CHAPTER 5.4.

COMMUNICATION AND STAKEHOLDER ENGAGEMENT IN AREA-WIDE PEST MANAGEMENT PROGRAMMES THAT INTEGRATE THE STERILE INSECT TECHNIQUE

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SUMMARY

Effective stakeholder communication and engagement is an essential component of area-wide integrated pest management (AW-IPM) programmes that integrate the sterile insect technique (SIT) because it has a large impact on programme success. Full-time professionals should direct communication activities and help secure vital support and “goodwill” from governments and community organizations. Good and frequent communication among programme staff, and between programme staff and stakeholders, is required to maintain engagement and support, and to keep the work goal-oriented even when some programme activities are controversial. The importance of engaging stakeholders in the programme is emphasized. The media can be valuable and effective partners by informing stakeholders and the general public about the facts and activities of a programme, especially if this is done in a non-technical and straightforward way. Methods of communication, including the use of videos and social media platforms, are described. Ongoing research helps overcome controversial aspects of programme technologies. Programme failure can result from poor communication and inadequate stakeholder support.

1. INTRODUCTION

Effective communication in area-wide integrated pest management (AW-IPM) programmes that include the sterile insect technique (SIT) is critical to success. The overall communication of programme goals, objectives, and activities is often not given as much attention as are the technical aspects of a programme, and inadequate stakeholder support can be a cause of failure. Good stakeholder communication is just as important for AW-IPM programmes as is good management (Dyck, Reyes Flores et al., this volume) because these programmes affect whole communities (Lindquist 2000, 2001; Pennington et al. 2021; Klassen and Vreysen, this volume).

AW-IPM programmes are visible; they may involve large communities or even several contiguous communities. The participation, support, and possibly the financial contributions of many, if not all, members of these communities, even if disparate, are essential for success. When urban areas have to be included, it is also necessary to inform this more complex segment of the community about the need for the programme, its objectives and progress. Quarantine checkpoints established to maintain pest free areas affect travellers who may not live within the programme area (Hendrichs, Vreysen et al., this volume). Since it is environment-friendly, the SIT technology is likely to be accepted by the public when properly informed. However, sometimes problems arise from the field and regulatory activities of AW-

IPM programmes, and these need to be resolved in a transparent manner (Reyes et al. 1988).

Stakeholders need to be pro-actively informed about area-wide programmes, with emphasis on the benefits that a programme brings to the community and country (Lindquist 2000, 2001; Mau et al. 2003). Communication activities require a strategy, implementation plan, and a budget just like other components of a programme; they are an integral part of it. Essential equipment and staff for these activities must be available at the beginning of a programme.

Before a programme is initiated, a survey should be made to identify the important stakeholders, the segments of the community that will be affected by the programme, and their likely primary concerns. A strategy of communication and engagement, and a plan for appropriate activities for each segment of the community, can then be developed and implementation started before initiating programme activities.

The details of the communication plan, and messages to the audience, will be unique to each programme. The type of media used should be suited to the communication plan and the situation (P. Rendón, personal communication). Translation of the messages into local languages may be necessary, and certainly the content, style, and format should fit the intended audience (Schwarz-Gehrke 1983). A periodic evaluation of the stakeholder communication programme is a valuable way to monitor and if necessary improve the communication strategy and activities.

Since technical specialists are often not good communicators, a full-time professional, with appropriate training and experience in communication, and a good knowledge of all aspects of the programme, should be appointed to lead the stakeholder communication activities (Dyck, Reyes Flores et al., this volume). Several persons together could form a communications team. Good interpersonal skills will help ensure an effective communication programme delivery. Consideration should be given to contracting public companies that can organize major media campaigns.

2. COMMUNICATING WITH STAKEHOLDERS

Regular and timely communication with a programme's stakeholders about programme objectives and benefits is an indispensable prerequisite to obtaining their support and participation. However, educating the public at large is difficult, and requires considerable effort and resources. Besides informing people about various aspects of AW-IPM and the SIT, using creative and effective methods is necessary to pre-empt the development of resistance that often develops when area-wide activities are initiated (Klassen and Vreysen, this volume).

Information provided on programme progress must be clear, reliable, up-to-date, relatively simple, practical, and sensitive to people's concerns. An opportunity for feedback should be provided. It must be recognized that perceptions among the various stakeholders will not be the same. The same issue may require more than one explanation, depending on the audience. Issues will relate to both technical and administrative matters. If prejudices or resentments are involved, not all issues may be solved satisfactorily.

Potential urban-rural conflicts, such as in an agricultural programme involving insects attacking tree fruits, can often be alleviated through information exchange and one-on-one meetings with antagonists. Obtaining the early support of labour organizations is highly desirable, and often essential, to assist in informing their members. Indigenous people should be informed about a programme and, where relevant to area-wide activities, their permission obtained to enter traditional or sacred areas.

