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Evaluation of IPM Programs –

Concepts and Methodologies

Papers presented at the First Workshop on
Evaluation of IPM Programs
Hannover, March 16 - 18, 1998

H. Waibel G. Fleischer P.E. Kenmore G. Feder

(eds.)

In cooperation with FAO

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Evaluation of IPM Programs – Concepts and Methodologies

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Preface

Integrated Pest Management (IPM) has become one of the most widely used catchwords in agricultural development and environmental conservation programs. Everybody claims to like IPM and even to do IPM, but the actual content of this term differs widely. A particular concern in this regard is that chemical companies redefine the term IPM in order to use it to boost pesticide sales. Hence, the question of measuring the success of IPM programs becomes crucial. As outlined in AGENDA 21 successful IPM programs are of central importance for the world's food security and for maintaining a healthy environment. Successful IPM therefore requires a change from pesticide dominated management to information based management of cropping systems on local up to global scales. Major goals for an IPM initiative are to reduce dependency on chemical pesticides, and achieve sustainable intensification at a level of pesticide use that corresponds with the social optimum.

The vast range of IPM interventions existing today makes it necessary to improve our understanding of the true impacts that can be expected from IPM. Since many IPM initiatives involve public funds that have opportunity costs, one needs to show that investments in IPM programs pay off. This raises the question of what components should be in an IPM initiative, e.g. to what degree farm-level activities should be complemented by policy measures. Traditionally, impact evaluation uses techniques of cost-benefit analysis, but these may be insufficient to capture the true impacts of IPM. Instead, concepts are needed that allow us to understand and assess the natural resource implications of IPM initiatives, their impact on human capital formation and their institutional consequences.

This workshop therefore aims at developing a methodology for IPM evaluation and at setting quality standards that can help to avoid misuse of the IPM concept. It has therefore brought together international experts of different disciplines to discuss methodology and practical procedure for impact assessment and multi-criteria evaluation of IPM. The structure of the workshop allowed economists, natural scientists, sociologists and anthropologists to portray their view about the different conceptual and methodological approaches for the implementation and evaluation of IPM programs.

The workshop consisted of two parts. The first part was devoted to presentations on a variety of approaches to IPM evaluation ranging from cost benefit analysis to anthropological approaches addressing the problem of measuring some of the non-market effects of IPM. These contributions, which are presented in the first part of the report were complemented by a contribution on some ecological principles of IPM (Zadoks) and a country case study as a special type of IPM intervention (Fleischer).

The second part of the workshop (chapter II of the report) contains the findings of four working groups that dealt with impact assessment at different levels : farm household, village, institutions and policies, environment and natural resources. Since the groups had a multi-disciplinary composition, the respective tools of natural scientists, anthropologists/extension specialists and economists were reflected.

The last chapter of the report draws some conclusions from the workshop, identifies remaining questions and provides an outline for the next steps towards the development of Guidelines on Good Practices for IPM Impact Assessment and Evaluation.

The workshop was hosted by the GTZ-Hannover University Crop Protection Policy Project, which is sponsored by the German Ministry of Economic Cooperation and Development (BMZ). It was conducted in collaboration with the Global IPM Facility based at FAO, and the World Bank, providing organizational, technical and financial support.

Hannover, Rome and Washington, April 1999

The Editors

Section I

Extended Abstracts of Presentations

Integrated Pest Management (IPM) in Asia: Are There Real Returns to IPM and Its Diffusion?

Gershon Feder and Jaime Quizon[1]

Background

As with the provision of any new on-farm technology, the methods used - to extend relevant information and skills to farmers and to encourage them towards their sustained practice of IPM - are as important as the technology itself for rallying wide-scale acceptance. Thus, as with assessing any new technology, it is as important to consider the benefits and costs of different IPM dissemination methods as it is to understand the on-farm returns and costs of IPM itself.

There are many ways by which IPM might be promoted on a large scale. Each IPM diffusion activity has its merits, which derive largely from the practice of IPM itself, and its costs, which in Asia are mainly publicly borne. For government policy makers (and program sponsors like the World Bank), economic assessments of these IPM diffusion approaches are necessary in order to justify a preferred diffusion strategy.

This paper identifies key elements for an economic impact analysis of approaches and programs promoting IPM use in Asia. It outlines a methodological, yet practical, approach to quantifying (and qualifying) the economic gains and losses of IPM and its dissemination. Cost-benefit analysis offers one approach to evaluating the economic impact of IPM and its diffusion. But as with any other analytical framework, there are clear limits to this approach. These owe mainly to the still unresolved difficulties with quantifying certain economic consequences of IPM practices, such as the benefits that derive from sustained IPM practice, including to human health and the environment.

[1] The World Bank, Rural Development Unit, Development Economics Research Group (DECRG), Washington, D.C., USA

Model

IPM performance can be evaluated from at least two levels. The basic farm level analysis investigates whether IPM and its dissemination - insofar as these change farmers' knowledge and thereby effect more efficient farm input use (particularly of pesticides) - result in higher farm profits. At the program level, the main analysis concerns how overall benefits of state-funded IPM diffusion efforts compare with their overall costs. Although there are various IPM technologies for different crops and while there are alternative methods to diffusing these practices, all these instruments and efforts uniformly aim at altering existing farm use of pesticides and promoting effective and efficient pest-management practices. IPM's primary objective is to help restrain pest damage at a level that maximizes farmers' economic returns, while utilizing the smallest level of chemical inputs. Farmers are IPM's main target beneficiaries. However, others may benefit from externalities that derive from sustained IPM practice and/or the IPM dissemination efforts.

Farm-Level Analysis

Consider the model of a farm household that produces multiple outputs ($Y_1, Y_2, ..., Y_n$) using multiple variable inputs ($X_1, X_2, ..., X_m$), including chemical pesticides (Xp). The household maximizes profits (Π) from considering the prices of farm outputs and variable inputs, but subject to constraints from fixed factors. These fixed factors include fixed inputs such as available land (L), the farmer's general level of pest management knowledge (K), and other factors (Z) which are left unspecified for the moment. The variable K is the main target of IPM diffusion efforts.

The farm household's maximized profits can be written as a profit function:

$$(1)\quad \Pi = \pi(\bar{P}x;\ \bar{P}y;\ L, K, Z),$$

where: $\bar{P}y$ refers to the vector of output ($\bar{Y}$) prices, $\bar{P}x$ to the vector of variable input ($\bar{X}$) prices, and with output supply and input demand equations, that correspond to maximized profits and derived from (1), expressed as follows:

$$(2)\quad \bar{Y} = f(\bar{P}x;\ \bar{P}y;\ L, K, Z)$$

$$(3)\quad \bar{X} = g(\bar{P}x;\ \bar{P}y;\ L, K, Z).$$

For IPM and its dissemination, the desired impact on profits comes from raising farmers' knowledge (K). This rise in K leads to a change in the input mix and in practices used, and in particular, to a smaller use of pesticides. Supposedly, higher farming returns follow from this decline in farmers' demands for pesticides and perhaps, of other inputs (such as labor) and from the rise in outputs owing to improved plant protection and cultivation practices overall. From equations (2) and (3) then, the premises are that:

(i) $\partial Xp/\partial K \leq 0$ and $\partial Y/\partial K \geq 0$.

Most farmers learn of IPM practices, directly or indirectly, through IPM diffusion programs. *Ceteris paribus*, smallholders who have been exposed to some form of IPM dissemination have greater or equal awareness and knowledge (K_a) than their counterparts who have not been reached by any IPM diffusion program (K_{na}). This suggests that:

(ii) $K_a \geq K_{na}$, and therefore that:

(iii) $\overline{Y}_a \geq \overline{Y}_{na}$, $\overline{X}_a \leq \overline{X}_{na}$, and $\Pi_a \geq \Pi_{na}$,

where the subscript a refers to farmers who have been reached directly by the IPM diffusion effort, and the subscript na to the others who have not. The outcomes for those who have been only indirectly exposed (such as through discussions with other farmers) would fall somewhere within these two groups. Statement (iii) describes some of the main desired consequences of IPM efforts, i.e., to raise farm yields, lower pesticide use and thereby, raise farm profits. Statements (i) to (iii) above are empirically testable hypothesis.

Assessing the farm-level impact of IPM technology and its diffusion is a complex task for which the common before-and-after or the with-and-without comparative study might not suffice. The largely short-run, cross-section nature of these usual case studies must contend with some basic estimation problems including: (a) the self-selection issues related to IPM program participation, (b) the secondary (or spillover) effects of IPM promotion which, if unaccounted, may understate the measured benefits of IPM efforts, (c) the difficulty with separating out the individual effects of different IPM dissemination efforts that may be ongoing simultaneously, (d) the difficult issues with establishing and measuring the long-run outcomes (e.g., on knowledge retention and diffusion) of IPM dissemination programs. However, two-stage and simultaneous equation procedures can correct for some endogeneity and self-selection problems. Also, village- or district-level (as opposed to household-level) analysis can eliminate many of the estimation biases that derive from secondary and extraneous program effects.

Program-Level Analysis

Different dissemination efforts entail varying costs, even though they are focused in like fashion on raising farmers' IPM awareness. Expectations are that these efforts payoff in experimentation and knowledge creation by farmers themselves, and ultimately to sustained IPM practice by them. The degree to which these desired outcomes occur depends on the particular IPM diffusion efforts followed. Briefly stated, a farmer's technical IPM knowledge (K_t) depends on the type of program exposure. The common belief is that with a more intensive training program (like FFS), farmers learn and retain more IPM-related knowledge compared with others who undergo less rigorous training, such as the IRRI-type of IPM extension (or FMPR). In notations,

(4) $K_t = k\ (FFS, FMPR, t, age, education, farm\ size, experience, others)$

where K_t may be some bounded IPM knowledge score, FFS and FMPR are (0,1) dummy variables (or examples thereof) that relate to whether the farmer attended an FFS of FMPR training session for IPM. One hypothesis is that, controlling for non-program factors that influence a farmer's technical knowledge (e.g., age, education, experience, farm size, and other factors)

(iv) $\partial K/\partial FFS \geq \partial K/\partial FMPR \geq 0.$

The proportion of IPM-knowledgeable farmers in any given village (or district) at any time t, say KN_t, is a direct function of the IPM diffusion efforts in the local area. Key village characteristics also determine Kn_t.
In equation form then,

(5) $KN_t = v(\ PFFS_t, PFMPR_t; V)$

where PFFS is the percentage of farm households that have undergone FFS training as of time *t*, $PFMPR_t$ is a similar percentage of FMPR participants, and *V* is a vector of relevant village characteristics.

Finally, there is also some causal relationship, mainly biological, between the early incidence of community-wide pesticide use and later emerging pest pressures in important crops like rice. If Z_t is a measure of the state of pest pressure (or the level of infestation) in year *t*, then in reduced equation form, Z_t may be related to the general level of IPM knowledge at the village level as follows:

(6) $Z_t = z(KN_t, V),$

where $\partial Z/\partial KN \leq 0$ and where the hitherto undefined variable Z in equations (1) to (3) can be replaced by the relationship defined by (6). Equation (6) suggests that IPM diffusion, if successful within a given community, also improves farm profits because it reduces the likelihood of pest outbreaks.

Cost-Benefit Analysis of IPM Diffusion Efforts

The gross benefits (GB) of an IPM diffusion effort for a given year is the sum of the incremental farm profit gains of (a) the direct program participants and (b) other IPM-knowledgeable farmers from the spillover effects of the IPM diffusion effort, i.e.,

$$(7)\ GB = \int_t \Phi_t \{N_t [(\partial\pi/\partial K)dK + (\partial\pi/\partial KN)dKN] + (Pop_t - N_t)\, KN_t [(\partial\pi/\partial K)dK + (\partial\pi/\partial KN)dKN] + OB_t\}\, dt$$

where Φ is the discount factor determined by the prevailing interest rate in time t; N is the total number of direct participant households; Pop is the total number of farm households in the target IPM program area; π and KN are as described in equations (1) and (5) and OB refers to other measurable economic benefits from IPM diffusion, including reduced health and environmental risks.

The costs (GC) of the particular IPM diffusion effort is the discounted sum of all the costs associated with the IPM diffusion activity. These include not only the direct program costs that are often funded by donors, but also the host country costs (i.e., mainly the large administrative overhead) of maintaining the IPM dissemination effort. The net benefits (NB) of a particular IPM extension effort is then the difference between its discounted benefits and costs, i.e.,

$$(8)\ NB = GB - GC$$

With empirical estimates of equations (1) to (6), or some notion of the relative magnitudes of the coefficients of these equations - such as the secondary spread effects of IPM extension efforts, the IPM knowledge retention deriving from different extension approaches, the severity of pest incidence with and without IPM - it would be possible to simulate the long-term economic outcomes of IPM diffusion efforts in equations (7) and (8).

