

QUANG NGAI RURAL DEVELOPMENT  
PROGRAM (RUDEP) - PHASE 2

Report on Main Causes of Post Harvest Losses  
on Households and Methods for Minimization



**VIETNAM-AUSTRALIA**

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# 1 Back ground

## 1.1 Location

Quang Ngai province is located in the central coastal region of Viet Nam. And occupying 5135 km<sup>2</sup>, with the population of 1,216,592 in 2000. About 42% of this land is in use. Over 70% is classified as highland in the west of the province. An average household has 0,2- 0,3 ha of cultivated area. Most of the inhabitants and agricultural production are concentrated along the coastal line of 35km wide. Over 92% of Quang Ngai's soil is lightly structured. They are Acid to very acid and of low fertility. With low organic matter contents and water holding capacities these soil are prone to agricultural drought. Some of the remaining 8% of soil groups, although small in area, provide opportunity to increase production.

## 1.2 Climate

The sub-tropical climate has a hot and wet all year round. The winter and summer temperature average about 20°C and 30°C respectively. Distinct wet season occurs from late October to early December. the rainfall in these months average 550mm (range of 165to 1432mm/month). These rain mark the start and end of the cropping cycle. Early start and late finishes to these heavy rains shorten the duration of the dry season and jeopardize the success of a third crop in the lowland and second rice crop on rain fed terraces. Moisture average of air in rain season is 80%-90% ,and 70%-80% in dry season. Like this very convenient for grain insects and mice are develop and damage.

## 1.3 Agro-cultural production and income of farmer

### 1.3.1 Current status agricultural and livestock production

a- rice : there are 90,000ha , including 22,000ha for 2 crops ,the rest for 3 crops. Yield average on Cultivate area 2 crops is 6-7 tons per ha. And 3 crops is 4-5 tons per ha. In the future (2010)rice area will reduce is 80,000ha and main is cultivate 2 crops. But total yield remaining the same.

b- Maize: Now these more 8000 ha yield average more 4 tons per ha. maize area is increasing in next time, and use high yield variety.

c-Cassava: Now these more 8000 ha, yield average more 15-16 tons per ha. New high yield variety is KM94 was main growing. Big problem of cassava is harvesting in rain season. In the next time the cultivate area may be increasing especial in upland.

d-All tentative crop(bean, sugar can, peanut, vv...) area was depending market. The cultivate area of sugar may reduce because income from the cassava higher and less look after than cultivate sugar can.

e-Livestock: including cattle are 194000 heads and fast increasing, buffaloes are 44000heads, pig are 539000 heads, chickens are 4,2 million heads.

f-Processing with are agricultural products for food and feed animal (milling, grinding and mixing)And some tradition products such as rice vermillion, girdle cake, candy, biscuit, vv...

*(provided with department agricultural and rural development of Quang Ngai province)*

## 1.4 Income of household farmer include

-Income from cultivate are holding from 40% to 60% total income of household farmers in lowland and from 70% to 80% of household farmer in upland. It is depending other location. Poor households are household farmer there are main income from cultivate

-Income from animal husbandry may be from 20% to 60% It were depend faculty and human resources of household farmer. Some of the household farmer there are high rate income from animal husbandry because they are applying new averred, mix food and look after veterinary.

-Income from service as milling, grinding with paddy, maize, cassava and other product for food, for feed animal and for trader. may be from 10% to 20% of the total

-Income from secondary job as building worker, wood worker, electrician, blacksmith, dress worker and other job from 50% to 60% .Standard of living of the household with secondary usually higher than households only agricultural produce.

Living standard of the household farmers is to depend income from agricultural production and secondary job usually higher than household farmer there are income from agricultural and livestock production

## 2 Result of survey

From 26<sup>th</sup> of May to 9<sup>th</sup> of Jun of 2004, we are surveyed in two different agricultural locations are the upland and lowland ,including 9 communes (Binh minh, Hanh phuoc ,Son trung, Pho chau, Duc phong, Nghia tho, Tinh tho, Son hai and Son giang) The interviewed persons was from On farm household , Commune officer, district officer. The propose of this survey is to understanding farmer current situation of port harvest technology emphasis on storage fatality, storage duration, time of insect appearance, damage of insect with agro-products ,method of insect management and impact of it to income of household. The information was collected basing on questionnaire with farmer and discuss with commune and district officer.

### 2.1 Current status of agro-products preservation

#### 2.1.1 On-farm households on upland

+ Kind of storage products:

\*Rice paddy:

In the up land(include communes as: Son Trung, Son hai Son giang, nghia tho communes .) 100% of interviewed households stored paddy with moisture content very high about 19%-20% with the ethnic minority household and 14-15% with the Kinh household .

\*Maize:

The ethnic minority household storage corn-ear in the top of the kitchen. The Kinh household stored grain maize in the gunny bag or iron round box with moisture are 14-16%

\*Cassava:

In the up land the farmer using a few about 10% for feed animal is fresh root crop all year round.90% was sell with the kind fresh root crop. In the lowland 20% of households stored dry thin slice of cassava with 13-14% moisture content. A rest they sell for trader or company starch processing with kind fresh root.

+ storage facilities

Using facilities different from farms depending custom of ethnic.

\* Paddy:

100% ethnic minority households are stored paddy in simple stores separate from house outside. It was made from bamboo and woods. A few using for food of the every day they keep in the gunny bag.100% the Kinh households are stored paddy and rice in the iron round box(20%), steel box(50%), Wood box(20%), big jag(5%), and gunny bag(5%).

\*Maize:

100% ethnic minority households storage corn-cob in the top of the kitchen. 85% of the Kinh households stored maize in the iron round and 15% gunny bag.

\*Dry thin slice of cassava usually store in the iron round.

### **2.1.2 On-farm households on lowland (100% population are the Kinh ethnic)**

+ Kind of stored products

\*Rice paddy:

100% of interviewed households( Including communes as Bing ming, Hanh phuoc, Pho chau, Duc phong, Tinh tho ... )stored paddy. There are 60% interviewed household stored paddy with moisture under 13%, and 10% with moisture 14%. The rest are more 15% moisture.

\*Maize:

In the low land farmer usually sale about 80% their products immediately after harvesting to trader with moisture content about 24-26%. And 20% .The rest of yield with moisture about 9%-14%

\*Cassava: In the lowland the farmer usually to cut and dry under sunshine. The dry thin slice cassava with moisture 13%-14%. They using for feed animal or sell to market. With about 15-20% their product .The rest they sell for company processing and trader.

