TEACHING MATERIALS

Integrated Crop and Resource Management (ICM) on Rice

Online Training Course on Rice Plant Management for African Countries",

24 – 27 October 2022

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FOREWORD

This teaching material provides information about integrated rice cultivation that can be used as a guide in the online learning process, in the "Online Training Course on Rice Plant Management for African Countries".

Thank you to those who have helped in the preparation of this teaching material. Hopefully, with the arrangement of these teaching materials, training activities can be carried out well, and these teaching materials can make it easier for Trainers and training participants in the learning process.

Finally, I hope this teaching material can be used, and useful for those who need it.

Lembang, September 2022

Trainer,

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I. Integrated Crop and Resource Management (ICM) on Rice

1. The Objectives of ICM are:

- To increase field and yield productivity
- To reduce the input budget
- To integrate a production system

2. Components of ICM:

- Seed quality
- Soil management
- Planting or transplanting
- Fertilizing
- Irrigation or water management
- Weeding Control
- Integrated Pest Management (IPM)
- Harvest and post harvest

3. The Steps of ICM on rice culture as follow:

1). Seedling

Nursery bed preparation

- Nursery bed around 5% from all planting area;
- Nursery bed between 2m x 10m (depend on the condition);
- Nursery bed should be ploughed until muddy;
- Height of water in nursery bed between 3cm – 5cm;

- Mixing rice husk in the soil as much as 2 kg/m² (to make easy in transplanting to the field).

Seed Preparation

- Seed should be soaked in the odium solution 3% (100 grams odium /35 litre of water). The characteristics of the best seed must sink in the water;
- After that, seed should be incubated for 24 hours.

Sowing

- Seed should be uniformly sowed;
- Seed should be transplanted when the age of 15- 20 days after sowing.

2). Field preparation

- The soil should be flooded before plowing;
- The soil should be plowed by depth 20-25cm and flooded for 5-7 days;
- The soil should be levelled before planting.

- The organic matter such as compost can be implemented as much as 5 ton/ha (depend on the condition) when the second soil plowing.

3). Transplanting

- Seed should be transplanted as much as 2-3 plant/hole
- Planting depth: 3-4 cm
- Planting distance :

  50 cm x 25 cm x 12. 5cm (legowo system)

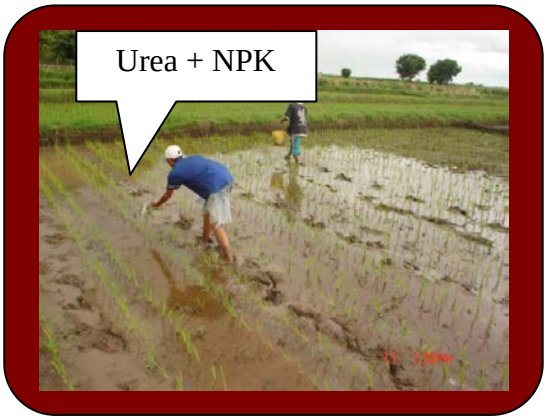
  25cm x 25cm (tegel system)

4). Fertilizing

fertilizer	Stadium 1 (10-15 DAT)	Stadium 2 (30-45 DAT)	Stadium 3 (50-60 DAT)	Stadium of Panicle	Harve sting
					
7 days compost	2-4 t/h	-	-	-	-
urea	40 kg/h	30 kg/h	30 kg/h		
NPK	60 kg/h	-	40 kg/h	-	-

NB: DAT: Days After Transplanting

- 7 days compost can be changed by Ordinary Compost and dung manure as much as 6 – 8 t/h for ordinary compost and 12-14 t/h for dung manure.

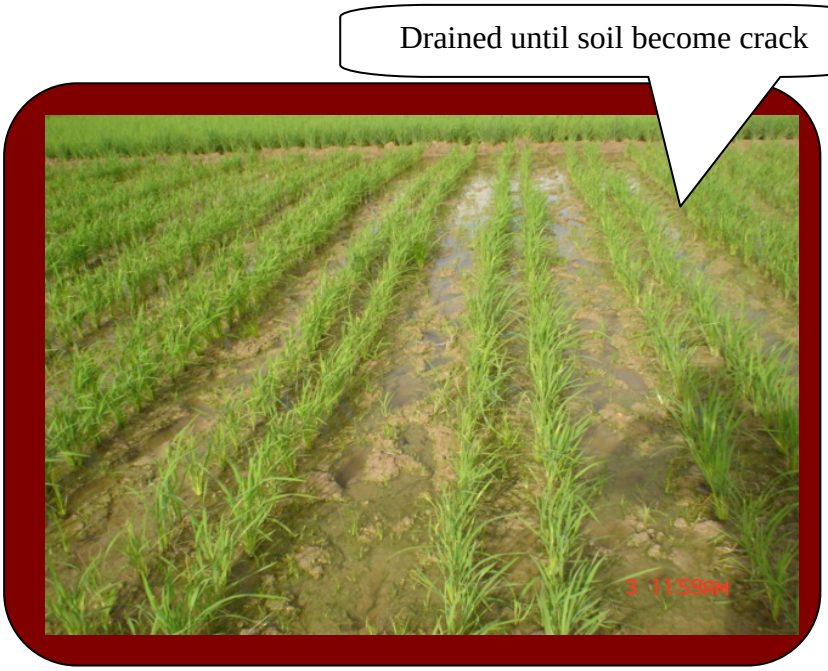


5). Irrigation management

- Rice field should be irrigated between 3-5 cm (***macak-macak*** in Indonesia language) for 10 DAT;
- After that, rice field should be drained and irrigated again;
- Rice field should be drained ten days before harvesting.

Depth of water between 3-5cm during 10 days after transplanting

Drained until soil become crack



6). Weeding

Weeding should be done three times when the age of rice 25, 35, and 45 DAT (depend on the condition) by using a traditional tool or herbicides.