Obtaining area-wide community support and cooperation is perhaps the most difficult aspect of stakeholder relations (Patton 1984; Tween 1993; Pereira 2001; Allwood and Vueti 2003). Even when the majority of stakeholders has understood a programme's approach and benefits through an education campaign, there are always some individuals who are not supportive of a public good that is beneficial to the community as a whole. In Canada, the most difficult group (that needed to understand the value of area-wide codling moth control) was the urban property owners who had a few apple or pear trees in their backyards. Some of these persons did not want to cooperate with the programme, or cooperated reluctantly, and in an area-wide programme it is essential that all cooperate. In urban areas where there are no direct stakeholders or beneficiaries, e.g. programmes against pests that attack fruit, activities of AW-IPM programmes applying the SIT may appear to be strange, intrusive, or even annoying, e.g. aerial release of sterile insects in bags or boxes, or formerly the application of aerial bait sprays over the Los Angeles basin in California, USA (Lorraine and Chambers 1989; Mangan and Bouyer, this volume).

In the case of insect pests of animals, and where the programme may include urban animals such as pets and stray dogs, it is often difficult to get urban residents to inspect and treat these animals (Dyck, Reyes Flores et al., this volume). In 2016 travellers on roads in the Florida Keys, USA, were required to pass checkpoints so that any pets being transported in private vehicles could be inspected by government personnel for possible screwworm infestation (Staletovich 2016; USDA/APHIS 2017a, b).

Obtaining formal support from stakeholders may require endorsement through local referenda or the passing of legislation by public bodies (Dyck et al. 1993; El-Lissy and Grefenstette 2007). Prior to a public vote or formal response to a programme's plans, a thorough information campaign will contribute to ensuring that the public has a good understanding of the issues at stake, especially if public funds or taxes are involved.

It is exceptionally difficult to conduct a programme in areas of political or civil unrest. Under these conditions, programme staff members who live in the area should be the ones contacting the local people -- they are probably more acceptable to the local population, and more aware of sensitivities, in finding ways to address the specific concerns of the people.

Local organizations, such as farmer associations and citizen groups, special-interest or donor groups, non-governmental organizations (NGOs), and industry-related groups, can be important supporters of a programme, and may even be helpful in addressing protests that impede programme operations. Such organizations are in a position of influence in a community, and can use this position to communicate information to particular stakeholder groups. If the livelihoods of

local stakeholders are at risk, e.g. being able to export their produce, they can help convince governments to support a programme (Dowell et al., this volume). They often care deeply about the specific issues that support the use of the SIT, such as environmental concerns. Nevertheless, local organizations may be small and therefore can be influenced by a few vocal or persuasive individuals; if they decide to oppose a programme, it will have a significant negative impact.

Admittedly, explaining technical issues to stakeholders is difficult. Technical experts have to realize that technical advice may not always be value-neutral (Lorraine and Chambers 1989). The public does not easily understand the concepts of AW-IPM and the SIT, and may be sceptical (especially about the need to control established pests). Special efforts have to be made to communicate the facts simply but effectively, using a variety of formats to ensure clarity. The public may require proof of the effectiveness of the technology. If not explained properly, using radiation to sterilize insects is easily misunderstood. Objections to releasing irradiated insects, which may be thought to be radioactive, must be handled carefully so that the facts are made clear and fears alleviated (Whitten and Mahon, this volume).

The response in Costa Rica to naturalists who objected to the eradication of the New World screwworm *Cochliomyia hominivorax* (Coquerel) was a public relations campaign called “The Ecological Fly”; it emphasized the value of using the SIT to help preserve endangered species in the forest.

Mass media can have a powerful effect on a programme. For example, the programme in India supported by the World Health Organization (WHO), where research on using sterile mosquitoes for control of the vectors of dengue haemorrhagic fever was conducted, had to be terminated by Indian authorities after severe negative publicity, wherein the programme staff was falsely accused by journalists of working on developing biological warfare. A timely rebuttal in the international media, to openly defend the programme and clarify the scientific issues, should have been made (Nature 1975), but this was not done properly, and the true facts were not made public until a clear rebuttal was published much later (WHO 1976; Jayaraman 1997).

Probably the hardest task for a programme manager, in regard to the media, is handling criticism, both fair and unfair. Much criticism arises from incorrect information or a lack of information (Klassen and Vreysen, this volume). However, sometimes there are significant issues at stake. It is important to keep stakeholder support for a programme strong; admitting to failure could weaken that support. Temporary programme setbacks need to be explained within the perspective of the overall goals. It is not helpful to become too technical; people will be more supportive if they understand the basics of the programme. For example, if people object to regular flights (for sterile insect release) over their homes, the need for these flights should be explained in a simple way. It is important to be positive, sincere, and timely, and to prevent small issues from becoming large issues. It is also vital to describe how the programme impacts on the residents of the community, the benefits people will get from it, and how they can contribute to it, e.g. by controlling pests on their own property.

