NEED FOR DIGITALIZING INTEGRATED PEST MANAGEMENT FOR FUTURE

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Abstract

Urban IPM is the mainstay for keeping sensitive premises free of pests and pesticides on a longer term. Food and beverage industry is one sector who have successfully implemented IPM in a global scale. Its continuity and expansion over years is also a strong indicator of the program's sustainability and success. However, in other sectors IPM adoption is slow. Urban IPM will become common if it principally addresses sustainability through manageability and adaptability. It has to move from a doctrine into a pragmatic user-friendly concept. Digitalization is one direction where all elements involved in IPM can be simplified, collected without disruption, made accurate and communicable. Adopting a digitalized IPM, will help provide larger coverage, access inaccessible areas, help round the clock monitoring, generate programmable data, maintain communication and determine action. The data will not only address pest issues, but also something beyond, such as look into human sensitivities, structural improvements, economics, and environmental concerns together. In this way IPM will direct pest control towards a "green" direction.

Keywords: Urban IPM, sustainability, digitalization

Introduction

Urban Integrated pest management (IPM) is principally a concept where the objective is to reduce pesticides from human vicinity and manage pests logically. This is emphasized historically by Olkowaski and Olkowaski, [1]. It is well known that even though pesticides do not pose a high level of risk to human health if the application of the product and the management of the application take place according to proper and adequate procedures [2], but persistent and repeated exposures to pesticides over a life time may pose greater risk especially to the pediatric population [3, 4, 5, 6, 7, 8]. With this understanding, pesticides continue to be used indoors. In USA the Food Quality Protection Act (FQPA) was passed in 1996, and the federal agencies were mandated to implement IPM [9]. Rest of the world is far behind in its adoption as a statute or law.

Possible Reasons why IPM remain Relatively Unpopular as a Practice

An internet search results indicate that the acronym IPM may refer to at least 300 different meanings [10]. Bajwa and Kogan [11] found 67 definitions of the acronym in their search between 1995 and 2000. Even if a search is conducted for the phrase "Integrated Pest Management", the answer can be varied. In a digital world which we have transformed into, a confusion created with name or definition can be an impediment, more so when clients/customers are not from the same academic background.

Elements of urban IPM has been adopted from agriculture [12]. Understandably so, as agriculture is focused on keeping pests below economic threshold level, whereas, the desire of stake holders in urban areas is based on esthetic, health, or economic considerations, which could be either "zero tolerance level" [13, 14]. or pest below "aesthetic injury level" [12] or below 'tolerance level" [15]. The last two of the three are highly variable parameters, dependent on stakeholders.

Added to this scenario is another fact created by the three major governing bodies in the world namely Food and Agriculture Organization (FAO), US Environment Protection Agency (EPA) and World Health Organization (WHO). Each one of them have treated IPM with their own definition [16]. FAO defines "IPM to mean careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms" [17].

While the US EPA defines "IPM as an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment" [18].

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Figure 1. A technician using gel bait to treat cockroach infestation. (Photo Credit: Partho Dhang).

Whereas, the WHO Regional Office for Europe defines IPM as "a common-sense approach to pest management. By using a hierarchy of control practices – including public education, sanitation, pest exclusion, and other biological and mechanical control methods, while limiting pesticide application – long-term pest management can be achieved while minimizing environmental and public health hazards" [19].

The approach of the organizations is directed towards a common goal, but there is no agreement on a single definition [16]. Furthermore, the definitions "lack specificity and the terms used are not widely understood by consumers, making public education challenging" as mentioned by Sweeney [16].

Impediments in Implementing Urban IPM

Executing IPM in urban ecosystem faces various obstacles. In a WHO publication, Sarisky et al listed cost, regulatory restrictions and unavailability of emergencies, such as pesticides, as barriers to implementing IPM programmes [19]. Cost component of IPM over conventional treatments has been demonstrated in a number of reports. Rambo presented conventional pest control services to charge USD 65 an hour while IPM services costs USD 80 an hour [20]. The average cost for IPM and conventional treatments were USD 4.06 and USD 1.50 per unit respectively for controlling German cockroaches [21]. A Purdue University study found IPM program to cost nearly double to a bait-only treatment for cockroach control [22]. A report from outside North American reported a four times higher cost for IPM to conventional spray for controlling of German cockroach [23].