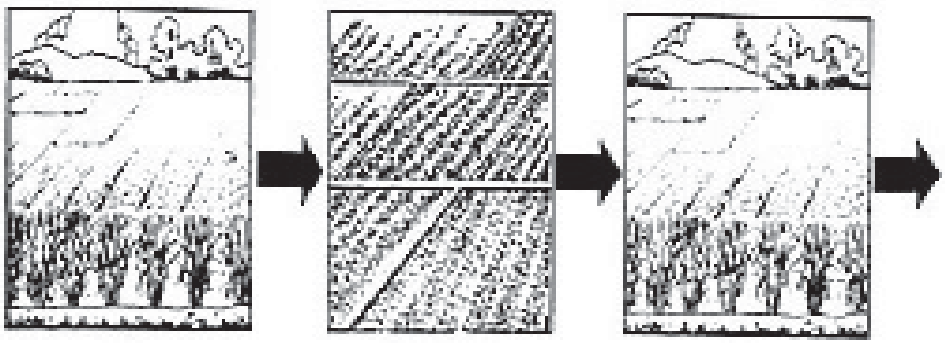
7). Integrated Pest Management (IPM)

IPM is one of the method which is implemented to control pest and diseases on the main crops where the synthetic pesticide use should be done in the last choice.

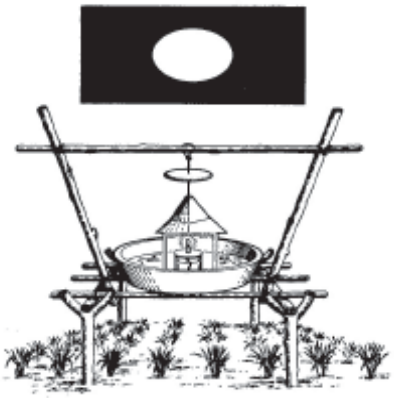
Methods of IPM consist of:

- Varieties rotation
- Crops Pattern (rice-crops-rice or rice-rice-break)
- Planting according to the planting schedule
- Using predator
- Using trap (trap light, sex pheromone)
- Balancing fertilizer

Crops pattern



Rice Crop Rice

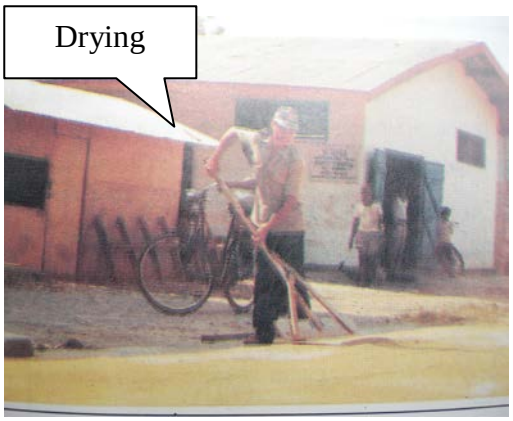


Trap light

predator

8). Harvest and post harvest handling

Harvest and post harvesting handling should be done as well as possible because can decrease the dry grains yield. Post harvesting handling should be started from ways of harvest, transportation tool, thresher, drier, milling and yield processing.



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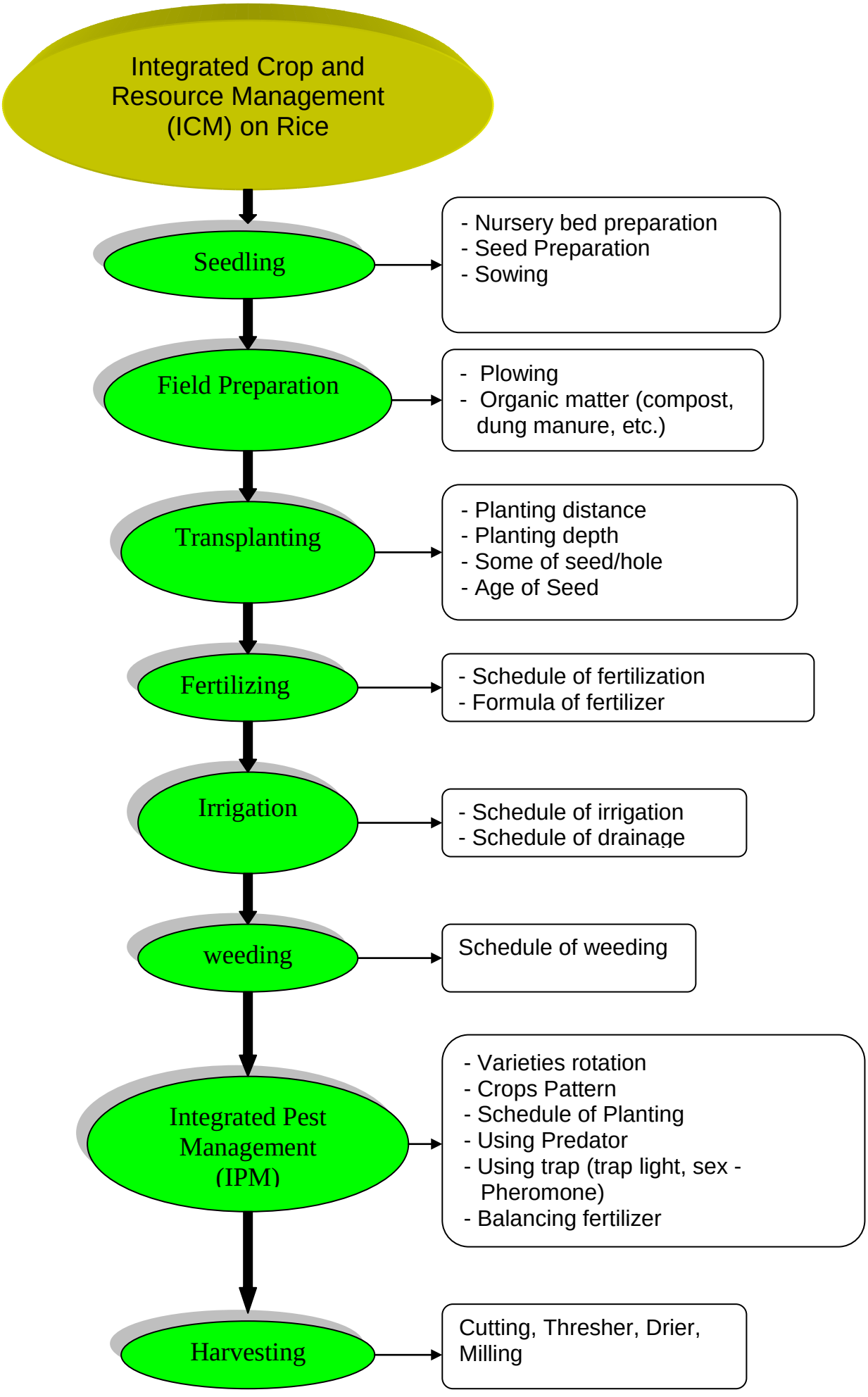

