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Extension strategies for integrated pest management (IPM) practices in the context of developing countries

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ABSTRACT

Feeding the 9,000 million people expected to inhabit Earth by 2050 will present a constant and significant challenge in terms of agricultural pest management. This huge target of feeding the 9,000 million plus population is one of the main reasons that attract the policy makers and farmers, especially of the developing countries, to be get trapped in the ambit of the routine chemical pesticide applications that require less attention, effort, and management skill. At the same time, misunderstanding of the costs and benefits pave the way for simple prescriptions for prophylactic pesticides applications as this appears to be simple, attractive and un-demanding with visible results as compared to Integrated Pest Management (IPM) practices. Many costly (both in socio-economic and environmental terms) chemical pesticide applications are wasted through incorrect practices, including unnecessary preventive application. As chemical pesticides carne into wide use in developing countries, many sound traditional practices were abandoned and pesticides became the sole pest management tool. Little education about the shortcomings of pesticides was offered when pesticides were introduced into developing countries, including non-compatibility with non-target organisms, pest resistance, secondary pest outbreaks, and human and environmental hazards. The above mentioned facts explain the peculiar situation where despite a 15 to 20 fold increase in pesticide use since the 1960s, global crop losses to pests - arthropods, diseases, and weeds - have remained unsustainably high, even increasing in some cases. These losses tend to be highest in developing countries, averaging 40 – 50 per cent, compared with 25 – 30 per cent in high-income countries. Alarmingly, crop pest problems are projected to increase because of agricultural intensification, trade globalization and, potentially, climate change.

Since the 1960s, integrated pest management (IPM) has become the dominant crop protection paradigm, being endorsed globally by scientists, policymakers, and international development agencies (Thomas, 1999; Ehler, 2006; World Bank, 2005; Kogan, 1998; Kogan, Croft and Sutherst, 1999; Lewis *et al.*, 1997; Kogan and Bajwa, 1999; Orr, 2003). The definitions of IPM are numerous, but all involve the coordinated integration of multiple complementary methods to suppress pests in a safe, cost-effective, and environmentally friendly manner (Ehler, 2006; Kogan, 1998). These definitions also recognize IPM as a dynamic process in terms of design, implementation, and evaluation (Kogan, 1998). The integrated pest management (IPM) approach stresses the development of a broad base of management practices and control tools over a single pest control and seeks to maintain ecological and other resources over time (Altieri, 1993; NRI 1991; Smith and Reynolds, 1966; Taylor, 1989). Given this lack of a single technical and social strategy for solving complex problems in agricultural pest management, IPM programs are based on a holistic, adaptive, systems management approach (Delucchi, 1989). In practice, however, there is a continuum of interpretations of IPM (Kogan and Bajwa, 1999; Morse, 2009; Jeger, 2000), but bounded by those that emphasize pesticide management (*i.e.*, "tactical IPM") and those that emphasize agro-ecosystem management (*i.e.*, "strategic IPM," also known as "ecologically based pest management") (Morse, 2009; Barfield and Swisher, 1994; Royer, Mulder and Cuperus, 1999). Despite apparently solid conceptual grounding, theoretical prominence, sound principles and substantial promotion by the public and non-profit organizations, Integrated Pest Management (IPM) continues to suffer from anaemic adoption rates in developing countries with a discouragingly poor adoption record, particularly in developing-country settings (Ehler, 2006; World Bank, 2005; Orr, 2003; Morse, 2009; Jeger, 2000; Barfield and Swisher, 1994; Royer, Mulder and Cuperus, 1999; Zalucki, Adamson and Furlong, 2009; Way and Emden, 2000; Morse and Buhler, 1997; Pedigo, 1995), raising questions over its applicability as it is presently conceived (Orr, 2003; Morse, 2009; Morse and Buhler, 1997; Van Huis and Meerman, 1997).

To change this prevailing set of attitudes towards chemical pesticide application and to end this pesticide dependency and at the same time low rate of adoption of IPM technologies, in the developing countries, with new, positive motivators for developing country farmers: understanding, excitement at learning, and empowerment of the farmers are to be incorporated in the larger extension paradigms for promoting IPM. In doing so, we must keep in mind that in practice, farmers rely on knowledge developed by farmers, reinvent ideas brought from outside and actively integrate them into complex farming decisions. However, the issue of the

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development of the capacity of the farmers to start and carry on IPM practices in their field must be looked into.

Capacity building of the clientele for adopting IPM practices

No IPM program can remain viable for long without programs for educating and training the users. Once the extension agents and agricultural plant protection officers begin to understand their subject, and with guidance from the IPM experts, they should assist in future program development by extending their knowledge. A full spectrum of extension services include field level monitoring, short-term forecasting, and establishment of economic injury levels or Economic Threshold Limit (ETL). In addition to basic IPM technical skills, training may include teaching skills for effective delivery of training materials (Lionberger and Gwin, 1991). The farmers will gain more confidence and respect for their local agent when he/she is primarily responsible for working with them. Information and training are two integrated components of a capacity building process on IPM practices to be followed by the farmers.

