Building new phase of IPM in Indonesia

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Abstract. A milestone on plant protection in Indonesia was marked by establishment of Integrated Pest Management (IPM) since 1986 through Presidential decree Inpres no. 3 th. 1986. Moreover, IPM was implemented and has made a fundamental change in plant protection institution, farmer’s capacity and agricultural practices, and consequently rice pest’s problems. Furthermore, IPM was also implemented in horticulture and estate crops. During 33 years-historical journey of IPM, socio-political situation, global environmental problems and issues, science and technology has dynamically changed which affect IPM implementation. The paper categorized IPM development in Indonesia into three phases; emergence-growth, stationary and survival, and new phase of IPM. Every period has specific characteristics on: pest problems, science and technology, national and global environmental issues, human resources, role of plant protection institutions and mode of dissemination. A new phase of IPM is needed to make a strong and resilience plant protection system, therefore able to face and manage more complex problems plant pests, diseases under change of climate in the coming years, to secure food and agricultural productivity and sustainability. New phase of IPM absolutely need farmers field school, and enrichment of technology and approach including agro-ecology and landscape approach, biotechnology, information technology (IT), remote sensing and biosensor technology.

1. Introduction

Indonesian agriculture has an important role in meeting food supply, economic and socio-culture needs. Rice is the main food crop in the country. In addition, Indonesia has the largest palm oil plantation in the world, the second largest rubber tree plantation, and the third largest cocoa in the world. Main spices crops are originated from this area, like clove trees (Syzygium aromaticum), black pepper (Piper nigrum), nutmeg tree (Myristica fragrans). Banana, durian, mangosteen are the most important fruits and most important vegetables are chili pepper, shallot and longyard bean.

The crop protection system in Indonesia follow Integrated pest Management (IPM). Indonesian IPM started from rice and then spread to horticulture and estate crops. IPM in Indonesia has a glory past history. In the glory periods, one million farmers trained through IPM farmers field school, cut of pesticide subsidy, and maintaining high productivity. Success stories of the IPM in the past are used as a model for the implementation of IPM especially on rice in other countries [2,5].

In the last decade, IPM implementation is seems to weaken, indicated by increase use of pesticides and more pests outbreaks. Unfortunately, plant health problems due to pests and diseases become
more complex. This paper aims to describe the phases of the development of IPM in Indonesia, influencing factors. Moreover tactic for building new phase of IPM is formulated.

2. Development phase of integrated pest management in Indonesia

The development of IPM in Indonesia can be grouped based on sociopolitical conditions, plant protection institutions, human resources in plant protection, technology that is developing and being used widely, and occurrence of pests and diseases in these periods. The development phase of IPM in Indonesia is similar to the microbial development phase which consists of the emergence and growth phase, the stationary-survival phase, extinction or death (Fig. 1).

2.1. Emergence-growth (1986-2000)

This period was in the New Order government, in which it was a centralized government. The periods included the birth of IPM after Inpres no 3 th 1986, the banned of 57 brand of insecticides. The presidential decree was strengthen by UU no 12 th 1992 in UU Plant Cultivation System. PP. No 13 1995 on Plant Protection.

In this periods plant protection agencies was established in most of rice production centers. Plant protection agencies managed by central government, with enough resource allocation acts as data center of rice pests, biocontrol agents centers, and training center.

In human resource this period was marked by the appointment of large numbers of pest observers. The monumental stage of this phase was the implementation of large-scale of Integrated Pest Management Farmers Field School (IPM-FFS), of which 1 million rice farmers were trained in SLPHT [6, 11]. Pest observers were given D1 PHT education in collaboration with universities, and additional training in the field training facility (FTF).

Rice varieties that were widely used by Indonesian farmers at that time were Cisadane, IR 64, and Cihorang. Some local varieties were still widely used by farmers, especially sticky rice, and local rice such as pandanwangi and menthikwangi.

The technology developed in addition to reducing the use of pesticides was the collection of borer egg clusters, parasitoids and limited use of biological control agents against plant diseases, generally Trichoderma. Parasitoids, Trichoderma, and Beauveria were developed in the regional plant protection laboratory.

In this period there was relatively no outbreak of brown rice plant hopper on a broad scale in a relatively long time. At the end of this period IPM began to be developed in vegetables and plantations [11].

![Figure 1. Development phases of integrated pest management in Indonesia.](image-url)
2.2. Stationer-survival (2000-2019)

This period was marked by the end of the New Order government. Large sociopolitical changes made Food and Horticulture Protection Agency (BPTPH) and regional laboratories to be under control provincial government, in which previously by central government. This lead to great variation in development of the institutions, depending on the commitment of the provincial government.

In terms of human resource development, there has been a decline in IPM-trained pest observer, and also number of recruited pests observers. While those who were appointed in the 1986-1987 period have begun to retire. Meanwhile, IPM-FFS was conducted in fewer scale. On the other hand in the early decades of this period many IPM-FFS plantations and IPM-FFS on horticulture were also carried out. In the final years of this period no IPM-FFS carried out anymore, while the massive increase in food production policy was very limited application of IPM principles.