Integrated Crop and Resource Management (ICM) on Rice
Seedling
- Nursery bed preparation
- Seed Preparation
- Sowing
Field Preparation
- Plowing
- Organic matter (compost, dung manure, etc.)
Transplanting
- Planting distance
- Planting depth
- Some of seed/hole
- Age of Seed
Fertilizing
- Schedule of fertilization
- Formula of fertilizer
Irrigation
- Schedule of irrigation
- Schedule of drainage
weeding
Schedule of weeding
Integrated Pest Management (IPM)
- Varieties rotation
- Crops Pattern
- Schedule of Planting
- Using Predator
- Using trap (trap light, sex - Pheromone)
- Balancing fertilizer
Harvesting
Cutting, Thresher, Drier, Milling

Farm Business Analysis of Integrated Crop management on Rice Field between Legowo and Tegel System

Remark	Legowo	Tegel
Input: 1. Production Budget 2. Labors 3. Rent Rice Field	 494.000 Ar 436.000 Ar 600.000 Ar	 494.000 Ar 436.000 Ar 600.000 Ar
Total	1.530.000 Ar	1.530.000 Ar
Output: 1. Production 2. Income	 6 t/h 3.600.000 Ar/h	 4 t/h 2.400.000 Ar
Profit	**2.070.000 Ar/h**	**870.000 Ar/h**

Notes:

- Production budget:
  1. Seed 20kg 24.000 Ar
  2. Urea 100kg 140.000 Ar
  3. NPK 100 kg 120.000 Ar
  4. Compost 2000 kg 200.000 Ar
  5. Bio pesticide 20 l 10.000 Ar

- Labors:
  1. Plowing 80.000 Ar
  2. Paddling 80.000 Ar
  3. Leveling 30.000 Ar
  4. Transplanting 70.000 Ar
  5. Weeding 2x 36.000 Ar
  6. Fertilizing 3x 10.000 Ar
  7. Harvesting 80.000 Ar
  8. Threshing 30.000 Ar
  9. Transportation 20.000 Ar

II. Rice-Fish Culture

1. The Objectives

- To get a better production and farmer's income.
- To reduce the failed harvesting.

2. Components of Rice-Fish Culture

- Seed quality
- Soil management
- Transplanting
- Fertilizing
- Fish (baby fish)
- Irrigation
- Weeding
- Integrated Pest Management (IPM)
- Harvest and post harvest

3. The Steps of rice - fish culture

Principally the steps of rice – fish culture are the same as ICM method. The differences are between planting, fertilizing, irrigation, and weeding method.

Notes:

- Make canal between legowo rows with depth 15 cm.
- Before the fish is planted in the rice field, make sure all activities such as fertilizing, weeding, insecticide application have been finished.

- Density of fish depend on the size and the kind of fish.

  For gold fish *(Cyprus carpio)* as follow:

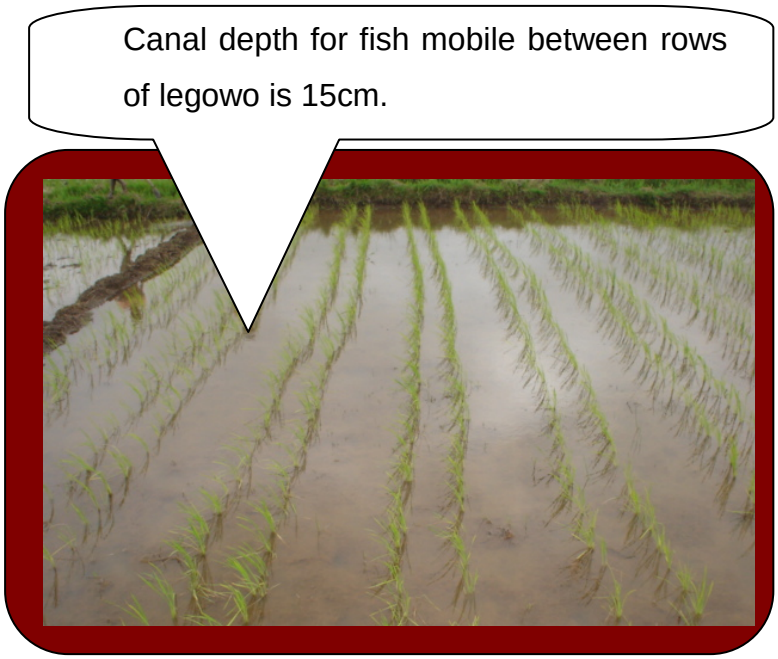
  1 kg = 40-50 fish → density of fish is 1500 – 2000 per hectare.