A. Information

Information of IPM on whatever media it is being put up should focus on simplicity, clarity, and cultural sensitivity. Too much information can confuse the extension agent or farmer. Poster design should involve local extension agents and farmers, with whom all materials should be pre-tested at the design stage to ensure correct cultural style, clear symbols, and language. A flip chart offers a useful way to illustrate ideas on the spot or respond to questions inquired by the viewer.

Additional dissemination tools for IPM information include specialized training sessions, hands-on workshops, and village meetings. Training sessions emphasize safety, use and disposal of pesticides, qualities and principles of IPM, and successful farm practices in the village. Workshops include identification of pests and natural enemies, examples of feeding patterns and symptoms on crop parts, components of composting, preparation of soap sprays to decrease spider mites and aphids, and dry Neem seeds as a way to suppress pests.

Pest identification games, innovative experiments, and active participation of farmers add excitement to the IPM learning process (Matteson *et al.*, 1994). Village meetings discuss potential pilot projects, review the progress of the educational programs, and critique effective use of tools. IPM education should be introduced to the public as well as primary, secondary, and university level students to build bridges for tomorrow's agriculture. Students are good volunteer recruits to help create and design IPM training sessions and workshops, often possessing the necessary enthusiasm and they gain practical experience in the agricultural field. Class projects can be designed for a student to help compile information on farming practices, monitor pests, revise sampling methods to suit a farmer, and prepare skits for villagers on pesticide dangers. Mass media channels, including radio announcements, featured news articles, informational fact sheets, agricultural field days, and celebration of special dates such as World Food Day etc. are a few ways to disseminate information as well as build the capacities of the practicing farmers, farm women and rural youths to implement IPM practices.

B. Training

Training in crop protection with special reference to IPM has frequently been highlighted in the past by FAO, the World Bank, UNDP and bilateral programmes. Funds are available from many different sources for overseas training for personnel from developing countries. Some forms of training, such as those involving a split between the home and host countries, have particular merit. Most training activities need better co-ordination and focus.

A recent feasibility study by the Agricultural University in Wageningen, the Netherlands, on needs and constraints of information and documentation for IPM in the tropics, is relevant to such problems (Van der Weel and Van Huis, 1989). Training of the different groups involved in crop protection is vital to technology transfer and IPM implementation. This has not been sufficiently emphasized in most national IPM programmes. *Training must target the following groups: farmers (as the final client group); extension workers; crop protection technical services personnel; researchers; trainers (tertiary and secondary); and policy makers.*

Currently, training materials, curricula, trainers and evaluation materials are lacking for many crops. Because the majority of farmers in developing countries are illiterate and often poor, the extension of IPM as new technology is a matter of human resource development. This suggests that the type, method and content of training should relate to local conditions in addition to just presenting the technical aspects of IPM. Training deserves high priority and unless given due attention will remain a serious bottleneck to the implementation of IPM.

In the context of developing countries, 'farmers' are small-scale, low-income and resource-poor. They are the intended beneficiaries and ultimate users of all IPM

research output. Recurring features in successful agricultural research outputs adopted by farmers are linked to genuine consultation with the farmers at all stages of the research process. This begins with the identification of the problem, through research design, to the development, testing and evaluation of recommendations. Because of the enormous variation in circumstances of the target beneficiaries of research, flexibility is needed in the research system. Farmers cannot be provided with a particular 'package of recommendations', because these are unlikely to match their individual circumstances.

External solutions have a low probability of working in the long term; 'packages' of external solutions are almost certain to fail. The active involvement of farmers in designing IPM solutions to fit their specific circumstances is of vital importance, but is rarely achieved. However, limits to the contribution that farmers are able to make to the research process need to be recognized, and account must be taken of their lack of technical knowledge. Informal groups of farmers or neighbours (who may include some non-farmers) often make joint decisions about agricultural practices, including IPM. Farming groups that have formed for various reasons (*e.g.* village administration, irrigation management, or religious purposes) can serve as an important institutional basis for group decision-making about cultivation practices, purchasing chemicals, and co-ordinating the use of IPM methods.

The limited educational background of farmers impedes IPM implementation in some countries, although extension workers feel that, with the appropriate involvement of farmers in technology testing, receptivity of IPM could be higher. There is evidence that even farmers with little education are able to understand and apply thresholds for insects. There is therefore a need to involve farmers in the development of IPM training material, much more than with other aspects of new technology, because of the knowledge nature of IPM technology. Furthermore, the role of NGOs and of farmers themselves in providing training should be encouraged.

Together with NGO personnel, village level extension workers are the frontline workers on IPM. Many do not have specialized training in plant protection, let alone IPM, and they have other duties. The evidence from Asia shows that this group requires training, using knowledge in a synthesized form, including generalized principles. The influence of the agrochemical industry is also a major factor to contend with in government efforts to implement IPM. Farmers are not helped by what appears to be a direct conflict between industry's objective of more sales, and the IPM message of rational pesticide use. This points not only to the need for private industry and public sector extension to work in a more complementary manner, but also for training programmes that would reconcile the perceived conflicts between the aims of the two groups.

