THE PRESENT STATUS OF PESTICIDE USE IN INDONESIA

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Abstract

Rice production in Indonesia in 1981 totalled 21.9 million tons, representing an increase of 8.12% over the 1980 production which reached 20.3 million tons. The increase was obtained through the utilization of the recommended new technology implemented through the BIMAS and INSUS programs. Similar intensification program was applied to secondary crops and vegetables. Insect pests and diseases are factors lowering the yield. The brown planthopper, the green leafhopper as vectors of tungro virus disease and rats are still important limiting factors for production. Secondary crops like soybeans and mungbean suffer from leaf feeders and pod feeders. On vegetables such as shallot, red pepper and cabbage insect pests are dominant. Weeds are also creating problems and data indicate a yield reduction of 25–35% in irrigated rice, 75–90% in upland rice and about 45% in corn and legumes. Pesticides including insecticides, fungicides, rodenticides and herbicides are used along with other components, such as extensive use of resistant cultivars and strict cultural practices based on the integrated pest management system. Insecticides used are the carbamate group, organophosphorus compounds, some combinations of insecticides and recently the synthetic pyrethroid insecticides. Brodifacoun rodenticide has been widely used by the farmers recently although coumarin products are still being used. The fungicides are used mainly on corn against downy mildew, on secondary crops and vegetables.

In the 1980/1981 and 1981 crop seasons about 9,000 tons of insecticides, 2,500 tons of fungicides and 75 tons of rodenticides were distributed. In the 1981/1982 and 1982 crop seasons an increase of insecticide use was observed due to the extension and increase of the area planted with food crops, secondary crops and vegetables. About 15,000 tons of insecticides, 433 tons of rodenticides are available for distribution. The use of herbicides is concentrated in North Sumatera, South Sulawesi, Aceh, Kalimantan and Lombok for the control mainly of *Monochoria vaginalis, Cyperus diformis, Echinochloa crusgalli* and spikerush. Thiobencarb, 2,4-D, MCPA, oxadiazon and piperophos singly or as combinations are being used. In 1981 about 350 tons of herbicides were used by the farmers and in 1982 the total use increased to 1,618 tons. The tendency of increase of pesticide use is not due to more frequent applications, but is the consequence of the expansion of the area cultivated with food crops and vegetables, which needs protection from pest damage. The present and future role of pesticides in Indonesia is conceived as a complementary component within the framework of the integrated pest management system.

Introduction

The development of the agricultural sector in Indonesia is geared to the increase of food crop production, primarily rice. To reach the target, the implementation is carried out through intensification programs (BIMAS and INMAS) and special intensification programs (INSUS) covering not only rice but also secondary crops, such as maize, soybean, mungbean, peanuts and vegetables.

Since the programs were implemented, the average rice production during the Pelita II (Second Five Year Plan) has increased by 3.78% per year, being equivalent to 584,000 tons of rice.

In the first three years of Pelita III (Third Five Year Plan) average production increased by 7.79%, being equivalent to 1,455,000 tons of rice.

The 1980 rice production totalled 20.3 million tons representing an increase of 13.28% over 1979, while the production in 1981 totalled 21.9 million tons representing an increase of 8.12% over the 1980 production. Thus the target set by Pelita III was obtained earlier then was scheduled.

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The acreage and the kinds of crops involved in the intensification program are listed in Table 1.

Table 1 Intensification program for paddy (1979–1982)*.

Type of land	Area planted (ha)		
	1979/1980	1980/1981	1981/1982
1. Sawah (wet rice)	897,925	1,345,692	2,150,808
2. Semi-wet rice			
a. special intensification	–	–	51,340
b. common intensification	2,490,934	2,453,581	1,966,058
3. Tidal swamp rice			
a. pasang surut	69,995	54,998	69,039
b. lebak	–	–	79
4. Upland rice			
a. special intensification	–	–	18,054
b. common intensification	174,586	173,693	254,480
Total	3,633,440	4,027,964	4,509,866

* up to March 1982. Source BIMAS, March 1982.

As indicated in the Table there is an increase in area every year. From the total surface area amounting to 5,316,904 ha in the 1981/1982 crop year 84.82% or 4,509,866 ha were included in the intensification program and the remaining 807,038 ha or 15.18% were cultivated in a traditional way without or with minimum use of advanced technology.

In the intensification program a package technology consisting of high-yielding varieties, use of fertilizer, good irrigation facilities and use of pesticides is being offered.

Out of the 4,509,866 ha about 87.75% or 3,957,577 ha were planted with new improved varieties and from this amount 2,199,588 ha or 55.58% were cropped with varieties resistant to brown planthopper biotype 1 (bph 1) and brown planthopper biotype 2 (bph 2).