  1 kg = 100 – 150 fish → density of fish 2500 – 3.500 per hectare.
- Normally fish is planted in the rice field one month after transplanting of rice.
- Fish can be harvested one month before harvesting of rice.

Fertilizing:

Fertilizer	Stage 1 (10-15 DAT)	Stage 2 (30-45 DAT)	Stage 3 (50-60 DAT)	Stage 4 Panicle	Harvesting
					
7 days compost	2-4 t/h	-	-	-	-
urea	100 kg/h				
NPK	100 kg/h	-	-	-	-

- DAT: Days after transplanting
- 7 days compost can be replaced with ordinary compost as much as 6 t/h or dung manure of 8 t/h.


Canal depth for fish mobile between rows of legowo is 15cm.


Gold fish


2000 fish/ha

Farm Business Analysis on Rice – Fish Culture with Legowo System

Remark	Sum
Input: 1. Budget for Rice 2. Fish 3. Labors 4. Rent Rice Field	 484.000 Ar 200.000 Ar 436.000 Ar 600.000 Ar
Total	1.720.000 Ar
Output: 1. Production: ▪ Rice ▪ Fish 2. Income ▪ Rice ▪ Fish	 6 t/h 400 kg/h 3.600.000 Ar 1.200.000 Ar
Profit (Rice + Fish)	**3.080.000 Ar/h**

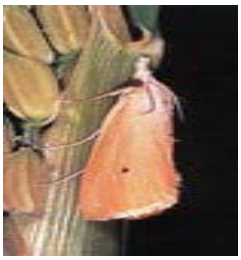
1 fish = 1 gram will become 200 gram after 2 month

Notes:

- Budget for rice:
  1. Seed 20kg 24.000 Ar
  2. Urea 100kg 140.000 Ar
  3. NPK 100 kg 120.000 Ar
  4. Compost 2000 kg 200.000 Ar

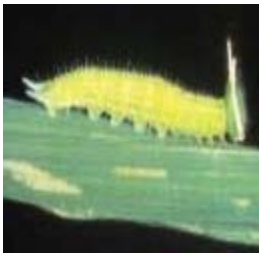
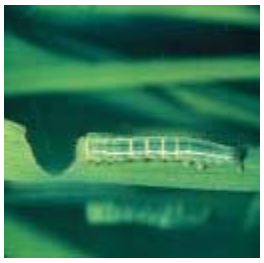
- Labors:
  1. Plowing 80.000 Ar
  2. Paddling 80.000 Ar
  3. Leveling 30.000 Ar
  4. Transplanting 70.000 Ar
  5. Weeding 2x 36.000 Ar
  6. Fertilizing 3x 10.000 Ar
  7. Harvesting 80.000 Ar
  8. Threshing 30.000 Ar
  9. Transformation 20.000 Ar

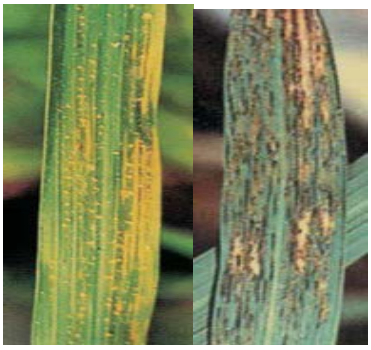
III. Pest and Diseases Problems

Name of Pest and Diseases	Syndrome	Prevention	Remarks
 **Stem borer** *(Scirpophaga incertulas)*  **Stem borer** *(Scirpophaga innotata)*  **Stem borer** *(Chilo suppressalis*)  Larve of Stem borer	 *Dead heart*  *White head*	IPM: ▪ Plant rotation ▪ Using trap Insecticides: ▪ karbofuran ▪ bensultap ▪ bisultap ▪ karbosulfan ▪ dimehipo ▪ amitraz ▪ fipronil	Prevention must be done if the population of s dead heart or white head syndrom show more than 10% per groups.

 **Brown planthopper** *(Nilaparvata lugens)*  **Green leafhopper** *(Nilaparvata nigropictus)*	 *hopperburn*	IPM: ▪ Use legowo system ▪ Resistant variety ▪ Plant rotation ▪ Using trap ▪ Crop pattern Insecticides: ▪ Bupofresin ▪ BPMC ▪ Fipronil ▪ amidakloprid ▪ karbofuran ▪ metolkarb ▪ MIPCI ▪ Propoksur ▪ tiametoksan ▪ karbosulfan ▪ amitraz	Prevention must be done if the population of hopperburn syndrom show more than 10% per groups.
 **Black bug** *(Scotinophara coarctata)*		IPM: ▪ Weeding ▪ Short variety	Prevention must be done if the population of black bug show more than 10% per groups.
 **Rice bug** *(leptocorisa oratorius)*		IPM: ▪ Weeding ▪ Balancing fertilizer ▪ Using trap Insecticides: ▪ BPMC ▪ Fipronil ▪ metolkarb ▪ MIPCI ▪ Propoksur	

 **Rat** (*Rattus argentiventer*)	 Rice field attacted by rat	IPM: ▪ Fumigation ▪ Trap barrier system ▪ Sanitation Insecticides: ▪ Rodenticide	Rodenticide was implemented when the poulation of rate are aboundant
 **Gall midge** *(Orselia oryzae)*		IPM: ▪ Resistant variety ▪ Plant rotation ▪ Using trap Insecticide: ▪ karbofuran	Syndrome look like onion leaf
 **Caseworm** *(Nymphula depunctalis)*		Insecticides: ▪ fipronil ▪ karbofuran	Prevention must be done if the leaves was broken more than 25% per groups.
 **Armyworm** *(Spodoptera sp.)*		Insecticide: ▪ BPMC	