It is usually an advantage to receive support from an international organization. Such a body lends stature to a programme. International support can stabilize a programme even if local support fluctuates or diminishes, but it cannot replace local commitment and “ownership”. The FAO/IAEA has a long history of providing some support to AW-IPM programmes that apply the SIT (Barnes et al. 2015).

Financial supporters require regular reports on the financial status of a programme. However, in addition, donors and governments need to know that there is public support for the programme. Articles in the national press, or items on television and radio, provide indirect support.

Effective communication among programme staff is essential. Programa Moscamed, which involves three countries (Guatemala, Mexico, and USA) and includes several mass-rearing facilities and field centres distributed over vast territories in southern Mexico and Guatemala, uses an internal website to improve the information flow and allow programme staff to have instantaneous access to an enormous amount of data. Having the appropriate information helps to keep workers motivated, focused, coordinated, and productive. Opportunities should always be given to staff members to express their ideas on how the programme is progressing, offer suggestions for improvement, and participate in planning, assessment, and decision-making. A team that is informed encourages cohesive behaviour and mutual support.

To facilitate operational efficiency and effectiveness, a reliable communications system between insect-production facilities and field operations is needed (Rhode 1969; Dyck et al. 1999). The rapid sharing of data among staff members is essential for appropriate and timely decision-making, and fostering good cooperation and coordination (Vreysen, this volume).

Field staff members at all levels must be well-informed about programme goals and activities; they interact directly with the community, and therefore play an important role in informing stakeholders about the programme.

3. COMMUNICATION AND STAKEHOLDER ENGAGEMENT

Not only do the biological and geographical characteristics of an AW-IPM programme impact the required features of an effective stakeholder communication programme, but so do the sociology of a community, the type of inhabitants, culture, traditions, economics, politics, and even the security concerns involving rebel groups and the military.

Barnes et al. (2015) pointed out that the beneficiaries of a programme need to cooperate actively, e.g. implement effective sanitation in their backyards, fields and orchards, carry out husbandry and other cultural controls in a standardized and timely manner, contribute to accurate field data recording, have realistic expectations of what the deliverables will be, and fully understand how they need to be involved. As Dyck (2017) asserted in another context – stakeholder involvement matters!

A participatory approach to extension methods is appropriate for knowledge-intensive technology. Stakeholders learn more when they are involved and engaged. Field days with “hands on” demonstrations, “farmer field schools”, visits to “model

farms” where the SIT is being applied, and “open house” days at project facilities are all helpful extension tools (Peshin and Dhawan 2009). Stakeholder meetings, e.g. meetings of farmer cooperatives and associations (Kakinohana et al. 1993), are useful for informing all interested parties of plans, progress, and problems. If there are language barriers among stakeholders, meetings provide opportunities for multi-language explanations and discussion (Rhode 1969).

A detailed example of involvement with the community is described by Bustamante et al. (2014), De Urioste-Stone et al. (2015), and Sommerfeld and Kroeger (2015) in connection with a programme to control Chagas disease in Guatemala. Researchers spent considerable time living in the communities that were being studied in relation to the control of the vector; the communities actively participated in proposing solutions to the pest and disease problem (community-based participatory and partnership strategy) that led to empowerment; “bottom-to-top” and “top-to-bottom” strategies were combined, and community volunteers were trained and supervised in applying cultural and other pest-control measures.

In preparation for an experiment in which transgenic mosquitoes were released in an urban area of Brazil, a major public awareness and engagement campaign was conducted (Capurro et al. 2016), emphasizing participatory action and a community-based programme involving frequent communication with local, state and national leaders. The social aspects of regulatory issues of the releases and project activities were assessed, including people’s perceptions after releases stopped, and then followed by feedback and joint evaluation. The procedures in this study provide an example of methods that can be used to prepare for and measure the social impact of mosquito releases on an urban human population.

In a similar project on dengue in Australia, the effectiveness of community engagement was studied; stakeholder acceptance of the open-release field trials (release of *Wolbachia*-infected mosquitoes) was essential for the project to proceed (Kolopack et al. 2015). Note a similar project in Singapore (Liew et al. 2021).

As a result of the long history of applying the SIT in Okinawa, Japan, public awareness is high. Local people cooperate readily in assisting field operations. However, a lack of risk awareness in relation to maintaining the pest-free status can result from the long-standing familiarity with such projects (T. Matsuyama, personal communication).

4. METHODS OF COMMUNICATION AND STAKEHOLDER ENGAGEMENT

AW-IPM programmes need to communicate with the public! It is vital to build good relations with community leaders, as well as several media outlets and people in the media business, so that opportunities to communicate with the public become available, and the best way of reaching the right audience is found. The appropriate media outlets must be carefully discerned to maximize the desired communication to the target audiences.

Information provided to leaders and the media must be correct, authoritative, and also realistic about both the problem and the solution so as not to oversell a programme (Barnes et al. 2015). When the message is clear and straightforward, the SIT and related activities can be promoted effectively through the media.

