emphasised legal, formal and hierarchical concepts of administration, was too formalistic. The strong central control assumed in such concepts of administration was not relevant in the context of contemporary Portugal. Post-revolutionary governments were relatively weak and unstable. No government has successfully articulated and implemented coherent, long-term policies with respect to Portugal's agricultural production problems. Furthermore, the weakness of a highly centralised approach to administration of the Ministry of Agriculture was recognised. The policy of decentralisation of the ministry by granting more discretion to Regional Directorates of Agriculture lasted for three or four years when the PIMS effort got under way, although implementation of this policy was sporadic and lacked in operational detail. In practice, and particularly with respect to the development projects such as PROCALFER, "decentralisation" meant that national objectives were minimally tolerated or ignored by regional implementors. Neither national nor regional authorities were aware of the need, inherent in decentralised programmes, to clearly negotiate a

bargain over development policies, objectives and strategies.

The second "alternative technology", a version of the PIMS that did not include the use of microcomputers, was in fact tried for a few months. The PIMS had been, and continues to be, used in other countries without a microcomputer component. However, in the Portuguese case, the attractiveness of microcomputers was greatly increased by the immediate and obvious need to estimate costs and prepare budget requests for recurring regional PROCALFER activities. In the first four regional workshops, estimates of resources used in programme activities were written on flip charts as regional implementors developed the estimates. Unit costs for each resource were later supplied by regional administrative officers and the necessary calculations were performed by the PIMS team using small electronic calculators. It was highly desirable that these calculations be done in time to show the resulting budget request to those who had estimated the resource requirements. This improved the accuracy of the estimates and imparted a knowledge of the programme costs and the need for "cost consciousness". Calculating the estimated costs consumed a great deal of time of the PIMS team. Errors were occasionally made in this rather simple but highly repetitive process.

Future Plans to Modify and Replicate the Technology

PROCALFER's microcomputer systems have been in use for approximately ten months now. Much of what was intended for the microcomputers still lies in the future. Currently, three microcomputers are being used by the PIMS team to help prepare regional budget requests and perform a series of other management tasks. For example, the PIMS team and other PROCALFER headquarters staff also use the microcomputers for word processing and financial projections. PROCALFER management specialists from three or four regions have been trained to use the microcomputers for cost estimation and budget preparation, but not for other applications. Two headquarters staff have made significant progress in developing a microcomputer system to track and analyse the subsidies paid by PROCALFER to limestone producers. A microcomputer-based method for keeping track of and analysing the various requests for subsidised credit received by PROCALFER is also in operation. The analysis of limestone subsidies is being started with the Visicalc program and the analysis of credit requests is contemplated to use DM Master, a data-base management program. A third headquarters staff member, who is seen as a major potential user of the microcomputer systems, has made only tentative efforts to use them. His work involves statistical analysis of the results of the hundreds of research plots conducted by PROCALFER each year.

In speaking of plans to modify and replicate the microcomputer, we should make it clear that these plans are not formally approved by the Portuguese Coordinating Group. It should also be pointed out that the use of microcomputers in PROCALFER is most eagerly supported by the PIMS team and its American consultants. The Coordinating Group retains some of its healthy scepticism towards microcomputers and the PIMS effort more generally.

In order to exploit more fully the potential benefits of the microcomputer systems

in a cost-effective manner, their use in future should be expanded in two ways. The microcomputers should be used for more PROCALFER management tasks, especially in the programme monitoring and reporting. Additional microcomputers should be purchased for use by PROCALFER's regional projects. This intensification and expansion of microcomputer use would involve the purchase of five or six additional microcomputer systems and the provision of technical assistance for the development of several additional applications. Technical assistance may also be provided to some Portuguese users who may have been using, and who now want to advance to the more powerful CP/M operating system.

Local Support

In discussing the requirements for and availability of local support we should remember that PROCALFER is implemented in different geographical locations. Although requirements for local support are substantially similar in all locations, the availability of such support varies considerably. In general, all requirements for local support may be obtained relatively easily in Lisbon, while other locations may present difficulties.