+ Storage facilities for paddy

Using storage facilities in households different as iron round box, steel box, gunny bags and big jar. The capacity of gunny bag and wooden box is smallest (50-80kg/unit) while steel box have highest capacity (100kg/unit). PP bag contain 40kg.

- In all on-farm households , paddy containers are placed inside the houses

### **2.1.3 Off-farm households**

+ Kind of stored products:

There are three kinds of stored products: paddy, dry cassava and maize.

+ Storage facilities: for paddy

Most of households stored agro products inside house and used facilities as steel box, Ironed round steel, wood box, and gunny bag. very a few household there are simple warehouses to keep the products

## **2.2 Storage purpose and duration in different household**

### **2.2.1 On-farm household**

+ Paddy: There are big differences in storage purpose and store duration between households. Beside keeping product for food, households stored products 20% for seed, 100% for feeding animal and only 23% for selling. The storage duration here is 4-6 months (70%) and 2-3 months (30%).

+ Maize: Maize in the household is stored for selling (60%), for feeding animal (40%). Duration of storing is 3-6months (30%).With in the lowland and 6-8months in the upland. They use for feed animal with moisture content about 9%-14% .

+Dry cassava:70% household using for feed animal, 30% sell with high price

### 2.2.2 Off-farm household and trader

+ Paddy: Off-farm households and trade stored paddy for selling (both for seed and food purpose), for processing and for feeding animal. Store duration of trader is almost less 1 month

- There are 30% household farmers storage for seed. on the 6 months

## 2.3 Insect appearance and it's density in different storage facilities

- In paddy store: There are five insect species appeared in store at different time, they are Scoriae, S.cerealellan, R.dominica L.pusillus, O.surinamensi and C.pusillus. S.oryzae appear earliest in 3rd month of store in gunny bag and storage tent. In 5th month of store, all kind of store containers were attacked by insects. Except of storage tent the paddy may damage early first month because paddy with high moisture content. big jar was using storage seed and very good

-In maize store: There are two species of insects (S.zeamays and T.castaneum) attacking maize store. Insect appears very early even in first month of store in gunny bag. Density of insect increases along with storage time. In the upland corn cop stored in the top of the kitchen, insect appears fif<sup>th</sup> month.

-In cassava store: There are two species of insects (Araecerus fasciatus and T.castaneum) attacking cassava store. with cassava there is moisture more 15% usually fungi and insect appears in 2nd month, especially of store in gunny bag. The moisture under 13% insect appears in 4th month or 5th month depend of store facilities.

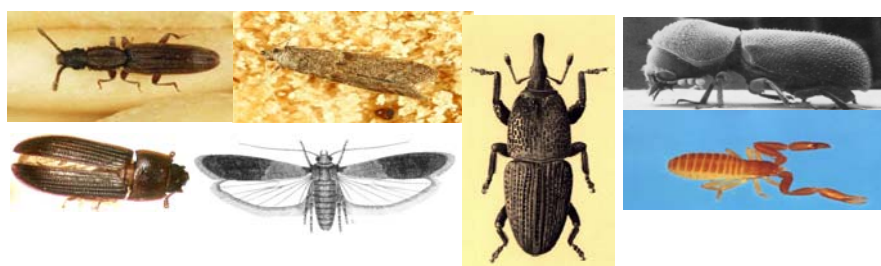


*Table 4: Insect appearance and density in storage facilities*

Period of Storage (Month)	Kind of insect in the different facilities and density				
	Iron round box	Steel box	Wooden box	Big jar	junny bag
paddy					

2nd					<i>S oryzae</i> +
3rd	<i>S oryzae</i> +	<i>S oryzae</i> +			<i>S oryzae</i> ++
4th	<i>S oryzae</i> + <i>S.cerealella</i> + <i>R.dominica</i> +	<i>Soryzae</i> + <i>S.cerealella</i> +	<i>S oryzae</i> + <i>S.cerealella</i> +		<i>S oryzae</i> +++ <i>Scerealella</i> + <i>dominica</i> +
5th	<i>S oryzae</i> ++ <i>S. cerealella</i> ++ <i>dominica</i> +	<i>S oryzae</i> ++ <i>S c erealella</i> + <i>R dominica</i> +	<i>S oryzae</i> ++ <i>S cerealella</i> +	<i>oryzae</i> +	<i>S oryzae</i> +++ <i>Scerealella</i> ++ <i>dominica</i> +
7th	<i>S oryzae</i> + <i>Scerealella</i> ++ <i>R dominica</i> + <i>C pusillus</i> + <i>O surinamensis</i> + <i>L pusillus</i> +	<i>S oryzae</i> + <i>Scerealella</i> ++ <i>R dominica</i> + <i>C pusillus</i> + <i>Osurinamensis</i> +	<i>S oryzae</i> + <i>Scerealella</i> ++ <i>Rdominica</i> +	<i>S oryzae</i> ++	<i>S oryzae</i> +++ <i>Scerealella</i> ++ <i>R dominica</i> +++ <i>L pusillus</i> + <i>Osurinamensis</i> + <i>L pusillus</i> +
<b>Maize</b>					
2nd					<i>Szeamays</i> +
3rd	<i>S Zeamays</i> +	<i>SZeamays</i> +	<i>S Zeamays</i> +		<i>S zeamays</i> ++
4th	<i>S Zeamays</i> ++	<i>S Zeamays</i> ++	<i>SZeamays</i> ++		<i>S zeamays</i> ++ <i>T castaneum</i> +
5th	<i>S Zeamays</i> ++ <i>T castaneum</i> +	<i>SZeamays</i> ++ <i>T castaneum</i> +	<i>S Zeamays</i> ++ <i>T castaneum</i> +	<i>S zeamays</i> +	<i>S zeamays</i> ++ <i>T castaneum</i> +
6th	<i>S Zeamays</i> ++ <i>T castaneum</i> +	<i>S Zeamays</i> ++ <i>Tcastaneum</i> +	<i>S Zeamays</i> ++ <i>T castaneum</i> +	<i>S zeamay</i> +	<i>S zeamas</i> ++ <i>Tcastaneum</i> ++

Note: + low level (under 5 adult/kg); ++ medium level (5-10 adult/kg);  
 +++ high level (upper 10 adult/kg)



## 2.4 Insect management of different storage owners

- The farmer control insect by traditional method as they are using sunshine to drying their agro-product .40% interviewed person storage Paddy with moisture is 12%, maize with moisture 10%. 60% interviewed person storage paddy with moisture more 14% and maize with moisture more 14%.

