Agricultural Administration 12 (1983) 27–42

Transfer of Technology to Small Farmers: On-Farm Research in the Philippines*

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(Received: 21 May, 1982)

SUMMARY

This is a revised version of a paper presented to the Second Social Science Planning Conference at the International Potato Centre, Lima, Peru. It describes the evolution of a programme intended to (a) identify factors currently limiting potato production, (b) suggest and test, through the medium of 'on-farm trials', alternative practices and (c) evaluate agronomically, economically and socially the implications of the alternative practices. The major philosophical, organisational and practical features experienced in the field are described. The steps taken to overcome difficulties together with a few personal comments of the authors are presented.

* This project was carried out under the auspices of the Philippine Potato Programme with which all the above Institutions are associated.

Agricultural Administration 0309-586X/83/0012-0027/$03·00

INTRODUCTION

In the Philippines the potato is a small-farm crop, confined to the highland regions. The crop seldom accounts for more than 1 ha, *ca.* 50% of the cropped area,[1] and yields have been thought generally to be low, *ca.* 6·6 tonnes ha^{-1},[2] but production costs are high, thus it is regarded as a luxury food limited to the catering trade, the wealthier classes and perhaps festive occasions.

Research station results have indicated that yields in excess of 20 tonnes/ha may be readily achieved;[3,4] thus the potato was identified by the National Authorities as a crop which can serve as a model to demonstrate the flow of technology from research to utilisation in an effort to improve yields whilst maintaining or lowering production costs.[5]

The model adopted by the Philippine Potato Programme (PPP), an association chaired by the Ministry of Agriculture of institutions interested in the production and utilisation of the potato crop, was based on the International Potato Centre's (CIP) approach of Optimising Potato Productivity (OPP),[6] which forms an integral part of their 'farmer back to farmer' strategy of technology transfer.[7] Initial trials were begun in late 1979 and the following paper summarises the major philosophical, organisational and practical features experienced in the field since the senior author joined the project in February 1980. Many of the points are likely to be encountered, both in the Philippines and other developing countries, when similar projects are initiated. The steps taken to overcome difficulties and a few personal comments of the authors are presented.

INITIAL APPROACH

The initial scheme was to develop a package of technology incorporating the best technology available. This package was to be tested on farms and evaluated agronomically and economically before being promoted by the Extension Services. As new technology became available it would be incorporated into the package, tested on farms and, if successful, a revised package would be promoted.[5]

Organisation of the project and the field practices were as follows:

(i) The PPP set up a sub-committee of field coordinators comprising a senior extension worker, a socioeconomist, an agronomist and a

post-harvest specialist. All were employed by institutions based in the production area.

(ii) The sub-committee drew up a detailed agroeconomic survey questionnaire aimed at identifying current practices and problems.

(iii) The sub-committee formulated a low cost, high-income package of production technology which consisted of 22 steps.

(iv) Field extension technicians conducted the agroeconomic survey and identified farmer cooperators.

(v) Two packages were tested from December 1979 to April 1980 and a further six from March 1980 to July 1980. Each trial was the responsibility of one technician and covered an area of approximately 1 ha but had no direct comparison with the farmers' own practice, reliance being placed on farmers' estimates of yield in previous seasons, as gathered from the agroeconomic survey.

(vi) All material and labour costs were borne by the farmer cooperator, although assistance was offered in negotiating a loan with one of the banking institutions associated with the PPP.

EVALUATION

At the end of each trial series an evaluation meeting was held comprising members of the Management Committee of the PPP, the field coordinators and the extension technicians. These meetings were valuable in that they allowed for the free flow of information, particularly from the technicians to the Programme leaders. Many useful discussions took place, problems were elucidated and solutions aired. The more notable points were:

Philosophy

(i) The trials were complex and difficult to carry out in the field. Farmers did not appear to appreciate the philosophy and principles involved and all farmers selected those technologies which they considered most appropriate to their situation, thus forming their 'own package'. Comparison between trials was therefore not possible.

(ii) Reliance on survey data to estimate farmers' inputs and yields

was not practical. Both vary considerably from season to season, e.g. according to the incidence of pests and diseases.