Discussion:

Waibel started the discussion by referring to the need to a more precise assessment of costs in the context of cost-benefit analysis. *Feder* replied that assessment of costs is easier than for benefits. However if the example for the costs of extension is taken, an arbitrarian distribution of costs among different programs may be needed.

Heong pointed at the definition problem for diffusion of technology adoption. He raised the question whether there are indicators for defining an IPM farmer. *Feder* replied that indicators might be different for the crops affected. They are mainly related to yields and production costs. A way out would be to measure the profit increase at the farm over time. *Hruska* stated that there are a lot of items to be known. How much of the total budget has to be devoted to impact studies? How does the World Bank measure success? *Feder* remarked that in every project a budget line for monitoring is included. The World Bank measures success in comparing the assumptions on yield increases, cost savings etc. with the results achieved.

Zadoks continued the discussion on the diffusion of IPM technologies. In the Netherlands, rural sociologists observed that there is no continuum of diffusion. Farmers either adopt high-tech farming or aim for low-input agriculture. *Feder* relied that still the same analytical framework can be used. Two sublevels of technology may be distinguished by defining the characteristics of each group.

Pincus cited project experiences that a lot of time is needed to measure benefits of IPM programs. It appears that cost-benefit analysis of conventional pesticide use is still weak. There is a bias in scrutinising the impacts of IPM, an effort that has never been done with pesticides. We usually assume rational use of pesticides which is unlikely. If we choose a given point of time as baseline for assessing IPM impact, pest pressure due to inefficient pesticide use may distort our results. *Feder* argued that there are already studies on the environmental and health costs of pesticide use. Some benefits of IPM can be expected from this side. There are vested interests in planning and evaluating IPM programs. However, it has to be shown that IPM is beneficial in order to gain credibility. The objective of impact assessment is to clarify that despite the costs of IPM implementation, it's still beneficial.

Biggs noted that there is a preoccupation within IPM systems that rely on the implicitness of what is IPM. IPM has to be defined. There may then be a problem with the differentiation between *ex ante* and *ex post* which is commonly used. IPM adoption may be a process. There is no normal adoption curve which means that one has to look at other elements such as human capital formation and institutional capability. *Feder* made clear that there is no option of not evaluating IPM fully. Donor organizations want it. We know since Rachel Carsons „Silent Spring“ that there is excessive use of pesticides. An *ex post* analysis has still some *ex ante* elements since some of the expected benefits occur after project implementation. Institutional analysis is unlikely a substitute for economic and environmental analysis. *Kenmore* added that institutional analysis is an important issue as the work of the Hannover group has shown. IPM is not a problem of definition, but of circumspection.

Assessment of Household and Village Level Impacts of IPM

Do Kim Chung[2], Jonathan Pincus[3], Agnes Rola[4],
David Widawsky[5]

The impact of IPM programs can be viewed from a range of perspectives, from the impact on international trade, the national economy and international organizations at the highest level of aggregation to the effects on the day-to-day decisions made by crop producers at the microeconomic level. Household and village impacts are among the most profound effects of a given IPM intervention. This should not imply, however, that these effects are easily measured. The application of IPM involves improved understanding of agro-ecological principles under dynamic ecological and economic conditions. New approaches are therefore needed to integrate the relevant techniques from both the social and natural sciences to study the impact of IPM on farmers' practices and local decision-making processes.

This presentation is based on our individual and collective experiences in conducting three separate economic studies of Asian rice IPM. The three studies are being carried out by SEARCA (Rola), IRRI (Widawsky) and FAO-Hanoi Agricultural University (Chung-Pincus) in the Philippines and Vietnam. Although the focus of the studies varies to some extent, we have worked closely together over the past two years to establish what we consider to be appropriate research methods relevant to empirical work on knowledge intensive technologies in general and IPM in particular.

As a knowledge intensive technology, IPM requires a more subtle approach than that which has commonly been applied in studies of technology adoption. IPM is not simply a single decision rule, but rather a set of inter-linked concepts. Rather than measure IPM adoption as, for example, a binary variable (adopt/not-adopt) with a fixed effect on input demand and/or production efficiency, we view IPM knowledge as a dynamic continuum, implying a more complex relationship between knowledge acquisition and farmer practice. The evidence shows that knowledge of IPM may be substantially heterogeneous, even among participants in the same IPM

[2] Hanoi Agricultural University, Vietnam

[3] FAO-Intercountry Programme on Integrated Pest Control, Vietnam

[4] University of the Philippines, Los Banos, Philippines

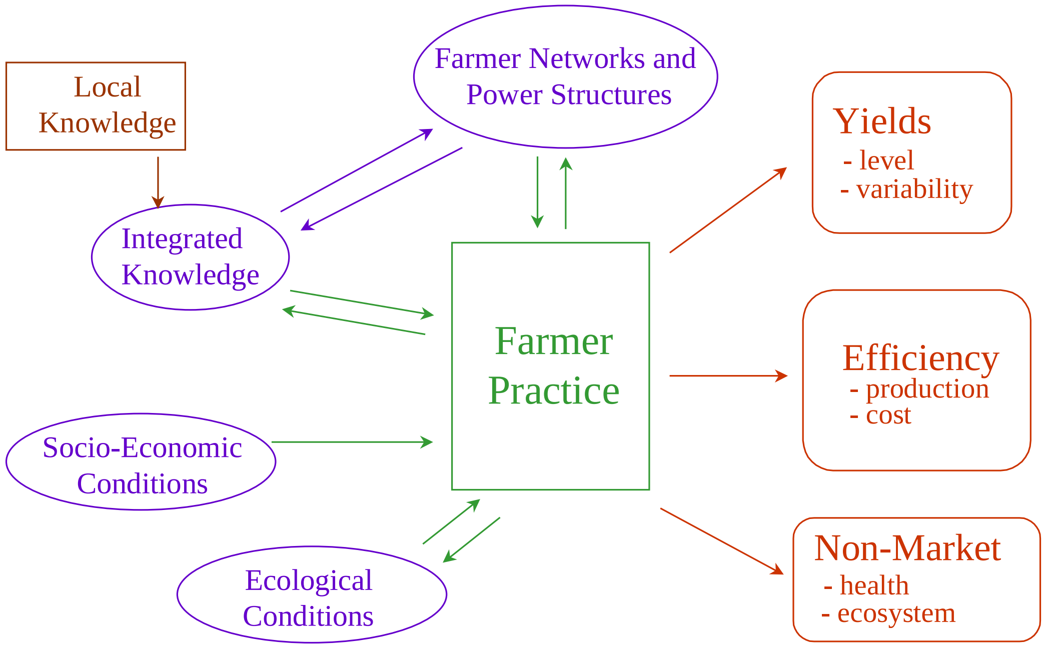
[5] International Rice Research Institute, Los Banos, Philippines

program, and that farming practice itself is an important source of new knowledge. Since differences in crop production decisions may arise from different levels of IPM competency, we use structured questionnaires and analytical techniques to derive indices of IPM knowledge that may vary both within and among groups of IPM and non-IPM farmers.

Unlike many other technologies, the impact of IPM depends on the ongoing interactions between natural conditions and farmers knowledge. In cases where there is no pest infestation, there may be little impact from IPM knowledge other than the knowledge that prophylactic pesticide sprays may be unnecessary. In cases of pest infestations, however, one may observe profoundly different decisions that are rooted in farmers' knowledge of IPM. To address the importance of these types of ecological/knowledge interactions, we are collecting detailed data on ecological conditions in individual plots in order to ascertain the level of correspondence among farmers' knowledge, ecological conditions, and pest control behavior.

As a knowledge intensive technology, IPM techniques are acquired by farmers through some type of communication. Besides the direct link between farmers and IPM programs, much of the impact of IPM programs at the household and village level may arise from farmer-to-farmer transfers of information and technology. We are attempting to develop methods for measuring the degree to which to tertiary farmers (those not directly involved in an IPM program) realize the impact from IPM programs. These methods are based on modeling social networks of farmer and the diffusion process that takes place within them.

Figure 1:



The complex interactions among these various components of IPM are illustrated in the figure shown above. The impact of a given IPM intervention can be measured using metrics common to studies of technology adoption such as the impact of the technology on yield and yield variability, production and cost efficiency, and demand for inputs. However, farmer practice is not a blank slate upon which IPM training programs imprint new concepts and decision rules. Instead, improved understanding of agro-ecological principles interacts with existing local knowledge within a framework given by prevailing socio-economic and ecological conditions. Local information networks and power structures also influence the processes of information generation and sharing.

To account for these interactions we have formulated flexible estimation models that allow us to capture the relationships among knowledge, ecological conditions, and socio-economic conditions that influence farmers' practices and ultimately their economic well-being. While we are focussing on market based metrics, these methods could also be used to measure important non-market impacts on health and the environment. We believe that these methodological innovations provide a more realistic framework for studying the impact of IPM interventions in rice and in other cropping systems.

Discussion

The discussion centered around the question of indicators for knowledge change. It was outlined that changes of knowledge over time were assessed by making before/after comparisons and by cross-sectional comparisons. There is the assumption that knowledge is a major constraint in household economics. Increase in knowledge may be sustained by using an effective extension approach and by making sure that policy makers support knowledge generation and transmission. In general, farmer field schools should be considered as an extension method in a broad sense, not limited to IPM.

The participants agreed that the dynamics of impacts at the local level should deserve more attention. In addition, price effects must be considered in the analysis. Risk has been included in Agnes Rola's study.

Policy Perspective of IPM Evaluation

Hermann Waibel[6]

This paper deals with the methodology of IPM evaluation as a part of impact assessment. It is argued that evaluation needs a policy perspective if the true impact of IPM is captured.

At the start of a project a clear vision of what is expected must be established if a conclusion can be made whether the investment in IPM is justified. The success of IPM projects must be measured relative to their objectives. These depend on the point of departure, i.e. the situation of crop protection in the country. There are two distinct situations:

1) A country, a region or a cropping system is already dependent on pesticides with strong indicators of their over-and misuse. Then the major goal of IPM must be to reduce pesticide use to a socially optimal level and get the system out of this dependency.
2) In a situation of extensive agriculture with zero or low levels of pesticide use, the aim of an IPM project consequently will be to avoid the system to be driven into pesticide dependency (or any other dependency like transgenic plants) as a pre-condition for sustainable intensification.

An IPM project is expected to produce economic and non-economic benefits which accrue to farm households and the society.

