DISCUSSION PAPER

Report No.: AKU 47

Methodological Issues in the Evaluation
Of Extension Impact

by

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July 1985

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1. Introduction

The impact of extension is an imprecise term. Does it for example mean the full set of changes, direct and indirect, resulting from an extension initiative or does it have narrower connotations of change; in the organization of extension for example or, less simply, the immediate and direct effects on farmers of extension activity. The literature is littered with such semantic niceties concerning the definition of monitoring, evaluation and impact [see for example United Nations 1984] but these need not detain us. Our purpose in this paper is to examine some of the methodological issues and problems involved in undertaking an evaluation of extension designed to observe and measure changes in the operational efficiency of extension agents changes in farm husbandry knowledge and the increase, if any, in agricultural productivity induced by the introduction into an area with agricultural extension, of a more intensive system. We do not therefore specifically address issues that arise in evaluating the contribution of an established system of extension to agricultural output. Moreover, our attention is centered on extension in less developed countries, the locus of much recent investment, rather than the more sophisticated systems of Europe and North America.

We begin in Section 2 by outlining a conceptual framework for evaluation. In Section 3 we briefly review some earlier evaluative studies of
extension. Section 4 describes the methodological approach to the evaluation of extension in a recent case study undertaken by the authors. Section 5 describes the application of a cost benefit analysis and Section 6 summarizes the main results of the case study. In Section 7 we draw some conclusions.

2. A Framework for Evaluation

To have a reasonable chance of success any extension system must become well known to farmers. This is mainly a matter, in most developing countries, of ensuring that there are sufficient, adequately trained and equipped, staff. It is important however, that farmers be aware of the availability of these staff and their ability to provide useful information and to answer questions. Once a satisfactory level of awareness is established amongst the farming community it is reasonable to expect that an effective process of knowledge dissemination will begin; providing, of course, that the extension service offers information to farmers that is relevant to their needs. An increase in farmers knowledge about crops and cropping practices is the intended direct product of extension. Obviously managers of an extension system hope that additional relevant knowledge will lead to the adoption of improved husbandry by cultivators and will ultimately be translated into increased agricultural productivity.

Knowledge, once disseminated by the extension service and acquired by the farmer, has a tangible, measurable product only if applied. The application of such knowledge by farmers is generally termed adoption and is usually measured by adoption rates, that is, the proportion of farmers applying
knowledge of a particular crop practice that they have acquired from the extension service. Although adoption cannot take place without knowledge, it is not an automatic consequence of the acquisition of knowledge as many other influences may affect a farmer's decision to adopt. Obvious amongst these is the profitability of the practice, the availability of key inputs, sufficient credit and complementary knowledge. Hence, although adoption is commonly taken to be an indicator of the output or effects of extension (its measurement is relatively easy) it does present significant problems of attribution which can be tackled only with considerable difficulty and complex analytical tools. Nevertheless, the measurement of adoption rates, and their corollary, the reasons for non-adoption, is a legitimate evaluation activity capable of yielding valuable insights for extension management and policy makers.

Similar problems beset the use of crop yields (productivity) as an evaluative measure. Unless data from a complete analytical framework (see below) are available yield data provide only a rough measure of the effects of extension. A conceptually complete evaluation requires that information on the effects of the project be collected in accordance with the schema in Figure 1.
Figure 1: A COMPLETE EVALUATION FRAMEWORK

<table>
<thead>
<tr>
<th>Before Project</th>
<th>After Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Project</td>
<td>The situation before the time the project is introduced in an area identical to that where the project is planned.</td>
</tr>
<tr>
<td>With Project</td>
<td>The situation in the area where the project is planned before the project is undertaken.</td>
</tr>
</tbody>
</table>

Figure 1 demonstrates that an estimation of the effects of extension (or any other project) requires a comparative approach along two dimensions. Rarely is this possible for either practical or administrative reasons. Sometimes, however, it is possible to work along only one dimension, most commonly, studies of the situation in the area where the project is undertaken both before and after (as well as during) implementation. Even this somewhat inadequate approach is not possible in areas (projects) where monitoring and evaluation efforts are not made prior to the project and subsequent implementation covers the entire country or state. In these situations evaluation must remain, as it were, within a single cell of the matrix - the situation in the area of the project during and after implementation. Such a restricted form of evaluation, common in many project situations, is unable to yield definite answers about the effects of extension.