When the various groups of stakeholders are identified, methods of communication can be selected that fit the groups. For example, programmes in Mendoza, Argentina, used television and radio broadcasts of sporting events to communicate short key messages about their activities. Press kits may be a useful way of giving information to journalists. Sometimes communication in more than one language is required, but always in a format and style appropriate to the audience. Monitoring media coverage reveals which issues interest the public.

Drawings of the basic concepts of the SIT (sequence of insect rearing, sex separation, irradiation, release of sterile insects, and monitoring) are shown in many outreach materials, enabling everyone to understand the processes involved. As an example, a simple and humorous cartoon used in Thailand (based on an original cartoon from MOSCAMED, Guatemala) is shown in Fig. 1. Such drawings get the message across in an easy-to-understand manner. Another drawing is given in Broll (2016), illustrating the application of the SIT against mosquitoes. The basics of the SIT are described on the FAO/IAEA website (FAO/IAEA 2018e). The FAO/IAEA also produced a tri-fold leaflet with explanatory text about the SIT (FAO/IAEA 2018f). The SIT is also explained in simple terms in many of the videos and photo essays listed in section 5., e.g. FAO/IAEA (2015a; 2016a, e); other examples are in Engelking (2017) and Viegas and Gil (2018).

Figure 1. Cartoon illustrating the basic principles of the SIT applied against fruit flies. (Cartoon from Thailand, reproduced with permission from Watchreeporn Orankanok.)

Exhibits in public places and fairs are useful to create awareness of a programme. A display about the Okanagan Kootenay Sterile Insect Release (OKSIR) Program in Canada was set up in a museum (on the history of the fruit industry in the region), attracting local people and tourists.

House-to-house visits are often a good way to ensure that residents are informed about the programme and the need for their cooperation. Communication through the mail, telephone messages or public meetings is useful, but in many cases there should be direct communication at a personal level (P. Rendón, personal communication).

Opportunities can be created in rural areas — informal meetings and using speakers on vehicles — to communicate with farmers and those who do not readily get messages through large-scale media services (Patton 1984).

A toll-free telephone number should be available for persons to ask questions about the programme and to report on related activities. Also, a “Frequently Asked Questions” (FAQ) or “Questions and Answers” (Q&A) item on a programme website is useful for the general public and other stakeholders (OKSIR 2018a; OPG 2018).

Universities are expanding the teaching of the principles of AW-IPM and the SIT (Lindquist 2001). In Madeira, Portugal, Caldeira (2001) emphasized the need to use both technical and non-technical materials, in a variety of formats, and in various public settings, to inform urban dwellers, including school children, of the objectives and activities of the Mediterranean fruit fly programme. Informing members of school clubs in Ethiopia stimulated cooperation in setting up tsetse fly traps. Students in South Africa and Argentina (Box 1) learn about AW-IPM programmes through official additions to the school curriculum. In Argentina, an interactive computer game helped teach the basics of the SIT to children, allowing players to release bags of sterile insects to hit target infested trees displayed on a screen (P. Rendón, personal communication).

Box 1. Students in Argentina Learn about the Sterile Insect Technique

The BioContainer Programme of ISCAMen, Argentina, was developed for 6th-degree school students (12–13 years old) to study the biology of the Mediterranean fruit fly, its role as a fruit pest, and the eradication programme (R. Mellado, personal communication). The BioContainers (Fig. A) are paper boxes containing sterile male pupae, provided by de Biofactory of Mendoza. Boxes include written information and instructions about the fly’s life cycle, and how sterile insects control the pest. The emergence of adults from pupae can be observed through a window in the box. After flies have emerged, students are asked to release them on host fruit plants in their own or someone’s backyard, assisting local pest control, and engaging the students and their families in the control process in urban areas. In the past 5 years the Programme has given boxes to 108 050 students, leading to an estimated 432 200 personal contacts, e.g. parents, siblings, and friends.

Before boxes reach students, school teachers are trained in the biology of the pest and the use of the BioContainer. In 2018, 1580 school teachers participated in the BioContainer Programme.

After using a BioContainer, students have the opportunity to visit de Biofactory. The factory has a circuit of glass bridges from which one can see the whole process of raising insects from egg to pupae, and the subsequent irradiation process, without actually entering the plant. In the past 5 years, 2650 students have visited de Biofactory.

Figure A. Left: BioContainer logo. Centre: BioContainer containing living sterile male fruit flies. Right: Opened BioContainer showing emerged flies. (Photos from R. Mellado, reproduced with permission.)

4.1. *Press Releases*

Below are some examples of press releases related to AW-IPM programmes:

- International Atomic Energy Agency (IAEA 2017). 27 April 2017 – Atoms for peace and development in the 21st century
- New Zealand: Plant and Food Research (PFR 2018a). 14 March 2018 - Scientists discuss sex-less insects; 22 March 2018 - Dropped in for fruitless sex
- International Atomic Energy Agency (IAEA 2018a). 19 April 2018 – IAEA conducts successful test of drones in fight against disease-transmitting mosquitoes.