On the farm household level, economic benefits for example are :

- savings in pesticides
- increased yield
- more stable income
- increased business opportunities
- improved health status

Among the non-market benefits which nevertheless can be of economic relevance to individual decision-makers but which are not directly measurable in terms of farm profit one may list :

- increased understanding of the agro-ecosystem
- increased self confidence

[6] Institute of Horticultural Economics, University of Hannover, Germany

Aside from the farmers and farm laborers other groups of the society can benefit from IPM through :

- cheaper food
- safer food
- improved environmental quality
- savings in foreign exchange

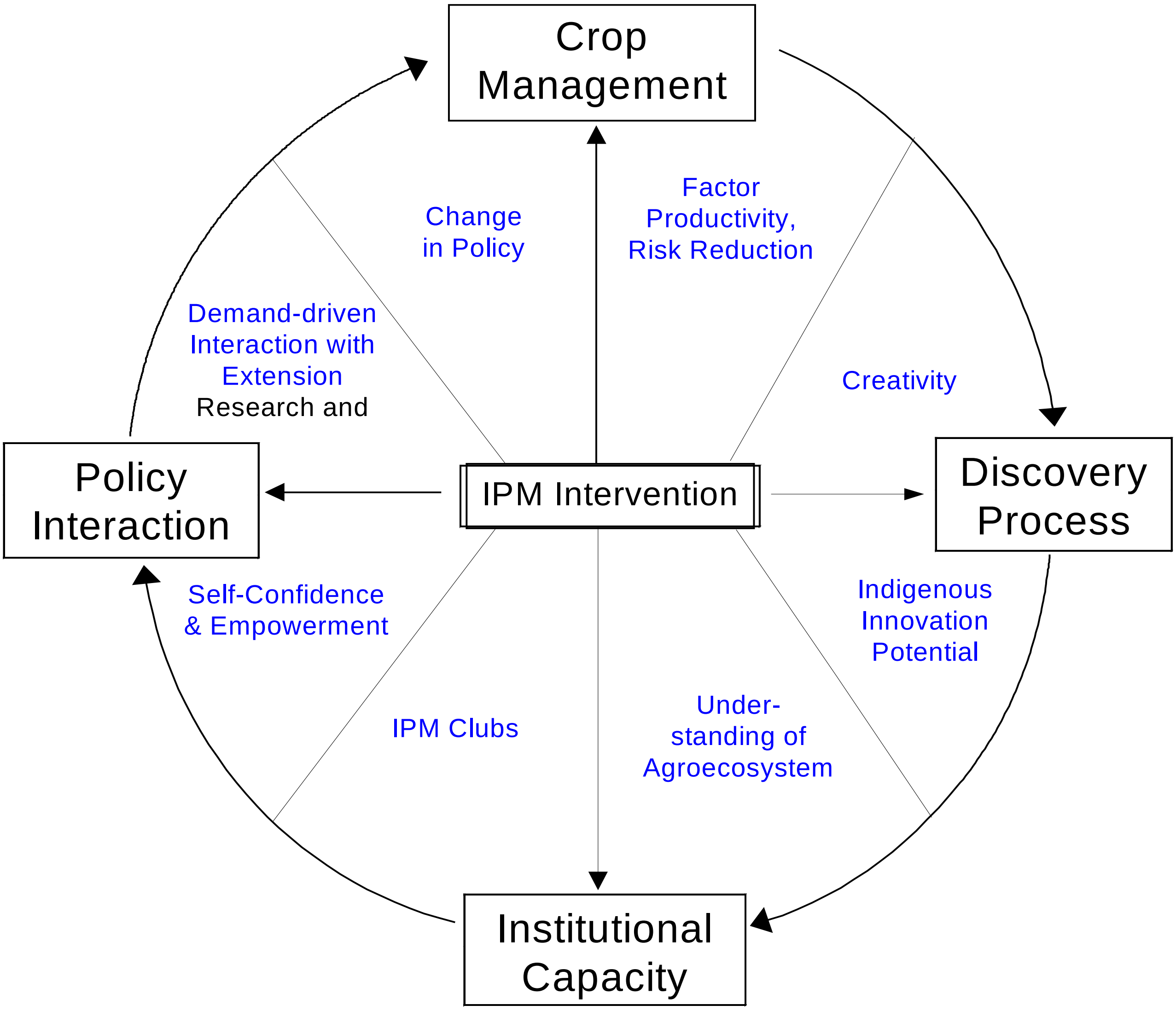
Benefits must be measured in the framework of cost benefit analysis and incorporated into a multi-criteria analysis. Measuring the success of IPM must accommodate its dynamic nature. A successful IPM intervention in a country or a region will induce a process that not only leads to better crop management decisions making but also stimulates a discovery process, strengthens the build-up of institutional capacities at village level and intensifies policy interaction (see figure 1).

Furthermore, an unfavorable policy environment is a major reason why there is so little of the ‘real’ IPM which is defined as follows:

> *a crop protection system which is based on rational and unbiased information leading to a balance of non-chemical and chemical components, moving pesticide use levels away from their present political optimum towards a social optimum defined in the context of welfare theory (*Waibel and Zadoks, 1995).

Therefore, if the impact of an IPM intervention shall be sustainable, IPM will have to change current crop protection policy at the national and, depending on their scope, also on the global level. Hence, the assumptions made regarding the farm level impacts of IPM can be ascertained if policy change does in fact take place.

Figure 1 : Framework for Participatory Evaluation of IPM Projects



To measure the policy impact of IPM the first step is to identify price and non-price factors that are likely to pre-determine pesticide use towards a level above the social and private optimum. For the analysis of the policy and institutional environment the 2 by 2 'subsidy box' has proven to be a useful tool (Table 1).

Table 1: Factors, Which May Lead to an Overuse of Pesticides

	Price Factors	Non-Price Factors
Obvi-ous	**I** – Below market price or free distribution of pesticides through government or development organizations – Subsidies for pesticide production – Pesticides in credit programs – Subsidies for complementary inputs – Preferential rates for tax or exchange rates	**III** – Dominance of pesticide research – Inadequate government research in environmentally benign pest management – Misguided government activities in reducing pesticide damage – Subsidies for pesticide intensive crops – Export promotion of agricultural products
Hidden	**II** – Outbreak Budget of plant protection service – Externalities of pesticide production – Externalities of pesticide use	**IV** – Lack of adequate procedures for the definition of crop loss and pests – Lack of transparency in regulatory decision making – Insufficient information about pesticide risks and safer alternatives – Curricula of agricultural extension and education – Misinformation of farmers by chemical industry

Source: Waibel (1990)

The factors listed in Table 1 have shown to be decisive in explaining the situation of pesticide dependency. The different factors can be grouped into :

(i) ‘obvious’ price factors, i.e. clear pesticide subsidies such as preferential exchange rates or direct support for the domestic pesticide industry,

(ii) ‘hidden’ price factors such as the failure of institutions to internalize pesticide externalities

(iii) ‘obvious’ non-price factors, like the dominant role given to pesticides in government activities

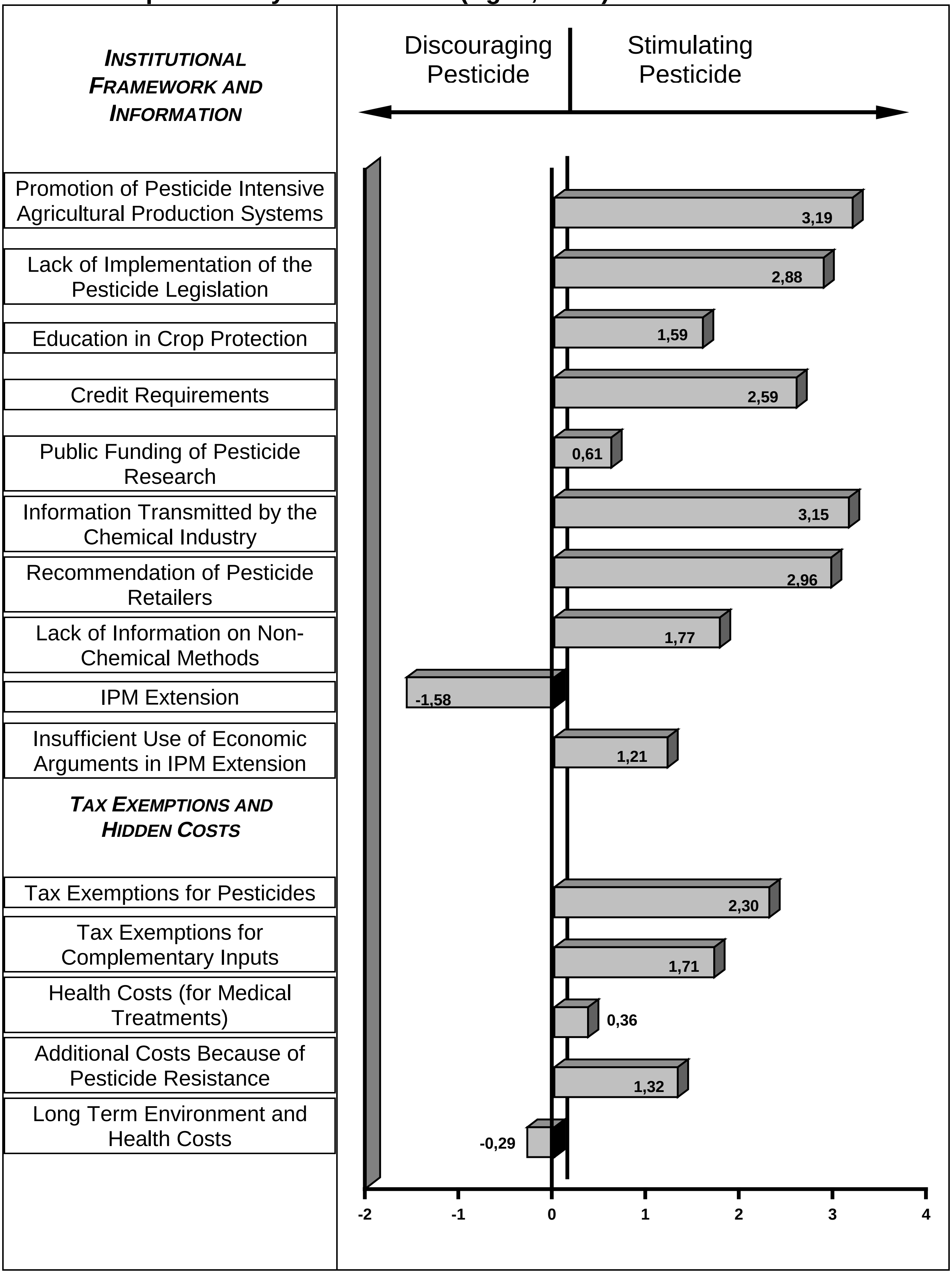
(iv) ‘hidden’ non-price factors such the more subtle procedures that were developed and became accepted during the ‘pesticide period’

Ideally, the direction and the relative strength of these factors should be known when planning an IPM project. Project planning and evaluation is most effective if it can draw upon a country study on pesticide policy (Agne, 1996; Jungbluth, 1996). If such document is non-existing it is nevertheless advisable to undertake a 'policy workshop' together with the major interest groups affected by an IPM project. It is important that the discussion is being extended beyond the circle of crop protection experts to avoid that the assessment will be limited to technical aspects only but include the economic, political and social dimension. One of the results of such a workshop is a better understanding of the relative strength of the forces which affect pesticide use in a country or a region.

An example of such an initial policy workshop is given in Figure 2. In this workshop in Costa Rica more than twenty experts from different institutions expressed their opinions in a questionnaire distributed during the workshop and subsequently discussed. Participants were asked to give their ratings on a scale from -5 to +5, a minus indicating a discouraging, a plus indicating an encouraging effect on pesticide use. Results showed that factors of the information environment, the institutional setting and economic factors are important in stimulating pesticide use. Results must be interpreted against the fact that participants agreed that there is a general overuse of pesticides in the country.

In conclusion, although economic evaluation remains important and has to start with the cost benefit (CBA) concept applied in other sectors of development assistance, routine CBA is no longer a sufficient condition for impact evaluation. CBA is based on assumptions that can carry a considerable degree of uncertainty. Hence reliability of results depend on the quality of the data. Therefore, adding a policy component to IPM projects is important if their impact shall be sustainable. If the policy environment becomes more conducive to IPM the assumed farm level impacts, which often are only measured in pilot schemes, are more likely to be verified. This adds a policy dimension to the evaluation of IPM interventions.

Fig. 2: Determinants of Pesticide Use and Their Impact According to an Expert Survey in Costa Rica (Agne, 1996)



Finally, one must not overlook that there is also a resource and quality issue in evaluation. Quality of results to a considerable degree depends on the efforts one is willing to spend in looking for what really causes and makes a difference. If no difference can be found at the first look, it does not mean that no difference exists. Serious evaluation of IPM projects, especially because of the “software character” of IPM, must recognize that it is insufficient to measure what can be easily measured or just give it an arbitrary value. In the past it was too often and too quickly concluded that if something cannot be easily measured it may not be important or it may not even exist. The challenge we are facing today, with every group that participates in crop protection promoting “their” IPM, no longer permits to treat evaluation as a routine exercise.

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Discussion:

The participants discussed first the role of cost-benefit analysis. *Waibel* pointed out that there is the danger of taking CBA without considering whether this evaluation tool is still sufficient in the way that it pictures the changing project and IPM environment. If the quality of evaluation deteriorates, vested interests and political pressure may find an easy entry point into decision making.

With regard to intensification in a sustainable way, the example of the weed striga as a pest accompanying the intensification of low production systems was cited. Ethiopia is an example for farmer’s indigenous knowledge in systems without pesticides, e.g. on plant varieties. Farmers developed their own strategies for weed suppression. In Ethiopia intensification is currently a political problem. A top down strategy is used. The intensification of agriculture is pushed with all means, also with the help of pesticides. The traditional systems are under threat due to the efforts of promoting modern production technologies and systems.