Use of local materials. Use of local materials and services in conjunction with both PIMS and the microcomputers has been limited, but may increase significantly. As was discussed earlier, the microcomputers, although not of Portuguese origin, were purchased from a Portuguese retailer. Purchase in Portugal was extremely important to establish a relationship with the best source of local maintenance and repair—a local dealer. This relationship has been established and the services provided have been generally satisfactory. It is expected that an increasing amount of technical assistance and training currently being provided by Americans can be provided in the near future by Portuguese personnel. There will be continuing roles for American consultants, but those roles will be concerned less with technical support of the microcomputers than with their application to particular fields, that is, management, soil science, agricultural economics, etc.

Skill requirements and learning. Microcomputers do require users to learn a great deal. Fortunately, they and their user-oriented software are also very capable teaching machines. This fortunate combination of high demand for learning with extraordinary teaching abilities may be a very significant advantage in the introduction of microcomputers *vis à vis* that of other advanced technologies. In other words, although other technologies also require a great deal of learning, they do not normally provide, in their daily use, the interactive learning environment and continual feedback associated with microcomputer use. The overwhelming majority of PROCALFER microcomputer users are new to computers, yet they are highly motivated to learn how to use them.

Having said this, we should caution that there are notable exceptions. The PROCALFER case confirms the United States experience that older persons and people in senior positions may not be willing to assume the risks of failure inherent in trying

to learn how to use the microcomputer. Such persons seem to experience the delight of learning when they do have an occasional experience with the microcomputer, but they do not readily return to learn more and more. The PROCALFER experience also suggests that some persons may lose interest in using the microcomputers when the learning curve associated with a particular application flattens out, and the relative drudgery of entering large amounts of data into the computer begins. Personal enthusiasm for using the microcomputers is also sometimes dampened by the difficulties in trying to change organisational practices to make them more amenable to computerisation.

The importance of typing skills and their impact on computer use, and vice versa, have been interesting to observe in the PROCALFER context. Users who are already touch typists adjust rather easily to using microcomputers, particularly for word processing, but also for other tasks. Female employees in low-paid jobs (receptionist and janitorial services) have made efforts to use the typing tutor program, Master Type, to learn how to touch type. Mastery of typing means significantly better career opportunities for them. The "menu-driven", user-oriented character of the software opens possibilities for these individuals to learn a valuable skill. The "arcade game" atmosphere of the software also provides an incentive to practice these skills.³

III. EVALUATION: ORGANISATIONAL RESPONSES AND INTERIM IMPACTS

The introduction of the microcomputer technology as part of an overall effort to improve the management of PROCALFER's implementation has been underway now for a year and a half. This section presents our formative assessment of the transfer process. First, we review the response of various organisational units and actors to the introduction and use of the emerging technologies. Specifically, we are interested in knowing how the Portuguese at the central and regional levels reacted to the new technology and coped with changes in their work environment. The second dimension relates to the initial impacts on work productivity, social relationships and development results that are evident at this relatively early stage of the technology transfer process. Emphasis is given to the technological impact of the microcomputer as a component of PROCALFER programme management improvement.

Organisational Response to the Emerging Technology

In this section, we present our initial findings about how these major organisational groupings are responding to the new technology.

Portuguese response. Portuguese reactions to the microcomputer technology, as a subcomponent of PIMS, have been rather strong. Initially, there was open scepticism due to previous negative experiences with mainframe computers in the Portuguese agricultural research context, and because the computers appeared to be like an

unnecessary luxury during the initial phase of programme implementation when it was extremely difficult to get some of the most basic tasks accomplished (such as constructing the PROCALFER headquarters office, staffing it, and obtaining resources). For instance, it took more than a year before the Coordinating Group could actually spend its budgeted funds, and even then all expenditures (except some very small amounts) had to be approved directly by the minister. In this type of administrative environment, the rise of microcomputers for management and coordination purposes was frequently and understandably seen as a case of misplaced priorities.