4.2. *Web Stories and Web Audio Interviews*

Below are examples of web stories:

- Gaspar (2016a), IAEA, 7 June 2016 – South African experts advance in researching nuclear technique to fight malaria, sugarcane pest
- Gaspar (2016b), IAEA, 28 June 2016 – How a nuclear technique helped save the Western Cape's orange industry
- Gil (2017a), IAEA, 14 December 2017 - Argentina uses nuclear technology to control insect pests
- Jawerth (2018), IAEA, 5 September 2018 – Irradiated fruit flies: the secret to protecting Thailand's premium fruit exports
- Marais (2019), IAEA, 14 March 2019 – Integrated pest management to boost dragon fruit production in Viet Nam
- Rawat (2019), India Today, 24 January 2019 – Horny mosquitoes in high demand: why scientists are developing sexually active mosquitoes (contains links to videos describing the SIT).

Below is an example of a web audio interview:

- UN News (UN 2018), 20 April 2018 – Breakthrough drone-powered mosquitoes: “absolutely no impact” on other species.

4.3. *Other Methods of Communication*

- Engaging directly with stakeholders -- personal visits of programme staff to project sites, e.g. farms, to hold discussions with the property owners
- Stakeholder engagement survey, e.g. OKSIR (2018d)
- Meetings and presentations to farmer cooperatives and grower associations, citizen groups, schools, and the general public
- Articles in newspapers, books, and magazines, e.g. Gil (2017b); Paquette (2019)
- Newsletters, e.g. OKSIR (2016), brochures, fact sheets, and calendars
- Manuals such as those produced by the FAO/IAEA (2018b, f)
- Expositions, public displays and demonstrations, and giving away key chains with a project logo (A. Bello Rivera, personal communication)
- Postage stamp, e.g. a stamp featuring the SIT and Dieter Enkerlin, a pioneer in applying the technology in Mexico (Fig. 2)

Figure 2. Postage stamp issued in Mexico in 2011 featuring the SIT and Dieter Enkerlin. (Stamp reproduced with permission from W. R. Enkerlin.)

- In Okinawa, local advertisements (including in airports and seaports) of project activities, and flyers and newspaper inserts, are widely distributed (T. Matsuyama, personal communication)
- The Moscamed Programme in Guatemala promotes bee-keeping; this enables growers to see for themselves that aerial sprays applied to suppress the Mediterranean fruit fly in pest hot spots do not kill bees (P. Rendón, personal communication)
- Programme logo – using an attractive, simple but self-explanatory logo gives a programme an identity and an enhanced public image, and encourages staff to be proud of the programme (Fig. 3)

Figure 3. Examples of programme logos: Left - Xsit in South Africa; Centre - FruitFly Africa in South Africa; Right – Senegal tsetse fly eradication project in the Niayes region (Senegal 2018). (Reproduced with permissions from T. Lombard, N. Baard, and B. Sall, respectively.)

- Online information sources, e.g. project websites -- providing programme information, publications for download, links, and videos, e.g. OKSIR (2018a, c), OPG (2018). Real-time data and information can be provided, e.g. the weekly area-wide distribution and population densities of the pest based on results from trap and other monitoring, and assisting farmers with timely advice on field operations (Nelson et al. 2021)
- Online forums; blogs maintained by interested stakeholders
- Email, electronic messages on smart phones
- Telephone calls, call centre.

5. VIDEOS AND PHOTO ESSAYS

In recent years there has been a large increase in the number of videos and photo essays available online - for viewing and sometimes for downloading. A partial list of those available through the FAO/IAEA is provided in FAO/IAEA (2016a, 2018a).

5.1. *The SIT and AW-IPM*

- Science, sex, superflies (FAO/IAEA 2007a)
- Using nuclear science to control pests (FAO/IAEA 2015a)
- The SIT - an environment-friendly method of insect pest suppression and eradication (FAO/IAEA 2016a)
- How a nuclear technique is helping the Dominican Republic win the war against the Mediterranean fruit fly (FAO/IAEA 2016c)
- Using nuclear science to control mosquitoes (FAO/IAEA 2016e)
- Using nuclear science to control pests (FAO/IAEA 2017a)
- Area-wide management of insect pests (FAO/IAEA 2017b).