By using resistant varieties to control the brown planthopper, which is a major pest, a lesser amount of insecticides is needed. On the other hand to increase the cultivation of secondary crops, as shown in Table 2, for which no resistant cultivars to insect pests are available yet, an increasing amount of insecticides is being used, especially on soybean and mungbean.

After carbohydrate requirements had been fulfilled an intensification program of vegetables as a source of vitamins and minerals was initiated in 1979/1980. Up to 1981/1982 an increase in acreage was observed annually, involving the cultivation of several kinds of vegetable crops as shown in Table 3.

Table 2 Intensification program for secondary crops (1979–1982)*.

Crop	Area planted (ha)		
	1979/1980	1980/1981	1981/1982
1. Maize	684,638	970,203	892,183
2. Soybean	97,399	131,022	151,744
3. Mungbean	29,456	41,196	30,911
4. Peanut	73,185	112,171	124,786
5. Cassava	234,922	302,405	338,218
6. Sweet potato	14,628	14,021	15,132
7. Sorghum	5,920	17,054	10,306
Total	1,140,148	1,588,072	1,563,280

* up to March 1982. Source BIMAS, March 1982.

Table 3 Intensification program for vegetables (1979–1982)*.

Crop	Area planted (ha)		
	1979/1980	1980/1981	1981/1982
1. Shallot	12,150	11,010	17,897
2. Red pepper	18,070	23,570	30,764
3. Potato	7,100	8,043	12,026
4. Cabbage	6,409	7,538	7,265
5. Chinese cabbage	4,094	6,087	6,582
6. Tomato	1,858	2,604	3,883
7. Garlic	239	797	1,459
8. Lowland vegetables	16,409	27,105	32,080
Total	66,329	86,754	111,956

* up to March 1982. Source BIMAS, March 1982.

Pest problems

1 Insect pests and diseases

Data on pest incidence in rice collected throughout Indonesia in 1980 and 1981 indicated that seven insect pests and one vertebrate pest infested rice for a proportion of more than 10,000 ha. Based on the occurrence of the infestation in the last three years the order of importance was as follows: Rats, *Rattus argentiventer;* stem borer, mainly the yellow stem borer, *Tryporyza incertulas* and the white stem borer, *T. innotata;* leafroller and leaf folder; rice stinkbug, *Leptocorisa oratorius*; armyworms; brown planthopper, *Nilaparvata lugens*; green leafhopper, *Nephotettix virescens* and *N. nigropectus*; rice gall midge, *Orseolia oryzae* and stinkbug, *Podops vermiculata*.

The above mentioned pests caused damage to about 898,500 ha in 1980 and about 910,000 ha in 1981.

Rice diseases, which occurred regularly were caused by *Xanthomonas oryzae, Rhizoctonia oryzae, Tungro* virus, *Piricularia oryzae* and *Cercospora oryzae* and the area damaged by each disease varied between 3,000–11,000 ha.

Soybean, a potential crop, with an area of 750,000 ha harvested each year hosted more than 20 species of insects (Soekarna, 1964). The major pests are the beanfly, *Agromyza sojae*; flea beetle, *Longitarsis suturellinus*; some leaf-feeding insects such as soybean beetle, *Phaedonia inclusa*; some caterpillars; podborer, *Etiella zinkenella*; podsuckers, *Riptortus linearis* and *Nezara viridula*. In 1981 about 20,000 ha were infested by various insects with a damage intensity of 13%.

Two diseases considered important in some soybean areas are anthracnose, caused by *Colletotrichum glycine* and soybean rust, caused by *Phakospora pachyrhizi*.

On mungbean similar pests are found except for the soybean beetle.

Some pests causing important damage to maize are the seedling fly, *Atherigona exigua*; the stalkborer, *Ostrinia nubilalis* and the corn earworm, *Heliothis armigera*.

A disease common on corn and causing serious damage is downy mildew (*Sclerospora maydis*).

Some horticultural crops, such as cabbage suffered serious damage from the diamond back moth, *Plutella xylostella* and *Crocidolomia binotalis*.

Pseudomonas solanacearum and *Xanthomonas campestris* are agents infesting cabbage.

Spodoptera exigua and *agrotinae* are important pests of shallot while aphids, thrips and fruit fly, *Dacus* sp. cause serious damage to red pepper. Two diseases considered important are that caused by *Pseudomonas solanacearum* and fruit rot caused by *Colletothricum* sp.

(1) Use of insecticides, fungicides and rodenticides

For the control of insect pests and diseases in Indonesia the concept of integrated pest management is being adopted and implemented as far as the component technology is available.