Later, when the first microcomputers arrived and were set up in PROCALFER office, another concern became evident. Microcomputers are physical entities; thus their use, non-use and misuse was evident for all those who visited the office. Thus, the Coordinating Group and PIMS team became very concerned about ownership, control and related issues of appropriate use.

Many of the potential PROCALFER microcomputer users in the Central Departments and Regional Directorates also viewed the new technology as a source of new bureaucratic power and personal advancement. There is a widespread desire to learn how to use microcomputers, accompanied by requests for the PROCALFER programme to purchase and support additional equipment. This places additional strains on the Coordinating Group to determine the criteria by which PROCALFER should provide additional microcomputers. The Coordinating Group is currently in the process of defining guidelines on these and related microcomputer technology issues.

Finally, some mention needs to be made about how the individuals most directly involved in the microcomputer transfer process (the members of the PIMS central team and the seven regional management specialists) have reacted to the microcomputers. In general, the response and attitude of these individuals has been very positive and favourable. Throughout, they have looked at the introduction of the microcomputers as having two dimensions. First, microcomputers are a tool that can assist with immediately useful management tasks. In addition, since they represent a fairly low-cost investment, one does not need to keep them busy all the time. They only need to be used when they are appropriate to the management task at hand. Second, the introduction of the microcomputers represents a learning opportunity with respect to whether they can actually assist in improving PROCALFER's coordination and management, and are cost-effective in the Portuguese agricultural context. The PIMS members have thus viewed the microcomputers as tools to be usefully employed, or put aside, based on whether they are serving an appropriate PROCALFER implementation purpose.

One interesting aspect of the PIMS team's experience relates to how it has reacted to the constant changes in microcomputer hardware and software. In the past few years, the users of the microcomputers felt that the microcomputer technology was changing extremely rapidly. Industry or trade journals are constantly recommending the acquisition of the latest in memory boards of the newest software package to benefit most from the microcomputer system. And with the proliferation of various hardware and software configurations, an astounding number of technological

combinations exists, enough in fact to confuse, at least temporarily, even the most experienced microcomputer salesperson. The Portuguese have recently requested a review of new software packages even though they are only beginning to tap the potential capacity of their existing software. Also, the Portuguese (and American counterparts too) are becoming frustrated by the compatibility issues that arise when any new piece of software or hardware is added to their current system. Some problem, often minor but difficult to resolve immediately, always seems to arise that makes the use of the technology appear much less desirable than it actually is.⁴

The microcomputer seems to be attractive for several reasons. First, the technology demands continuous learning from the user and supplies an interactive environment that readily facilitates the learning process. This is very evident in the PIMS cost estimation and programme budgeting application of the microcomputer. In that application, the Portuguese users were required to learn the Visicalc program and the cost-estimation templates at the outset, but the microcomputer assisted at every step along the way by giving constant specific feedback to the user at every point in the process. A second appealing feature of this emerging technology is its transparency, that is, the ability of the user to sit down at the terminal and in very little time both do something productive with the tool and have an intuitive feel for how the tool works. For this reason, fear of the technology (and accompanying resistance to it) is minimised as is the need for intermediary technical specialist to assist in the process. Finally, although microcomputers have some way to go before they are fully user-oriented, what is impressive about them in the Portuguese environment is the degree to which the technology is already professionally appealing and immediately available for productive use.

United States contractor and donor agency response USDA and USAID have been strong supporters of the PIMS technology from the outset. It was USAID that made the initial request for a one-week management improvement consultancy in early 1981. Following that, both organisations cooperated in assuring that substantial technical assistance and training resources would be devoted to jointly improving Portuguese management performance and strengthening the programme management capacity. Throughout, key personnel in both organisations have played an active role in formulating the management improvement strategy and in monitoring and evaluating its execution. The United States consultants and Portuguese PIMS members have worked closely with USDA and USAID staff at every important juncture in PROCALFER's development.⁵

The staff of both external organisations has also been supportive of the microcomputer component of PIMS. The initial request for microcomputers and the initial assessment completed in late 1981 was made by the USDA team leader in conjunction with the United States management consultants. USAID officials were quite sceptical at the outset. Recently, both organisations have endorsed the introduction of microcomputers on a wider scale, but not without some obvious misgivings. Like their Portuguese counterparts, the United States consultants are open to criticism in regard to their handling of the microcomputer technology

INTERIM IMPACTS OF THE MICROCOMPUTER TECHNOLOGY

At this juncture, three years into the implementation of the PROCALFER programme, a substantial number of results can be reasonably attributed to the introduction of the microcomputers as a component of the broader PIMS effort. This section presents our assessment of the intermediate results associated with the transfer of this emerging technology.