The literature on the evaluation of extension is extensive and has recently been summarized by Orivel [1983]. Those who have attempted to evaluate extension have done so from a variety of perspectives with mixed results. Some, usually aggregative, studies [e.g., Evenson and Jha 1973], recognizing the dependence of extension on agricultural research, combine the two and have shown a positive relationship between them and agricultural productivity. Other studies have concentrated on estimating the effects of extension by comparing farmers who have contact with extension agents with those who do not [e.g., Harker 1973]. These evaluations underestimate the effects by not taking into account the way in which information, once acquired by one farmer, can be passed on to others. Other studies have concentrated on assessing extension performance by measuring the extent of farmer-extension agent interactions [e.g., Giltrow and Potts 1978, Chambers and Wickremayake 1977]. Other studies have examined the extent to which extension agents visits to farmers are biased in favor of the rich and influential [e.g., Leonard 1973]. Some evaluators see the internal efficiency of the extension system as the crucial parameter and study farmer to agent ratios and the quality and motivation of extension agents [Hoeper 1983] or the location and mobility of extension workers [Rahim 1966]. In the context of exploring the relationship between education and farmer productivity some investigators have sought to establish whether extension is a substitute for, or a complement to, education [Lockhead, Jamison and Lau 1980]. Such studies however, even when they yield unambiguous results, shed
little quantitative light on the net benefits of extension. To do so requires not only rigorous comparative analysis but a formal means of establishing whether, if positive effects are observed, the effects are commensurate with the costs incurred to produce them. Such studies have been undertaken in developed countries, of which Griliches [1958] study of hybrid corn in the U.S.A is perhaps the most well known. Studies in developing countries have usually been less rigorous, evaluating extension through a simple before and after comparison of crop yields [e.g., Benor and Harrison 1977, and data reported for Ethiopia in Lele 1977]. Such studies, however, do not identify and hence evaluate, the contribution of extension to increases in output because they do not separate out the contributions of factors such as material inputs, soil quality, supply constraints and other variables likely to influence output. Nor do they take into account the possibility that, with time, there may be autonomous growth in productivity.

In recent years there has been a remergence of interest in evaluating extension partly as a consequence of the recent, but wide-spread, introduction of an intensive and highly supervised form of extension - the Training and Visit (T&V) System. Well described in Benor, Harrison and Baxter [1984] the system requires a high degree of professionalism, relatively high ratios of extension staff to farmers, frequent staff training, the intensive and regular supervision of field staff and a strict adherence, by extension workers, to a pre-determined schedule of farm visits to pre-selected contact farmers. The rapid spread of T&V has given rise to claims of tangible success [e.g., Benor and Harrison, 1977] and provoked considerable criticism
[e.g., Moore 1984]. But both proponents and critics lack substantive and objective empirical evidence with which to substantiate their claims. More rigorous evaluation is required. To do so we chose a comparative methodology based on a case study which, because it was undertaken at approximately the mid-point of an extension project, operated mainly within the two right-hand cells of the evaluation matrix in Figure 1. Nevertheless, as explained below, strenuous efforts were made to approximate the requirements imposed by the two left-hand cells of the matrix.