Research is directed toward the development of varieties resistant or tolerant to the target insects or diseases, which is considered as the cheapest and most practical tool of pest management from the farmers' point of view.

However since the use of resistant cultivars only does not solve the pest problem, it should therefore be combined or integrated with other means of pest management, such as adjustment of the transplanting time, utilization of natural enemies, sanitation, use of pesticides, etc.

Guidelines on when and how the pesticides should be applied for the control of major pests on food crops was formulated (Directorate Plant Protection of Food Crops, 1980), and recently a color map was printed showing the pest complex of rice and its distribution throughout Indonesia (Directorate Plant Protection of Food Crops, 1982).

The expansion of the area cultivated with food crops, including secondary crops, and vegetables among others was the cause of the increase in pesticide use in Indonesia, as shown in Table 4.

Table 4 Amount of pesticides distributed (ton)*.

Pesticides	1979/1980 WS	1980 DS	Total WS+DS	1980/1981 WS	1981 DS	Total WS+DS	1981/1982 WS	1982 DS	Total WS+DS
Insecticides	4,035	2,480	6,515	5,603	3,402	9,005	8,823	6,160	14,983
Rodenticides	59	77	136	45	30	75	293	140	433
Fungicides	50	50	100	622	1,895	2,517	81	32	113

* Source BIMAS, March 1982.
WS = Wet season. DS = Dry season.

In the 1979/1980 and 1980 crop seasons about 6,500 tons were distributed with an increase in the following years to 9,005 tons in the 1980/1981 crop season to reach approximately 15,000 tons in the 1981/1982 and 1982 crop seasons.

Although an increase in fungicide use from 100 tons to 2,500 tons was recorded in 1980/1981 and 1981 it decreased again in the 1981/1982 and 1982 crop seasons to 113 tons.

Rodenticides distributed in the period 1979–1982, which consisted of brodifacoum and coumarin products totalled 215 tons on the average.

Insecticides and fungicides included in the BIMAS, INSUS and INMAS programs in the 1981/1982 and 1982 crop seasons, based on their active ingredients are as follows:

Insecticides	Fungicides	Rodenticides
1. fenitrothion	1. chlorothalonil	1. brodifacoum
2. monocrotophos	2. mancozeb	2. coumarin
3. basudin	3. acyl alamine	
4. phenthoate		
5. chlorpyrifos		
6. carbofuran		
7. carbaryl		
8. carbamates		
9. triazophos		
10. fenthion		
11. endosulfan		
12. some combinations.		

(2) Future use of insecticides, fungicides and rodenticides

The intensification program of food crops and industrial crops aiming not only at self-sufficiency in food and other agricultural and estate crops, but also at exports will meet problems among which insect diseases and vertebrate pests are one of the main constraints.

The strategy of pest management in Indonesia is directed to the development and implementation of the integrated pest management system. Therefore, all kinds of component technology should be utilized and integrated to achieve maximum gain with the least negative effects on the environment. In this context, pesticides are one of the important supporting components, still needed for Indonesia as shown in Table 4. The type of pesticide used or to be recommended in the long run, should be compatible with other control components and at least show a low toxicity to the natural enemies.

2 Weeds

The primary objective of weed control practices is to minimize losses of yields due to competition between weeds and crops and also to create suitable conditions for crop growth so that maximum crop yield can be achieved. Experimental results from the Central Research Institute for Food Crops during the years show that weeds cause a 25–35% reduction in yield for irrigated rice, 75–90% for upland rice and about 45% for corn and legumes (Central Research Institute for Agriculture, 1977).

Handweeding has been commonly applied for a long time in the rice growing areas of the developing countries of Asia including Indonesia (Moody, 1977). One of the factors is the low cost of weeding and labor which can be easily obtained, in addition to the economic constraints on the farmers to buy herbicides. Low cost of handweeding in Indonesia [approximately US$0,40 daily wage as observed by De Datta and Barker (1975)] makes chemical control difficult to adopt by the rice farmers. But in the last three years, in the sparsely populated areas such as the large islands outside Java progressive farmers have started to use effective herbicides i.e. benthiocarb/2,4-D IPE, oxadiazon, piperophos/2,4-D IPE, in addition to 2,4-D amine and MCPA which they

used to apply.