The success of IPM and IPM FFS programs in the previous period, also demonstrated the fact that IPM-FFS alumni became many leaders of farmers who drive environmentally friendly agriculture, organic agriculture, SRI (System of Rice Intensification) and farmer training centers (P4S). On the other hand, IPM-FFS alumni were also motor for the Biological Agency Service Centers (PPAH) which are spread in various regions in Indonesia.

Hybrid rice was introduced to Indonesia from 2007, but its contribution to increased production was questionable, because it was mainly because most are vulnerable to major pests and diseases. Limiting rice hybrid technology was largely susceptible to major rice pest diseases [4]. Hybrid rice in a controlled environment was claimed to have productivity of 15-30% higher compared to conventional varieties [9], but in the conditions of farmers planting in the field, the productivity performance of hybrid rice is not better than conventional varieties [1, 7]. At the end of this period, new types of superior varieties such as IPB 3S began to develop. In addition to existing parasitoid and predator technologies, microbial-based technologies for biological agents both for pest control and disease increasingly developed, both for IPM for rice as well as for secondary crops and vegetables [8]. During this period, especially in the 2nd decade, biological control technology for pests and diseases grew fast. In addition to traditional predators and parasitoids and *Trichoderma*, the development of biological control was using plant growth promoting rhizobacteria (PGPR), antagonistic yeasts and endophytic microbes [13].

During this period there was a great development of modern biotechnology for plant protection, especially the diagnosis and characterization of pests and pathogens. A significant diagnostic technology was the use of specific primers, such as those for *Fusarium oxysporum* TR4 in bananas. In addition, several pathogens were known to have genetic diversity so that once known to one species but genetic diversity has implications for virulence differences. Some have been used for pests and diseases, especially horticulture and plantations.

The use of pesticides in rice tends to increase, if in 1998 rice farmers sprayed 3 times/season, in 2014 farmers in Klaten and Karawang applied pesticides 10 times/season [15]. The periods was marked by more frequent pests outbreak, the outbreak of brown plant hopper in 2010 and 2017. The 2010 outbreak was limited to Java. While the 2017 outbreak occurred in Java, Lampung, Bali. In second decade of period the problem of emerging pests and diseases arose [12]. There was more intensive international trade in agricultural products and seeds between countries. During this period emerging pests and diseases became a global issue. Both exotic pests and existing pests were increasing in intensity rapidly such as rice blasts (*Pyricularia oryzae*), *Begomovirus* in chili pepper plants, tomatoes and tobacco in 2000, fusarium wilt and bacteria in bananas.

2.3. After 2020: extinct or new phase?

Period after 2020 the challenges of protection become heavier in terms of human, institutional and developmental aspects. The absence of IPM FFS again means no regeneration of IPM FFS farmers. This also threatens the sustainability of biological control agents post (PPAH), almost all of PPAH managed by IPM FFS alumni.
Varieties were developed such as IPB 3S, aside from conventional varieties such as Ciherang and Inpari groups, other new types such as IPB 3S will more develop. There will be fast growth of technology including biological control and biotechnology, supported by 4.0 technology such as remote sensing, biosensors and information technology (IT).

On the other hand the threat of emerging pests and diseases is greater because the trade in products and seeds between countries will be greater, and climate change will be more apparent [12]. If there is no extra effort made, then IPM will lead to extinction or death.

2.4. New phase IPM?
Indonesia needs a strong and resilient plant protection system to maintain agricultural productivity and sustainability. The plant protection system must be in an IPM scheme. The ideal form to deal with this situation is that IPM is able to manage effectively pests and diseases so that there is no outbreak of large-scale pests and diseases, both domestic pests and migrants. The new phase of IPM has the following characteristics: relies on human resources, like farmers and officials, a strong plant protection lab, supported by the latest technological developments and approaches including agroecology, landscape, biosensors, remote sensing, automation, and information technology.

To achieve this, several urgent steps are needed: (1) IPM FFS needs to be conducted again on a massive large scale, enriched with the latest technology in rice, horticulture and plantations; (2) Strengthening regional plant protection laboratories so that it functions as a data center for pests, pests forecasting, forecasting for agricultural climate, staff training, and reference of plant protection technology; (3) Designing effective mitigation actions against new pests/diseases, as well as potentially enter the country. All of these need strong support from government policies.

The past success of IPM in Indonesia is determined by 3 fundamentals, namely a solid scientific foundation, adequate policy support and a strong and mass education [2, 6]. The capacity of farmers is very important for the success of IPM, because in real world, in the field who face pest problems are farmers. Continuous farmer education accompanied by assistance after the field school is needed to maintain the sustainability of the IPM implementation process by farmers [13].

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