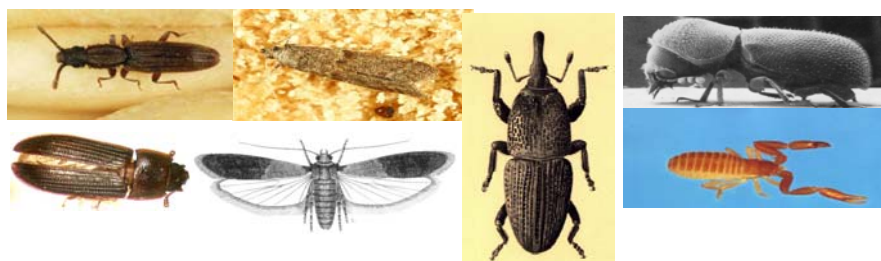
There are very less storage owners used biological methods for monitoring storage insects as botanical

## Chemical method was not used in stores of on-farm households

On-farm household usually re dry by sunshine when insect appearance for monitoring storage insects

2nd					<i>S oryzae</i> +
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4th	<i>S oryzae</i> + <i>S.cerealella</i> + <i>R.dominica</i> +	<i>Soryzae</i> + <i>S.cerealella</i> +	<i>S oryzae</i> + <i>S.cerealella</i> +		<i>S oryzae</i> +++ <i>Scerealella</i> + <i>dominica</i> +
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Note: + low level (under 5 adult/kg); ++ medium level (5-10 adult/kg);  
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## 6. Insect management of different storage owners

- The farmer control insect by traditional method as they are using sunshine to drying their agro-product .40% interviewed person storage Paddy with moisture is 12%, maize with moisture 10%. 60% interviewed person storage paddy with moisture more 14% and maize with moisture more 14%.

There are very less storage owners used biological methods for monitoring storage insects as botanical

Chemical method was not used in stores of on-farm households

On-farm household usually re dry by sunshine when insect appearance for monitoring storage insects



### 3 The main cause of Post harvest loss of agro-products.

Through field surveys and discussion of opinion with farmers and local officials, the main reasons for post-harvest losses of agro-products may be concluded as follows:

- a) Loss in harvest and transport;
- b) Loss in preliminary processing (threshing, shelling, drying, cleaning);
- c) Loss due to harmful bioorganisms (including storehouse insects, birds, rodents, poultry) and mold
- d) Loss coast because have to buy rude product (as high moisture content product)
- e) Loss of quantity because was harvest late.( Cassava and sugar can)

Paddy: The percentage of loss during harvest and transport is normally 1,5% the loss increase above 10% by field rat if harvest in long time. the loss due to premature harvest in case of rain, typhoon, flood leading to spoiled or germinated agro-products, depends on weather conditions. Especially, if the drying can not be done timely, the loss will be bigger.

Cassava: if harvesting too late, the rate starch in the fresh root will be able to reduce so much is estimated at 50% and qualitative loss at estimate 20%.

Drying under the sunshine normally requires 4-5 days, hence the loss rate due to spillage, pickings by birds, poultry, rodents... is estimated at 2%.

The damage caused by bioorganisms, on many aspects, may be concluded in following 3 main points:

- + Quantitative loss due to insects, birds, rodents, mold... which directly ravage.
- + Qualitative loss due to reduction of nutritive value, degradation of protein, lipid, vitamin in agro-product after being damaged by insects, birds, rodents...; the commercial value and using value are decreased. Agro-products will lose the initial characteristic color and taste.
- + Pollution and poisoning of agro-products due to the wastes and toxins, such as aflatoxin, emitted by poisonous fungus, thus directly impacting the consumers' health or transmitting diseases to people and animals.

In order to reduce to the minimum the post-harvest loss, attention must be paid to the reduction of loss in preliminary processing and drying activities, thus improving the quality of agro-products and preventing the penetration of insects, birds, rodents... into the stores.



Maize was damaged by insect pest.

The bio-chemical process is very active in agro-products due to high moisture rate. Drying agro-products in a reasonable time may reduce the loss of dry matters in agro-products.

The loss of agro-products during storage, caused by insects, birds, rodents..., is very big, about 3-6%, even 20-30% (in up land), it is depending on the conditions of each area. Therefore, it is necessary to prevent the penetration and destruction by these animals during the conservation of agro-products.

The ravage of insects and rodents leads not only to the quantitative loss but also to big reduction of commercial quality of agro-products. And the qualitative loss is not easily estimated. Agro-products may even be by 50% spoiled, polluted or intoxicated due to the secretions of insects and rodents.



## **4 Minimize post harvest loss, made increase income for household farmer**

### **4.1 Minimize post harvest loss in phase harvest.**

Quang Ngai is a province of central Vietnam. Rains, typhoons, floods often occur during the harvest of crops, therefore, drying agro-products under the sun has limitations. The loss may be raised to 30% due to untimely drying, leading to the qualitative reduction of agro-products. The change from 3 crops to 2 crops and using new varieties there is high productivity. In the phase harvesting more convenient than cultivation 3 crop. Area under cultivation 2 crops increasing and yield too increasing.

### **4.2 Minimize post harvest loss in phase preliminary processing.**

\*The reduction of loss rate while threshing in the field by set the thresher or shellier on the partition.

\*The reduction of loss while drying products. Including strew, birds, chicken and rat damage. Especially the loss rate will more if dry in long time.

The loss rate while dry very high. Especial harvest while raining. Therefore using dryer is very necessary for Quant Ngai farmers. especially cultivate crop 3rd

Good point:-Don't not depend weather.