(1) Use of herbicides

In 1972 progressive farmers in North Sumatera with holdings covering about 500,000 ha of irrigated rice fields began to apply MCPA in their fields (Sundaru, 1977). This area is for the most part planted with estate crops like rubber, oil palm, coffee, etc. Herbicides have been applied in these estate crops for the control of weeds like *Imperata cylindrica, Mikania* spp. for a long time, including MCPA and 2,4-D for killing broadleaved weeds. This situation and conditions peculiar to rice cultivation in the area led the farmers to apply MCPA in their fields (Sundaru, 1977). In 1973 during the oil crisis MCPA disappeared from the market and the farmers switched to the use of 2,4-D amine which is becoming increasingly popular and effective in killing *Monochoria vaginalis, Sphenoclea zeylanica* and sedges *Cyperus difformis, Cyperus iria* and *Fimbristylis littoralis* as the dominant weeds in that area. In 1975 new herbicides like 2,4-D butyl ester were demonstrated on farmers' fields but due to their toxicity to rice, their use did not become widespread. The farmers still use 2,4-D amine, such as U Bi 46, etc. (Table 5).

Table 5 Total amount of herbicides sold in North Sumatera (liter).

Year	MCPA (Agroxone-4)	2,4-D (U 46 Bi)
1974	17,503	12,610
1975	2,673	7,560
1976	17,023	10,080
1977	7,000	–
1978	5,000	–

Source: P.T. Agricon and P.T. Chandrajaya, 1977.

In 1980 demonstrations on the new herbicides in farmers' fields by several Agricultural Companies in cooperation with the local Agriculture Extension Services brought a new prospect of chemical control. By the use of 2,4-D amine year after year weed population changed from broadleaved weeds and sedges to grasses (Sundaru, 1977). These conditions forced the farmers to apply new effective herbicides. Since that time benthiocarb/2,4-D IPE (G), oxadiazon (EC and sprinklers) and piperophos/2,4-D IPE (G) have been widely marketed all over the region.

In South Sumatera, farmers at the Palembang rice estate covering about 500–600 ha have used since 1975 benthiocarb/2,4-D IPE (G) for direct-seeded rice. But during the fallow time noxious weeds appeared and glyphosate was used to kill these weeds before broadcasting the rice seeds.

In South Sulawesi which covers a rice area of about 500,000 ha progressive farmers apply herbicides on their fields, using MCPA and 2,4-D amine which are effective in killing several dominant broadleaved weeds and sedges (Central Research Institute for Agriculture, 1977; Sundaru, 1977) (See Table 6).

In 1980 benthiocarb/2,4-D (G) was introduced. Since the price is much lower than the cost of weeding, farmers are interested in applying it. In the mean time other herbicides like piperophos/2,4-D IPE and oxadiazon appeared in the market and the farmers began to use them. It seems that granular herbicides and sprinklers are preferred over EC formulations.

Table 6 Total amount of herbicides used in South Sulawesi (liter).

Year	2,4-D (DMA-6)	MCPA (Agroxone)	Paraquat (Gramoxone)	Paraquat + diuron (Paracol)
1976	–	836	5,469	325
1977	–	3,700	3,046	330
1978	757	2,154	6,319	908

Source: Agric. Extension Service South Sulawesi, 1979.

(2) Future of herbicide use

In the last 2–3 years progressive rice farmers have used new effective herbicides, which could give good control on the dominant weeds in Indonesia, i.e. *Echinochloa crusgalli, Leersia hexandra, Cyperus difformis, Scirpus juncoides, Fimbristylis littoralis, Monochoria vaginalis, Sphenoclea zeylanica*. But as in the advanced countries perennial weeds, like *Paspalum distichum, Sagittaria trifolia* which propagate through stolons have become a problem.

It seems that the use of herbicides in the near future will increase as shown on Table 7.

Table 7 Total amount of herbicides sold in North Sumatera, South Sulawesi and West Java (liter/kg).

Year	Piperophos + 2,4-D (Rilof H)	Oxadiazon (Ronstar)	Oxadiazon + 2,4-D (Ronstar)	Thiobencarb + 2,4-D (Saturn-D)	Alachlor (Lasso)
1980	–	–	2,000	150,000	–
1981	9,000	5,000	20,000	315,000	352,000
1982	60,000	–	55,000	1,500,000	1,618,000

Source: CIBA GEIGY Ltd., Rhone Poulenc Ltd., Petro Kimia Kayaku, Monsanto Ltd., 1982.

Especially the use of the granules and the bottle sprinklers which is replacing that of sprayers is increasing.

It is expected that the use of effective herbicides in the coming years will have a good future in areas where weeding cost is high and labor is not easily available, like in North Sumatera, Aceh, South Sumatera, South Sulawesi, North Sulawesi, Nusa Tenggara Barat and Nusa Tenggara Timur. But even in Java where in general labor is easy to obtain, in certain areas the use of herbicides is being adopted by the farmers and the cost is much lower than that of handweeding. Herbicides which are already registered and could be marketed are listed in Table 8.