 **Green horned caterpillar** *(Melantis leda ismene)*		IPM: ▪ Predator use such as Trichogrammatidae	
 **Green semilooper** *(Naranga aenescens)*		IPM: ▪ Predator use such as Trichogrammatidae	
 **Mole cricket** *(Gryllotalpa oreantalis)*		IPM: ▪ Land levelling ▪ Flood rice field Insecticides: ▪ fipronil ▪ karbofuran	
 **Rice whorl maggot** *(Hydrellia philippina)*		IPM: ▪ Drain rice field Insecticides: ▪ BPMC ▪ Bensultap ▪ karbofuran	

 **Golden apple snail** *(Pomacea canaliculata)*	 	IPM: ▪ Drain rice field ▪ Intermittent irrigation	
 **Bacterial leaf blight** *(Xanthomonas campestris pv. Oryzae)*		IPM: ▪ Resistant variety ▪ Balancing fertilizer ▪ Water management	
 **Bacterial leaf streak** *(Xanthomonas campestris pv. oryzacola)*		IPM: ▪ Resistant variety ▪ Balancing fertilizer ▪ Water management ▪ Use legowo system	

 **Blast** *(Pyricularia grisea)*	IPM: ▪ Resistant variety ▪ Balancing fertilizer ▪ Water management Fungisida: ▪ Metil tiofanat ▪ Fosdifen ▪ kasugamisin	The diseases caused by *Pyricularia grisae*
 **Sheath blight** (*Rhizoctonia solani* Kuhn)	IPM: ▪ Resistant variety ▪ Balancing fertilizer ▪ Water management ▪ Weeding ▪ Use legowo system Fungisida: ▪ Heksakonazol ▪ Karbendazim ▪ tebukonazol	The diseases caused by *Rhizoctonia solani*
 **Stem rot** *(Magnaporthe salvinii)*	IPM: ▪ Balancing fertilizer ▪ Water management ▪ Weeding	

 **Tungro** Virus tungro	IPM: ▪ Schedule of planting ▪ Resistant variety	The diseases caused by virus from green leafhopper vector
 **Grassy stunt**	IPM: ▪ Schedule of planting ▪ Resistant variety	The diseases caused by virus from brown planhopper vector
 **Regged stunt**	IPM: ▪ Schedule of planting ▪ Resistant variety	The diseases caused by virus from brown planhopper vector

 **Phosporus deficiency**	IPM: ▪ Add phosporus fertilizer in the rice field ▪ Use organic matter (compost, manure,.)	
 **Nitrogen deficiency**	IPM: ▪ Add Nitrogen fertilizer in the rice field ▪ Use organic matter (Compost, manure,.)	
 **Iron toxicity**	IPM: ▪ Add phosporus in the rice field ▪ Tolerant variety	

IV. PRODUCING ORDINARY COMPOST

1. Tools

- Hoe
- Fork
- Water can
- Plastic canvas
- Banana stem
- Wood or bamboo

2. Ingredients

- Rice straw
- Dung manure
- Grass
- Lime/dolomite
- Urea
- Water

3. Formulation

- Formulation of compost depends on the amount of compost.

4. Procedure to make

- To prepare the place and make a frame
- To pile up the ingridients such as rice straw, grases and so on. To achieve a thickness of 20 cm per layer and compact with feet, after that sprinkled by urea solution.
- To put dung manure around 5 cm-thick
- To sow lame homogenitly
- To water with the clean water.
- One layer is already finish.