4. A Case Study in Extension Evaluation

Our evaluation covered several aspects of the extension-farmer-productivity chain, and several analytical approaches were applied to deal with different issues. To clarify and quantify the impact of T&V extension on (i) system efficiency; (ii) changes in the rate of growth of knowledge dissemination; and (iii) farm output, a comparative analysis of extension activity and productivity in two, specially selected, geographically adjacent areas - Karnal district and Kairana tehsil in North Western India - was undertaken. These two areas are similar in most agro-climatic respects, but had different extension systems during the period of the study. In Karnal T&V extension was operating, having replaced the older system of multi-purpose extension agents, which continued to function in Kairana. A detailed farm-level survey was conducted in 1982/83 in both areas, about 3-4 years (depending on the season considered) after the T&V extension system was introduced in Karnal district.
To establish that the extension system had indeed been reformed we asked farmers whether they had noticed any change. Improvements in the operational efficiency of the extension system were assessed by examining the relative importance of farmers' sources of information in relation to their exposure to extension in the two areas. Extension agent interaction with farmers was measured by calculating visit frequencies by farm size, further disaggregated in the T&V area, according to whether the farmer was a contact or non-contact farmer [Feder and Slade 1984].

During the sample surveys, farmers were questioned on their knowledge of specific practices, and about the time when they first learned them. Knowledge is difficult to measure without conducting a thorough examination of a respondent's understanding of all aspects of a given recommendation. For some practices this was possible, but for others detailed testing was beyond the time and resources available. In such cases, however, it was possible to establish the farmers' awareness of the practice. Such awareness is an important indication of knowledge because, by definition, a farmer who is unaware of a practice cannot be familiar with its detail. From the resulting data, the growth in the number of farmers who were aware of different technologies in 1978, the year before T&V extension was introduced in Karnal, and in 1982, four years later, were calculated for both areas. Later analysis employed two alternative standard specifications (logistic and negative exponential) of the time path of growth in knowledge diffusion.
[Feder and Slade, 1985]. By comparing, for the with and without T&V situations, the parameters estimated from these functions we established practice-specific differences in the rate of growth in knowledge diffusion in the two areas.

Subsequently, econometric techniques which accounted for differences in the quantities of variable and fixed inputs, the types of soils, human capital, irrigation (both quantity and quality), and the production environment were used to estimate the percentage output differentials between the two areas for two major crops; high-yielding varieties of wheat and rice [Feder, Lau and Slade 1985].

Such an approach implies that when differences in variable inputs are controlled, the effect (if any) of extension on input use is ignored. If differences in the use of variable inputs are not taken into account then the output differential includes the effect of extension on farm efficiency as well as the effect on the use of inputs, provided that price differentials are also controlled. A complete accounting for the effects of extension should therefore take both types of effect into account (a simplified representation of these two effects is depicted in Figure 2). Our analysis attempted this but owing to inadequate price data the possible effect of extension on input use was eventually ignored. The residual productivity differential between Karnal district (T&V area) and Kairana tehsil (non T&V area) not accounted for by the extensive set of explanatory variables listed above could have been attributed to differences in the extension systems if
Figure 2: Embodied and Disembodied Productivity Differentials

Output in Area b

Output in Area a

Disembodied Differential

Embodied Differential

Total Differential
there were no other systematic factors differentiating the two areas, and if it could be assumed or established that the two areas were, in 1978/79, (pre T&V) at the same productivity level, after similarly accounting for differences in the levels of explanatory variables in that year. This last assumption could not be maintained and we therefore undertook detailed calculations to establish the baseline productivity differential.

If a similarly detailed farm-level sample for 1979 had been available, we would have replicated for the base year the econometric analysis which we applied to the data from the 1982/83 sample, and the residual productivity differential for 1979 would have been estimated directly. In turn this would have allowed us to test whether the 1982/83 residual productivity differential was larger than the 1979 differential. As above, any difference between these two levels would then have been attributable to T&V extension assuming that the rate of increase in productivity between the two areas, in the absence of any change in the extension systems, was the same.