Table 8 List of registered herbicides for food crops until 1982.

No.	Herbicide	Common name
	Rice	
1.	D M A -6	2,4-D amine
2.	Hedonal liquid	2,4-D amine
3.	U 46 Bi	2,4-D amine
4.	U 46D Fluid	2,4-D amine
5.	Weedamine	2,4-D amine
6.	Esteron 45P	2,4-D butyl ester
7.	Basagran D 50 EC	bentazon + 2,4-D
8.	Rilof H 5G	piperophos + 2,4-D IPE
9.	Rilof H 500 EC	piperophos + 2,4-D IPE
10.	Ronstar 15/30 EC	oxadiazon + 2,4-D iso octyl ester
11.	Ronstar ODS 5/5 EC	oxadiazon + 2,4-D iso octyl ester
12.	Saturn-D 10G	thiobencarb + 2,4-D IPE
13.	Esamir 400	MCPA
14.	Harcros MCPA	MCPA
15.	Agroxone-4	MCPA
16.	Gramoxone	paraquat
17.	Paracol	paraquat + diuron
18.	Stam F-34	propanil
19.	Ronstar 25 EC	oxadiazon
20.	Ronstar 2G	oxadiazon
21.	Ronstar 12 L	oxadiazon
22.	Basagran 50 ML	bentazon
23.	Rifit 500 EC	pretilachlor
24.	Rifit 3G	pretilachlor
25.	Gesapax	ametryn
26.	Diffenex	chlometoxynil
27.	Satunil 40/20 EC	thiobencarb + propanil
28.	Actril DS	ioxynil + iso octyl ester
29.	Rambasan 40	MCPA
	Maize	
30.	Gesaprim 50 WP	atrazine
31.	Agroxone-4	MCPA
32.	Saturin 50/5	thiobencarb + prometryn
	Soybean	
33.	Lasso	alachlor
34.	Afalon 500 EC	linuron
35.	Dual 500 EC	metalachlor
36.	Sencor 70 WP	metribuzin
37.	Maloran 50 WP	chlorbromuron
38.	Saturin	thiobencarb + prometryn
	Potato	
39.	Sencor 70 WP	metribuzin
40.	Enide 50 WP	difenamide

Source: Pesticide Committee, Dept. of Agriculture, 1982.

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Discussion

El Sebae, A.H. (UNARC/Egypt): Is leptophos still being used in Indonesia?

Answer: Soekarna, D. (Indonesia): It is used on a strict basis by specialized personnel who are well trained.

Mochida, O. (IRRI): Are there any data to show any positive correlation between yield and production increase of rice and the amount of pesticides consumed in Indonesia?

Answer: Soekarna, D. (Indonesia): Although precise data are not available, it appears that in rice, yield loss can be reduced by 20 to 40% if pesticides are applied.

Ishikura, H. (Japan): You indicated fluctuations in the consumption of rodenticides. For example in 1981 the consumption was much higher than in 1980 and 1982. Is it due to the occurrence of outbreaks in that year or is it associated with a special rat control campaign sponsored by the government?

Answer: Rat outbreaks are erratic, hence the consumption of rodenticides.

David, B.V. (India): 1. What are the rodenticides used in Indonesia? 2. You mentioned about the use of combinations. Do you recommend the use of tank-mix combinations or ready-to-use combinations? Do you require registration from the government?

Answer: 1. We use coumarin derivates and brodifacoum. 2. We recommend ready-to-use combination products supplied by the companies for controlling the stem borer and the brown planthopper if they occur together. Presently the use of combinations is decreasing due to the introduction of resistant varieties.

Knusli, E. (Switzerland): WHO has been publishing impressive figures on accidental poisoning of farmers in the developing countries. 1. What is the situation in Indonesia? 2. What is being done and what can be done further to reduce the number of such accidents?

Answer: In Indonesia highly toxic pesticides are not used and when data on fish toxicity disclose harmful effects, the registration is not authorized. There are also strict regulations for the introduction of pesticides. There is a special organization, the Pesticide Committee under the jurisdiction of the Ministry of Agriculture which controls the introduction of pesticides. Moreover, the extension service officers are responsible for training the farmers on how to use the pesticides.

Valencia, S.L. (IRRI): You mentioned that you are presently using pyrethroids. Is it on rice or on vegetables. If on rice, what particular pyrethroid and what particular pest species are you controlling?

Answer: Pyrethroids are used on vegetables and not on rice due to their toxicity to fish.