Demonstrating the IPM technologies to the potential clientele

The demonstration of IPM Technologies should follow the pathway of (1) designing village-level demonstration plots, (2) arranging small scale farmer projects (Matteson, 1991a), and finally (3), advancing to large-scale, long-term implementation (Kenmore, 1991).

A demonstration plot should be initiated by the IMP experts and associated extension experts working close to the farming village for observation and participation purposes. The team should assist in the set-up, aid in the record-keeping, coordinate reviews of progress, and work in coordination with the farmer throughout the project. A farmer should be actively involved in managing his or her own experimental IPM technology. Farmers 'learn and do' by seeing and trying potential IPM techniques in practice. Adaptation to change in farming practices is gained from knowledge, support, and hands-on experience. Farmers must be convinced that IPM has something to offer before they will practice IPM on a large scale on their farm. It is important for the demonstration plot to have objectives, good communication between participants, and defined roles. Without continual communication, support, and encouragement, on-farm experiments will fail (Matteson, 1991b).

Components of a well-designed project might include a compost pile, a water drainage system or water' collection system, wind blocks, monitoring traps such as pitfall traps for crawling insects, attractive coloured, sticky card traps for flying insects, and water traps for aphid collection. Trapping systems should be efficient and not interfere with regular farm practices. Local volunteers and students can participate in the demonstration plot and take on various responsibilities assigned. The crop loss assessment project is to be arranged for the volunteers to record rainfall from assembled rain gauges in villages. Each volunteer was supplied with a worksheet and pencil. With many observers looking closely at a crop, and its growth and pest complex, knowledge and awareness will increase and the program will grow.

A simple and c1eady defined pilot project may involve pesticide vs. no pesticide plots, a monoculture vs. polyculture planting, and fertilizer vs. no fertilizer

treatments (Matteson, 1991a). Simple recording systems arc adequate to monitor pest and beneficial insects. For example, a peg board constructed for the IPM plant protection project may be placed on a post in the field. The board is to be equipped with moveable coloured pegs representing levels of various pests, where pegs were moved up and down to indicate counts of insect population levels. Representative coloured flags are to be placed on the pegboard to designate caution, warning and danger levels of pest numbers and to alert farmers of potential injury levels. For example, a yellow flag (caution) represented minimal numbers of enemy insects and a red-coloured flag (danger) depicted larger numbers of enemy insects likely to cause economic loss if not controlled. A simple map may be drawn of the field making areas of high pest numbers by the partner farmers themselves. These practices increase observational skills and promote critical thinking.

Pilot projects can be arranged for potential adopters of IPM strategies by selecting a few villages with two or three devoted and representative farmers. Participants of the demonstration plots and pilot projects should receive acknowledgment for their efforts. Participators will likely to greatly appreciate the awards with a sense of accomplishment. In addition, symbolic "IPM Participation Farm" signs can be posted at experimental plots and in farmer fields to contribute to IPM awareness in the village.

IPM programs include keeping realistic goals and allowing enough time for each stage to take hold and gain strength before implementing the next one. Developing relationships and bridging the link between the practical knowledge of the farmer and the technical knowledge of extension and research personnel is crucial in this process. It is important for farmers to participate in every step. A team approach has proven itself to be the most effective method of organizing IPM research. By formulating expert working groups comprising IPM experts and extension experts, they can prioritize farmers' needs, address constraints, gather and evaluate forgotten and existing practices, stress local technologies to suit the small farmer, gain support from the government, and instil IPM philosophy based on a systems management approach [Prevention, Exclusion, Suppression and Thoughtfulness (PEST)]. Educational programs with effective delivery systems and tools, in combination with on-farm projects, offer farmers practical experience, knowledge, and incentive. It's through all these efforts that the farmer will achieve a new and improved farming system.

In doing so, we must keep in mind that in practice, farmers rely on knowledge developed by farmers, reinvent ideas brought from outside and actively integrate them into complex farming decisions. Effective extension seems based on checks and balances that match intervention power with farmers' countervailing power, and mobilize farmers' creativity and participation in technology development and exchange.

Alternative models of IPM extension strategies rely on the extension investment, design, and practice that stress adult learning and its facilitation. In these models, the farmer is seen as an expert and farm development as driven by farmers' energy and communication. It suggests that a shift to knowledge intensive sustainable practices requires a learning process based on participation and empowerment is direly required. Focus is to be centred increasingly on the need to teach IPM knowledge and skills in a consciousness and confidence-raising framework that changes people's view towards the use of the chemical synthetic pesticides as well as organic bio-pesticides and other control measures.

Further, it may be suggested that a more vigorous analysis and discussion of the factors discouraging IPM adoption in developing countries may accelerate the progress needed to bring about its full potential.

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