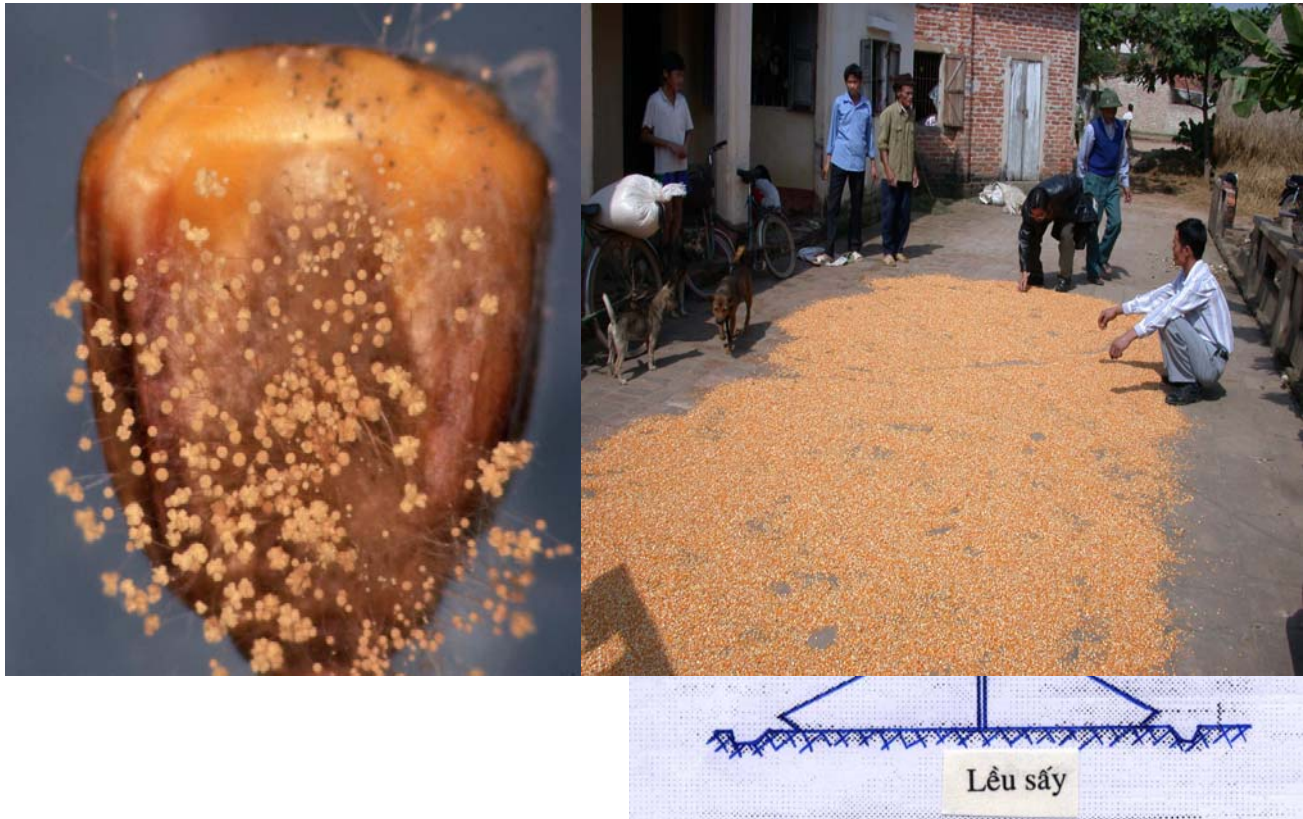
-time dry shorter.

-Loss rate smaller.

It is necessary to invest in building the drying yard from brick or concrete instead of earthen yard, other wise agro-products can be dried on canvas or bamboo mat, to prevent the products from mixing with earth, stone and impurities. Agro-products should not be dried on the road.

If the drying done timely, quality of agro-products higher and killed all most insects in the agro-products.

Especially with thin slice cassava need drying on timely, for preventing yeast operating grow in momentum and microorganism develop and damage



**Funguses**

**Drying maize**

### **4.3 Minimize post harvest loss in while preservation by insect and mice.**

If use appropriate facilities for stored agro-product will prevent insect penetrate and developing. Concomitant to stop bad impact of weather as moisture and temperature of air with the quality of agro-products. Quang Ngai farmers are using different facilities for conserving agro-products

#### **5.3.1 Conservation in jute bags, fabric bags**

Good points: Low-cost, easy use

Weak points:

Impossible to restrict the impact of bad environmental conditions; only after 2 months, the moisture of products (paddy rice, corn...) increases and becomes favorable for insects and mold to generate and to develop.

Impossible to prevent the ravage of rodents, therefore this damage is very important.

#### **5.3.2 Conservation in metal container and, barrel**

Good points: Possible to prevent the damage caused by birds, rodents.

Weak points: As it is made of 0.5-0.8 mm sheet iron, a metal or wooden strengthening bar is needed. In case of parallelepiped shape, the container can not be completely cleaned, insects or grains may be left inside.

The grains left in the corners of the container are not easy to be taken out; after a long-time conservation, these grains may cause partial moisture, lumping to stored products, hence facilitate the development of insects and mold.

The wooden container is made of poor quality wood; after a short time, there are splits and slits, from which insects and rodents may penetrate. It is also not easy to clean.

Improved equipment can overcome the weak points of existing facilities.

The equipment is made of zinc plated sheet iron of 0.5-0.8 mm thickness; the body of cylindrical shape can be easily manufactured; strengthening ribs are made on the body to reinforce it instead of supporting bars, therefore the surface is smooth. The body is divided into 3 parties for an easier manufacture and the 3 parties may be detached separately for a better cleaning after each storing cycle.

-The container bottom is made with a conic shape of 60<sup>0</sup> taper, corresponding to the self flowing angle of grains (rice, corn ear, beans...), thus it is easy to take out grains.

-The outlet gate is arranged at the middle of the body, so that the container is always in equilibrium, stable, not tilting or falling down.

-A regulator is provided for adjusting the quantity of products to be taken out; the products are removed from the upper part to the lower part and the products can be regularly stirred.

-The equipment is set on 3 legs for isolating from humidity of the ground.

During the demonstration and essay before farmers, it is necessary to show them the following good points of improved facilities:

-The products may be taken out from the upper part to the lower part;

-After each storing cycle, the container may be dismantled into parts for cleaning; all insects and grains of the previous harvest may be entirely removed;

-Grains of the lower part may be moved to the upper part for aerating inside the container, avoiding the partial or total moisture increase in the stored products.

-The impacts of bad weather conditions upon the stored products are limited. The contamination of insects from the previous harvest to the next one as well as the generating and development of new insect is restricted. The ravage of such harmful animals as birds, rodents... is also prevented.

-The height of the container may be extended for saving the occupied area in farmer's house.

#### 4.4 Storing facilities with improved structure:



Wood box.

storage tent.

#### V. Determine size of technology operation to reduce the post-harvest loss

On the basis of post-harvest agro-product conservation science and technology, technical situation and conservation means of local farmers, agro-product conservation technology process at the scale of household includes following measures:

- 1.To harvest in time
- 2.To improve product preliminary processing and selection in order to protect against insect contamination from the field to home.
- 3.To use suitable storehouse and containing facilities to restrict the environment's bad effects.
- 4.To improve cleaning operations for the storing place and storing facilities to protect agro-product against insect contamination from previous harvest to the new one.
- 5.To use physical methods such as sieving, drying, stirring ..act.. and to apply insect control procedure to the storehouse.
- 6.To use biological measures such as the restriction of moisture absorption, heating, vaporizing, fermentation and decay etc. in order to control insects in the storehouse.
- 7.To use natural compound to protect against insect pollution and to minimize the usage of chemicals.
- 8.To strengthen the propaganda for everybody, to organize training course for cadres and farmers aiming at providing the post-harvest technology knowledge and awareness to farmers.