The area or size of site to be treated in urban areas are much smaller and limited. Large areas are undoubtably more economical to run a IPM program than smaller ones. At times the treatment sites in urban areas may be distantly spaced from each other with barriers in between, such as a compound with multiple structures spaced between parks, waterbodies, empty spaces and right of ways. This makes the mobilization cost of an IPM program much higher and at times prohibitive.

Other impediments would be the nature and complexity of sites. In agriculture, the ecosystem is largely a homogenous habitat. In contrast urban ecosystem constitutes an assemblage of multiple habitats consisting of structures, landscape, parks, pools, right of ways and much more [12]. This ecosystem is also split into sections with multiple sensitivity based on individual stake holders. Also, offices, homes, hospitals, restaurants, shops, commercial centers, schools, manufacturing units, public markets have varied assemblage of pests. Obviously, a heterogenous nature of the ecosystem is the first impediment in its ease of implementation.

Urban IPM involves multi-level stake holders, who differ in their background and perception. A single treatment site may need coordination between administrator, engineer, housekeeper, landscaper and sanitary staff. Difficulties in communicating with each other remains an obstacle. In addition, stake holders have shown combination of negative behaviour such as psychological resistance to change, fear from loss of authority, resistance against learning new technologies, and general fear of failure; in addition to fear that IPM will restrict use and access to pesticides, and the notion that IPM is more expensive than traditional pest control, preventing IPM adoption [24].

IPM implementation requires the implementor/staffs to be skillful, knowledgeable and confident. A noticeable industry trend towards over-reliance on products and industry designed practices is preventing development of skills among practitioners. Application of chemicals by spraying remains the most dominant work in a pest control activity. This approach is less skillful and less time consuming. Overall controlling pests has become more or less a singular act, requiring no or less specialized training and knowledge. This aspect is made very clear when Forschler described "termite management to continue operating under a 50-year-old insecticide-based business model that has little relevance to the academic knowledge base [25]. Further, the author remarked in te same publication "that industry acceptance of a knowledge-based practice model is hindered by business practice based on insecticide treatment".

Success of Urban IPM

Urban IPM has proven to be successful whenever it has been correctly implemented. The foreseen advantage of urban IPM has also been extended to specialty programs such as Integrated Vector Management (IVM) and Integrated Termite Management (ITM) to control mosquitoes [16, 26] and termite [27, 28] respectively. Urban IPM has also been included as state statutes or law by Florida in 1992, California in 2008 and Georgia in 2009 [29]. In the US, 35 states have adopted laws that restrict pesticide use in schools, with 21 of those states requiring or recommending schools to adopt IPM [30].

Elsewhere urban IPM implemented in selective locations consisting of multiple structures proved sustainable compared

Figure 2. Staffs digitally managing IPM schedule for ahead of an operation. (Credit Partho Dhang)

with conventional pest control services and showed reduced pesticide use and reduced complains [19, 24, 25, 31, 32].

One sector where attempts to implement IPM has been most successful globally is the food and beverage industry. In an attempt to restrict pesticide usage and maintain operations pest free on a longer run, many companies adhere to strict IPM procedure. Information gathered from personal interviews, code of practice document [14, 33], and referring to internal company documents, there is verified proof that IPM programs are put to rigorous practice in this sector. These programs pass third-party audits and many obtain high rating for quality. The continuity and expansion of the program over years is a strong indicator of IPM's sustainability and success.

Future of Urban IPM

Urban IPM will survive and possibly become common if it principally addresses sustainability through manageability and adaptability. It has to move from a doctrine into a pragmatic user-friendly concept.

The future of IPM lies in encouraging commerce and sustained business. A large part of the pest control business is dependent on a system of generating residual income, referred to as maintenance which involve monitoring, preventing, communicating/reporting and occasional treatment. IPM can make use of this system and generate income incorporating sustainable and environmentally responsible approaches. One such shift would be digitalization, involving precise data collection tools such as smart devices and monitors, analytical and reporting software and communication tools. Monitors with remote sensing can supplement expensive labor, reduce manpower, and provide accurate data for analysis. These monitors can cover large area and inaccessible areas and work around the clock providing real time information. Digitalization will help to instantly collect and analyze data which conventional pest control cannot do simply. In this age data is a powerful asset when governed through a well-designed collection and analysis system in a program [34]. The collected data not only helps provide feedback on pest activities, but also help to advance IPM applications related to quality of building, future policies, need for specific research, training, and extension. There are several pest management software systems available in the marketplace either as off the shelf or with some degree of customization to address various needs of pest managers [34]. A review of many digital devices and software has recently been published by Siddiqi [34].