5.2. *Fruit Flies*

- The Middle East's fruitful valley – Israel (FAO/IAEA 2007b)
- Olive fly: nuclear technology to protect an ancient fruit (FAO/IAEA 2009)
- Medfly eradication: what to expect (FAO/IAEA 2011)
- Better fruit for Neretva Valley (FAO/IAEA 2012)
- Nuclear techniques keep insects at bay in Croatia's Neretva Valley (FAO/IAEA 2015b)
- Tackling fruit flies with nuclear technology in the Dominican Republic (FAO/IAEA 2016b)
- How a nuclear technique is helping the Dominican Republic win the war against the Mediterranean fruit fly (FAO/IAEA 2016c)
- How a nuclear technique helped save the orange industry in Western Cape, South Africa (FAO/IAEA 2016g)
- Using nuclear technology to control pests (FAO/IAEA 2017a)

- Nuclear technology helps the Dominican Republic fight insect pests (FAO/IAEA 2017c)
- Nuclear technique helps prevent insects from harming your coffee beans (FAO/IAEA 2017d)
- Successful control of the Mediterranean fruit fly in Jordan (FAO/IAEA 2017e)
- Argentina tackles fly pests using nuclear technology (IAEA 2018b)
- Irradiated fruit flies: protecting Thailand's fruit exports (FAO/IAEA 2018c)
- Video Programa Moscamed Guatemala (PMG 2018a)
- Video Programa Moscamed (SS 2013, 2018a, b)
- Web novela: Misión Moscafrut (SS 2018c)
- Control y erradicación de la mosca de la fruta (SS 2018d).

5.3. Mosquitoes

- With IAEA support, Sudan suppresses mosquito populations (FAO/IAEA 2015c)
- Preventing procreation: IAEA and mosquito control (FAO/IAEA 2015d)
- Zika crisis – the IAEA responds (FAO/IAEA 2016d)
- Using nuclear science to control mosquitoes (FAO/IAEA 2016e)
- Drones for good 2016: FAO/IAEA's ROMEO system for aerial release of sterile male mosquitoes (FAO/IAEA 2016f)
- 20 million sterile mosquitoes for release - California (Haridy 2017; Debug 2019)
- Video on rearing mosquitoes in Singapore (Co 2019)
- Nuclear technique helps fight mosquito-borne illnesses (FAO/IAEA 2019a)
- Technique de l'insecte stérile, Le moustique tigre. Videos, in French (TIS 2020).

5.4. Moths

- Pink bollworm eradication program: informational video (NCCA 2009)
- Photo Essay: How a nuclear technique helped save the orange industry in Western Cape, South Africa (FAO/IAEA 2016g)
- Falling Moths. Unmanned aerial vehicle (UAV) releasing codling moths in New Zealand (PFR 2018b)
- Palomilla del Nopal (*Cactoblastis cactorum*) (SS 2018e)
- Accessing SIR trap counts online (OKSIR 2018b)
- False codling moth in South Africa (Xsit 2018, 2019).

5.5. Tsetse Flies

- Photo Essay: Eradicating flies to improve lives -- IAEA helps countries in Africa to combat tsetse fly (FAO/IAEA 2013)
- Paving the way for tsetse eradication – Ethiopia's journey (FAO/IAEA 2014)
- A farewell to tsetse (FAO/IAEA 2016h)
- The IAEA and food – tsetse fly eradication – Senegal (FAO/IAEA 2017f).

5.6. *Screwworms*

- SIT pilot test against New World screwworm (*Cochliomyia hominivorax* Coquerel) in Artigas, Uruguay (FAO/IAEA 2018d).

6. TECHNICAL INFORMATION ON AW-IPM AND THE SIT

A source of technical information on AW-IPM and the SIT is the Insect Pest Control Section at the FAO/IAEA (FAO/IAEA 2015a; 2016a; 2017b; 2018a, b, e, f, g):

- Information on AW-IPM and the SIT (FAO/IAEA 2018e; Wikipedia 2018)
- Publications arising from major conferences and symposia on insect pests (FAO/IAEA 2018h), e.g. FAO/IAEA (2000, 2007c, 2021)
- Publication of results from research conducted by entomologists at FAO/IAEA (lists of scientific papers and annual reports) (FAO/IAEA 2018b, i, m)
- Coordinated Research Projects (CRPs) -- results are published in peer-reviewed journals (FAO/IAEA 2018j), e.g. ZK (2015), FE (2016)
- Special issues of journals on research related to the SIT, e.g.: EEA (2017)
- Technical reports (consultant and advisory group meetings) (FAO/IAEA 2018k)
- Manuals and protocols (FAO/IAEA 2018l)
- Newsletters and annual reports (FAO/IAEA 2018m)
- Thematic plans (FAO/IAEA 2018n)
- Information and knowledge management (FAO/IAEA 2018o)
- Forthcoming meetings (FAO/IAEA 2018p)
- FAO/IAEA technical cooperation projects (FAO/IAEA 2018q)
- News from the FAO/IAEA on the SIT (FAO/IAEA 2018r)
- Regularly updated databases, e.g. IDIDAS, DIRSIT, TWD, IDCT (Bakri et al. 2016; FAO/IAEA 2018b; TWD 2018)
- Online glossary of SIT-related terms with definitions, references, and a search function (FAO/IAEA 2018g)
- E-learning course available online (FAO/IAEA 2019b).