Unfortunately, such detailed farm-level data from our study areas (Karnal district and Kairana tehsil) for 1979 were not available. However, some data derived from seasonal crop-cutting estimates were obtained. These provided a time series of mean yields for wheat and rice for both Karnal and Kairana. These mean yields had a number of deficiencies. First, sample sizes were small, and thus the number of observations underlying the Kairana tehsil means was only 30-40. Second, the mean yields did not differentiate between irrigated and unirrigated conditions, or between high-yield varieties
and traditional varieties. Our 1982/83 sample, however, focused only on high-yield varieties under irrigated conditions. Third, no information was available on the mean input levels (and other relevant explanatory variables) pertaining to the sample observations used to calculate the mean yields. Fourth, the mean yields in any given year included random elements which fluctuate over time, e.g., a severe pest problem in a given year, or an adverse micro-climatic condition such as hail. Thus, the differences in mean yields were not directly comparable with our estimates of productivity differentials.

In order to overcome these deficiencies, we undertook a number of adjustments so as to derive, from the available data mean yields for 1979 which were compatible with those used in our analysis of the 1982/83 survey data. We then utilized econometrically estimated values of the parameters 1/ associated with explanatory variables (e.g., inputs) to generate an estimate of the residual productivity differential between Karnal district and Kairana tehsil in 1979. This differential was then subtracted from the one estimated for 1982/83 to obtain the net differential in productivity attributable to T&V extension. The gains due to this net differential were calculated under several alternative scenarios and subsequently utilized in a cost-benefit analysis (see Section 5) of the incremental investment in T&V extension.

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1/ These were estimated from the detailed data collected during the 1982/83 sample surveys.
Only the differential for wheat was used, as that for rice, although similar in size, proved not to be statistically significant.

We originally intended to evaluate the effect of T&V extension on the adoption of a variety of farm practices and the use of inputs, but the lack of detailed farm level data on adoption and input use in the pre-T&V (baseline) year implied that the analysis could be carried out only under the assumption that adoption and input use were identical, ceteris paribus, in the T&V area and in the control area before the introduction of T&V. This was deemed to be too restrictive, and abandoned. We did however obtain estimates of the upper limit of the effect of T&V extension on the use of the main farm inputs and these showed the effect to be small; probably because both areas were agronomically advanced before T&V was introduced in Karnal.

We also intended to specify extension variables at a degree of detail which would have provided operational insights into, for example, the optimal agent/farmer ratio, but there was insufficient variability in the indicators to allow derivation of substantive conclusions. We thus opted to evaluate T&V extension, as a system, by comparing it with traditional extension.

5. Cost-Benefit Analysis

The final step in the evaluation required that the value of the increase in farm output, resulting from our estimates of the productivity differential attributable to T&V extension, be set against the additional costs incurred to make the additional output possible. To do so the familiar
technique of cost-benefit analysis was applied to the T&V system in Karnal [Feder, Lau and Slade 1985]. Although the analysis was undertaken ex post, a complete series of either costs or benefits for the entire life of the project were not available. Therefore, we were obliged to make a number of assumptions redolent of an ex ante analysis.

The stream of incremental extension costs (adjusted to constant 1979 prices) was constructed using data on the actual costs of the first four years of T&V extension in Karnal and projections made at the time of project appraisal. In scenarios where the project life was assumed to be less than the life span of physical structures and equipment, appropriate residual values were calculated and deducted from the costs.

As recorded above, the increase in yield attributable to T&V extension was estimated for the third year of the project. However, it is reasonable to expect gains to continue to accrue over time. In the absence of data with which to estimate future (after the third year of the project) extension-induced gains, we were obliged to construct a dynamic model to simulate the future evolution of the change in productivity, both with and without T&V extension. The model is depicted graphically in Figure 3.

The model assumes that in the absence of T&V extension, the average yield grows at a constant rate, $\frac{1}{1}$ and that after a few years the initial impetus to productivity resulting from the introduction of T&V slows down.