Hruska asked for examples from other countries where a change of crop protection policies has taken place. *Waibel* replied that some countries like the Netherlands, Denmark and Sweden have taken steps toward policy shift. However, it is difficult to put countries on a scale, more indicators are needed. *Reiche* added that the model of policy change is generally top down. One participatory aspect is the conduct of policy workshops. They can be repeated after around five years time and evaluated how perceptions changed to what extend and in what direction. But of course there are several elements not being participatory like the statistical data processing.

IPM Evaluation Concepts: An Anthropological Perspective

Jeffery W. Bentley[7]

Evaluation methods for IPM should be easy, fast, inexpensive and replicable. Methods should also be chosen because they are appropriate to the given topic, and not for other reasons (for example, being methods that are currently in vogue).

Structured survey questionnaires violate three of these basic precepts. They are difficult to carry out, expensive and slow. Proponents of survey questionnaires argue that they are replicable since they are quantifiable. Yet they are also one of the least **trustworthy** methods because they elicit testimony in a context that is completely decoupled from reality. Suspicious, uncomfortable respondents often seek to protect their privacy during structured interviews by tweaking the truth.

Participant observation is one of the most reliable methods because field workers make observations themselves and can discuss them with local people. A distinguishing characteristic of this method is that when it is done well field workers stay in one place long enough to gain people's trust. Although the results are not strictly quantifiable (unless combined with other methods, such as a census) they are more trustworthy than those obtained through a structured questionnaire.

Farmer knowledge has four distinct sets of properties depending on how important a given topic is to farmers and how easy it is for them to acquire knowledge based on direct observation (Bentley 1992). These four sets of properties are explained in the table below by comparing them to textures, i.e. thick, thin, empty and gritty. Learning more about what farmers know is an integral part of an IPM program (Bentley and Andrews 1996). However, this is difficult to achieve using structured surveys. The task is more directly addressed through participant observation ("hanging out"), short questionnaires, interviews and ethnobiology. The latter is a technical method for learning about local biological folk taxonomies and their associated knowledge. Although it does require some esoteric knowledge, the quality of the information obtained is appropriate for use by an IPM program (Berlin 1992; Hunn 1982; Alexiades 1996).

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Besides learning local knowledge, IPM programs consist of other activities, such as generating and validating technology, extension and documenting behavioral change. Technology is generated in a number of ways, for example by borrowing it “off the shelf”, inventing it using conventional scientific method or inventing it with farmers by learning about what they know and filling in the gaps (Bentley 1994; Bentley et al. 1994).

Technology invented by farmers can be validated by scientific method. For example, after receiving IPM training at Zamorano, Honduran farmers invented sugar water to lure ants and vespid wasps onto maize to control fall armyworm. The technology is now being formally validated by Luis Cañas, a Purdue University (Department of Entomology) doctoral student.

Extension can be documented using participant observation, record keeping and before-after tests. Similarly, behavioral changes can be documented using short questionnaires, participant observation and participatory rural appraisal (PRA) methods with extensionists. PRA has recently been criticized (Biggs 1995; Richards 1995). Although PRA is useful for eliciting felt needs, much of IPM does not fall into this category. For example, if farmers do not know that parasitoids exists, PRA will not discover that farmers need to learn about parasitic hymenoptera. However, these methods do have their uses. A recent experience in Colombia suggests that PRA techniques can be used with extension agents to elicit their knowledge of farming in a way that extension agents find uplifting and fun.

Table 1: Local Knowledge and Responses of IPM Programs

Description	Example	'Ideal' IPM Response
Thick: local people know more about the topic than scientists do. The local knowledge can be empirically verified by the scientific method.	Honduran campesinos know more about wasp honey and how to harvest it than do entomologists. Farmers know various techniques for controlling bird pests without killing them, e.g. stringing tape from old cassettes, like ribbons in the field.	Learn from farmers. Validate their knowledge and techniques.
Thin: local people know the topic in a way that scientists can understand, although local knowledge is less complete than scientific knowledge.	Honduran campesinos know many predatory insects by folk names, but do not realize that they are beneficial (natural enemies of herbivorous insects).	After learning about the local system, teach local people the missing ideas. Add to their folk knowledge.
Empty: local people know	Honduran campesinos are	Fill in the gap in local

nothing about the topic.	unaware that parasitic wasps exist.	knowledge. Teach them about parasitic wasps.
Gritty: local people have beliefs and perceptions that are at odds with scientific notions. The local ideas seem strange, pre-modern, wrong, etc. to scientists. These ideas cannot be verified using the scientific method.	The belief that insect pests are spontaneously generated by insecticides or chemical fertilizer is fairly widespread among small-holder farmers.	Be careful. Chose your battles. Avoid contra-dicting people unless it matters to the IPM program. Carefully learn the local perception and its reasoning, which often is logical, but is based on incomplete facts, and then use local rhetoric to explain the scientific perspective (e.g. insect pest outbreaks following insecticide use are the result of genetic re-sistance and the death of beneficial animals, not spontaneous generation). Teach these ideas with respect for the local people.

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Discussion:

Participants noted that a lot of the presented methods can be used for measuring change in agencies, e.g. participant observation of extension. However, PRA might be much more suited for work with extensionists than with farmers. Therefore, PRA might be poorly suited for IPM evaluation, since in pest ecology there is so much beyond the knowledge of farmers.

Biggs argued that there is preoccupation of economists with large data sets. Bentley pointed out: „Hanging out with a policy maker in the field might be more effective for policy change than huge data piles." *Fleischer* asked who actually would be held responsible for the selection of the methods in a specific situation and suggested a structured process for the selection. *Waibel* noted that ICLARM used a resource flow chart where farmers take an active part. *Bentley* added that there is some experience on such methods in Indonesia. Men tend to put much attention on agricultural production issues while women are more concerned on health issues. *Winarto* concluded that a critical issue is the capability of the researcher involved in IPM evaluation.

Evaluation of IPM Extension: Institutional Aspects

Janice Jiggins[8]

Clarifications

The legitimacy of evaluative statements depends on explicitness with regard to assumptions about causality. The classical evaluation of any extension activity has been based on assumptions of linear cause and effect *as if* agriculture is a closed human activity system or a closed biophysical system. It is perhaps not surprising that attribution of effects to cause has been problematic within the classical mode, since agricultural systems rarely can be satisfactorily treated as closed systems in either their human or biophysical dimensions.

If agriculture is viewed as an open non-linear system, it then possesses an irreducible ambiguity or indeterminacy in terms of 'quantitative solutions' (values). Farmers, in this view, approach their environment in ways captured by the metaphor of a 'dance' in which actors are locked into a reciprocal engagement with, or adaptive co-structuration of the institutional relationship among people, agriculture, and ecosystem. In this view, decision-making is seen as performance within an inherently unknowable spatial and temporal dynamic in which trend is the key trigger to management. There is a growing body of scholarship and practice which sees evaluation of the 'dance' as best handled by participatory processes and interactive evaluation methods (see section 2).

Quasi-experimental statistical designs represent an intermediate position capable of picking up coarse-grain effects:

t-1	t-2	t-3
Sub-population/ area 1	IPM extension intervention	i. farmers with IPM sampled ii. farmers w/out IPM
sub-population/ area 2	No IPM intervention	i. farmers w/out IPM sampled ii. farmers with IPM

The design requires that sub-populations 1 and 2 are similar. Statistical tests can be applied to survey data from the sampled farmers to check for systematic bias attributable to the initial criteria used to select the

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farmers/areas for recruitment to the IPM intervention. If such bias is found, then nothing much can be learned from a comparison between the with/without cases at time 3. In any event, at best the design establishes correlation but not causation.

The availability of baseline information concerning farmers/agro-ecosystems at time 1, assists the *a priori* selection of population samples (i.e. to meet the test of similarity). However, such data are rarely available in any quantitatively rigorous form, either concerning farmers and farming systems and almost never concerning ecosystem dynamics. Again, farmers' own indicators of states and trend, which can be recaptured for historic situations, may be seen as the appropriate response to this dilemma.

A typological approach based on sufficient examples can be used but the constant danger is that the category boundaries will be shifted to 'prove' the desired outcome. Further, such approaches tend to be over-represented at level one scales (e.g. Farmer Field Schools) and under-represented at higher hierarchical levels. No one, as far as the present author is aware, has as yet found a theoretical way to determine what is in fact a 'sufficient' number of examples to draw reliable inferences from typologies.

There have been attempts more recently to explore the utility of ecological concepts of hierarchy to evaluation of institutional effects. However, the extrapolation of the concept of hierarchy as defined in ecology to the concept of 'nested institutions' in the human domain may be hazardous where social and information networks, social movements, and withdrawal or exclusion from institutional membership, are the key to understanding institutional effects.

Comparative case studies may have a role, as demonstrating the possible innovation pathways. They can *describe* what behavior occurs among sub-groups of actors and institutions and *explain* what causes such behavior within the sub-groups. However, the extrapolation of the findings to other situations can be hazardous, as conclusions (i.e. inferences without evidence) about people, institutions and conditions that may be different to those studied. I.e. their capacity to deal with scaling issues in ways comparable to ecological analysis of scale effects is problematic. Another way of stating this is to say that the fine-grained insights necessary to understand decisions, actions and effects localized in an agro-ecosytem are difficult to transport satisfactorily into the coarser-grained analyses of wider scales of interaction (and *vice versa*) though various modeling techniques attempt to do this.

Another approach is to *reduce* the evaluation task to what can be measured. ‘Effort’, for example, can be measured in terms of financial commitments, number of advisors/facilitators, time demands on farmers and advisors, number of FFS etc. ‘Outputs’ can be measured in terms, for example, of reduced pesticide use, increased yields, increased net income. However, these data leave unexplained *how* effort translates into outcome, and does not deal with the confounding factors inherent in learning processes i.e. only correlation and not cause is established.

A further approach is simply to assume functional explanations and then to seek to document these e.g. if the function of FFS is to capacitate farmers’ agro-ecosystem management, then ‘proof’ is adduced to demonstrate that this is indeed the function. That is, the evaluation rests on disguised tautologies.

Promising Ways Forward

If agro-ecosytem management is seen as a problem of non-linear system management, then evaluation methods based in constructivist (rather than positivist realist) epistemology are appropriate. This is not to exclude ‘objective’ measurements and instrumentation but to locate the use and outputs of these within another process and interpretative frame.

The emerging labels for this task include ‘interactive valuation’ or ‘participatory evaluation’. They utilize techniques and methods that include soft systems methodologies, PRA, participatory resource and agro-ecosystem mapping, and user involvement in various GIS techniques and the specification of trend indicators (in ecologists’ terms, qualitative indicators but which often rely on or generate numeric data). Specifically with regard to institutional evaluation they include the use of tools such as Actor Linkage Matrices.

It should be noted that the *objective* of evaluation changes in this scenario, from an external ‘third eye’ assessment of performance *as if* activity could be managed by controlled design, toward involvement in assessment processes that seek to improve situations through shared learning about how to move in the direction of a moving target (sustainability). The *focus* also shifts, from an emphasis on cause and theories of, to an emphasis on reasons and meanings, and ideas about.

References

The following publications and peer-reviewed conference papers justify, legitimate and illustrate the points made above:

Bawden, R. (1997): The Community Challenge: The Learning Response. Keynote plenary address to the Annual International Meeting of the Community Development Society. Athens. Georgia. USA. July.

Biggs, S. and H. Matsaert (1998): An Actor Oriented Approach for Strengthening Research and Development Capabilities in Natural Resource Systems. Paper presented to M&E Mini Conference. 25-26 August. ODG, Norwich, University of East Anglia.

Jiggins, J. (1995): Development Impact Assessment: Assessment of Aid Projects in Nonwestern Countries. Chapter 12 in F. Vanclay and D.A. Bronstein, (eds.), *Environmental and Social Impact Assessment*. Chichester: John Wiley and Sons p. 265-282.

Jiggins, J. and N. Röling (1998): Interactive Valuation. The Social Construction of the Value of Ecological Services. Paper to the Second Conference of the European Society for Ecological Economics. 5-6 March. Geneva. University of Geneva.

King, C. and J. Gunton (1998): Sustainability Indicators Used by Farmers in Queensland Cropping Systems. Paper presented to the Third European Farming Systems Research and Extension Symposium. 25-27 March. Hohenheim. University of Hohenheim.

King, C., J. Coutts, and J. Jiggins (1998): Unearthing Paradox as a Focus for Facilitating Improved Rural Sustainability. Accepted paper to the 15th. International Association of Farming Systems Research and Extension Symposium. 30 November - 4 December. Pretoria. University of Pretoria. RSA.