A word of caution is required here. The information available at this time is extremely formative in nature. For this reason, we present the results of the assessment along three general dimensions—technology costs, PROCALFER changes, and agricultural development results. Within each of these dimensions, we review the additive impact of the microcomputer technology within the overall PIMS management improvement context.

Technology costs. The cost of the emerging technology is difficult to estimate accurately. Many different types of resources are used by the technology, including permanent and temporary staff, transportation, training, consultants, and equipment. It is also difficult to determine the precise boundary of the technology, thus permitting us to include accurately and exclude various activities in the cost figures. Readers should therefore treat the estimates outlined here as interim approximations of the overall costs.

The microcomputers are estimated to have had a total cost of approximately us\$75,000. These costs can be broken down into three categories—hardware costs, software costs, and orgware costs. The hardware costs for the three Europlus models, purchased locally in Portugal, came to a total of us\$15,000. The software packages purchased for Apples, along with the Cost Estimation and Budget Package that was custom-designed, add another us\$15,000 to the system costs. Finally, the orgware dimension, which includes staff time for learning microcomputer applications and establishing necessary policies and procedures for operating and maintaining the microcomputer technology, is at present estimated to be us\$45,000. The orgware dimension of the microcomputer technology would have been much higher if the consultant's recommended applications and development and training plans were implemented as scheduled. As it is, considerable orgware expenditures have now been approved for 1984, and it is expected that most future expenditures for the existing microcomputers will occur in the orgware category.⁶

Changes in the PROCALFER programme. An extensive list of organisational changes can be directly and indirectly linked to microcomputer technology. Changes—both positive and negative—are evident for many different PROCALFER actors, at different organisational levels, and along different dimensions. In this part of the assessment we focus on changes that have two primary characteristics. First, they are fairly substantial in nature. Second, they can be reasonably attributed to the use of microcomputers. To compare and contrast the relative impact of the emerging technologies, we first describe the overall results of the PIMS technology and then discuss the additive impacts of the microcomputer technology. In this way, it is hoped that the reader will begin to develop a better understanding of the precise ways in

which the microcomputers are creating an impact on the traditional Portuguese managerial and administrative practices.

These areas of evident PROCALFER change are:

- improved performance of management functions and tasks;
- alterations in social relationships; and
- changes in organisational roles.

Each of these areas of organisational change is briefly described below.

Improved performance of management functions and tasks: The overall PIMS technology directly influences the performance of several management functions by PROCALFER actors and institutions. At the central and regional levels, Portuguese and United States personnel have negotiated, and renegotiated on several occasions, a consensus of PROCALFER objectives, strategies, responsibilities, action plans and budgets. The PIMS technology, minus the microcomputer component, appears to have been the salient factor contributing to these improvements in management performance. However, the microcomputer technology has had a substantial additive value in this area, especially in relation to the performance of cost estimation and budgeting tasks.

Thus, while the objective setting, strategy articulation, and responsibility assignment functions have been aided by the existence of the microcomputer, the regional cost estimation and budgeting development process has been most substantially affected. The use of microcomputers has allowed the Coordinating Group, working with the regions, to develop efficiently the budget requests for 1984 and to alter them quickly as budget reductions were required by the Ministry of Finance. Budget reductions were made with the least possible damage to PROCALFER's objectives for 1984, while complying with the dictates of the Ministry of Finance. In the past, equal percentage reductions in all budget categories were made by the Ministry of Finance without concern for programme objectives. Given staff resource limitations in Portugal, it is very unlikely that the PIMS cost estimation and budget development system—which is very data-intensive—devised for PROCALFER would be feasible without the introduction and continued use of the microcomputers.