As a case study, a work by Duggal, [24]. Is presented here describing digitalizing an IPM program for Santa-Clara County, California which took care of 36 county departments housed in over 188 facilities. A PDA based digitalized system replaced a previously existing paper-based arrangement and removed limitations such as one-directional flow of information, unreachability, modifiability, remotely accessibility, slowness in modification and updating, and information protection. Digitalization allowed precise time-based pest reporting from a project area spread across 10.64 million square feet in an area covering a 50-mile radius throughout the county. The work concluded by stating "digitalizing the program allowed long term strategy creation which is an essential requirement for the success of any IPM".

The program reported "reduction by 95% of total number of pesticides, number of applications using pesticides, total pesticide volume and toxic exposure to pesticides". In addition, for a five-year period, the performance data recorded a steady decline in service-related complaints. The complains were restricted to only 7% of the total of 180 buildings which were identified as court complex, hospital complex and correctional facilities, areas receiving high influx of people and goods. Similar examples of pest management activities across urban environment are described in the County of Santa Clara IPM – Program implementation and annual IPM progress reports, 2022 [34].

Even though pest can be successfully eliminated, their re-infestation remains a challenge. In this context it is found that one of the factors which makes re-infestation easy is problems related to building and surrounding landscapes [14, 35]. Root cause of re-infestation happens where building design are not addressed at the outset. Mostly engineering and architect are largely unaware of the relationship between building design and pest [14]. Buildings should necessarily be designed to prevent attraction, entry and harborage of pests [33]. Importance of building playing a role in pest prevention is further evident from the document produced by San Fransisco Department of the Environment which created a local, peer-reviewed resource that introduced pest prevention as part of building and landscape design, ultimately reducing the need for expensive and hazardous pest control measures [35].

The San Fransisco Department of the Environment report also identifies costs associated with IPM monitoring and feedback based on landscape situations as essential for ensuring ongoing IPM implementation and more effective pest management. Building and their surrounding landscapes can be digitally monitored to not only help cut labor cost, but also increase efficiency and accuracy of the monitoring work. Smart traps for rodents, flies and cockroaches with inbuilt communication software allow uninterrupted real time data transmittal, allowing coverage to both accessible and inaccessible areas of the building and landscape without the need for human inspectors. Examples from Europe and Australia

Figure 3. An advance light trap incorporated with a communication port (Courtesy of Alcochem).

on electronic rodent management with reporting software is gaining popularity [33]. These tools have larger coverage area, useful in areawide situations, programmable, less energy and labor consuming.

Furthermore, digitalizing all other aspect of the urban IPM including costing, tracking job and personnel; tasking vehicle and equipment, data communication; virtual design; data and database sharing; and time and energy management will make IPM programs competitive and sustainable.

Conclusion

Urban IPM is the mainstay for keeping sensitive premises free of pests and pesticides on a longer term. This has been in practice in many instances and in particular for the food industry. The success is achieved by creating a pool of trained people within the available workforce of the customer, as well as contracting or outsourcing from outside, who unidirectionally work towards implementing IPM. In one instant these pools of people have been referred as "IPM Champions" [14], thus differentiating and separating them from being regular practitioners. This action is a must for urban IPM to remain distinct, relevant and sustainable.

The competition to urban IPM comes from conventional pest control, where IPM is often wrongly pointed out to be expensive, needs excessive documentation, slow to execute and involve restrictions. On the other side conventional pest control has been shown to be ineffective with respect to efficacy, in addition to being short-term and significantly more detrimental on the environment.

The way out from the quandary is adopting digitalized IPM, to generate unbiased round the clock data and determine action. The data will not only address pest issues, but also something beyond, such as look into human sensitivities, structural improvements, economics, and environmental concerns together. In this way IPM will direct pest control towards a "greener" direction.

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Conflict of Interest

The author declares no conflict of interest.

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