Pearson, C.J. and R.L. Ison (1997): *Agronomy of Grassland Systems*. Second Edition. Cambridge. CUP:

Röling, N. and A. Wagemakers (eds. 1998): *Facilitating Sustainable Agriculture*. Participatory Learning and Adaptive Management in Times of Environmental Uncertainty. Cambridge. CUP.

Discussion:

The discussion centered around the observation that institutional change is difficult because of vested interests in bureaucracies. Participants suggested to apply the principles of modern reengineering of organizations to IPM extension systems. *Jiggins* added that in most cases, the process produces champions of change whom a platform has to be given. Participatory video techniques might be used. Also, bureaucrats become involved by bringing them to the field. *Widawsky* proposed self-evaluation of the extension personnel which raised discussions on potential biases. *Jiggins* concluded that therefore different tools have to be used for evaluations ("Not just a hammer!").

People, Power, and Partnerships to Sustain IPM Impacts: Assessing Advances in the Adoption of Agro-ecological Alternatives

Lori Ann Thrupp[9]

Introduction and background

Ecological alternatives to chemical-intensive agriculture are being developed in many countries. Integrated pest, crop, and soil management practices have been increasingly adopted and successfully applied. They are bringing about positive qualitative and quantitative changes in productivity, knowledge, and in socio-economic welfare. However, there is a lack of data on these impacts, and how they compare with conventional methods. More efforts are needed to document, measure, and spread information on the impacts of such efforts, and how they were achieved. This is necessary to show the multiple dimensions and values of such changes, and to justify further development of these alternatives.

Evaluations or impact assessments require innovative and comprehensive methods to account for complex qualitative processes, such as ecological dynamics, changes in knowledge, and organizational and social factors. Farmer participatory methods are seen to be particularly important to incorporate into the evaluation process. Involving local farmers and communities (along with technical and/or scientific staff) in this process of assessing changes has important functions: it serves as a form of training and valuable learning about pest and crop management, enables efficient information collection, and similarly, is a means of empowerment for people. Although donors' or investors' requirements for cost-benefit data often drive the evaluation procedures and methods, meeting the farmers' and project managers' particular interests (in learning processes and experimentation) is equally important, though sometimes neglected, for doing effective evaluations. Commonly, evaluations focus on the results alone, to the neglect of the process and inputs. The means to achieving changes in agricultural methods include not only technical and financial inputs, but important human resources and political/social factors, such as institutional cooperation or exchange among farmer groups.

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Processes and Methods for Evaluation

Experiences have shown great value in ensuring active participation of farmers and community members in *all stages* of project design and development, for most rural/agricultural development projects including IPM projects. Adoption and sustainability of efforts tend to improve when farmers are actively involved in the decision-making and implementation of all activities, as partners alongside technical and scientific staff.

Even if farmers are illiterate, they can be quickly and easily trained for evaluation, and are fully able to identify and monitor the effects and changes of a given project or technology. Participatory methods may not always substitute more standardized evaluation tools used by economists, to measure costs, benefits, and rates of return; but they can be used as complementary methods. They can even be more valuable for multiple learning purposes and for assessing qualitative dimensions, than the standard evaluation methods.

The types of farmer participation that are advantageous in evaluation process include: 1) Helping to decide on processes and parameters for evaluation; 2) participating in training and education on how to keep records and how to monitor pests, diseases, soils and crop changes; 3) participating in data collection, monitoring, and analysis throughout the cropping cycle, and over various growing seasons; 4) sharing, analyzing, and discussing results among scientists and with other farmers; and 5) identifying lessons and conclusions with scientists and technical people about the meaning and the implications for further actions. This kind of active involvement at many stages has multiple benefits, including improving efficiency of data-gathering and sometimes lowering costs, providing education and skills for the local people which has added benefits, and enabling empowerment of the local people as well.

Another beneficial method to incorporate in the evaluation process is facilitated group discussion among farmers, technical extension people, scientists, and other community members. Such group meetings, involving joint conversation, analysis, and decision-making, prove useful to identify and assess the impacts including historical trends and comparisons between past and present circumstances. Drawings, posters, and charts made by farmers have proven to be useful in Asian experiences to reveal the results of IPM. Such artistic tools include pictures of pests and beneficial insects, different stages of insect development, methods used for trapping pests, and other agro-ecological dimensions that they observe in the field. Yet another useful participatory approach is writing a joint report or publication on the project effects with farmer authors, along with project managers or scientists. Examples of farmer participation in documenting the results have been shown in Vietnam and Indonesia.

The use of interdisciplinary teams is a final, useful factor that needs to be included in all kinds of methods for evaluation. Whether using conventional or participatory methods, the evaluation will be improved if people from different fields and backgrounds are involved. Similarly, having multi-sectoral teams , including representatives of different groups or sectors of society (e. g, women groups, private sector, as well as researchers and farmers), can also be a useful part of the evaluations, when/if possible.

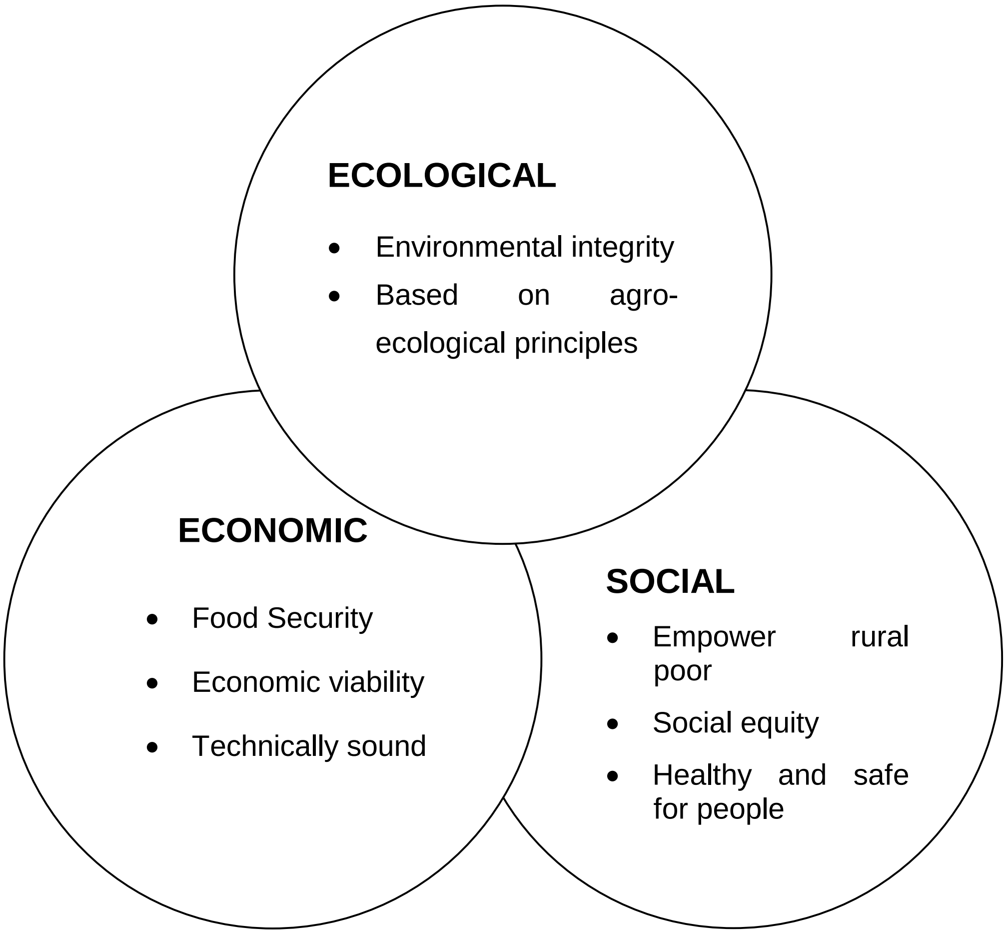
The many possible parameters for evaluation can be lumped into four different categories or types: WHO are the beneficiaries and actors involved; WHAT types of impacts have emerged (including agronomic and technical, production and economic results, socio-economic, and ecological etc.); WHY are people adopting (or not adopting) changes and why are people motivated to get involved; and HOW are the activities and changes achieved – i. e, what methods and learning processes contribute to such reforms. The questions of why and how can be particularly important to address, to understand what factors are really contributing and explaining changes; yet these aspects are often neglected in conventional standard evaluations. Assessing all of these factors can help project managers or donors, as well as farmers, to understand the methods and processes behind changes, and to make improvements in project management over time.

Lessons from „Partnerships for Sustainable Agriculture“

Some useful lessons about processes and factors of success in IPM have been analyzed and documented recently through a set of case studies, on „Partnerships for Sustainable Agriculture,“ undertaken during 1995-97 by the World Resources Institute and many partners (Thrupp 1997). These analyses addressed relatively successful integrated pest and crop management projects in Bangladesh, the Philippines, Kenya, Senegal, Peru, Nicaragua, Cuba, and the United States. The cases entail collaborative initiatives involving farmers, researchers, and extension or development institutions (NGOs and/or government agencies). The role of NGOs, ranging from grassroots farmer associations to large international non-profit institutes, has proven to be particularly in many collaborative efforts.

In general, these initiatives are working towards a wider and more holistic approach of „sustainable agriculture“ and rural development, explicitly or implicitly. The concept involves a convergence of ecological, social, and economic factors, as shown in Figure 1. The basic agro-ecological principles in this approach include *diversity* (crops, flora/fauna, systemic varieties), *adaptability and resilience* (in contrast to rigidity), *synergy* (between plants, soil, nutrients), *nutrient recycling, and regeneration and conservation of resources.* They adapt methods to local ecological conditions, based partly on sound experimentation, and observation.

Figure 1: Components of a Sustainable Agriculture Approach



The cases offer lessons about common elements of success that ensure effective implementation of sustainable and profitable production practices. Although these initiatives encompass varying biophysical and socio-economic situations, they reveal common key elements of success for the implementation of sustainable and profitable production practices. The most important elements are the changes in social, institutional, and organizational approaches that facilitate learning and adoption of changes. Such factors are often overlooked by decision-makers and project planners who tend to focus on specific technologies.

The development of effective systems for knowledge and sustainable technology development needs a supportive policy environment and political commitment. Several countries have tightened regulations over pesticides, but lack the mechanisms and resources to implement and enforce the laws. Public funding for IPM is minimal compared to the resources dedicated to conventional agriculture policies and programs

Developing factors of success -- particularly the organizational and institutional dimensions for knowledge development and exchange -- is by no means easy. It requires resources, hard work, commitments by individuals and institutions, and considerable time and patience. Furthermore, several constraints remain as major barriers to the development of such collaborative initiatives and human resources for sustainable agriculture, as illustrated in the „Partnerships“ cases. The path to applying integrated methods and participatory approaches has sometimes been bumpy at state institutions or large research institutions, where conventional methods tend to be well entrenched. The barriers most often mentioned by the case study participants were: contradictory messages from chemical companies; weak government policies and institutions; questionable financial sustainability; lack of information and education; and internal weaknesses in IPM projects. Of these, the most serious challenges are external pressures from outside the project or program, particularly the pressures and economic influence of the agrochemical companies and their sales agents, and lack of policy support.

To address the other institutional challenges, an overall useful approach is increasing investments in people (i.e. human resources) involved in rural/agricultural development efforts, through improved education on agro-ecological principles, increasing peoples' access to information, and capacity-building on participatory methods. The successful experiences show that this kind of investment is needed for people in many institutions and at many levels. Innovative training programs are particularly important and needed for government people (such as extension agents) who work on conventional agriculture. These people must be retrained on new concepts and principles. A new orientation in learning empowers people to implement effective changes.

References:

Thrupp, L.A. (ed., 1996): New Partnerships for Sustainable Agriculture, World Resources Institute, Washington D.C.

Discussion:

Bentley raised the questions whether most of the data needs outlined in the presentation have to be qualitative or quantitative. Thrupp agreed that it would be desirable to have more quantitative data since it helps to make the case more effectively. *Hruska* wanted more details on what has been summarized under institutional changes. Explanation was given for institutional co-operation of international organizations and NGOs.

Diversity and IPM

Jan C. Zadoks[10]

A major discussion topic in ecology is the diversity-stability riddle. Whereas the classical school tends to believe that diversity creates stability, Robert R. May demonstrated the contrary: stability creates diversity. The solution of the riddle possibly is in the time scale to be considered. Whereas stability may create diversity on a time scale of some 10,000 years (Great Barrier Reef, Amazone Forest), diversity may create stability (but not always) in the short run, that is within a crop season.