(iii) The complete package was considered by many farmers to involve considerable financial risk, especially when the areas involved in the trials were taken into account. Trials were thus limited to the larger, financially secure farmers, which were unrepresentative of the provinces as a whole.

The offer of help to negotiate a bank loan was generally not accepted by farmers: firstly, many farmers were squatters or tenants and had no collateral in terms of land rights; secondly, farmers considered the risks too high, particularly when such large areas and thus investment were involved; thirdly, many farmers had their own source of finance, e.g. a neighbour or merchant, and they did not want to disrupt this often long-standing relationship by borrowing from another source for one season only.

(iv) The economic costing was difficult, many estimates being necessary.

Administration

(i) The extension technicians were scattered geographically with no transport of their own; thus it was difficult to coordinate activities and hold rapid discussions.

(ii) The field technicians carried out the trials in addition to their normal duties and they were unable to give the trials the close attention required. This insufficient contact and supervision was partially responsible for the lack of understanding and involvement by the farmers.

Data collection

(i) The preliminary survey was drawn-up by the sub-committee without the aid of professional advice. The survey was complex and its execution beyond the scope of most extension workers, who had no knowledge of survey practices.

(ii) Interpretation of the mass of data collected was difficult. Also, only those farmers who had already been located as cooperators were surveyed. Thus the sample was biased and the numbers too small to draw any general conclusions.

(iii) The field technicians had not chosen the farmer cooperators at random, preferring to visit those that were readily accessible and with

whom they were acquainted. Their farms tended to be the larger, they were more progressive farmers and not representative. They were, furthermore, the subject of many surveys and demonstrations and the continuing use of these farmers is probably the source of several misunderstandings and fallacies concerning production practices.

(iv) Farmers' estimates of previous yield were often unreliable, as were their estimates of farm area. Reliance could not, therefore, be placed on comparisons between farmers' estimates of yield per unit area and those obtained from trials.

(v) Whilst regularly travelling through the area it became apparent to the authors that many of the responses in the initial survey were inaccurate; e.g. visual estimates indicated that yields were, in fact, considerably more than the previously assumed 6·6 tonnes/ha.

Field practice

(i) Each trial covered approximately 1 ha. This effectivity restricted trials to large farms; the average holding being only around 1 ha (De la Cruz, private communication), and even this area may have comprised many fragmented terraces.

(ii) All field work was carried out by Ministry extension technicians; a group which should have had close contact with the farmers.

Training and extension

(i) Some extension technicians had little experience with the potato crop due in part to a reorganisation of the Ministry of Agriculture.

(ii) None of the technicians had any practical experience in conducting field trials.

REMEDIES AND COMMENTS

In order to overcome the problems several steps were taken:

Philosophy

(i) Demonstrations were carried out at 10 locations, from March to July 1980, of the CIP's 'OPP' approach,[9] in which only one or several interrelated variables were compared directly in the field with the farmers'

own practice; thus allowing a true comparison between the current farmer technology and improved practice.[8] A change to this approach was made beginning October 1980

(ii) The simplified approach allowed for the size of each trial to be reduced to 500 m^2, thus the average and small farmer could be included. Reduction in trial size does not appear to have had any effect on the level of accuracy of the results.

(iii) The reduction in trial size reduced the financial risks incurred by the farmer, aiding the incorporation of smaller farms into the project. For the season October 1980 to March 1981 a small financial subsidy was offered to farmers participating in trials involving certified seed, because a considerable increase in input costs was envisioned. Whether such subsidies were of much practical value in aiding the trial programme is not known at this point, but several technicians have suggested that if a cash inducement is needed to encourage a farmer then he will have little interest in the trial and will probably not look after it as well as a fully committed cooperator.

(iv) A simplified approach to economic costing was used in which a partial budget analysis was used in place of the full economic costing.[9]

Administration

(i) A senior Filipino field technician (de los Santos) was appointed as a field coordinator and together with the senior author was empowered to take all day-to-day decisions. Transport, an essential for any coordinator, was also available, thus frequent visits could be made to all trial sites and decisions made rapidly. Errors in the field have been greatly reduced. Unfortunately, the field coordinator, like the field technicians, is involved in the project in addition to his normal duties, thus only limited time is available for his activities. A full-time field 'leader' would be the ideal goal for the project if it is to continue at its present size and form.