INGREDIENTS

Dung manure

Rice straw

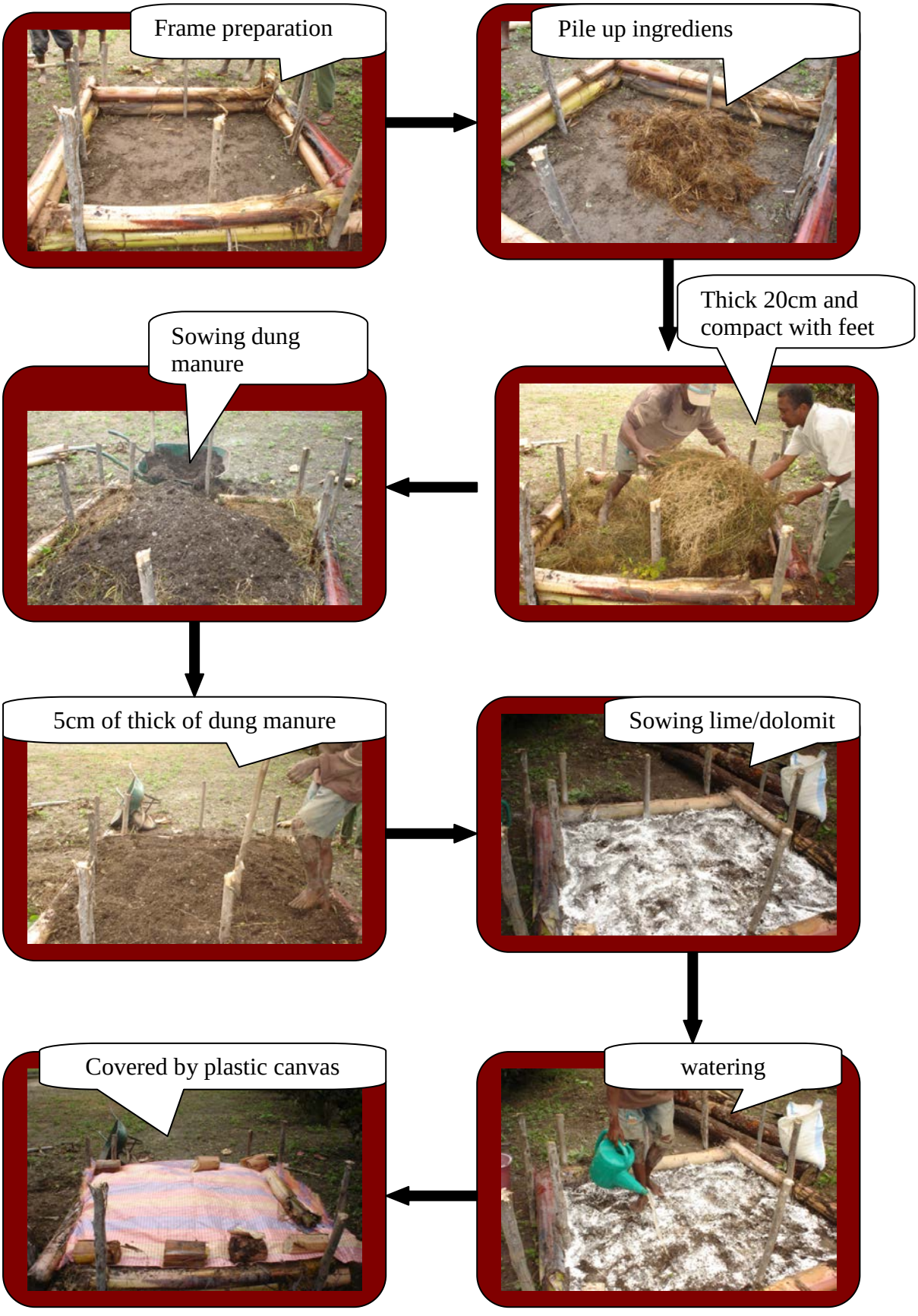
Grass

Legume

Dolomit

Urea

PROCEDURE TO MAKE



5. Notes

- The compost can be made to become a lot of in one places
- The compost should be returned every week in order to accelerate decomposition process.
- If fermentation is good then the middle of the compost heap will get up to a temperature of 50-60 ºC.

6. Remarks

- The composition process will be better if all ingredients are chopped.
- Using Legume will be better if avaliable.

V. PRODUCING 7 DAYS COMPOST

1. Tools

Hoe, fork, plastic canvas

2. Ingredients

Activator, sugar cane solution or molasses, or sugar solution, clean water, dung manure, rice straw chopped, grasses chopped, rice husk, rice brand.

3. Formulation

- sugar cane solution : 100 ml
- Activator : 100 ml
- Clean water : 10 l
- Dung manure : 2-5 cans
- Rice straw : 1 cans
- Grasses chopped : 1 cans
- Rice husk : 0,5-1 cans
- Rice husk burned : 0,5-1 cans
- Rice brand depend on the amount of compost

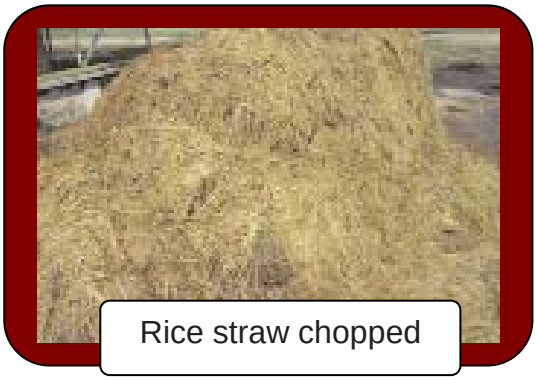
4. Procedure to make

- To mix all ingrediens such as dung manure, grasses chopped , rice straw and rice husk.
- To prepare activator solution as much 100 ml + 100 ml of sugar solution + 10 lt of clean water.
- To water fine rice brand by activator solution
- To mix up all ingredients consist of dung manure, rice straw, rice husk, grasses chopped with fine rice brand and activator solution.
- Humidity around 40%
- To make a heap around 40 cm of thick.
- To cover with plastic canvas.

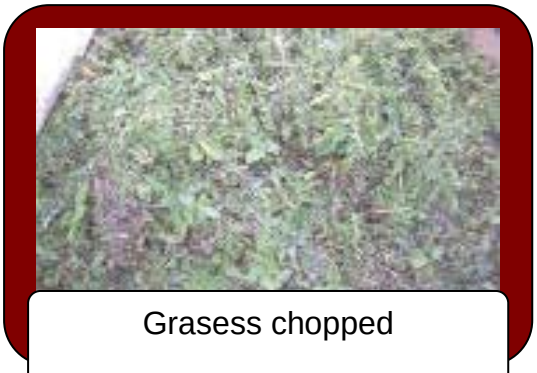
5. Notes

- All materials do not put in the ground.
- Put under roof to prevent sunlight directly and rainfall.
- Turn upside down twice per days during five days
- Put on the cement floor or use rice straw or grasses for mat

Dung manure



Rice straw chopped



Grasess chopped

Rice husk

Activator + sugar cane solution + water (A)

Fine rice brand + activator solution (A)

Mixing all materials

Pile up and cover by plastic canvas

Turn up twice a day

Sifting the compost

6. Remarks

- Cows manure is better for producing compost although all manure can be used. Special for chicken and ship manure should be kept at least 3 month before using.
- All organic mater such as leaves, grasses etc. can be used for making compost.
- Fermentation process will running well if the water content is not more then 40% and the temperature between 40°C - 60°C.
- One of ways to know the humidity and temperature are to press the compost with hand, if it is compact mean the humidity already around 40% and the temperature will show more then 60°C if your hand can not stand until 5 second when your hand entered in the heap of compost.
- The compost must be turn up every 8 hours as long as the temperature showed between 40°C - 60°C.
- How to know the good quality of compost:

  - Good smell, the temperature should be warm, there is a lot of mycelium, and the compost is not compact. All of these indicators will be happened since 2 – 6 days during the fermentation process.
- The compost should be immersed in the soil when we want to use it.

VI. PRODUCING ACTIVATOR

1. Tools

Drum, water cans, plastic bucket, stainless pan and plastic sheet.