In crop protection the riddle becomes more puzzling. In an indigenous crop such as wet rice in the tropical lowlands, with a crop history of thousands of years, diversity is expected to create stability. Is such also true for cabbage in the tropical highlands, where it is a recently introduced crop?

Cases where spatial diversity creates stability, in the form of suppression of pests and diseases, have been found in the small grains, including rice, when mixtures of varieties are sown and even when different pure varieties are sown in strips or mosaics. The effect is possibly limited to polycyclic fungi (and similar insect pests), with many cycles per season and a brief reproduction cycle. Intercropping and relay cropping using different species may have protective action against certain fungi and insects, may be neutral in other cases, and could be decidedly disadvantageous in some cases. The desired protective effect certainly does not occur against polyphagous and/or migrant pests.

Crop rotation as a means of temporal diversity normally has a positive crop protection effect and thus should be part of any IPM scheme. It is particularly effective against soil-borne fungi and nematodes but the price of a wide rotation may be too high in areas with intensive agriculture such as The Netherlands.

Intentional diversity as a protective measure in crop protection cannot be accepted by deeds of expectation and faith but has to be studied case by case. In IPM, diversity in the field, on the farm and in the village may be good, but as a stand-alone it is not good enough. Plant breeding, with or without genetic modification, seed certification, sanitation and healthy transplanting material are needed too, especially as a protection against virus diseases.

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Soon, a discussion of IPM without consideration of the effects of genetic modification of either crop plants or beneficial organisms will be a waste of time, since presently most of the research and investment money goes to that area. Genetically modified crops, either for resistance to pests, herbicides or both, certainly have various kinds of ecological side effects, favorable and undesirable ones, which must be studied on a case by case basis. No generalities are applicable yet.

It is noteworthy, that the USA has two major schools of thought on sustainable crop protection. The entomologists go for IPM, the phytopathologist aim at plant health management. The remarkable difference is explained largely by differences in the history of the respective sciences, the education of the two groups of scientists, and the nature of the pests (including disease agents) to be controlled. Technically the two schools are compatible but emotionally they do not understand each other well.

Discussion

Participants agreed that for the quantification of benefits of IPM to the environment, the contribution of biologists is definitively needed. There is some progress in environmental economic assessment, as the recent workshops of the Ecological Economics Association show. However, health effects seem to be much easier to assess than environmental effects. *Hruska* wondered about assessment of the effects of genetic modification in developing countries. *Widawsky* noted that there has been transgenic breeding for pest resistance in rice. However, farmers don't want the varieties because the market looks for other quality characteristics.

Participants were concerned about the general problem that more and more variables for evaluation come up. It was felt that comparable analytical tools that show some consistency are needed.

Social Costs and Benefits of Chemical Pesticide Use - Case Study of German Agriculture

Gerd Fleischer[11]

Pesticide use in Germany presently amounts to about 35,000 tons of active ingredient per year. Although major cutbacks of cereal and oilseed prices took place following the reform of the Common Agricultural Policy of the European Union in 1992, the share of pesticides in total production costs is still rising. The favorable ratio of product to factor prices, positive scales of returns to pesticide use and the high farm-level costs of implementing methods of integrated pest management (IPM) lead to a path-dependence of pesticide-intensive agriculture and horticulture. Thus, a systems change to integrated farming in which non-chemical control methods are preferred is impeded. This shows that a true evaluation of the economic viability of IPM is barely feasible without analyzing the economic and institutional conditions that have led to the widespread adoption of chemical pesticide use.

Following the principles of welfare economics, an economic assessment of the benefits and costs of pesticide use in the old federal states of Germany has been undertaken. This includes the identification, quantification and economic assessment of unintended side-effects of pesticide use which cause external costs to the society. If external costs are significant and presently not internalized in private users' decision-making, chemical pesticide use is too high. Pesticide prices are lower than their socially optimal level. Since resources for IPM methods are undervalued from a society's perspective, their use should be intensified.

The German plant protection act of 1986 stipulates that plant protection products should have no adverse side-effects on human health, drinking water and the natural environment. Furthermore, it demands that farmers must adhere to the principles of IPM while using pesticides. It appears doubtful, both from the economic and the institutional framework conditions, whether farmers achieve this in practice. Therefore, it can be expected that the present command-and-control approach does not prevent the occurrence of external costs.

External costs caused by unintended negative side-effects of pesticide use amount to at least 252 million DM per year. Additionally, various effects were identified, but currently could not be assessed in monetary terms. The real long

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term costs for the society are above this value. The bulk of the costs occurs as damage prevention costs. Actual damage to human health and natural resources presently amounts to 92 million DM. However, it is hypothesized that a large part of damage may be detected only in the long run due to the current lack of quantifiable data. The ratio of external costs to pesticide expenses is 23 %.

The costs of contamination of drinking water resources by pesticide residues are between 128 and 186 million DM per year. A large share of this amount is spent for monitoring programs of water suppliers and federal state agencies. Regular government monitoring of pesticide residues in food costs 23 million DM/year. Due to lack of data, biodiversity loss was only partly assessed. Damage to plants by herbicide use - assessed via contingent valuation of biodiversity protection - causes costs of 10 million DM/year. Production loss in the agricultural sector, i.e. damage to honey bees is 2 to 4 million DM/year. Damage to human health (acute poisoning cases) costs ca. 23 million DM/year. Additionally, there are costs of government control activities (e.g. plant protection service, registration of pesticides) of 66 million DM/year.

Other negative side-effects of pesticide use include chronic effects on human health, long term effects on the sustainability of agricultural production and soil fertility as well as induced preference changes of consumers for drinking water.

Benefit assessment of pesticide use is difficult from a methodological point of view. In this study, a regional production and factor demand model is used in which the own-price elasticity of pesticide demand is the crucial variable. The agricultural sector is the better able to react in a flexible manner to a ban of pesticides the higher the elasticity of pesticide demand. Various farm-level studies have shown that high elasticities are more likely than lower ones especially from a medium and long term perspective.

Taking the most realistic scenario of an own-price elasticity of pesticide demand of 0.5, benefits of pesticide use in German agriculture (old federal states) currently are 1.15 billion DM. Previous studies show far higher benefits of pesticide use. This is probably caused by a systematic overestimation of benefits due to various factors, e.g. neglect of probable adjustment measures for pest management in the case of pesticide abandonment, biases in statistical data from station trials on pest control etc.

The results of the study suggest a current social benefit cost ratio of pesticide use of 1.47. A total ban on pesticide use in German agriculture (old federal states) would cause a net welfare loss of less than 900 million DM which is equivalent to less than 5 % of net domestic agricultural product.

It has been concluded that German plant protection policy should reconsider its basic strategic approaches since pesticide use has been shown to yield limited economic benefit. Furthermore, although a highly sophisticated regulatory framework has been established, external costs can not be prevented completely. Existing command-and-control approaches have failed to reduce pesticide intensity. Therefore, economic instruments should be given more attention in pesticide policy. In addition, the institutional framework of benefit and risk assessment of pesticides shows weaknesses with regards to the appropriate consideration of societal preferences for public goods.

Reactions of the various stakeholders in the institutional setting of German plant protection policy to the study results were ambiguous. Public debate is characterized by its high degree of fragmentation between proponents of the status quo and advocates of a progressive reduction of pesticide use that follows the policy plans of neighboring countries in Europe. Thus, study results became an important tool for the latter group in supporting their demand for policy change by pointing at data on social costs.

References:

Waibel, H. and G. Fleischer (1998): Kosten und Nutzen des chemischen Pflanzenschutzes in der deutschen Landwirtschaft aus gesamtwirtschaftlicher Sicht *(Social Costs and Benefits of Chemical Pesticide Use in German Agriculture)*, Kiel (Germany): Vauk-Verlag.

Discussion:

Kenmore pointed out that the results make the case for IPM very compelling, especially in convincing policy makers. In view of the huge efforts of the pesticide industry for market promotion any kind of information depends on the context in which it is put. This study obviously revealed the differences in benefit estimates compared to previous studies.

Pincus raised the question about the political impacts of the study. *Fleischer* replied that environmental pressure groups lacked sufficiently convincing arguments for major policy changes in the debate on the revision of the crop protection act. Additionally, the discussion on pesticides taxes might be supported. *Waibel* added that another major impact may be on regulatory decision-making. The findings on external costs challenge the assumption made by the scientific committee responsible for pesticide registration that damage costs can effectively be prevented. Most of the actual damage could not be valued, e.g. the impacts on biodiversity and the long-term health effects. The real damage is higher than given by the figures.

Biggs contributed that the study provided information on policy strategies for the society. He wondered how an economist would calculate the rate of return of an investment in this study. Participants argued that one should look at the impacts on policy change which in this case depended largely on the timing of the presentation of results. Furthermore, the introduction of a pesticide tax could serve as an indicator. The probability has been increased by challenging the assumption that there are no external costs. Such studies could be seen as a baseline work for any successful IPM project. However, normally such research components are not yet included in the assessment of development projects. Currently, there are other criteria for decision-making such as the relevance for social issues, the state of the art in the research area, and the judgement of professionals in that area.

Kenmore reminded that the study was commissioned by the Agricultural Ministry who had been surprised by the results that were different from what was expected. The results of the study had been in the third round of parliamentary enquiry from the opposition party. *Biggs* noted that it was definitely a negative outcome for the ministry, but the rate of return for the public debate may have been very high. One should look for elements that favor this kind of activity and for assessment criteria that may be used by policy makers.

Section II

Working Group Sessions

Introduction

The objective of the working group sessions was to

- identify components of the issues addressed,
- specify parameters for IPM impact assessment
- identify and select indicators
- propose methods for estimating indicators for impact assessment and cost benefit analysis
- indicate expertise required
- identify relatively less studied themes in impact assessment

Four working groups have been established:

I. The impact of IPM projects on the farm household

II. Village level impacts

III. Impacts on regional, national and global institutions and policies

IV. Environment and natural resources.

The discussions in the plenary sessions highlighted the priority issues for impact assessment studies. The targeted addressees of those studies are

1. governments contemplating IPM projects or policies
2. advocacy groups intending to promote policy change
3. institutions involved in educational programs

Working Group I

The impact of IPM projects on the farm household

The group recognized that the topic of IPM evaluation at the farm level covers a wide variety of sub-topics. The following possible impacts of IPM projects were identified as subject to evaluation:

1. Improved economic well-being
2. Adoption of new technologies (passive); adaptation of technologies to local conditions (active)
3. Improved knowledge and analytical capacity
4. Diffusion of knowledge farmer to farmer
5. Decreased health risk
6. Healthier ecosystem

Requisite methods vary enormously depending on the goals of the evaluation and the resources available for the assessment or study. These methods range from quick and inexpensive monitoring exercises that are included in all IPM programs, to expensive research projects requiring substantial time and investment in external expertise.

For the purposes of tracking changes in farmers' practices, the use of new technologies and the success of IPM extension efforts within the context of an IPM project, the most appropriate methods include short surveys, participant observation, interviews and direct observation. A skilled field worker can learn a great deal about IPM practice by spending sufficient time in the locality to gain familiarity with farmers' behavior patterns and knowledge base. Short questionnaires are useful for collecting required data on pesticide use, and direct observation can augment the structured surveys (for example visiting fields with farmers and watching practices, or spending time at pesticide shops).

Participant observation is a quick and useful method for analyzing complex cause and effect relationships. For example, extension efforts are one type of intervention into knowledge and production systems that may have a large impact on farmer practice. However, the only way to know if the intervention has indeed achieved its objectives is to learn more about farmers' knowledge and compare this with their actual practice in the field. This can be done through a large-scale survey covering a vast array of production and knowledge variables. But it can also be achieved relatively quickly and cheaply by training field workers to collect information through casual discussions, interviews and direct observation[12].

Participant observation could also be done by students during the first year and the last year of the project. During their field work the students should be supported financially with scholarships.

More formal evaluation exercises are also to be carried out within the context of IPM projects. The group suggested to conduct three formal socio-economic surveys within the evaluation of a three-years project: first a baseline survey before the project starts, second a survey after the first year and third a final survey after the completion of the project which includes the overall data analysis. In order to be representative these survey are supposed to include a relatively large number of farmers (about 250).

At the same time it is proposed to execute case studies on soil, water, the health status of the farm population as well as biodiversity and food web issues. Pesticide sales in the project district are to be tracked and progress of training activities are to be monitored continuously.