In the coming year, the Coordinating Group and the United States agencies plan on completing the transfer of the PIMS technology, both functionally and geographically. Functionally, a monitoring, reporting and evaluation system still remains to be elaborated. The Coordinating Group recently agreed to use the microcomputer in helping to perform these feedback and control tasks. The regions have agreed to go along with this, at least temporarily, in return for an opportunity to learn how to use the microcomputers for PROCALFER applications and eventually to acquire them for their regions.

Alterations in social relationships: Any new technology, especially one that requires a loosely-knit "bundle" such as PIMS and the microcomputers, involves substantial alterations in interpersonal relationships in the host organisation. The changed relationships in PROCALFER that seem most significant to us at this time are:

- greater acceptance of female professionals;

— modification of relationships between regional and national authorities

Each of these changes is discussed briefly below.

(i) *Greater acceptance of female professionals*: Female technical/professional staff members in the Ministry of Agriculture have difficulty in being recognised as fully competent technicians. In the early stage of the PIMS intervention, members of the Coordinating Group expressed their concern that "the girls" (referring to the female members of the PIMS team; most of whom are about 30 years old, married with children, college graduates, with five or more years of professional experience in the ministry) would not be effective in working with the regions because they would not be able to stand up to the regional authorities.

After 18 months, it is our impression that the women have done exceedingly well. In general, it seems that the Coordinating Group's fears were exaggerated and that to the limited extent that they were justified, the expertise exhibited in the regional work by both female and male members of the team has fully overcome any prejudices. In part, this "female triumph" is because the interaction in the regional workshops has seldom led to the furious clash of central and regional authorities that the Coordinating Group expected. The PIMS team explained national positions and objectives, but refrained from trying to impose these on the regions when it was at all possible to do so. The ideal was to avoid taking sides in the multiple, continuing national-regional disputes and to act as an unbiased communications channel. In some respects the female members of the team have proven superior to their male counterparts in doing this. The women seem not to become as frequently involved in the dispute at hand as do the male team members.

The female members of the PIMS teams, none of whom are touch typists, also have shown some tendency to do more keyboard work with the microcomputer systems. The keyboard work means occasional tedious tasks of feeding and manipulating large amounts of data. This is not particularly enjoyable work, but it does lead to an intimate knowledge of how the computer system, particularly the software, works. We are interested in understanding this phenomenon better because it is related to understanding the potential changes in male-female and other power relationships likely to accompany the introduction of microcomputers. Our conjecture is that working with keyboards is a low-status, "female" job in Portuguese culture, which may create certain disadvantages for men seeking to learn how to use microcomputers. Since most executives are men, the relative propensities of men and women to work with keyboards may influence the long-term use of microcomputers in Portuguese organisations. In other words, the propensity for males to avoid working with keyboards may lead to microcomputers being used as organisational resources, with computer use open to many, rather than to microcomputers being used as "executive work stations", with use being limited to a privileged few. In our view, microcomputers should be treated as organisational resources, but there are strong precedents in Portuguese public organisations for public property to be treated as though it belonged to individual executives. For example, Ministry vehicles frequently sit idle, reserved for the use of senior executives, even though field crews may be unable to do their work for lack of transportation.⁷

(ii) *Modification of relationships between regional and national authorities* It is

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somewhat difficult to distinguish the value added by the microcomputers from the overall impact of the PIMS on regional-national relationships. In our opinion, the PIMS laid the basis for greater regional-national cooperation and for the introduction of the microcomputers. The microcomputers, and the management information system that they make possible, will in turn sustain the integrated management system envisioned in the PIMS; although this is yet to be fully demonstrated. In effect, we are postulating that the information system, based on microcomputer use, will be valuable enough to the Coordinating Group and to the regions that it will be continued and expanded over time. We expect microcomputers to play an important part in the continuing operation of the system in at least the following three ways:

- (i) They contribute to the motivation of all, but particularly the regions, to continue to participate. Microcomputers are a very attractive technology. Their very real abilities, as well as the high technology glamour that surrounds them, has led most PROCALFER participants to be eager to work with them. Regional participants do not yet have microcomputers in their places of work. They have been told that they will have microcomputers in their places of work only after they have been trained and have demonstrated the ability and desire to apply and support the computers in conjunction with PROCALFER work.
- (ii) They decrease the drudgery of operating the information system and increase the accuracy of the outputs. Although the PIMS team has demonstrated that the PIMS is possible without microcomputers, the likelihood that it will continue and expand is greatly increased by reducing the effort and tedium involved while adding to the fun involved in learning a modern technology. Also, to achieve levels of accuracy with a manual system comparable to that in the current microcomputer-based system would be extremely difficult. Data need only be introduced to the microcomputer-based system via the keyboard once, in order to be used in several calculations. Non-computer systems usually require the data to be entered through the keyboard a number of times; thus dramatically increasing the probability of error in the results.
- (iii) They establish the boundaries of the information system. One of the primary objectives of the PIMS has been the integration of PROCALFER's regional projects and national efforts. Once microcomputers are in place at all levels, a certain logic for operation of the information system will be established. Information exchange within the system of microcomputers will be easier and more "logical" than exchange across the boundaries of the system. This point is particularly germane from the Coordinating Group's point of view. By determining who gets computers and when they get them, they can shape the information system to fit PROCALFER's national and regional needs.

We believe that the changes in relationships discussed above are the precursors of significant organisational changes in PROCALFER. One way to describe these changes is to say that the character of the dominant organisational dialogue is changing. We believe that the changing dialogue is the result of the tools, techniques and processes of the PIMS effort, specifically including the microcomputers. In other applications of the PIMS, not involving microcomputers, similar results have been achieved. However, the PROCALFER experience has shown that microcomputers, when

introduced with proper selection of relevant tasks and attention to the need for support and training, can make a powerful contribution to improving the quality of the organisational dialogue. Reduced to its simplest level, the objective of the PIMS system is nicely matched with the capabilities of a microcomputer system to process information and model alternatives.

Change in organisational roles: Traditionally, the design and installation of new organisational procedures and operations related to information-processing were reserved for a group of organisational specialists, systems analysts, and designers. An interesting characteristic of many of the most popular software programmes, like the Visicalc spreadsheet for example, is that they, at one and the same time, provide the user with an overall structure of analysis and allow users to adapt the structure to their particular needs. In effect, the knowledgeable user assumes the role of designing his or her own procedures or routines in a way previously unimagined in the bureaucratic context.

This feature of the technology can have beneficial as well as harmful impacts in public sector settings. On the positive side, this "structured-flexibility" feature allows the individual manager to design applications that are fully adapted to the needs of the local situation. Moreover, this can usually be done with few or no external resources in a very short period. On the negative side, this attribute introduces the possibility for the proliferation of system designs that are not compatible with systems in other units or the organisation as whole. For example, in the PROCALFER setting there was a tendency for each field team working with the cost-estimation Visicalc templates to adapt them to fit the practices of the individual regions. Integrating these regional budgets into a single national budget was thereby made more difficult. In essence, the microcomputer allows users to establish optimal systems at a unit level that may be sub-optimal at the organisational level. This is obviously a problem for which the normal bureaucratic response (rule-making) should be adequate. However, the microcomputer technology provides a potentially superior remedy to this problem in the form of password protection of templates, or parts of templates. Through the use of password systems, the abilities of individual users to view and/or make changes in templates and/or data can be limited or expanded as appropriate. It is interesting to speculate on whether the password mechanism might also be used to assure consensus on management information entered in the microcomputer, such as programme objectives.

Development results

Income distribution: Any impacts of the PIMS and the microcomputers on income distribution will be indirect; that is, they will result from the overall PROCALFER programme rather than the management system itself. However, the management system can be designed in such a way as to call attention to income distribution issues, or to ignore them.

