Sustainable Development Strategies and Challenges for Promotion of Integrated Pest Management (IPM) Program in Bangladesh Agriculture

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Abstract: Global concerns regarding unsustainable pest management have made the promotion of integrated pest management (IPM) a priority for the government of Bangladesh. Based on secondary data this study first analyzes the institutional role or strategies for the promotion of IPM followed by identification of challenges of this environment friendly agriculture. Findings reveal strategies that have launched by various public and private organizations for promotion of IPM were inadequate and in some context less effective compare to necessity and expectation. Hence, the efforts are mostly failed to achieve desired success. The identified challenges for this divergence are inadequate training, less effective dissemination techniques, few NGOs participation, lack of research, farmers’ poor socio-economic profile, unfavorable attitude towards pesticide use and pitiable IPM disseminator and adopter ratio. In addition, to overcome the challenges as well as to reach the destination of sustainable agricultural development through IPM, ways are suggested. The findings will be helpful to establish IPM program not only in Bangladesh but also other developing countries where this environment friendly farming is practicing.

Key words: IPM · Sustainable agricultural development · Strategies · Challenges

INTRODUCTION

Bangladesh is one of the most densely populated countries (964/sq.km) in the world with a remarkable growth rate of 1.29% [1]. The consequence of this over population is decreasing land as the land is predetermined. Findings reveal that land is becoming an extremely scarce commodity in Bangladesh and declining by 1% per year [2]. The inverse relationship between increasing population and decreasing land has led farmers to use huge agro-chemicals, especially pesticide. Of course, this is not only reason that the farmers’ use pesticide at a high rate, another dominant reason is the relentless attack of pest in crop production. Estimates show that annually 25% of vegetables, 16% of rice, 11% of wheat, 15% of jute and 25% of pulses produced in the country are lost due to pest [3]. In order to fight against pest, the farmers’ are heavily rely on pesticides.

In one hand, the farmers are bound to use pesticide to increase yield as well as to meet the demand of ever-growing population. On the other hand, pesticide overuse has potentially negative implications for agriculture, the environment and human health. In this dilemma, such method is needed that can suppress pest, increase production and keep the environment safe and sound. Usually individual methods of pest control have the capability to suppress pest nevertheless no single method provides satisfactory outcome and as such an integrated approach is essential. Farmers need alternative pest management approaches that are not only environmentally sound but also economically feasible. By considering these, the one and only alternative that can help to increase agricultural production and reduce pesticide misuse is the integrated pest management (IPM) [4].
Over the years, a debate is continuing about the concrete meaning of IPM because of its diverse concept given by different agencies and organizations. However, the international and bilateral development agencies and the private sector and NGOs, have used the definition of IPM as a combine approach to sustainable agricultural development. The only matter where they feel disagreement is the role of chemical pesticides in IPM approaches, of which most of the organizations favor an explicit reduction [5]. According to the University of California Statewide Integrated Pest Management Program [6], IPM is: “An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines and treatments are made with the goal of removing only the target organism”.

However, this study uses the meaning of IPM as to combat pest through monitoring that ensure rationalizing pesticide use. The IPM farmer follow all the four key components of IPM programs like, pest monitoring, accurate pest identification, manage the crop to prevent pests from becoming a threat and evaluate all the possible control methods so that appropriate method can be taken [7]. On the other hand, the conventional farmers do not follow these criteria and use pesticide without evaluating any alternatives. Thus, current conventional agriculture where pesticides are using frequently and at a high rate is damaging soil structure, creating health hazards, degrading environment, deteriorating food quality and making it economically costly to society and increasingly so to the farmers [8]. In response to increase awareness about the sustainability of conventional agriculture, the government has collaborated with international assistance agencies to promote IPM [9]. In this context, the present study will face the following questions:

- What strategies have been taken to the promotion of IPM farming?
- Are these strategies success to achieve objectives?
- If not, what are the challenges behind this?
- How the challenges can be overcome?

**MATERIALS AND METHODS**

This paper is made based on secondary information available from various sources like books related to integrated pest management, journal, thesis, proceedings and periodicals. Moreover, some informal discussions were held with experts in plant protection, agricultural extension and agricultural scientist to get proper direction of the study. In addition to this, various reports like National IPM policy report [3]; National agricultural policy [2], Bangladesh Bureau of Statistics [1] and World Bank report [5] were assisted to fulfill the purpose of the study in an effective and meaningful way.