2. Ingredients

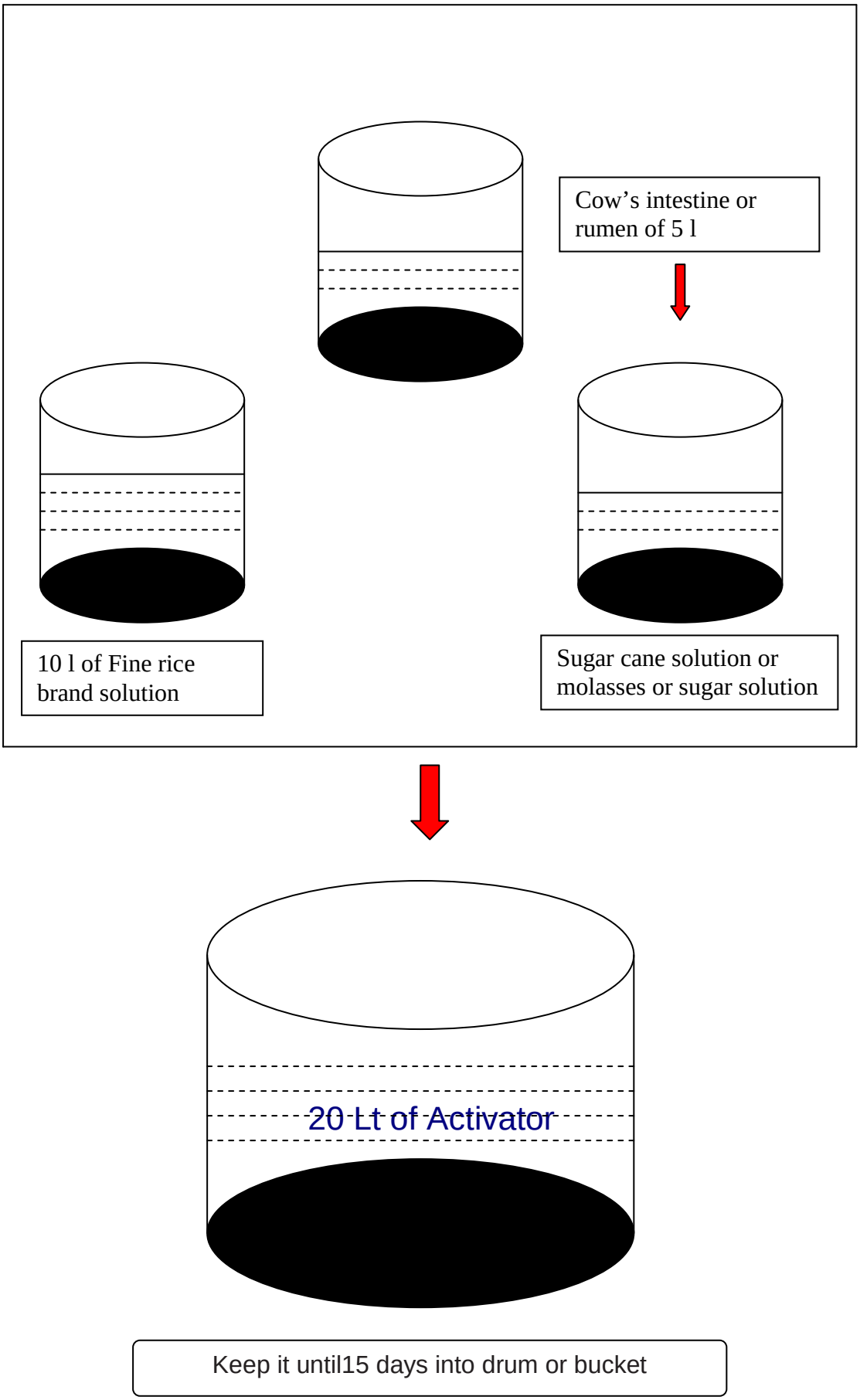
- Rumen or cow's intestine
- Sugar cane solution or molasses or sugar solution.
- Fine rice brand
- Water

3. Formulation

- Cow's intestine: 5 l
- Sugar cane solution: 5 l
- Fine rice brand: 2 - 3 Kg
- Clean water: 10 l

4. Procedure to make

- 2 kg of fine rice brand should be boiled with 10 litter of water.
- Keep until cool
- Cow's intestine solution is mixed by sugar cane solution.
- After that, put into rice brand solution.
- Covered by plastic sheet
- Keep it until 15 days


Cow’s intestine or rumen of 5 l
10 l of Fine rice brand solution
Sugar cane solution or molasses or sugar solution
20 Lt of Activator
Keep it until15 days into drum or bucket

Cow's intestine

Sugar cane solution, fine rice brand solution

After 15 days

Activator already finish

5. Remarks

- The cow’s intestine must be mixed in the sugar cane solution directly (maximum 3 hours after take it).
- The sugar cane solution can be changed by sugar solution.
- The cow’s intestine is better then rumen but we can use the rumen if the cow’s intestine is not available.
- How to know the good quality of activator
  - Good smell and the colour should be yellow
- The activator can be used after 8 days.
- Keep it in the bottle plastic or drum or jerry can and covered well.