PROCALFER is an ambiguous case with respect to income distribution. During PROCALFER's design, little was known about farm-level profitability and the microeconomics of Portuguese farm families. What is now known is the result of studies conducted in several regions of northern Portugal during the past two years

under PROCALFER auspices. However, one sees little evidence that this information is reflected in the day-to-day decision-making of the Coordinating Group. It may be that the raw microeconomic data have not yet been translated into specific programme guidelines. The Coordinating Group may also feel that agricultural production is a prior question.

Portuguese elected officials and the Coordinating Group have sought a nationwide focus for the credit programme allegedly because of the political power of the richer farmers of the south. Work in the south can also be defended on the basis of the higher productive capacity of the farming units there and the potential balance of payments impacts through this increased productivity.

Balance of payments: As in the case of income distribution, PROCALFER's impact on balance of payments is still unclear. Farmer productivity has not increased so dramatically as to significantly and unambiguously reduce the balance of payments deficit. The PROCALFER Agricultural Policy Studies component of the programme has greatly increased the understanding of this issue. It is interesting to note that the United States consultants on this Policy Studies team believe microcomputers to be essential to their work in Portugal. Microcomputer use in the policy area to date has allowed Portuguese and American economists to develop several initial models of the Portuguese economy with minimal resource input and training.

IV. CONCLUSIONS

Microcomputers are now an integral part of the PROCALFER programme. We judge the attempt to transfer this technology to be a qualified success up to this point, with good prospects for future intensification and expansion. We now offer some tentative observations about the transfer of these emerging technologies substantiated by the PROCALFER experience. That experience is only partly applicable to the situations one would encounter in transferring microcomputer technology to developing countries.⁸

Portugal, although the poorest country in Europe, is an advanced nation with production factors (that is skilled labour and capital) and infra-structural conditions (electrical power, repair services, telecommunications systems, etc.) more similar to other European nations than to Third World nations. There is little doubt that in the near future more modern managerial technologies augmented by microcomputers will become commonplace in Portuguese organisations, including PROCALFER, regardless of the success or failure of this particular transfer attempt.

The following, in our view, are the major lessons to be learned from the PROCALFER experience:

1. Microcomputers seem to be a significant symbol for most people. When introduced into an organisation in the context of a broader management improvement effort, they readily generate supporters and opponents, though few

may have direct experience with the machines. Only those who have "hands on" experience understand the realistic capabilities and limitations of the microcomputer systems:

2. Microcomputers have strong actual and potential impacts on interpersonal and intergroup relationships in organisations. Since many of these impacts are modifications to existing power and influence relationships, their introduction tends to provoke anxiety. Care should be taken to ensure fairness in introduction and use. This implies widespread access to machines and information;
3. Commercially available microcomputer software can serve as a basis for reasonably comprehensive, useful management performance improvements in organisations. In PROCALFER, the microcomputer has facilitated the use of an improved cost estimation and budgeting system, and holds promise for the programme management information system. Managers are thereby made better managers rather than computer programmers;
4. Problems with the technology are interesting challenges that must be overcome, but are not the key constraints to its successful transfer. The nature of the transfer process and changes in organisational relationships are most serious concerns;
5. The cost-effective transfer of microcomputers in a programme management context is facilitated by the presence of applications that are congruent with the comparative advantages of the technology: transportability, ease of use, multifunctionality, durability, and high computational power;
6. The rapidly changing nature of the technology discussed in this chapter guarantees that some current actions will appear to be seen as mistakes. No "blueprint" for transfer can adequately anticipate future events. Therefore, a learning-by-doing transfer methodology is highly advisable;
7. Management/administrative applications of microcomputers in developing countries should include a relatively large complement of training/skill-building software. Arguments in favour of such software include the following:
 - office staff in developing countries often lack basic skills;
 - high-quality training opportunities are seldom available in developing countries;
 - microcomputer systems can be exceptionally good "teaching machines"; and
 - an emphasis on training/skill building combined with widespread access to the microcomputers may strongly influence the ultimate impacts of this technology on equity and employment;
8. For microcomputers, optimal (rather than maximum) applications to directly productive organisational tasks should be sought in any given transfer attempt. This technology is cost-effective at surprisingly low levels of use. Thus maximising productivity may drive out long-term learning and have adverse effects on social equity. In the PROCALFER case, the management improvements resulting from the PIMS technology generated productive organisational tasks suitable for microcomputer use.