**RESULTS AND DISCUSSION**

The discussions have been made in two steps. The first step deals with the institutional role or strategies (public, private and combine) for the promotion of IPM program. The second step deals with an assessment of the strategies, identification of challenges and ways to overcome the challenges.

**Institutional Role for Promotion of IPM:** In Bangladesh, the promotion of IPM program, are shared by both public and private sectors though public sector play a more significant role than private. Among public sectors, the Department of Agricultural Extension (DAE), the largest agro-based organization, is major responsible to implement the IPM activities. Besides, some Non-government Organizations (NGO’s) are involved with the extent of IPM programs. With the collaboration of GOs and NGOs, different international agencies; Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP), bilateral donor agencies; United States Agency for International Development (USAID) and Danish International Development Agency (DANIDA) and development banks; World Bank (WB) and Asian Development Bank (ADB), are implementing various projects to disseminate IPM throughout the country [10-12].

**Role of Public Sector:** For better extension of IPM practices throughout the country, there is a need to develop some means and ways that the farmers get information about IPM and DAE finally developed some strategies like, Farmers Field School (FFS), IPM Club, Extension Agent Visit and Field Days. The approaches are discussed below:

Supported by the FAO-Regional Vegetable and Cotton IPM, the FFS is training program that begun in the early 1990s to help farmers diversify their crop production using the IPM concept. The curriculum included the ability to understand technical issues, to learn by discovering and to stimulate a problem-solving
attitude. The benefits of FFS are that they provide farmers with a great depth of understanding about IPM. [13] and [14] conducted two studies to examine the impact of FFS and indicate that FFS trained farmers have higher yields and lower pesticide use than non-trained farmers. One FFS program covers 25 farmers in a village. In 2009, the DAE conducted a total of 2,313 FFS programs.

The IPM club is less intense than a FFS and serves as a forum for farmers to meet and discuss pest problems and to create further awareness about IPM by encouraging farmers who did not attend the FFS. The DAE hopes that if the club can be successful and can generate some profits, it will attract other members of the village to join and learn about IPM. Currently, there are over 16,000 IPM clubs across Bangladesh while each club size ranges 50 to 100 members [10].

Extension agents living in villages and visiting local farms individually and in group meetings is perhaps the oldest and most common extension method in the world. Since they are locally known to the farmers, thus it helps them to disseminate IPM information to the farmers in the easiest and convenient way. There are approximately 12,640 extension agents, known as Sub Assistant Agricultural Officers (SAAO) and they reach around 11 million farmers household per annum [12].

Field days are an example of a method that is more intense than mass media. The typical field day demonstration lasts for one day or several days. During an IPM field day, experts come to a village and put on demonstrations to introduce new IPM technologies or practices to farmers. Ranging in size from 50-500 people, field days provide the AEC with an opportunity to reach a large number of farmers and show them examples of how the agricultural technologies have been successful through demonstrations [11].

Role of Private Sector: Private sector NGO’s and companies work diligently to extend IPM information to the farmers. Among various NGO’s, the Cooperative for American Relief Everywhere (CARE), Mennonite Central Committee (MCC), Grameen Krishak Shahauk Shangtha (GKSS) and IPM CRSP (Integrated Pest Management-Collaborative Research Support Program) are conducting training and field days to teach IPM practices to the farmers. Additionally, companies such as Ispahani Biotech and Safe Agriculture Bangladesh Ltd. (SABL) extend IPM technologies through advertisements and training to promote sales.

CARE, the international NGO play the most significant role to disseminate IPM to the farmers among all the NGO’s currently working in the country. The CARE programs focus on helping 221,375 of the poorest Bangladeshi’s, many of whom are illiterate, through implementing IPM programs dealing with crop husbandry [15]. Through providing training and resources in different areas such as IPM, credit and market access, CARE creates a technical package that has the potential to improve the lives of many of Bangladesh’s rural poor [16].

Collaborating with 13 local NGO’s, MCC, also an international NGO, actively disseminates IPM information to over 10,000 farmers each year through mass media channels, demonstrations and field days. During 2009-2010, MCC carried out 119 demonstrations in five districts focusing on seven IPM practices for vegetable crops. The GKSS, a local NGO mainly produce compost materials and sell them to the farmers, retailers and government agricultural programs. Additionally, the organization also works to train farmers to adopt environment friendly technologies through FFS, yard meeting and field demonstration that have reached over 2000 farmers [10]. The IPM CRSP works to develop, adapt and diffuse IPM technologies. The program focuses on vegetable IPM as pesticides use is very high on vegetable production in many parts of Bangladesh. The IPM CRSP trains CARE personnel, who then extend the practices and knowledge to farmers.