The cost of the three years multidisciplinary evaluation was estimated at about 250,000 US$.

Table 1 details data to be collected at the farm household and appropriate methods that can be used for this purpose:

Table 1: Data and methods required for the evaluation of IPM projects

Type of Information	Methods
Economic (farm budgets, income, expenditures)	➢ Gross margin analysis, partial budgets ➢ Surveys leading to production, profit and cost functions, frontier functions, simulation models, latent variable models, sector models ➢ Sales figures from pesticide kiosks and farmer cooperatives ➢ Use of credit to purchase inputs from local banks and cooperatives

[12] Results from evaluations of this sort are descriptive rather than analytical, and are therefore considered by many to be unscientific. However, this is not a problem for most IPM programs in that their primary interest is not to help farmers use new methods and not to generate social science. Participant observation and direct observation have the added benefit of producing very reliable information in the space of a few weeks and at low cost. A number of innovative evaluation techniques have been applied in existing IPM programs in Asia and Latin America that achieve the main goal of assessing farm-level effects of IPM training.

Agro-ecosystem/ environment	➢ 'More cats fewer rats', i.e. simple indicators of dependence on chemical control ➢ Population counts, biodiversity, natural enemies ➢ Soil and water sampling ➢ Poisoning incidence of livestock, fish ➢ Potential for stocking fish/relationship to pesticide practices
Health	➢ Cholinesterase levels ➢ Pesticides in mother's milk ➢ Expenditures on medical treatment ➢ Days of work lost ➢ Signs and symptoms of acute poisoning and correlation with spray events ➢ Storage of pesticides, risk to children ➢ Hospital/health care center records ➢ Health exams for professional sprayers
Farmers' knowledge of IPM	➢ Informal interviews ➢ Knowledge indices based on structured questionnaires ➢ Correlation of knowledge and practice ➢ Knowledge revealed in changed behavior, for example timing of operations, soil fertility management ➢ Crop loss perceptions, subjective probabilities ➢ Local inventions/innovations to deal with pest problems
Information networks	➢ Social network model ➢ Estimate social distances ➢ Track diffusion of knowledge from farmer to farmer ➢ Rise/spread of informal/formal farmer associations with IPM agenda ➢ Farmer meetings with IPM content ➢ Relationship to local extension system and farmer involvement in system

The plenary discussion yielded a prioritization of indicators and its related data collection methods (Table 2):

Table 2: Priority issues for impact assessment

Results	**Data collection methods** (before/after, with/without project)
1. Adoption of new technologies (passive); adaptation of technologies to local conditions (active)	• Short questionnaire, part of household survey • Controlled comparison have two or more geographical areas with different situations (e.g. one with radio, one without/ and have a participant observer in each one) • Direct observation of pesticide containers (amount, kind, storage, disposal) • Participant observation, is the best method for teasing out complex relations between, e.g. radio programs, behavior change • Interviews • Drawings (ask local people to draw pest control scenes, measure amount of drawing devoted to new techniques) • Direct observation of adaptations • Interviews with key informants • PRA-type methods with extensionists (first 5 results) • Test (before & after) of farmer knowledge • Survey of local pesticide sellers (volumes & types sold) • National pesticide statistics
2. Improved knowledge and analytical capacity	• see 1
3. Improved economic well-being	• Farm budget survey on income and expenditure

Working Group II

Village Level Impacts

IPM programs in developing countries place a strong emphasis on the social and community-level dimensions of technological change. Recent years have seen a growing recognition that scientific and technical aspects of agricultural development are inseparable from the cultural, social and political context. This working group was assigned the task of identifying the potential village or community-wide effects of IPM practice and suggesting indicators that could be used in evaluating the impact of IPM interventions.

The results of the discussion are presented in the table below. The group identified six sub-topics that could be addressed when considering the community-level impact of an IPM program. Under each sub-topic the group arrived at a number of parameters that serve to sketch out the general framework of inquiry. The third column of the table provides a list of specific indicators pertaining to each sub-topic. Neither the parameters nor indicators are intended as an exhaustive list of issues falling under the topic of community-level impact. The group was careful to point out that social, cultural and political conditions vary greatly among countries, regions and even localities in the developing world. We can therefore expect that the potential village-level impact of IPM training programs will reflect this diversity.

The six sub-topics provide a useful entry point for discussion of local institutions and their relationship to the social, cultural and political aspects of IPM development. The first sub-topic deals with the important issue of participation in IPM activities, particularly among women, ethnic minorities and the various socio-economic strata in the community. IPM programs must be careful to ensure inclusiveness, and to make sure that activities are structured to remove impediments to participation among typically marginalised groups such as women, ethnic minorities, wage laborers and tenants.

The second sub-topic addresses the social dimensions of knowledge generation and exchange of information. Experience in a range of countries has demonstrated that farmers have both the capacity and desire to produce as well as use the science underlying IPM technologies. In actively contributing to the available stock of IPM knowledge farmers move from passive recipients to active producers of technological content. This not only improves the quality and relevance of information but also opens the way for wider application of IPM principles to a broader range of problems, crops and off-farm issues.

The sustainability of local institutional capacity is addressed under third sub-topic. Parameters included here cover the scope and content of formal IPM institutions and the relationship of IPM groups (both formal and informal) to existing village, regional and national institutions. This is closely related to the fourth sub-topic, which considers the potential for community-level advocacy of IPM principles. It is now widely recognized that supportive national policy is required for sound IPM implementation at the local level. Less attention, however, has been paid to the important issue of *local* policy making (for example, how local authorities respond to perceived pest 'crises' and decisions relating to the distribution of inputs and credit). Active IPM groups can have a favorable impact on the local policy making process, helping to avoid inconsistencies and build in farmer-centered strategies for extension and technological change.

The scale effects associated with pest management practices, extension and research are included under the fifth sub-topic. Although some of the economic, environmental and health effects of IPM are captured at the farm or household level, there still remain significant spill-over effects for the community taken as a whole. For example, pest resistance and resurgence result from heavy aggregated use of pesticides by a number of farm households, and the external costs associated with these problems are not captured at the micro level. Similarly, the development of markets for non-chemical alternatives, including biological control agents and information, depends on increased interest and awareness across the entire community.

The final sub-topic considers the relationship between farmers and the formal extension and research services. This is a cross-cutting issue relevant to all of the previous five sub-topics, but cannot be subsumed under any of them. In many locations active groups of IPM farmers have tended to place greater demands on the research and extension apparatus. Although in some places this has met with resistance, in others the greater interest in scientific material (previously considered too 'complex' for farmers) presents tremendous opportunities for improving the quality and relevance of extension efforts.

Table 3: Parameters and Indicators of Sub-Topics

Sub-Topic	Parameters	Indicators
1. IPM and Social Diversity	• Involvement of all social strata • Women’s participation • Subsistence and commercial producers • Participation of people from ethnic minorities	• Positive and negative effects of IPM on different social strata. • Social status of IPM leaders • Share of resource-poor farmers in IPM activities • Share of women in total IPM participants • Share of wage laborers in IPM activities • Share of ethnic minorities in IPM activities • Incidence of pesticide poisoning involving women • Wage rates for spraying • Timing of activities and women’s work schedules • Age and gender characteristics of information recipients
2. Knowledge Creation and Sharing	• IPM information sharing • Intensive IPM knowledge exchange • Discovery and understanding of pest predator relationships • Creation of new concepts • Spread of IPM principles to non FFS crops • Emergence of farmers as agents of change	• New field problems identified and solutions initiated • Rate of spread of IPM principles to non FFS villages • Farmers planning meetings to solve pest problems • Inter-village and intra-village forums and research committees for scientific learning • Kinds of new concepts/categories/ideas discussed • Requests for research/extension contributions • Farmers taking on the role of trainer for other farmers • Types of farmer experiments • Methods and technologies generated by the community • ‘Introduced’ technologies challenged and modified by IPM groups • Number of non-IPM farmers familiar with IPM principles • Knowledge of chemical control methods

3. Durable Institutional Capacity	• Village culture • Content of IPM groups activities and form of organization • Incentives to sustain IPM • Recognition of farmer scientists • Integration of IPM into other community activities • Promotion of science literacy	• Number of 'IPM hamlets' • Number field studies/experiments • Incorporation of IPM into school curricula • Frequency of formal meetings • Range of group IPM strategies • Dialogue/relationship with village officials • Collective organization of pest management activities • Extent to which formal community institutions support IPM • Share of IPM club members in total population • Formation of science clubs • IPM socialization, including plays, poetry, social events, etc. • Establishment of IPM 'learning center' • IPM practice embedded in district environment action plans • Village funds spend on IPM activities
4. Advocacy	• Self-confidence • Empowerment of community in issues related to pest management and beyond	• Village technical knowledge as power to influence outside agencies • Internal support to reinterpret/resist external pesticide promotion • IPM groups involvement in setting political agenda • National farmer organizations and relationship to local IPM activities • Women's group representatives and lobbying efforts on behalf of IPM and women in IPM • Policy changes that reflect farmers preferences, pressure and testimony • IPM activists and their links with consumer groups
5. Scale Effects	• Aggregate effects of individual actions taken by farmers • Ecological scale effects • Social scale effects (community based pest management)	• Recovery of ecosystem • Chemical accumulation • Demand for non-chemical products • Community-wide Health effects • Decision-making power/priority setting

6. Extension-Community Interactions	• Incentives for agricultural agencies to promote IPM • Stronger accountability to community • Community influence on content of extension material/subject matter	• Farmers seek out extension workers and materials • Extension collaborates in farmer to farmer training efforts • Community contribution to IPM extension • Increased time allocated to on-farm IPM research by extension system • Community recognition/appreciation of IPM extension workers • IPM village of the year award and other attempts to recognize achievement at the community level

The following issues were prioritized:

1. Diversity and heterogeneity of village level structure. Age and gender analysis, general statistics and participatory methods are appropriate tools.
2. Knowledge generation and behavioral change: reliable methods for measuring the interaction are not yet available.
3. Embedding IPM into structures and institutions. Narratives and historical information can be utilized.
4. Advocacy. The strategies of actors and groups should be analyzed by case studies and key informant interviews.
5. Scale effects, synthesis, knowledge, claims/ sets, economic returns to scale, participant observation and scaling-up.
6. Community – extension service relationship.

Working Group III

Impacts on regional, national and global institutions and policies

This working group focused on the impact of IPM programs on institutions and policies which create either an enabling or disabling environment for IPM. It is important to look at the history and development of policies and changes. The involved institutions should be assessed in a “before” and “after” comparison with regard to their performance and the adoption of new paradigms, structures and activities. It has to be determined what can be considered as project or process effects. Additionally, there is a need for sustainability indicators as a basis for the evaluation.

The participants discussed i) what kind of impact exist, ii) what are relevant indicators, and iii) what methods can be used to measure the indicators identified. The last section highlights the main items to look at.

<u>As components of an impact assessment on the policy level the following institutions should be evaluated to what extent IPM issues are reflected in their structure</u>:

- International agreements
- Institutional relations between various stakeholders (government agencies, private sector, NGOs)
- Pesticide and IPM regulations
- Extension systems
- Credit schemes
- Focus of research institutions
- Status of development of green commodity markets

<u>Indicators for the measurement of the status of IPM in the listed components are the following:</u>

- Changes in policy formulation and implementation
- Network of influence
- Level of interaction with policy decision makers
- IPM initiative : is it institutionalized?
- Change in the mission statements of institutions

- Changes of role and responsibilities of institutions
- Educational curricula
- Existence of policies to support biological or IPM techniques versus policies for pesticides
- Elimination of pesticide subsidies (set of indicators)
- Effectiveness of pesticide legislation
- Structural change between institutions
- Responsiveness to farmers
- Changes in institutions (incentive structure)
- Farmer social movements
- Evidence of acceptable good science
- Capacities for change in extension approach
- Proportion of research budget for IPM
- Price premiums
- Evidence of independent policy analysis
- Incorporation of economic instruments in crop protection policy
- Existence of policy workshop (who and how)

<u>Methods for Measurement of Indicators</u> (inductive = a; analytic = b):

- Mapping of stakeholders (b)
- Scoring of skills – the knowledge of service institutions
- Policy analysis (quantitative/qualitative) (a/b)
- Portfolio analysis of research program and development
- Scientific contents analysis
- Comparative analysis
- Legal analysis
- Interest/ conflict group analysis
- Grid group analysis
- Technology consensus conference (a)

As key issues for reforming policies, the following were prioritized by the participants: i) pesticide and IPM regulations, ii) effectiveness of pesticide legislation, iii) changes in the incentive structures of institutions, iv) changes in policy formulation and implementation, v) elimination of pesticide subsidies, vi) incorporation of economic instruments in crop protection policy An institutional reform should aim at enhancing capacities for change, especially in extension approaches. An educational reform is likely to contribute largely to this.

