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Comment

Scaling up communication of scientific information to rural communities

K.L. Heong, M.M Escalada

A wide gap exists between what scientists and rural farmers know. The rapid advancements in digital technology are likely to widen this gap even further. At the farmers' level, this knowledge gap often translates into poor and inefficient management of resources resulting in reduced profits and environmental pollution. Most modern rice cultivars can easily yield more than 5 tons per hectare when well managed, but millions of farmers often get less than 5 tons using the same production inputs. In pest management, for instance, rice farmers often apply pesticides unnecessarily, as they base their decisions on visual clues and over estimations of potential damages by pests. Frequently, farmers overestimate potential losses due to pests by more than ten-folds. In the Philippines, scientists estimated that about 80% of farmers' insecticide sprays were unnecessary as they were either applied at the wrong time, for the wrong pests or both. Using the wrong chemicals at the wrong dosages is also common. Highly visible symptoms such as leaf damages are often signs that stimulate farmers to spray. In fertilizer management, most farmers believe that more is better, perhaps since the local terms for fertilizer are often translated to mean "fat" in many countries. Similarly in other resource management decisions, farmers rely on their own beliefs and perceptions. While there are strengths in farmers' indigenous knowledge, there are also weaknesses. If some of these weaknesses are modified, farmers' resource management decisions and skills can be improved. Thus discovering the key weaknesses should be the first step and developing a communication strategy for the new information to reach the millions of rice farmers is next.

Tons of scientific information are communicated between scientists through publications, electronic media and conferences. But very little will actually reach rural communities because of limited access. Even when access is facilitated, the scientific literature is riddled with jargon which only a few in the discipline would understand. In addition, the information may not have direct use or may not be in the appropriate prospective and need further synthesis. Sometimes rural communities may have the information but are not motivated to act. We suggest that scientific information alone is insufficient to benefit rural farmers unless it is further processed, simplified and effectively communicated to reach a wide audience. As pointed out by Akio Morita, the founder chairman of Sony, to be successful in business, technological creativity is not enough. There is need for creativity in product development and marketing as well. To add value to scientific information and "getting science into practice" so as to benefit rural communities, we suggest that there are various phases involved. In this comment we discuss and share our experiences in implementing the phases.

The initial phase is identifying the problem and the associated ecological as well as the sociological issues and conducting research to better understand them. Understanding the root causes besides the direct causes of the problem is important. It is also important at this phase for all stakeholders to gain a common understanding of the various issues.

The findings are then used as inputs into the second phase, "technology development" where technical information is "distilled" into an "actionable" entity expressed in the form of a "heuristic". Heuristic is a term introduced by Tversky and Kahneman[1] to refer to informal rules-of-thumb. Heuristics are developed through experience and guesswork about possible outcomes and may thus have inherent faults and biases. Research to understand farmers' current heuristics and reasons for their adoption will help scientists frame new heuristics that are "actionable". For instance, scientists discovered that leaf damages by leaf feeders in the early growth stages of the rice crop have little effect on yields. Farmers, however,

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spray insecticides to control the larvae (often called "worms") because of the highly visible symptoms. They strongly believe that the leaf damages will lead to yield loss and that the worms will multiply quickly and thus need to be killed immediately. These beliefs might stem from farmers overestimating potential losses and their loss aversion behavior as described in Prospect Theory[2] (proposed by Kahneman and Tversky) where the potential of loss has a disproportionately higher influence on decisions. However, entomologists have found that the rice crop can easily compensate for the leaf damages with no yield loss and biological control agents will prevent further development of the pest population. The early season insecticide sprays will disrupt the natural control mechanisms (or immune system) of the rice crop rendering it more vulnerable to secondary pests that are more damaging. Thus, these early sprays often do more harm than good. From the ecological and sociological information, a new heuristic "Spraying for leaf feeding insects in the first 40 days of the crop is not necessary" was established.

The third phase is encouraging farmers to evaluate whether this new and conflicting heuristic is true through farmer participatory research. This is equivalent to providing samples to consumers for testing. We developed a simple field experiment that farmers can conduct in their own fields themselves and invited farmers to perform this "experiment". The motivations were reduced cost (or increased profit), less work and reduced exposure to toxic pesticides, if this conflict information is true. In this process, the heuristic may also be modified and adapted to suit local conditions. For instance in areas where farmers are transplanting, "the first 30 days" can be used instead. After farmers' evaluations, the new heuristic may now be ready for up scaling especially in areas where early season spraying is a problem.