Since April 2009, Ispahani Biotech has been commercially selling some environment friendly component like bio-pesticides, pheromones and bio-control agents. Beside these, they market some beneficial insects. Like Ispahani Biotech, the SABL is a commercial provider of bio-control agents and pheromones. They organize multimedia field programs where they use a projector and screen to play a video. In 2009, approximately 250,000 farmers were reached using these media methods at an average cost of four taka per farmer (~$0.06). In the first six months of 2010, the company made over 4.7 million taka in sales (~$68,116).

The Collaborative Role: The introduction of IPM program was a result of collaborative efforts between the Government of Bangladesh and FAO. Thereafter, the international, bilateral and donor agencies are conducting projects on IPM jointly with DAE and NGOs. The major purpose of these projects is to train up the staff and the farmers regarding IPM. Within 2001, a total of 1,137
persons from DAE and 300 persons from different NGO’s have been trained as IPM trainers. Furthermore, DAE/DANIDA SPPS project and DAE/UNDP/FAO project to have so far produced 829 farmer trainers (FTs) [3]. Almost one hundred thousand farmers have already received season-long practical in depth training on IPM [17]. With the conclusion of phase II in 2006, the DAE and DANIDA have completed training 117,000 rice and 78,000 vegetable farmers on IPM. Ongoing projects of the DAE are expanding the use of ecological approaches to pest management to almost 400,000 farming households [17]. By the end of 2001, a number of DAE/DANIDA SPPS project and DAE/UNDP/FAO staff from DAE and different NGOs trained as IPM trainers project to have so far produced 829 farmer trainers (FTs) are inadequate in comparison to total personnel. In addition, ongoing projects of the DAE that will cover almost 0.4 million farming households under ecological approaches represents only a very small proportion of the country’s 14.7 million households that depend on agriculture for their livelihoods [18].

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Though a number of training that have already provided to the staff and farmers were inadequate in terms of necessity and expectation, but it helps farmers to form a favorable attitude towards IPM adoption. So, government organizations especially DAE and NGO’s should create more training facilities for the farmers and staff. At the time of farmer selection for providing training, there is a tendency to choose large farmers due to various reasons. This propensity is not consistent with the mission of IPM promotion. Generally the large farmers are innovative and they have more risk bearing capability. They are always more interested than others to adopt a new approach. Thus, special consideration should be given to the medium and small farmers who operated 70% of total area but have a low risk bearing capability. Another issue is though DAE is the major responsible for promotion of IPM farming, but the organization itself will never achieve the success. Hence to increase the scope of DAE regarding training facilities and others, the international agencies and development bank that are working in the country should take more projects with larger scale and implement jointly with DAE.

Amidst some dissemination techniques are developed through collaborative efforts of DAE and other agencies, but all are not equal effective. Among different techniques developed by DAE, the extension agent visits and FFS are more effective than others [19]. The extension agents disseminate IPM information through farm and home visit. The transactions cost of having extension agents’ visit is very low and the farmers feel comfortable to communicate with them. On the other hand, farmers have benefited substantially from their participation in FFS-based IPM training. Until the present, performance of these two techniques is good, but still there is a need to increase their effectiveness. Moreover, more dynamic cost effective dissemination strategy that ensures individual contact is necessary to encourage adoption of IPM technologies.

Like GOs, NGOs efforts are inadequate in comparison to their size, though there is a confusion regarding the actual number of NGO’s working in the country.

### Table 1: Regional distribution of IPM farmers in some selected areas of Bangladesh

<table>
<thead>
<tr>
<th>Division</th>
<th>District</th>
<th>Conventional Farmers</th>
<th>IPM Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka</td>
<td>Kishorgonj</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Mulshigonj</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mymensing</td>
<td>84</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Narsingdi</td>
<td>82</td>
<td>0</td>
</tr>
<tr>
<td>Rajshahi</td>
<td>Rajshahi</td>
<td>137</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Chapainawabgonj</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Bogra</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>Rangpur</td>
<td>Rangpur</td>
<td>68</td>
<td>26</td>
</tr>
<tr>
<td>Khulna</td>
<td>Jessore</td>
<td>111</td>
<td>54</td>
</tr>
<tr>
<td>Chittagong</td>
<td>Chittagong</td>
<td>56</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Comilla</td>
<td>61</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>689</td>
<td>139</td>
</tr>
</tbody>
</table>

Table 2: Categories of farmers with number and operated areas in Bangladesh.