(ii) To limit the workload for any one technician, a ceiling of two trials each was set. This has resulted in the involvement of many technicians with little experience with the potato crop.

Data collection

(i) The technicians were thoroughly briefed on basic survey principles and on the information required from the questionnaire, the question-

naire was radically simplified and the survey carried out prior to identification of the farmer cooperators. However, the existing workload of the technicians still restricted the number of farms that could be surveyed and reliance had to be placed on field experience in order to obtain a representative sample.

(iii) Briefing of the technicians and simplification of the questionnaire allowed for the more important points to be identified, but much basic information was still missed. For instance, this small survey allowed for the identification of those groups of farmers requiring assistance and gave valuable information about their geographical distribution, economic status and the overall production pattern, but some essential information, in particular relating to social factors and the quality of the field practices, was lacking. For example, no information was collected regarding the role of the wife or foreman in making day-to-day decisions. Similarly, whilst much data was obtained regarding the frequency of pesticide application and the products and quantities used, there was no information on the quality of application, that is, the technique used in the field. This problem is likely to be encountered by any quick survey of naturally cautious farmers, whether it is formal or informal and the sample large or small, particularly when it is carried out by untrained personnel.

The only apparent practical way to gain such information is for a non-biased, trained scientist, conversant with the local dialects and with interests in agronomy, economics and anthropology, to spend the full cropping season in the field observing and talking to farmers: the quality of the field practices, the real problems as the farmer sees them and his reasons for acting as he does should then become evident. Ideally, the scientist, if not a native speaker, should be thoroughly trained in the appropriate languages since experience has shown that working through a translator often leads to misunderstandings, particularly if he tries to put his own interpretation on the question or answer.

(iv) In addition to the Preliminary Survey, supplementary yield data were obtained through a yield survey in which sample yields were taken, in the field, from a total of 419 farms during the harvests of July to August, 1980 and 1981 and January to February, 1981 and 1982. Average yield per hectare was computed at 28·2, 17·1, 24·7 and 28·8 tonnes/ha, respectively,[7] figures which were not disputed by the farmers concerned and which agreed with their own private estimates of 'more than ... tonnes'. Obtaining such basic information is essential and further

similar supplementary surveys may be necessary if a meaningful project is to develop and the national programme to direct scarce resources and funds to those areas most likely to benefit the farmer and the nation as a whole.

Field practice

(i) For the first series of trials, beginning October 1980, four main variables were selected. Selection was based partly on the preliminary survey but also on the observations and experience of the authors during the previous six months. For example, the use of chicken manure was selected as a variable because the initial survey showed it accounted for 25% of the input costs but, more importantly, observations showed that, for the dry season at least, it was often undecomposed at harvest and thus of little apparent benefit to that crop.

Each selected variable was compared with the farmers' current practice and was considered to be most likely to be accepted by the farmers and to increase their monetary returns. They also acted as examples of the general classes of variables that may be expected:

(a) A reduction in variable costs: the elimination of expensive organic manure.
(b) No change in variable costs, merely a minor change in husbandry practices: a change in the timing of phosphate fertiliser application.
(c) An increase in variable costs: the use of improved (certified) seed.
(d) A change in capital costs: the use of improved seed storage techniques. This series of trials formed part of a larger project reported elsewhere.[11]

(ii) The use of only one variable enabled the farmer to understand and more readily identify himself with the trial. Farmer participation and regular visits by extension workers allowed a rapport to be built-up between them and much additional information was gained.

(iii) Farmer selection was critical to success since it was the farmer who finally bore the financial risks and the brunt of the day-to-day cultural practices. Thus, whilst ensuring that farmers were selected from within the designated group, preference was given to those most likely to actively participate as one of the team.

Once again, a thorough season-long initial survey would have been

most likely to identify suitable cooperators; since the opportunity should have arisen to strike a personal relationship and also to discover who was responsible for the daily decisions and management of the farm because this would be the person in most frequent contact with the technicians and who would have to be encouraged. For example, in this project it was noted that the farmer's wife often made most day-to-day decisions, thus it was she who had to be sought out and encouraged: an exercise made easier by ensuring that women were included in the field team.