7. SOCIAL MEDIA

Social media are interactive computer-mediated technologies that facilitate the creation and sharing of information and other forms of expression via virtual communities and networks. Social media platforms, e.g. Facebook, Twitter, YouTube, and LinkedIn (Fig. 4), are now a part of everyday communications. More than 100 000 000 registered users in the world have social media accounts. However, as is seen in recent times, precautions are needed when using social media to protect the privacy of stakeholder data, and to prevent the misuse of data.

FACEBOOK TWITTER YOUTUBE LINKEDIN

Figure 4. Some popular social media platforms.

The trend in the increasing use of social media also includes some AW-IPM programmes that apply the SIT:

- Guatemala - Programa Moscamed Guatemala (PMG 2018b)
- Mexico - Campaña Nacional Contra Moscas de la Fruta Nativas (CNCMFN 2018), SENASICA SAGARPA (SS 2018f)
- South Africa - FruitFly Africa (FFA 2018)
- USA - Animal and Plant Health Inspection Service (USDA/APHIS 2018)
- Plant and Food Research, New Zealand (PFR 2018c)
- Tephritid Workers Database (TWD), managed by the FAO/IAEA, invites workers to follow the TWD on Facebook (TWD 2018).

Most of the above programmes are associated with “parent organizations” that have social media accounts, e.g. the Insect Pest Control Section at the FAO/IAEA (FAO/IAEA 2018b). However, a major exception is Programa Moscamed Guatemala as described below.

7.1. Programa Moscamed Guatemala

Programa Moscamed Guatemala has its own website (PMG 2018b), and has social media accounts – Facebook, Twitter, and LinkedIn.

In a review of these social media at Programa Moscamed Guatemala (social media are part of its regular communication activities), the following points were made:

- The programme website was created in 2008. According to Google Analytics, from 2011 to 2017 the programme website was visited about 13 000 times per year. In 2018, website visits originated in 42 countries (71% of visits from Guatemala), 85% of which were made by new visitors. The majority (60%) of visitors were quite young – 18–34 years of age.
- In 2015 a space in the digital encyclopaedia Wikipedia was opened, and a link to the platform LinkedIn was initiated.
- Facebook is the most popular platform used in the programme; people from both urban and rural areas (including people on farms), and also people from various organizations and institutions, use Facebook.
- Facebook and Twitter are used to convey technical information on the community-support actions and activities of the programme, and on the availability of technical assistance and training, but also to obtain feedback from stakeholders. Most communication involves requests for clarification on programme activities and technical assistance, and for advice on agricultural

issues. Comments and questions from the public are mostly positive. However, a few negative and critical comments are also received, and these need to be handled promptly; such comments often relate to the environmental impact of aerial release and the chemicals applied in ground control of hot spots.

- The programme recommends that an area-wide programme should have a well-maintained website, use social networks, and set up information repositories such as databases and pages in Wikipedia. Each programme should have a full-time professional communicator to supervise the handling of information and communication with stakeholders. Support from programme leaders is essential.

8. SUPPORT FROM GOVERNMENTS

Obtaining the support of national, regional or local governments is dependent largely on the perceived importance of the commodity at stake, e.g. plant products for export (Buchinger 1993; Kinney 1993), health of livestock that are vital to the economy of the region, survival of subsistence farmers, human health threatened by insect vectors of disease, and recreational areas that require no or few environmental hazards such as insecticides that discourage tourism.

It is often difficult to obtain government support and the legislation and regulations needed to operate a programme. Considering the competing demands on financial resources, governments may regard pest control programmes as a low priority because they usually benefit only some, not all, segments of a community. Positive examples of exceptional support from national governments are the fruit fly programmes in Chile, Japan and Mexico. These successful programmes resulted in the opportunity to export crops to previously closed markets (MAG/SAG 1995; SAG 1996; Reyes et al. 2000; Teruya 2000; Enkerlin et al. 2015; Enkerlin, this volume).

Legislation and regulations are usually required to support the implementation of complex area-wide programme activities. Programme staff and others, possibly perceived as plant or animal health inspectors, will need to enter private property, monitor the pest population, inspect and treat crops or livestock, possibly remove derelict host plants, and enforce treatment and quarantine activities. Legislation to collect funds from the community, and to obtain enforcement authority, may be needed, but outreach activities to educate stakeholders and increase public awareness tend to reduce the need for enforcement actions (Dyck et al. 1993; Seymour 2018; Nelson et al. 2021). The approval of legislation and enforcement is an indication of government support for an AW-IPM programme. For example, legislation that regulates the culture of alternate hosts of the Mediterranean fruit fly *Ceratitis capitata* (Wiedemann) was recently passed in Spain to support an AW-IPM programme to control this major pest of citrus (W. R. Enkerlin, personal communication). Also, in California, USA, where fruit infested by this fly is sometimes smuggled into the state, legislation was passed to try to prevent this, and to levy fines against those who are caught smuggling banned fruit (CDFA 2005).