<table>
<thead>
<tr>
<th>Categories of farmers</th>
<th>Number (Percent)</th>
<th>Operated area (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large farmers (above 3 hectares)</td>
<td>04</td>
<td>26</td>
</tr>
<tr>
<td>Medium farmers (between 1 and 3 hectares)</td>
<td>20</td>
<td>44</td>
</tr>
<tr>
<td>Small farmers (between 0.2 and 1 hectare)</td>
<td>37</td>
<td>26</td>
</tr>
<tr>
<td>Marginal farmers (between 0.02 and 0.2 hectare)</td>
<td>19</td>
<td>03</td>
</tr>
<tr>
<td>Landless farmers (below 0.02 hectare)</td>
<td>20</td>
<td>01</td>
</tr>
</tbody>
</table>


However, no doubt about that there are hundreds of NGO’s are actively working in the country, but very few of them are showing their interest for the promotion of IPM. Unfortunately, most NGO’s give more emphasize on micro credit program rather than sustainable agricultural program. In some country, like Thailand, NGO’s have played a key role in the promotion of organic agriculture [20]. The NGOs personnel have more scope to contact with rural people like farmers than other organizations. So, more NGOs should participate in the IPM program to ensure sustainability. The ADAB (controlling body of NGOs in Bangladesh) should make an effective negotiation with all the large NGOs to include and proper monitor the sustainable agricultural program like IPM. Unfortunately in Bangladesh, like many developing countries, there is no strong monitoring and evaluation system on NGOs activities. The government should evaluate the NGOs activities and inspire them to engage sustainable agricultural program.

In spite of having continuous efforts from different organizations for the promotion of IPM and also have the profitability over conventional farming, still the adoption rate is low. What are the reasons behind it? To find out the fact there is a lack of research. In the developed countries, like U.S.A and Australia, there are several in depth research work on IPM. Even some developing countries, like Uganda, Philippines and Indonesia, there are in depth studies on IPM. In Bangladesh, to know the economic aspect of IPM, some studies have been conducted under the IPM CRSP, but this is not only the issue. There are a number of issues related to IPM where research should be conduct. Adoption of IPM technologies is complex and several factors are involved with this process. In spite of strong public support to increase IPM adoption, little is known about the extent of IPM. In this context, the research organizations, especially Bangladesh agricultural research institute and Bangladesh rice research institute and the agricultural universities can play a significant role.

**Socio-Economic Profile of the Farmers:** It is a fact that day by day farmers are getting more aware and feeling interest towards IPM practices, but their number are very few. Most of the cases it is happening to the large farmers who posses only 4% of the total farmers. Except this category, majority are the medium, small and marginal farmers who are 76 % in number and cover 73% of total operated areas (Table 2). These farmers always try to the highest utilizes of their limited land, but uncertainty goes with every step of their life. Natural disaster and poverty is a common scenario to them. The poverty of these farmers is deep rooted, pervasive and multi-faceted, relating not just to the absence of reliable incomes and production, but also to sanitation, shelter, inequities and lack of power. Moreover, majority of them have no formal education which is a hinder to form a favorable perception, attitude and awareness on IPM. In addition, they are less well known about the technical skills that are required to use IPM practices.

In this context, the GOs and NGOs should provide interest free agricultural loan to the farmers and also do monitor that this loan are properly utilizing or not for crop cultivation with IPM practices. Additionally, the DAE and NGOs individual or in combine may establish adult literacy program for the farmers. Besides formal education, the main focus of this program will be centered on IPM practices. This will help the farmers to gain skill of IPM practices as well as to understand the necessity of IPM adoption.