Other personal information regarding the candidate cooperator also affected his suitability; in particular, his relationship with his creditors. For example, several trials were lost in this project because the creditor visited the farm and insisted that, due to market prices, the crop, although very immature, be harvested immediately, leaving no time for the field technician to be notified. Such possible situations must be identified at an early stage.

(iv) To reduce error to a minimum and to ensure that all the necessary information was gathered, a very simple step-by-step guide was made-up for each experiment together with the necessary data-recording sheets. This approach plus regular visits by the field coordinators maintained uniformity across the trials and few errors in either the field techniques or data recording appear to have occurred.

(v) To spread the trials geographically and within the target groups, two trials were located in each of the 13 municipalities. Increasing the number of trials (target, fifteen per variable) reduced the risk of a series being invalidated due to the loss of too many trials. Experience to date would seem to indicate that under Philippine conditions 15–20% of trials may be lost through unavoidable circumstances, particularly weather.

Training and extension

(i) The inexperienced technicians attended a national course on 'Potato production technology' in which considerable time was devoted to 'Technology transfer'. In future it is intended to invite leading farmers to this course, thus further expounding the philosophy. More important, however, was the practice of the authors of regularly visiting each trial in the presence of the technician concerned. This enabled enthusiasm to be maintained and, indeed, technicians and farmers are now requesting help with their own additional trials, aimed at local or farm-specific problems. Also, it served as an ideal form of in-service training; thus the project is also enhancing the competence of the field technicians.

(ii) Whilst no formal programme was set up in which the trials were used as demonstration sites, they were always a focus of interest amongst neighbouring farmers.

The more enterprising field technicians encouraged neighbouring farmers to visit the sites and discuss the trials and in so doing they gained much supplementary information whilst serving a useful extension function.

Motivation

(i) Motivation of the technicians was of prime importance to the success of the project since much depended upon their diligent execution of the field work. The problems are not inconsiderable, particularly as the technicians are very busy: the creation of a 'feeling of involvement' by means of a careful explanation of the philosophy behind the project; regular meetings, in which senior members of the PPP enthusiastically participated; group participation in such activities as planting and harvesting; and finally, constant contact and encouragement in the field, appear to have overcome most of these difficulties.

Unenthusiastic technicians, who have not adequately supervised their trials, have been dropped from the project since they contributed little to the project or to the farming community at large and cause a considerable drain on time and resources that could be better allocated elsewhere.

(ii) Enthusiasm and cooperation on the part of the farmer was also of paramount importance since it was he who was bearing the financial risks and the brunt of the day-to-day field practices. Through their regular visits and patience, the technicians have built up an enviable rapport with the farmers and maintained considerable enthusiasm.

(iii) Finally, the enthusiasm and encouragement of the PPP hierarchy should not be forgotten; since unless leadership is given by these administrators, members in the field will feel that their efforts are held only in low esteem. The regular meetings and visits to the field by senior members of the PPP have avoided this pitfall.

INTERPRETATION OF RESULTS

In the period to December 1981 41 of the 'simple' trials were successfully harvested and a further 9 were lost mainly to adverse weather. Trials were evaluated individually and collectively for each grouping.

Interpretation of individual trials consisted of two interrelated phases: an agronomic phase and an economic phase:

Agronomic evaluation

In general it was considered that an increase in yield of at least 15% was required before a farmer would be likely to adopt a technology: this is an arbitrary figure based on farmer consultations and demonstrations, which indicated that this difference was the minimum that farmers could consistently perceive in the field during the harvesting process. Differences in quality were not included but were uppermost in many farmers' minds; however, quality differences are reflected in the economic analysis.

Economic evaluation

The economic evaluation consisted of a partial budget analysis to determine either the net Benefit Cost (*B C*) ratio[9] or, where there was no change or a reduction in costs, merely the percentage change in returns. To date, it has not been possible to place a definitive figure for the minimum *B C* ratio at which a technology is likely to be accepted. This minimum reflects changes in agronomic yield, actual production costs, the rate of inflation, other investment opportunities and, most importantly, the farmer's perception of risk involved in the new technology. Pending further follow-up studies on this aspect, an arbitrary figure of 0.65 for the net *B C* ratio or a change in economic returns of 10% has been used.