This case study has attempted to represent faithfully the experiences and highlight the lessons learnt during the course of a three-year management technology transfer effort which included the prominent use of microcomputers. This effort was based on two specific premises, namely:

- Successful transfer of a development programme's production technologies—including, in the PROCALFER case, technologies for soil acidity correction, improved fertilisation practices and forage production—necessarily depends on the timely introduction and widespread use of an improved managerial technology; and
- Microcomputer technology will be more rapidly adopted and appropriately used if introduced in conjunction with complementary improvements in traditional bureaucratic structures and processes.

Our experience to date is a substantial confirmation of these premises. The case presented in this chapter has concentrated on the second premise. It is perhaps in the rapidly changing nature of the multifunctional microcomputer technology that we face many new and interesting questions, rather than unequivocal answers.

In conclusion, our experience in Portugal suggests that emerging technologies, when properly acquired and introduced, have the potential for improving the overall implementation of complex development programmes. Moreover, the various positive features of the microcomputer—including its low-cost, high power, and multiple uses—also suggest that this technology is very promising for management applications in other countries. However, in all cases substantial and continuous attention to organisational support factors is required if the transfer of technologies is contemplated.

NOTES AND REFERENCES

1. N. Berge and M. Ingle: *Microcomputers and agriculture management in developing countries: Workshop proceedings report*, (DPMCI/OICD/USDA, Washington, DC 1982); (Mimeographed).
2. R.M. Thompson and E. Rizzo: *Proposal: DPMCI/OICD Implementation Planning and Management Assistance Plan: The Portugal PROCALFER Programme*, USDA, Washington, DC, February 7, 1982; (Mimeographed).
3. "The arcade 'game' atmosphere of this and other software is a double-edged sword. It tends to reduce the fear of the computer frequently experienced by new users and contributes to their desire to continue using it. However, critics of the microcomputer systems seize on the "game" atmosphere as "proof" that these computers are mere toys not capable of serious work.
4. What is usually needed in these cases is the availability of a fairly low level technical person who can debug simple compatibility problems. Until now, such debugging has usually been done by the United States consultants. This situation is now being remedied through a contractual arrangement with a local Portuguese support firm.

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5. The fact that both agencies supported the management improvement effort does not mean that there was continuing and close cooperation between the two agencies. In fact, there were continuing differences and a constant struggle over PIMS direction among all three groups of major actors - USDA, USAID and the Portuguese Government
6. "Existing microcomputers" refers to the three microcomputers that are the subject of this case study. Five additional microcomputers were purchased by PROCALFER in June 1983. Four of these systems were purchased primarily for use in aspects of PROCALFER only loosely linked with the PIMS work. One of these systems is being used for budget analysis by the section within the Ministry of Agriculture's Planning Cabinet that receives and reviews PROCALFER's budget requests. Systems for regional use have not yet been purchased, but are still contemplated. The purchases in June 1983 and the contemplated purchases will substantially increase hardware and software costs, but will have a less dramatic impact on orgware costs since Portuguese participants can perform some of the functions previously performed by the United States consultants.
7. This is a very complex situation worthy of careful study far beyond the conjecture and fragmentary evidence that we have in this case study. The strategies used in marketing microcomputers to businesses in the United States and Western Europe, where they are being sold as "executive work stations" and "personal productivity tools", would be a disaster were they to be successful in developing countries. The very idea of an "executive work station" in a typical Third World bureaucracy is ludicrous, but we should seriously consider the possibility that they may occur, and even proliferate, no matter how out of line with Third World needs they appear to be.
8. Frances Stewart: "Arguments for the generation of technology by less-developed countries" in *Annals*, No. 458, American Academy of Political and Social Sciences, Philadelphia, November, 1981, pp. 97-109.