*These measures will be properly applied as follows:*

**a)Prevention the generating and contamination of insect and weevil during harvest and preliminary processing.**

+ **Harvest:**

Agro-product must be harvested at its matured ripeness. If the harvest is too soon, the seed structure is not completed, the high content of water in the grain will cause difficulty to preliminary processing and drying. For each variety, ripe level for harvest is different. For example, local corn can be harvested at waxy ripeness or crossbred corn can be harvested according to seed supplier's instruction. In unfavorable condition, the harvest is to be done very fast to avoid accumulation of too much water in the grains, which may affect agro-product quality and facilitate development of mold and weevil. With cassava if harvest too late (cassava two years) percentage of starch reduced so much may 30-50%, and coast reduce.

+ **Preliminary selection:**

Purpose: to protect against harmful insect contamination from the field to home

The selection is carried out:

- According to crossbred variety and local variety.
- According to ripe level (premature ripeness and matured ripeness)
- According to type of agro-product (corn, rice) polluted and destroyed by insects in the field (gnawed by rat, moldy, eaten by weevil and other damage). Depending on damage level and insect pollution, decision on whether using or eliminating the products shall be made in order to avoid the contamination to good products.

+ **Preliminary processing:**

Purpose: to improve the quality of agro-product

To shell for separating grains will make drying process easier and will create equal quality in terms of:

- Ripeness
- Moisture
- Homogeneity of grain or corn ear size (for corn ear conservation)
- Polluted type of product and unpolluted type of product.
- Impurity ratio
- During preliminary processing, appropriate techniques must be applied so that the number of broken grains is minimized. Broken grains must be separated.
- The sorting in good product and bad one will make drying process most effective and will prevent insect contamination from the field to home.

+ **Drying**

Purpose: Drying purpose is to chase insects off the grain of agro-product and to inhibit their generating and development during storage.

Agro-product drying in reasonable period right after harvest will stop the development of insects or destroy them, ensure product safe moisture before storage. Under effect of heat, insects may die or fly away. Drying is an important operation as it determine agro-product storing quality.

*a) Sun drying:* This is a simple, economical, easy to apply drying method that requires low initial investment. Sundries agro-products are cleared of insects and have improved quality. Moreover, under solar radiation any mold will be destroyed. When sun drying is applied, following points must be taken in consideration:

-Dried layer must not be too thick (about 10 cm). After every one hour, dried grains must be stirred up so that every point can be evenly heated.

-Dried grains must be raked into separate beds for leveling radiating heat contact.

-Under the sunlight, insects and worm can move out every where or shelter in some gap or interstice. The drying yard should be coated with a cement layer of dark color and should be sloping so as to favor water draining. Earthen yard should be lined with bamboo or plastic mat (preferably of dark color)

+ **For corn:** Drying should be carried out with entire corn ear until a suitable moisture is got for shelling operation or for corn ear storage. Corn husk can be bound together in cluster for hung-drying and for storage.

Drying can be performed with lattice for reducing drying yard area and for quick gathering when necessary – Drying lattice can be made from bamboo, wood or steel and can be arranged in 5 to 7 levels all sloping towards the sun.

- When corn ear is dried it will be shelled - The seeds will go on to be dried until safe moisture to prevent worm to be generated during storage.

*b) Machine dryer:* To enable storage of agro-products at one's free will when harvest is carried in unfavorable weather conditions (prolonged rain, too high air humidity) we can apply artificial drying, using artificial heat to reduce water content in agro-products.

+ Rice will be dried at maximum Temperature of 40-50<sup>0</sup>C

+ Maize will be dried at maximum Temperature of 80<sup>0</sup>.

Drying is normally performed by means of normal dryer or drying oven. Drying operation must ensure even distribution of heat, with temperature not too high which can affect agro-product quality. During drying process, moisture must circulate and get out regularly – Simple dryer, with good maneuverability, normal electric fan, low power consumption is suitable to farmer house hold conditions. Under heat effects, insects and worms will die, a number of them can fly or move out to surrounding area, therefore surrounding area must be regularly cleaned.

- Drying at high temperature will affect agro-product quality, especially that of reproductive seeds.

**\* Dryer can be used as on-the-spot short term storage equipment for agro-product.**

According to research out come of Institute of Post-Harvest Technology on drying and storage of rice paddy and corn reproductive seeds within household, we have following data:

-In case of cutting-shelling-artificial drying, husked and polished rice recovery rate will be 68.88%

-In case of cutting-shelling-sun drying this recovery rate will be 67.54%.

This shows that, dryer is more efficient than natural drying.

+ *Cleaning and sorting operations have following purpose:*

-To get rid of impurities, insect carcasses.

-To homogenize seed size, to eliminate under matured seed, abortive seed, broken seed.

-To sort as per using purpose.

-To sort as per storing period.

In order to ensure storing quality, normal sieving and blowing methods can be applied so that impurities such as earth and gravel particles, garbage debris, abortive seeds, worm-destroyed seeds, broken seeds will be eliminated before putting the products in storage.

+ *Cooling*

Purpose: To avoid local increase of moisture which can favor the development of worm.

As agricultural seeds have low thermal conductivity, after drying (natural or artificial), dried grains should be put at aerated area in order to lower the temperature of dried- product mass before putting it in storage, to avoid later steam evaporation and accumulation due to temperature difference between day and night time or between indoor and outdoor space, or between inside and outside storage facilities.

**b) Prevention and destruction of insects during agro-product storage.**

+ *Cleaning storage facilities and place*

Purpose: To prevent insect and worm contamination from previous crop product to new crop product.

Storage equipment must be absolutely cleaned before putting stored product inside, because insect and worm live normally in gap and interstice of equipment. Cleaning, drying and chemical spraying can be applied. Some existing storage equipments are difficult to clean and not convenient for material putting in and taking out. Improved storage equipments should be used. These equipments meet any requirement on storage and are easy to clean and convenient for material putting in and taking out.

-For corn ear storage: This storing method is better because the seeds are still sitting deep in the cob, therefore insect can hardly penetrate into and aeration will be better. Moreover whole corn ear storing method will ensure better quality of seeds.

-However whole corn ear storing method normally required much area, much drying time, much room during transport, many packages or holding containers.

### + *Seed moisture control*

Purpose: To keep seed moisture at safe level

-During storing process seed moisture evolution must be regularly monitored. If any moisture increase is detected which can cause disadvantage to storing process, stored products must be dried naturally or artificially to moisture <13%

+ At 8-10% moisture, weevil and fungi can not appear and to earn one's living.