VII. PRODUCING BIOLOGICAL PESTICIDE

1. Tools

- Plastic tools such as bucket, drum, plastic sheet, rice ponder, and mortar.
- Wood and rubber

2. Ingredients

- Activator
- Sugar cane solution
- Clean water
- Leaves: neam, tephrosia, tithonia sp. Ageratum, pyrethrum, tobacco, tanatanamanga, glyrisidea
- Alcohol
- Vinegar

3. Formulation

BIOLOGICAL PESTICIDE:

- Activator: 1 litter
- Sugar cane solution: 1 litter
- Clean water: 10 – 15 litter
- Leaf pounded: 10 Kg

ALCOHOL PESTICIDE:

- Activator: 1 litter
- Sugar cane solution: 1 litter
- Vinegar: 1 litter
- Alcohol : 1 litter

NEAM

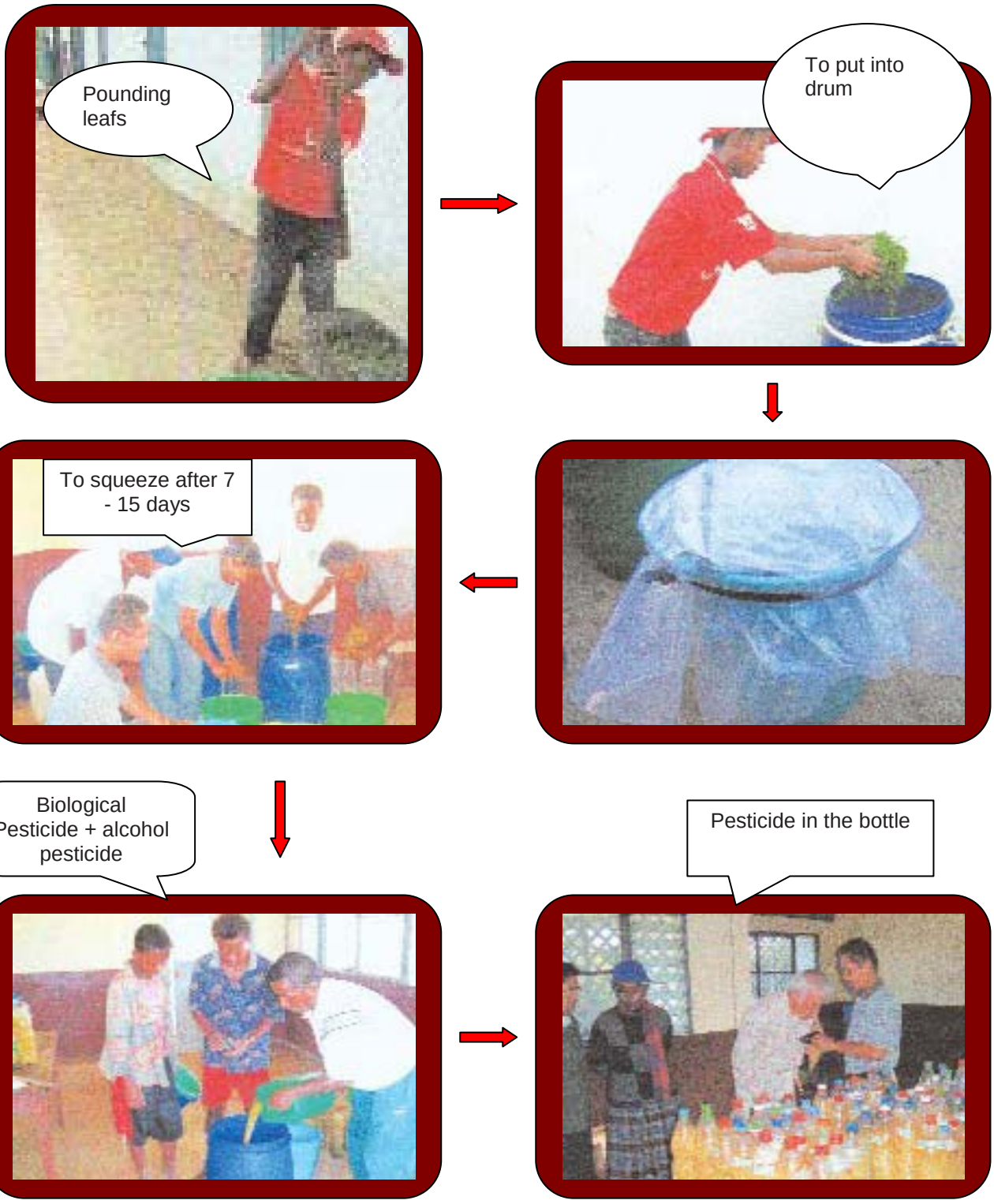
FAMAMO NA TEPHROSIA

BEMANGADY NA TITHONIA

AGERATUM

TANATANAMANGA

PYRETRUM


Pounding leafs
To put into drum
To squeeze after 7 - 15 days
Biological Pesticide + alcohol pesticide
Pesticide in the bottle

4. Remarks

- Pesticide and liquid fertilizer should be used during vegetative stage of rice and should be applied every 7-10 days.
- The pesticide can be mixed with liquid fertilizer.
- 1 litter pesticide can be mixed for 2 – 4 litter for application.
- Farmers experience in PC 15 in Ambatondrazaka 30 litter pesticide + 60 litter water for one hectare.
- The pesticide will be better used directly.

VIII. PRODUCING LIQUID/BIOLOGICAL FERTILIZER

1. Tools

- Water can, bucket, plastic drum
- Rice ponder
- Plastic sheet
- Rubber

2. Ingredients

- Activator, sugar cane solution, clean water
- Grasses, leaves such as legume, Cyperaceae, etc

3. Formulation

- Activator : 1 litter
- Sugar cane solution : 1 Litter
- Clean water : 10 Litter - 15 litter
- Grasses and leaves pounded : 10 Kilogram

4. Procedure to make

- All the leaves should be washed, after that is pounded.
- Put into the drum or bucket
- Prepare: Sugar cane solution 1 l + Activator l + clean water 10-15 l.
- After that, this solution should be put in the drum with leaves pounded
- Steer up
- Covered by plastic sheet
- The leaves should be immersed into the solution by using stone or wood.
- Keep it between 7-15 days

Pounding the leaves

Put into the drum or bucket

Sugar cane solution + activator" + water

Put the solution into the drum with the leaves

Keep it between 7-15 days

Refine

Liquid fertilizer in the bottle

References

1. Anonym, 1983, Field Problems of Tropical Rice. International Rice Research Institute. Manila, Philippines.

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