Mapping of stakeholders and policy analysis in general are considered as appropriate methods. Technology consensus conferences are useful since they provide a process-oriented perspective.

Working Group IV

Environment and Natural Resources

Generally, the components of the natural environment can be grouped into five broad categories, i.e. air, water, soil, crop and biodiversity. In terms of spatial differentiation, the impact of IPM on these resources can be on-site, off-site or both of these. Furthermore, effects can occur immediate or with a long time-lag through transmission in the ecosystem, thus giving the time dimension a large importance.

In terms of economic evaluation methods, use and non-use values (e.g. option value, bequest value, existence value) are to be distinguished. Intergenerational impacts deserve special attention, since new methods have to be found and applied in order to address equity issues.

A summary of possible range of impact of IPM programs on the environment and natural resources is shown in the table 3, separated according to their spatial dimension. Indicators and techniques for monetary assessment are distinguished between market impacts and non-market benefits.

Table 3: Summary on Effects, Indicators and its Proposed Assessment

On-site effects	Off-site effects	Market impacts	Non-market benefits
1. Crops:			
- reduction of residues in food and secondary products (*residues per weight unit*) – health impacts (*cancer incidences, mortality, morbidity*)		- lower expenditures – higher work productivity (*regression analysis, CBA*) – mortality: value of human life (*NPV; WTA*)	quality of life (*WTP to avoid exposure*)
2. Water:			
Improved drinking & washing water quality (*concentration level*)	Improved groundwater quality (*concentration level*)	- increased factor costs (*market techniques*)	total value: use and non-use components (*CVM*)

Increase of fish and fowl production as by-products (*yield*)		- income (*profit*)	- improved diet (*WTP for better diet*) - change in productivity and health costs
3. Soil:			
- erosion control (*ton/ha*) – conservation of soil quality (*indicators*)	- pollution (*concentration level)* - silting *(mg/l)*	- prices of land and water (*yield damage, profit functions*)	
4. Air:			
Reduction of immediate health effects (*ppm in air and rain*)	- reduction of long-distance effects of pesticides (*deposition in mg/m²*)		
Positive inter-field effects on the biota (*counts of border dynamics*)			
Positive inter-field effects on pesticide movement (*deposition of mg/m²*)		yield loss	
	reduced long-distance transport of pests (*counts*)		
5. Biodiversity:			
Increased agricultural biodiversity (*indicators*)		- change in yield and utility (*yield damage function*) - reduction of probability of pest outbreaks	
	increased biodiversity of environmental amenities (*indicators*)	- ecotourism (*expenditures*)	value of wildlife species (*CVM, hedonic pricing*)

WTP = willingness-to-pay; WTA = willingness-to-accept; NPV = net present value; CVM = contingent valuation methods

The following issues were prioritized:

1. Most of the concern, especially in developing countries, is about negative human health impacts of pesticide use. IPM programs have a significantly positive impact which extent is not yet fully known.
2. Intergenerational impacts of the effects on natural resources and the environment have not yet been sufficiently addressed since there are still methodological problems of economic valuation. Hedonic pricing and WTP measures are not satisfactory.
3. Increasing agricultural biodiversity is a major tool of IPM strategies. Sufficiently reliable indicators for different agro-ecosystems have to be elaborated and monitored.

Section III

Concluding Session: Synthesis and Future Action

The concluding session revealed a number of issues where some common understanding has been reached. However, from a retrospective view the workshop raised more questions than it was able to give answers. This was to be expected from a meeting given the diversity of disciplines and institutional affiliations. The participants agreed to a stepwise approach for integrating the different views with the aim to set methodological standards for trans-disciplinary impact assessment.

Conclusions

There were four major conclusions drawn by the participants.

Firstly, the methods of impact assessment and evaluation presented by the different experts revealed that despite of the many definitions about IPM there is broad consensus that IPM is about avoiding pesticide dependence and about achieving a socially defined optimum level of pesticide use. The discussions nevertheless made clear that there are many different types of IPM interventions. They range from ordinary farmer training to sophisticated Farmer Field School approaches. Also, effectively communicated research results that challenge existing paradigms and case studies that draw the attention of politicians and civil society can be subsumed under IPM interventions. Each may have various impacts and show different degrees of cost-effectiveness.

Secondly, the need for a document that outlines good practices for IPM evaluation is urgent, because of the diversity of IPM interventions that already exist and that can be further expected. Virtually all groups involved in crop protection, including the chemical companies who earn their profits from selling pesticides, label their concept IPM. They even use, which is completely legitimate, the Farmer Field School approach to market their products. There is no royalty to be paid to the creators of IPM. The IPM idea is a free good that can be taken, reproduced and modified by anyone. Hence, IPM can only be measured by its results and no longer by its inputs. Those groups that adhere to a purpose of IPM as outlined above almost exclusively depend on public funds for their IPM initiatives. Consequently, the only way they can protect their “IPM market“ is by showing that “their“ IPM contributes to social welfare, improves the environment and is in line with the sustainability paradigm as outlined in the AGENDA 21.

Thirdly, the different groups who participated in the workshop advocate different approaches to evaluation. There are those who see cost benefit analysis as the major tool of evaluation. They want to refine this tool by adding economic evaluation of environmental impacts and by applying contingent valuation methods and willingness to pay concepts. Others believe that evaluation should not be a checking procedure but should be designed in the spirit of a joint learning experience. It is clearly in this theme where significant differences between economists on the one hand and anthropologists and extension specialists on the other hand were made obvious from the discussions. It also became clear that cost-benefit analysis has its shortcomings and that its routine application can lead – and in fact sometimes did in the past – to sloppiness and “garbage in - garbage out“ exercises. This does not invalidate the instrument as such, because there is so far no alternative way how to judge the appropriateness of public investments relative to an alternative use of the funds. There is, however, a need to set standards which must be met if CBA is going to provide the information that facilitates decision-making.

Finally, there is the problem of measurement. Hence, unlike some of the “green revolution technologies“ assessing IPM impact is not a matter of adoption versus non-adoption. Rather it is a continuum that is expected to induce a number of processes which may not always be easy to measure because of the time lag with which they may occur and because of a lack of indicators. Thus inferences drawn from measurable short term income effects induced by IPM may be wrong if evaluation fails to capture processes that can lead to much higher income effects in the future. Therefore, additional methods of evaluation can reduce the uncertainty inherent in the assumptions entering cost benefit analysis and can provide additional criteria for assessment. These methods often go beyond formal surveys with standard questionnaires and are based on participant observations and case studies.

The remaining questions

The main overall question : How can economic approaches be matched or complemented with other social science concepts – and vice versa - needs further discussion. This general problem can be split into four specific questions :

How can the assumed non-market effects of IPM be identified and measured? This question goes to the natural scientists who have to become clearer about the mechanisms that lead to a change in pest management practices and how much of that is necessary in order to reach a significant impact. This question also goes to the anthropologists/extension specialists to formulate reproducible and transparent concepts on how to measure the assumed farmer to farmer interaction, improved village level cooperation and general empowerment of farmers. Equally, it is important to specify how inferences from observations in case studies to general conclusions about the existence of real processes can be made.

More clarity is needed on the role that can be attributed to changes that may take place in the civil society at large, e.g. changes in consumer attitudes, changing research paradigms, change in environmental ethics and others. Meaningful guidelines on IPM evaluation must not ignore developments that occur outside the farmer's practices but very little of that has entered the debate so far.

A related question is to identify and measure indicators of policy change as well as to specify appropriate intervention strategies that facilitate a change in policy which is conducive to IPM. Only if policy parameters change, creating a favorable environment for IPM, the assumption can be made that the positive results which may be found on a pilot scale, often as a result of the intervention by an external donor are likely to persist after donor support ends.

How can one avoid the flaws that often accompany the conduct of cost benefit analysis ? This question needs to be answered by economists looking critically at a range of examples. This also includes the question how decisive cost benefit analysis is for the funding of IPM initiatives. To answer this question economists have to examine procedures and actual funding practices of the major organizations.

The steps ahead

To advance the idea of Guidelines on Good Practice of IPM Evaluation and Impact Assessment requires several coordinated steps. The guidelines must overcome the major problem that existed in the past, i.e. different groups of the IPM community, e.g. cost benefit analysis experts, plant protection people and others were using different sets of methodologies to measure impact. Thus, results were not comparable and they may have had little impact on actual decision making. Moreover, the danger of misusing tools is far higher in the absence of a jointly shared framework of experiences on good practice. For example, IPM people out of a lack of understanding of economic concepts create their "own economics", hoping it would serve their purpose while economists tend to make simplistic ecological assumptions and tend to ignore factors that are beyond efficiency.

The first step is to clarify the methodological issues within the disciplinary groups. For the economists that means to find answers to the question specified above.

Their task is to set standards for cost benefit analysis and find ways how these can be put into practice. The other social scientists who promote methods looking beyond the question of economic efficiency, need to become clearer how the approaches are applied and what the results can show. They must convince traditional scientists that their methodologies yield better results for measuring the true impact and can complement the existing tools. The natural scientists need to become clear what IPM can do in terms of ecosystems changes under real world conditions. They should clarify the limits of what can be expected.

The second step is the conduct of case studies on examples of IPM projects where the expected effects of IPM can be measured. Examples for in-depth case studies are :

- country impact assessments dealing with the policy changes at national level
- village case studies exploring the extent of farmer-to-farmer interaction, the spread of knowledge and the change of village institutions
- simulation models of the agro-ecosystem development over time under IPM intervention.

Methodologies and their application in specific cases in principle should be open to external review processes. Observations should be verified with different tools, allow an ex-ante and ex-post comparison, and incorporate the knowledge and experiences of the people involved in IPM program implementation.

The next steps should be separate meetings of the disciplinary groups in order to clarify some of the critical issues as mentioned above. The groups first have to become clear on their position and their minimum requirements for trans-disciplinary evaluation guidelines. Thereafter, small interdisciplinary group meetings are proposed where complementarities can be identified which would lead to draft guidelines. These must be concrete in terms of describing minimum requirements and methodological standards but they must allow enough flexibility for use by various groups (from multilateral donors to small NGOs) in different socio-economic and cultural settings.

ANNEX 1: Workshop Agenda:

Monday, 16 March

9.00	Welcome address University of Hannover FAO Global IPM Facility World Bank BMZ	 H. Waibel P. E. Kenmore G. Feder J. de Haas
9.30	Introduction to the program and of the participants	H. Waibel
10.00	Coffee Break	
10.30	Presentation of IPM Evaluation Concepts 1. World Bank 2. IPM project economics 3. Policy perspective	 G. Feder J. Pincus, A. Rola. D. Widawsky, D.K. Chung H. Waibel
12.00	Lunch	
14.00	Presentation of IPM Evaluation Concepts (cont.) 4. Anthropology perspective 5. Extension/Institutional perspective	 J. Bentley J. Jiggins
15.00	Coffee Break	
15.30	Presentation of IPM Evaluation Concepts (cont.) 6. Participatory group 7. Biology and natural resources	 L. A. Thrupp P.E. Kenmore, K.L. Heong, J.C. Zadoks
16.30	Introduction to the working groups	H. Waibel
19.00	Reception with members of the Faculty of Horticulture of Hannover University	H. Waibel

Tuesday, 17 March

8.30	Split into working groups WG 1: Farm-household impacts WG 2: Village community systems impacts WG 3: Impacts on local/regional/national/global institutions WG 4: Effects on natural resources	
12.30	Lunch	
14.00	Presentation of results of working groups 1 to 4	Rapporteurs of working group
15.30	Coffee Break	
16.00	General discussion	P. E. Kenmore
19.00	Social event	H. Waibel

Wednesday, 18 March

9.00	Cost benefit analysis of pesticide use in Germany	G. Fleischer
10.00	Cross-cutting methodological issues	G. Feder
12.00	Lunch	
13.30	Introduction to the idea of guidelines on Good Practice for IPM Evaluation and Impact Assessment Discussion	H. Waibel
15.30	Closing	P.E. Kenmore

ANNEX 2:

List of Participants of the Workshop on IPM Evaluation

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