+ At 11-13% moisture, weevil will develop very slowly

+ At 14-16% moisture, weevil will reproduce and develop with high speed.

Seed moisture should be kept at 11-13% level because it will limit the reproduction and development of weevil and will reduce drying time and cost. Because reduce moisture of agro- products smaller 10% will spent so much money and time

#### \* *Seed moisture checking method*

-For paddy: Using hard objects to rub strongly the paddy grain, if the husk is detached and the rice grain cracks between the teeth, the moisture is acceptable. That main moisture of paddy estimate approximately 12%-13% Very good for store.

-For corn ear: if the cob appears to be dry and the seed top is found hard under digit nail, the moisture is acceptable. That main moisture of maize estimate approximately smaller than 15% Very good for store.

-For corn seed: using digit nail to press on the seed flank if the seed is found hard and no oil flows out, the moisture is acceptable. That main moisture of maize estimate approximately 11%-12% Very good for store.

-For dry thin slice cassava: Break by hand, so moisture estimate approximately smaller 13% very good for store.

### + *Seed mass temperature control*

Purpose: To keep temperature unfavorable to the development of insect and weevil and to condensation of steam.

During storing process, the stored seeds absorb and discharge a specific heat quantity. Along with activity of microorganism, this phenomenon can provoke heating inside the seed mass and stored product can be damaged. The seed mass must be stirred up so that heat can get off. Storing equipment that can facilitate stirring operation should be used. Keep temperature in the store facility the same of air

### + *Insect control*

Purpose: To detect harmful insect and to timely taking treating measure in order to prevent insect transmission and keep low the storing cost.

-Insect control is one of key operations in storing process.

-What is to be done is to prevent the transmission of insect into the stored product mass. Any risk of insect generating and developing must be prevented.

-If insects are generated and developed with big quantity in a product mass, this mass must be isolated from the other ones and must be used immediately in order to limit insect contamination harmful effect.

-Insect can be chased away and destroyed by using such methods as; physic-mechanical method (sieving), heat treatment (drying under sunshine or with dryer), vegetal based method (insect inhibition and destruction), chemical-based method (product preserving drug). In actual conditions of store house and holding facilities which do not meet technical requirements, in order to avoid bad impact on environment and human health, agro-product preserving drug of vegetal origin should be preferably used.

-Therefore reduce post harvest loss by prevent insect method more effect than exterminate insect method. Because the loss to exterminate insect including the loss by insect damage and to pay more for insecticide, salary and other. If to preventing insect only to pay a salary and other.



## 5 Selection of field rat killing methods.

In order to kill field rat with high effectiveness and to ensure safety for rat's enemies such as cat and dog, rat killing methods like ratraps and destroying the rat hole should be used, namely:

-Now semicircle shaped rattrap is used by farmers in many areas. This trap is simple and very easy to use. The bait may is a piece of sweet potato. It costs only 600-1000VND per set.

If usually check, may catch 3-4 units per trap. The rat can be trapped in nighttime and in the daytime.

-To find out the rat hole and then to destroy them by digging or sending smoke into the hole.

If regular use two this methods are will be minimize a significant rat on the field.

-To use trap cultivated crop high effect in the lowland.

-To use biological poison produced by Institute for Plant protection, Ministry of Agriculture. Poison composition includes microorganism causing disease only for rat mixed with sprouted paddy. This poison has no effect on other animals and people.

-In the rain season , all most cultivate area under the water. A lot so much Rats move to upland of the field. Therefore very convenient for control them.

-Cultivate area in Quang Ngai small, especially on the upland cultivate area is stair and com between hills and mountains. Therefore Rat control by some species unstudied enemy of Rat such as :Cat, scop-wil, Kite, weasel vv....

+once Cat in once year can arrest 500-600rats.

+Once scop-wil in once summer season can arrest 1000 Rats.

+Once Kite in the once day and night can arest8-9 Rats

+Once Weasel in once jeer can arrest 300-400Rats .

Therefore encourage farmer bring up Cat and protect unstudied enemy of the Rat will be minimize of population of Rat.

Field rat.



house rat.



## 6 Dryer for thin slice cassava

As know that. Agricultural production in location is small and farmer still very poor. for preliminary processing agro products timely and better. There are some small equipments may be appropriate with household as following:

### 6.1 Dryer tent use sunshine.

Machine dryer appropriate with dry thin slice cassava need big surface. Therefore Dryer tent very appropriate to drying cassava.

#### *Some technical parameters*

1. Kind	BS – 4 – 6
2. dry area, m <sup>2</sup>	150 – 200
3. capacity of drying, ton	4 – 6
4. Inside temperature °C	
- Summer season	50 – 60
- Winter season	35 - 45
5. reduction of moisture, %/h	1,5 – 1,8

#### **Operation principle**

the dryer tent using solar energy and operates following the principle of natural thermal convection

Good points of dry tent are:

-Drying agro-products in rain season don't depend on condition of weather. So dry time will shorter, minimize agro-product scatter and minimize the impurities.

-Temperature inside higher than out side because of there is effect class house ,and ability escape quicker than drying on the courtyard.

-The cost price has been fitted up very cheap

-Look for materials without difficulty

#### **Design.**

Include -frame was made from metal or bamboo.

-Roof was covered by the transparent PE thin layer.

-The foundation of a dry tent was made from refinedbridc or cement.

-Around there is drainage ditches

-There are two tent doors in two head to the circulation of wind and moisture.

-Two doors through from east south to west north

### Using.

- Agro-products was spread regular the surface high from 5-10cm
- After one hour need upset for equal leave the moisture.
- while dry, if there is rain, using film plastic or other convert for two head of dry tent

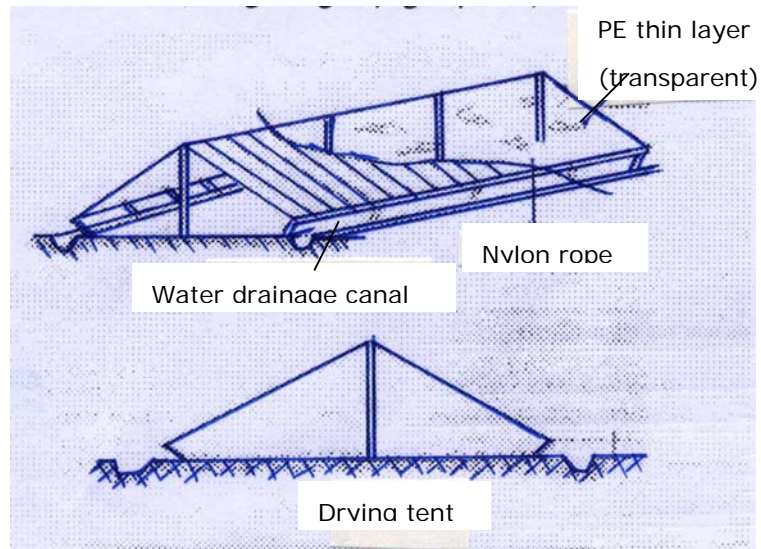


Fig. 5 Convection drvina tent BS-4-6

## 6.2 Some equipments For preliminary processing and store agro-product with appropriate with household

### 6.2.1 Machine use preliminary processing agro-products.

Manual slicing implement for cassava and sweet potato:



Fig. 2. Manual Cassava slicing implement

### Technical specifications

Capacity, kg/h	50-80
Thickness of slices (adjustable), mm	3-6
Weight, kg	4
Type of power	manual
Price, VND (reference only)	90,000
Installation conditions	At household
Number of operators, persons	1

➤ Pedal slicing implement for cassava and sweet potato:



Fig. 4 Cassava pedal slicing implement

### Technical specifications

Capacity, kg/h	120-150
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Thickness of slices (adjustable), mm	3-6
Weight, kg	30
Type of power	pedal
Price (for reference only), VND	400,000 – 450,000
Installation conditions	a group of households
Number of operators, persons	1

- Simple maize sheller and slicing implements for cassava and sweet potato could be demonstrated to relieve labour intensity of the farmers and enable convenience for drying stage.



Fig. 1 Manual maize sheller

#### Technical specifications of manual maize sheller

Capacity, kg of grain/h	40 - 70
Weight, kg	7.5
Type of power	manual
Price, VND	95,000
Installation conditions	At household or a group of households
Number of operators, persons	1
Scale of service	2 or 3 households can share 1 piece

### 6.2.2 The equipment for storing of agro-products is a tight equipment which may prevent the penetration of insects and harmful animals

**from outside. The storing equipment has cylindrical shape and is composed of two different parts: container and bottom.**

**a. Container:**

This is made of a flat sheet iron bent-rolled into a cylinder with bent edges and strengthening ribs; the mouth of the cylinder has no special characteristic, but the lower embouchure is made a little smaller so that when cylinders are inserted each to the other, we will have an empty, solid, long cylindrical tube. This long cylindrical tube is considered as a container.

**b. Bottom:**

The bottom is made of iron so that it can withstand the pressure without deformation or distortion. It is of a funnel shape, closely fixed on the 3 legs like a tripod; the distance between the bottom and the ground surface is at least 20 cm to prevent humidity effect from the ground and to facilitate the discharge of products through the bottom outlet of the funnel. The outlet is easy to close or open. Inside the funnel, there is a conic device which can facilitate regular flow of materials.

**c. Installation:**

The container may be installed at a convenient place, indoor or under the sheltered veranda; not to install it in a humid, stuffy place. The surface of the ground must be plane, ensuring the solidity and stability during the process of storage, loading and unloading of products.

The installation is implemented with the following steps:

Step 1: To verify the equilibrium and stability of legs; put the bottom frame on the legs. The legs and the bottom part of equipment must be equilibrated and stable to ensure its effective use and the safety for users.

Step 2: After the installation of bottom, the container is installed.

The joint of cylindrical container must be on lower side and closely filled with the inner diameter of the bottom frame.

Step 3: The products are loaded into the container until 20 cm under its mouth – another container section can be installed on the lower one and the loading will continue.

Step 4: To verify the container. Not to use more than 4 sections in a container, because it is difficult to load products if the container is too high. The highest surface of products must be 20 cm distant from the highest mouth of the cylinder for a better aeration and for putting the cover on the top.

The container for conservation of agro-products made of sheet iron is a cylinder of 1 m diameter, composed of 3 parts:

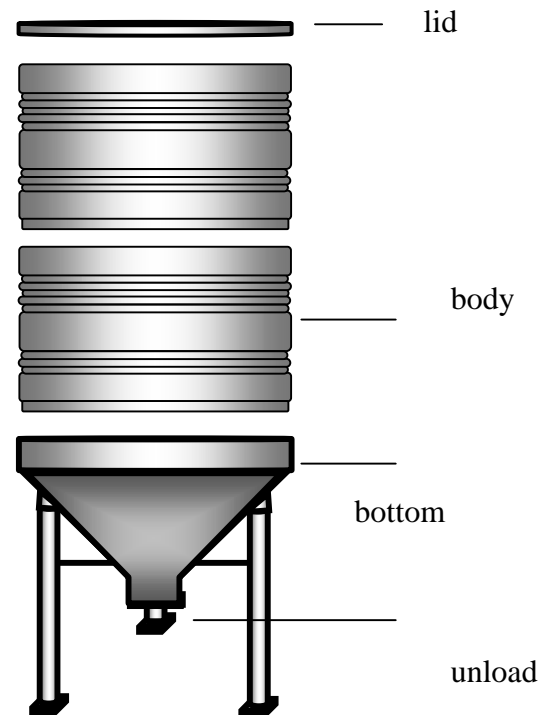
+. Bottom: a conic funnel with three legs with outlet gate at the middle which can be easily closed or opened.

+. Body: composed of 3 sections, 0.5 m high each, with strengthening ribs; the container section may be easily installed by closely fitting each on the other and can be easily dismantled. The number of sections may vary depending on the quantity of products to be stored. If necessary, different container are loaded with different products.

a complete equipment with the following good points:

\*Container is in accordance with the quantity of agro-products to be stored.

- \*Easy installation, dismounting and cleaning after each storing cycle, avoiding the products left from the previous harvest; easy unloading of the products;
- \*Possible to avoid heating and partial lump of products;
- \*Easy installation in farmer's house;
- \*Good aeration conditions in the mass of product thanks to the stirring possibility, hence the moisture and temperature of products may be regulated.
- \*The volume of products to be stored varies from 0.35 to 1 ton.



This type of equipment may be locally manufactured with locally available materials.

Therefore, in order to reduce the post-harvest loss, attention must be paid to the preliminary processing, including drying, to raise the quality of agro-products, take the initiative in preventing the ravage of harmful animals.

### 6.2.3 Grain dryer

a) Machine dryer: The dryer operates following the principle of thermal convection, including the cylindrical drying chamber and the heat supply net cage inside.

It has a lot of good points: compact and light structure, simple, easy use, low-cost. It may be used for drying paddy rice, corn, peanut, beans..., appropriate for use in middle and small farmer households in remote and mountainous areas.