Economic interpretation of the results has been relatively straightforward for those trials involving a simple change in variable costs or merely in agronomic practices. Some considerable difficulty, however, has been experienced in obtaining accurate data on the manhours required for an operation and its subsequent computation to a meaningful per hectare basis, since relatively small areas have been used for the trials. Fortunately, since the yield differences and economic returns have been so marked, slight errors in this particular computation have little effect on the overall picture.

A problem of far greater importance with respect to the economic analysis has been estimating the capital costs involved in constructing diffuse-light seed stores. The degree of complexity involved ranged from

very minor modification to existing structures to the erection of very complex stores, some of which had been more elaborate and expensively constructed than necessary from a technological viewpoint and thus unfavourably influenced the economic evaluation of the technology. Further, many stores were built from unused materials already on the holding and constructed during hours when labour would not otherwise have been usefully employed. Thus, there is a conflict between the true economic cost of adopting the technology and the farmers' perception of the cost, and probably neither reflects the optimum cost of producing good quality seed. Such a conflict may be envisioned for the adoption of other technologies involving capital investments.

Group evaluation

Results within any one group of trials were often very variable; thus to assess the appropriateness of each technology to the Mountain Province area as a whole, each variable was considered as a grouping, e.g. the fertiliser placement trials shown in Table 1. This format acted as a guide

TABLE 1

Fertiliser Placement Trials. Number of Trials Showing >15% Increase or Decrease in Agronomic Yield or >10% Increase or Decrease in Economic Returns

Factor	*Increase*	*Decrease*	*No change*
Agronomic yield	6	0	7
Economic return	10	1	2

to enable both farmers and extension workers to obtain an overall qualitative assessment of the technology, bearing in mind individual circumstances and risk. Detailed accounts of the trial procedures and results are to be published elsewhere.[11,12]

Farmer evaluation

It has already been indicated that the agroeconomic evaluation described above may only act as a guide, as may the farmers' own comments made during the enthusiasm of the trials. A brief follow-up survey immediately following the above series of trials indicated that the farmers concerned

and their immediate neighbours, who had been closely involved and consulted throughout, all stated categorically that they would adopt the new technology, even after only one season's results. However, it is becoming apparent as farmers plant successional crops that not all farmers have adopted the practices. This is in part due to natural conservatism but it would appear that other socioeconomic factors are involved. For example, many farmers are financed by merchants, who sometimes provide the necessary inputs in kind during the cropping season. A proposed change in practice on the part of the farmer may not suit the merchant therefore, and thus he may discourage the farmer. Only intimate knowledge of the farming system and a close relationship with all parties involved enables the researcher to identify and evaluate these other factors and to suggest methods of overcoming any problems.

DISSEMINATION OF RESULTS

The technologies tested have been shown to be agronomically and economically sound and of likely benefit to farmers in the area. The process has now begun of disseminating the information throughout the locality. In addition to the normal arms of the extension services (farmers' meetings, municipal notice boards and the media) a 'blueprint' or 'technoguide'[13] has been written. This technoguide has incorporated the same principles as the original 'package of technology'; but this package would be location specific, applicable to only a small area such as a province, with specific recommendations for each municipality or *barangay* (village) where necessary. Ultimately it is intended to translate the technoguide into the local dialects of the area. Each package is to be compared, as a single entity in the field, with farmers' current practices in that area. Similar problems of acceptance, particularly of expense, to those encountered in the original trials are likely to be encountered but, since each major item in the package has been tested under representative conditions, it is felt that farmers can choose those technologies which they regard as most appropriate to their own personal circumstances, in the knowledge that they have been thoroughly tested and positive benefits may be expected.

The path chosen by other similar projects will obviously depend very much on the ability of the extension services and their usual practices. However, experience has shown that attention should be given to this

aspect at the outset and that the extension services, the ultimate educational arm, should be consulted and involved throughout. Success or failure of the whole process depends ultimately on their ability to get the message across.

GENERAL CONCLUSIONS

In order for a programme of on-farm trials to be successful a logical stepwise approach, from the understanding of the farming system to the evaluation of results, must be adopted. Each step must be thoroughly explained and discussed by all participating persons and institutions, including a selection of potential farmer cooperators—the central pivot of any programme. Lack of understanding by any participator results in a lack of enthusiasm and frequent errors which may undermine the whole programme. The promotion of complex packages, therefore, is to be avoided.