Besides fines or other negative enforcement actions, positive incentives can also be provided to obtain the cooperation of people living within the area of an AW-IPM programme, e.g. trees for urban property owners to replace those that are

susceptible to the target pest (OKSIR 2018a), and free insecticide for farmers to treat cattle against pests (Dyck et al. 2000).

Strong government support helps to stabilize, legitimize, and empower a programme so that it can operate effectively. Ideally, governments have a long-term view, and an all-embracing view, of a whole community's welfare; this is needed to support the characteristically long-term AW-IPM programmes that apply the SIT. Endorsement of a programme by a government helps encourage the provision of the necessary resources, e.g. skilled personnel and facilities to rear and irradiate insects. Also, programme endorsement by a government, offer of technical assistance, or other kinds of incentive from another country that may represent a potential but important export market, will encourage programme success.

Nevertheless, political conditions change over time, and can change frequently (Patton 1984). Some politicians may have other objectives. Long-term support from a government is never a certainty. A programme needs to be protected from changes in government so as to provide the stability required to attain its goals.

In government programmes, the assignment of new key personnel can radically change the support given to a programme. Therefore, new people appointed to key positions need to be informed quickly about the programme. Political leaders are usually not technical experts. Therefore, efforts should be made to educate influential people.

Political sensitivities (Patton 1984) can negatively affect a programme. Political uncertainties and civil unrest have impaired the implementation of SIT-related programmes, e.g. in the case of the Mediterranean fruit fly, the area-wide eradication programme in southern Mexico and Guatemala, or the transboundary suppression programme in contiguous areas of Israel, Jordan and the Territories Under the Jurisdiction of the Palestinian Authority (Enkerlin, this volume; Hendrichs, Vreysen et al., this volume).

A high level of support from governments means the involvement of high-level officials, both decision-makers in the executive branch and those who approve programme funds or appropriations in the legislative branch of government. It is useful to identify a knowledgeable "champion" of the programme who can highlight the programme's benefits vis-à-vis politicians. Obtaining the authority and support from a senior government official, who understands the programme and its objectives, is a big advantage.

One of the important roles of government in successful pest eradication programmes is the official declaration that a particular species has indeed been eradicated in a certain area (Teruya 2000; Barclay et al., this volume; Vreysen, this volume).

9. TECHNICAL SUPPORT

AW-IPM programmes need the support of local, national, and international technical experts. This gives a programme technical credibility. Opposition from scientists, for whatever reason, tends to discredit a programme (Winston 1997; DFID 2002; Whitten and Mahon, this volume). Papers in technical journals, presentations at scientific meetings, and participation in training programmes and collaborative

research projects are essential to foster an open and fair exchange of information (P. Rendón, personal communication).

Frequent communication between programme staff and the scientific community is essential to generate “programme ownership” and “goodwill”, as well as to interest and involve researchers in improving technology (and thereafter possibly obtain the new technology for use in the programme). There are costs and operational limitations to adopting new technologies frequently, but programme managers must always be open to improve the techniques being used. Therefore, the technical and operational aspects of a programme, especially a long-term programme, needs to evolve over time (Buchinger 1993; Kinney 1993).

Applied research on various aspects of a programme conducted by a supporting technical unit, often called “methods development”, helps to ensure its success (Lindquist et al. 1992; LaChance 1993; Tween 1993; FAO/IAEA 2018j). The melon fly *Zeugodacus cucurbitae* (Coquillett) programme in Japan received very strong support through basic and applied research conducted at national institutions and agricultural experiment stations by entomologists in the country; certainly this contributed to the programme’s success (Kakinohana et al. 1993; Yamagishi et al. 1993; Itô et al. 2003; Koyama et al. 2004).

10. PROGRAMME SUCCESS OR FAILURE

Even though adequate internal and external technical support is fundamental to progressively increasing programme effectiveness and efficiency, technical issues are rarely the main reason for programme failure. Some AW-IPM programmes with an SIT component have failed, or achieved limited success, because of poor communication and engagement with stakeholders and inadequate public support.

Many lessons regarding stakeholder communication, engagement and support have been learned, some positive and some negative (Vreysen et al. 2007; Dyck, Reyes Flores et al., this volume):

- Stakeholder support at various levels is vital for the operation of an AW-IPM programme.
- Communication among programme staff, with the programme’s stakeholders and its financial supporters, and with the general public, is essential for a programme to receive the support it needs.
- Leaders in a community are role models; they are particularly influential in spreading the adoption of new technologies, and are important for promoting the acceptance of AW-IPM programmes.
- Continuing input from technical experts is needed to keep programmes up-to-date with the latest research findings, and to maintain technical credibility.
- Even though potentially costly and often not recognized by financial supporters, communication and engagement with stakeholders and the public is as important to a programme’s success as is effective management (Dyck, Reyes Flores et al., this volume).

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