The consumption of electricity is small; slack coal, compressed slack coal may be used as combustible.

Operation principle:

The SH1-200 dryer is a type of static dryer, with natural or forced aeration; for each batch it can dry 180-200 kg of paddy rice, or 220-250 kg of maize. It operates following the principle of convection.

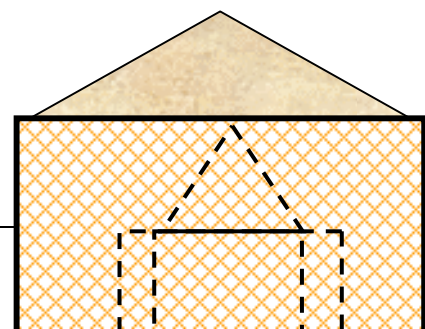
***Some technical parameters:***

- Capacity of drying paddy rice: 200 kg/batch
- of moisture: 0.6-0.7%/hour
- Drying duration: depending on weather and humidity of agro- products to be dried.
- Furnace: Compressed slack coal oven type
- Combustible: Compressed slack coal
- Combustible consumption: One piece of compressed slack coal/in 4-5 hours
- Power of pan: 135W
- Drying cost: 40-100 VND/kg it was depended at early moisture of the agro-product
- Installation conditions At household or a group of households
- Number of operators, persons 1

***Maintenance of dryer:***

After each harvest of paddy rice or maize, the dryer may be used for drying peanut, beans etc... After the harvest, the dryer must be dismantled into parts and conserved in a dry place, avoiding shock, rust (especially joints and net cage). The container of the dryer, may then be used for the storage of agro-products. After filling dried agro- products into the container, the products must be covered with canvas or plastic to protect against rodents, insects and humidity. The container may also be dismantled into parts and conserved in a dry, aerated spot.

The structure of this dryer is as follows:



Container ←

fan ←

Brazier ←

Machine dryer SH1-200 and rant dryer using sunshine very convenient for farmer of Quang Ngai province

- 1-Container (for holding paddy rice, corn, beans...) made of steel mesh or bamboo mat;
- 2-Heat supply chamber, made of steel mesh and sheet iron;
- 3-Outlet gate (for stirring and unloading agro-products), made of sheet iron of 2mm thickness;
- 4-Container bottom, of truncated cone shape, made of 2 mm sheet iron;
- 5-Hot air conduct, made of 2mm sheet iron;
- 6-Heat reception chamber, made of brick or 1mm sheet iron;
- 7-Furnace, made of brick or 2mm sheet iron;
- 8-Electric fan.

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## 7 Suggestion.

### *Extension of port harvest IPM in household*

#### *Introduction:*

Higher yields of many crops, particularly grain, and cassava especially dry thin slice cassava, have been achieved as a result of the development and implementation of efficient crop production and protection practices. It is essential that the availability of grain and other agricultural products is consolidated by the development of effective storage practices to minimize losses in stores. Recently, port harvest IPM is considered as an effective solution in controlling pests for product warehouses, especially for households. income generation and livelihood for farmer

Insect infestation produces losses, due to contamination of the grain with insect frass and fragments, due to molding resulting from moisture production and heating consequent on insect's metabolites, and finally weight losses due to actual consumption of the grain by insects. Reliable data on losses caused by pests in modern stores as well as in traditional grain stores in the developing countries are rarely available, but commonly an average 1% loss in industrialized countries contrasts with 10-30% in developing countries, where the high yield in the field linked with improvements to protect the harvested products in store. Nowadays, the safety of the workers and the environment as well as product quality represent significant issues of high priority. For the protection of stored agricultural products, port harvest IPM can be adopted in the context of a close system such as a agro-products store, warehouse, food processing factory or household.

In Vietnam, there is no any effective pest management method used for household. In addition, awareness of the farmers about storage is poor. Thereby, losses of grain due to insects are unavoidable.

So, it is necessary to change awareness and habit of the farmers, and to supply them with the port harvest IPM advanced agro-products storage methods. Besides, it is important to set up procedure of agro-products storage toward port harvest IPM and the field trial.

#### *Method of the training:*

- \*Providing Port harvest IPM brochures to farmers.
- \*Listening to farmers' responses.
- \*Discussing problems occurring during harvesting, preliminary processing and storage.
- \*Introducing some simple ways to solve the problems which may happen to commodities during storage.

Contents of the training courses:

- Introducing the situation of grain storage in the world.
- Providing the farmers with pictures and data of the quantity and quality losses of the stored products caused by insects, mice and main causes of crops' quality deterioration during storage on household scale and on-farm.
- Supplementing knowledge of Stored- product insects such as ecological, biological character, damage level, how to identify and detect insect in grain etc.

- Characterizing grain such as grain's alive activities occurring in storage, quality changes of some agricultural products (maize, paddy, cassava) during storage...
- Providing the farmer with methods control insect and mice.
- Using botanical in product storage. minimize use insecticide
- Warehouse and facilities used in storage including advantages and disadvantages using conservation system
- Discussing on post harvest losses at household farmer by interaction way such as:
  - +Harvesting and transfer.
  - +Preliminary processing.
  - +Drying



#### Guide of the stored maize for farmer on up land

- Discussing on post harvest losses while storage products at household case by interaction way such as
  - + preventing insect, mold and other bio-harmful
- . It means that participants make the question, the trainer answer and vice versa.
- Introducing some field trials and procedures of storage IPM including procedure steps, suitable facilities, appropriate storage methods etc.

Quang Ngai province is located in the central coastal region of Viet Nam. The sub-tropical has a bit high average temperature and humidity, so there are many factors such as biological, chemical and ecological factors that influence on agricultural stored products for center storage. We know that every solution has its efficacies to several harmful factors but IPM (the integration of people's awareness and biological, chemical, ecological, physical methods) is the most effective to barrier all catastrophic factors for agricultural products. From result of survey on current status of storage commodities in Quang Ngai provinces and the result should lead to an establishment of IPM storage procedure which is suitable for storage agro-product at households.

Establishing the procedure of the completed agro-products storage is useful reducing losses of post-harvest agro-products as well as cost of the storage. So, it is very appropriate with Quang Ngai farmers.

Moreover, the field trials of agro-products storage applying IPM procedure should be carried out at some households. The farmers and the extension staffs were trained on IPM procedure through not only lectures accompany with documents, brochures, pictures, but also practical field trials.

***Training focus:***

+ ***Prevention is main and minimize use insecticide to:***

-***Control insect.***

-***Control mice.***

+***Preliminary processing dry thin slice cassava.***

-***Dry technique.***