Before embarking on the trials programme *per se* a thorough understanding of the current farming systems must be held by all concerned. Survey questionnaires are no substitute for the stationing, in the field, over an extended period, of a scientist trained in the social, economic and agricultural sciences. Such a scientist is then more able to understand the more personal motives involved in the farmer's decision-making, e.g. the true role of the wife in decision-making or the relationship of the farmer to the creditors, merchants, etc. Field-oriented surveys, however, may be valuable means of confirming visual observations and obtaining necessary additional data; for example, in this project they were used to obtain a true estimation of yields, which had been consistently underestimated by previous survey questionnaires.

Even in areas already achieving average yields, there may be groups of farmers for whom alternative technologies would be beneficial. These technologies may not necessarily involve an increase in costs and may not even result in an increase in agronomic yield, but can still result in improved monetary returns. Such technologies appear most likely to be accepted.

Enthusiasm on the part of all involved is an essential prerequisite of a successful on-farm trials programme. Such a programme is by its nature a dynamic, long-term approach, which is constantly changing as new technologies become available. Planners and administrators, therefore,

have a duty to maintain enthusiasm through active participation at all levels. Such participation will also enable the administrators to consider the appropriate methods of disseminating the accumulated information, so that the trials programme will be of lasting benefit and not merely an end in itself.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the help and enthusiasm of all the cooperating farmers and field technicians, the encouragement of the Philippine Potato Programme Management Committee and the help given by staff at the International Potato Centre, Lima, Peru.

REFERENCES

1 Mante, J. A., Olgado, S. S., Domingo, B. H. & Baente, C. M. (1978) White potato socio-economic and marketing study. Part I: Benguet. Report No. 78-14, Special Studies Division Planning Service, Office of the Secretary, Department of Agriculture, Diliman, Quezon City.

2 Anon (1979) *Philippine Agriculture: Facts, Book and Buyers Guide*, 2nd Edn, Philippine Almanac Printers, Manila.

3 Bureau of Plant Industry. (1978, 1979, 1980) Annual Report of Baguio Experimental Station (unpublished).

4 Sano, E. O. & Hermano, F. G. (1979) Variety trials and evaluation of Irish potato at the Mountain State Agricultural College. *MSAC Research Journal*, 1(1), 70–89.

5 Anon (1979) Potato technology package pilot testing in the highlands. Mimeograph. The Philippine Potato Programme, Philippine Council for Agriculture and Resources Research, Los Baños, Laguna, p. 12 and appendices.

6 Anon (1978) Optimising potato productivity in developing countries. Report of a planning conference. International Potato Centre, Lima, Peru.

7 Rhoades, R. E. & Booth, R. H. (1982) Farmer-back-to-Farmer: A model for generating acceptable agricultural technology. *Agricultural Administration*, 11(2), pp. 127–37.

8 Cortbaoui, R. & Potts, M. J. On-farm research for optimising potato productivity (a description of CIP's current approach). *Proceedings of the Third Regional Symposium on Potato Production South-East Asia and the Pacific* (In press)

9 Horton, D. (1980) Partial budget analysis for on-farm potato trials. Social Science Department Training Document, 1980–88. The International Potato Centre, Lima, Peru

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10. Potts, M. J., Pacuz, L. M. & Sano, E. O. (1982) Yield estimates and common cultivars of white potato (*Solanum tuberosum* L.) in Benguet Province, *Philippine Agriculturalist*, **65**.
11. Potts, M. J., Albert, W. V. D., Rutab, F. R., Sano, E. O., Mariano, P. & Booth, R. H. (1982) An agro-economic assessment of seed-potato storage technologies in the Philippines. *The American Potato Journal*, June.
12. Potts, M. J., de los Santos, A. B., Sano, E. O. & Rutab, F. R. (1982) An agro-economic assessment of white potato manuring trials: Benguet and Mountain Provinces, *Philippine Agriculturalist*, **65**.
13. Anon. (1982) *Benguet technoguide for potato*. Philippine Council for Agriculture and Resources Research, Los Baños, Laguna.

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