The fourth phase is developing a communication strategy and selecting a pilot site. It is important to conduct this pilot project through partnership with local research, extension, mass media, government, NGOs and other implementing agencies. The project team will develop prototype materials to motivate farmers into action. Positioning the messages in "gain" frame in the materials may have higher motivational effects. For instance, we emphasized "increased" profits and used the symbol of a "piggy bank" or a stack of bank notes. It is important that these prototypes are pre-tested before the final versions are mass produced and distributed. In addition we emphasized the "triability" of the new information and broadcasted interviews of farmers who had carried out the "experiment". An important event in the strategy is to hold a high profile launching day to coincide with significant events, like World Environment Day or Earth Day or a local festival, where government officials, such as the vice minister, provincial governor and directors of agriculture are invited. Farmers who have carried out the evaluation experiments can also be invited to share their experiences. Such publicity helps to focus attention of the campaign and can motivate neighboring provinces into action.

The fifth phase is documenting the impact which is often conducted in parallel with the fourth phase. A rigorous research framework is planned at this phase to accurately quantify effects of the intervention. A Management Monitoring Survey (MMS) is carried out about 2 months after the launch to enable the team to make adjustments as needed. Baseline and post test data related to farmers' beliefs, attitudes and practices, collected before and after the launch, are then analyzed and documented. A "show and tell" press conference or workshop is another important event that can enhance adoption by other provinces and enhance multiplier effects. By involving policy makers in these high profile events, policy change that can favor widespread adoption is greatly enhanced.

The mass media approach to scaling up can be highly successful when it communicates a single intervention or message. One can start off with one intervention and when success is established, the incremental approach can be applied by adding one or two more heuristics. It is also useful to "brand" the new intervention for easy communication and recall. In the campaign to reduce insecticide use in the first 40 days, we branded it "No early spray". In the subsequent campaign to include the reduction of seeds and fertilizers, we branded it "Three Reductions, Three Gains". In this new campaign farmers were provided with recommended seed and fertilizer rates and "no early spray". Since savings from insecticide reduction provided the greater proportion of the earnings, the campaign motivated farmers to further reduce insecticides by using less seeds and fertilizers at the new recommended rates. It is well known in science that high seed rates promote a denser crop canopy. Coupled with high fertilizer rates, the crop canopy is conducive to the development of pests and diseases. Thus, farmers using the new seed and fertilizer rates will tend to observe less pest and disease symptoms and spray less. The three gains from the campaign are profits, improved human and environmental health. Because of the credibility

built from the earlier "no early spray" campaign farmers are adopting the "Three reductions, three gains" practices more quickly. It is thus important that rigorous research is conducted before establishing any new heuristic and extensive farmers' evaluation is conducted before a scaling up strategy is contemplated to avoid negative impacts.

The scaling up process will need to involve many stakeholders and developing a multi stakeholder partnership of high quality is essential to ensure success. To achieve this we used a participative style of leadership to stimulate creative problem solving, to promote high morale, satisfaction, local ownership and commitment. Group decisions and supportive relationships based on mutual trust and respect are strongly emphasized in meetings and workshops at all times. We also emphasize flexibility in our discussions, decision making and relationships. Initially the team establishes a "common stake" of the project which helps various stakeholders establish their own stakes, roles and commitments. We do this through developing a "common understanding of the various issues", a "consensus of the approaches" and a "common view of impact and its measurements". In addition we make special efforts to share all data, analyses, results, publications, financing, credits and awards.

To achieve large scale up, the commitment and support of local government authorities and agencies is essential. The project's goals will need to satisfy the local government's priorities as well as those of local implementing agencies. For instance, if the wages of the extension agents in the area are dependent on the amount of farm chemicals they sell to farmers, this conflict will significantly compromise implementation plans. Thus, at the start of the project, a stakeholder analysis will be useful to understand stakeholder relationships to decide whether to proceed or make the necessary adjustments before proceeding.

Notes and references

[1] A. Tversky, D. Kahneman, "Judgement under uncertainty: heuristics and biases", *Science*, 185, 1974, p. 1124-1131.
[2] D. Kahneman, A. Tversky, "Prospect Theory: An analysis of decision under risk", *Econometrica*, 47, 1979, p. 263-291.

Authors

K.L. Heong is a senior scientist in the International Rice Research Institute (IRRI), Los Banos, Philippines. kheong@cgiar.org.

M.M. Escalada is a professor of development communication in the Leyte State University, Baybay, Leyte, Philippines, currently on secondment at IRRI. escalada@gmail.com