Apart from socio-economic condition, psychological matter is another issue that hinders the farmers to adopt IPM technologies. Farmers feel confusion that if the IPM technologies are fail to gain desire yield or the demand of the product is low [21]. Not only IPM technologies but also any innovation there has a risk of losing investment for various reasons. Therefore, people like farmers adopt quite a pragmatic risk minimizing strategy [22-23]. In this context, DAE and NGOs worker should come forward to remove farmers’ confusion regarding adoption of IPM practices. Another significant issue is, sometimes after adoption of new practices, due to unavoidable issue like flood or other natural calamities farmers are failure to get desire yield. Thus, they are disappointing since they have no alternative income generating source. To adjust this, government should launch crop insurance or any kind of...
financial support program which inspires the farmers to adopt IPM technologies. In the developing countries, crop insurance is a common scenario and even though some developing as well as newly industrializes countries, like India, Malaysia and Thailand, launches this program. Beside these efforts, a well design and effective marketing policy should be implemented by the government where IPM product will get more favor. This is because; if the farmers observe there is no difference between IPM and conventional product regarding market value, then they will lose interest to engage IPM farming. (Data source: Pesticide Association of Bangladesh, 2011)

**Farmers’ Attitude Towards Pesticide Use:** Under the broad policy of sustainable agricultural development, the government of Bangladesh with alliance of FAO first started IPM in 1981. The major purpose of this policy was to reduce the over dependency on pesticide. Although pesticide usage initially declined after this policy was revoked, the use of pesticide has increased consistently during the past three decades. Farmers seem heavy pesticide use increases their yield and IPM may reduce the productivity. Thus, they are using pesticide at a high rate for long. A survey, studying the use of toxic pesticides in farmland during 1999 to 2008, showed that in 1999, the use of pesticides was close to 15,000 metric ton; which was doubled within 2006 and tripled within 2008. Fig. 1 shows the increasing trend of pesticide use over the last 10 years.

The increasing trend and overuse of pesticide creates several harm in soil, plant and human health. IPM can improve the scenario. Now it is evident through several researches that IPM farming where pesticides are use when needed and also judicious rate is more profitable than conventional farming in social, economic and environmental aspect [24]. The extension agent and the NGOs personnel should highlight this issue that helps the farmers to remove their misconception regarding overuse of pesticide. Public mass media should frequently feature and broadcast programs on the advantages and profitability of IPM farming and also the harmful effects of taking heavy pesticide used product. This will help consumers to make a favorable attitude towards IPM product as well as willingness to pay more for quality food. Thus, it would be the stimulus for farmers to pursue agricultural production through IPM practices.

**IPM Disseminator and Adopter Ratio:** From the regional to upazila (sub-district) level, a number of stratified personnel who are work with IPM dissemination and adoption. However, the upazila level, consist of Upazila (Data source: Pesticide Association of Bangladesh, 2011)Fig. 1: Trends in pesticide use in Bangladesh, 1999-2008 agricultural Officer (UAO), Additional Agricultural Officer (AAO), Agricultural Extension Officer (AEO) and also SAAO, play more significant role as they work closely with the farmers. Farmers feel more comfortable on SAAO’s as they are locally known. Individual contact has more influence than mass to take decision regarding adoption of new technologies. Currently, one SAAO serves 6-7 villages or about 900 farm households. For the promotion of IPM farming smoothly, there is always needed a balance between the number of IPM disseminating personnel and farmers. The picture says there is an acute gap between these two groups. Therefore, government should take initiative to recruit more SAAO. Furthermore, to keep monitoring on regional level to rural level, a national IPM program with well defined structure should be established. The structure should maintain a longitudinal and sometimes horizontal relationship among national, regional, district, upazila and rural level. It will help to co-ordinate all IPM activities throughout the country. In some developing countries, like Pakistan and Nepal, there exist national IPM program. They are successfully coordinating IPM activities through this program. This might be an ideal approach for Bangladesh aspect.

**CONCLUSIONS**

This paper has illustrated threefold; discuss the strategies that are taken by different organizations for establish IPM program and evaluate the success, identify the challenges that are hinder for promotion of IPM and suggest the ways to overcome these challenges. The public and private organizations have individually and sometimes jointly taken different strategies to diffuse and adopt IPM. These efforts are appreciable but not yet able to gain desired success. For this divergence, we identified several challenges include inadequate training,
less effective dissemination techniques, few NGOs participation, lack of research, poor socio-economic profile of the farmers, farmers unfavorable attitude towards pesticide use and poor IPM disseminating staff and farmers ratio. To overcome these constraints major responsible is on GOs followed by NGOs and other international agencies. A sturdy and efficient combine effort is also needed. Hence, to establish IPM program firmly, the government should pay more attention on collaboration between different groups, include national and international organizations, biologists, social scientists and farmers. The findings of the study provide an insight into the progress needed and the ways for the promotion of IPM program in Bangladesh, which bear very influence for policy formulation. Moreover, this experience in the promotion of IPM program is a good learning opportunity for developing countries at this time when they are trying to adopt sustainable agricultural program.

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