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$\frac{1}{1}$ Estimated from a trend analysis of pre-project yields.
Figure 3: Time Pattern of Productivity Change

\[ \ln y \]  
(log. yield)

With T&V  
Without T&V

\[ \delta \]  
Productivity gain due to extension in 1982/83.
Thus after a number of years, \( T^* \), average yields, with and without T&V extension, are again the same. Therefore, the model conservatively assumes the supply of new knowledge from research to be limited. As a result, the gross benefits accruing from T&V extension are positive only in the years prior to \( T^* \) in Figure 3; a period which can be called the "project's life". If it were possible to stop the project as soon as marginal benefits equal or are only slightly lower than marginal costs, a shorter project life would result which may be called the "efficient project life". The model was used to estimate the project's total benefits for several variants of each of these concepts of project life. Finally, rather than calculate the corresponding internal rates of return, we chose to establish the level of statistical confidence with which a minimum acceptable rate of return could be expected.

6. Main Evaluation Results

The results of the evaluation showed that the diffusion of knowledge regarding improved farming practices for wheat was faster in the area covered by T&V extension, but no clear superiority could be discerned for rice. Crop yields for farmers whose main source of information was extension were found to be higher than those of farmers who learned mainly from other sources.

After three years, the area where T&V extension was introduced had a 6–7 percent gain in the productivity of wheat compared to the area with traditional extension. Significant results were not obtained for rice. The gains in wheat provide (at the 90 percent confidence level) a rate of return
of more than 15 percent (more than 20 percent using the concept of an efficient project life) to the incremental investment in T&V extension.

Most of the gains in yield induced by extension were found to derive from farmer's access (through the larger number of extension field workers) to timely and research-based advice concerning their specific production problems. The study area was very advanced even before the introduction of T&V extension, and no significant gain was identified in the use of high yielding varieties or fertilizers.

7. Conclusions

Although the methodology of the evaluation described above may have been adequate to cope with the particular circumstances that were confronted, a number of lessons seem clear.

We have several times alluded to weaknesses in our data base. Hence, we conclude that if evaluation is to be efficient, suitable studies should begin long enough before the start of project implementation to collect sufficient material for a clear picture of the pre-project situation. Such work is not incompatible with normal prefeasibility or preparation studies and indeed could be of material assistance. Data collection should continue at intervals until most adjustments resulting from the project intervention are complete. This may be long after the end of direct implementation. Without time series information spanning a sufficient period, it is difficult, as we have learned, to obtain an understanding and a measure of the
magnitude of the changes that have taken place. It goes almost without saying that the data collected should be of high quality. This requires painstaking attention to detail and a process of supervision which ensures that key variables are not omitted or imperfectly measured. These practical matters are addressed at some length in Slade and Feder [1985].

Secondly, we conclude that the comparability of the subject area and the control area is crucial. The evaluation framework in Figure 1 requires that the two areas be identical. In practice this is obviously unlikely, but it is, analytically, possible to control for small differences between them. These differences must, however, be minimized. By selecting geographically neighboring areas physical, climatic and cultural differences between the control and subject areas can be largely eliminated. If however, as is the case with extension, the objective is to evaluate the effects on productivity of institutionally provided knowledge, which once released observes few natural or administrative boundaries, then the contamination of the control area by the subject area is possible. Minimizing this possibility requires the two areas to be separated by some feature (in our case a large river) which strongly inhibits such contamination.

These conclusions imply a third. Those who undertake these evaluation studies must approach their work with a clear idea of what they are trying to do. It matters little whether the aim is to evaluate the so-called direct changes or to measure the project's full impact. In either case, an explicitly defined evaluation scheme, a clearly articulated set of questions
to be answered and a carefully constructed analytical framework must be in place before data collection begins. The asking of questions and the collection of data merely because they appear interesting will not yield a convincing evaluation or advance our understanding of the processes of change, unless they are part of a systematic, consistent and analytical evaluation framework.
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