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CURRENT STATUS OF AGRO-PRODUCT STORAGE IN VIETNAM

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ABSTRACT

In 2001 to 2002 the Post Harvest Technology Institute (PHTI) of Vietnam interviewed 272 persons in a survey conducted in three different agricultural regions, comprising 9 provinces. Those interviewed came from farm households off-farm enterprises in the marketing-chain and central storage managers.

The purpose of the survey was to determine the current status of post harvest technologies with emphasis on storage facilities, storage duration, time of insect appearance and population density during storage, and methods of insect management including the use of phosphine and the role played by women in postharvest activities. In addition the distribution system of grain and of pesticides in Vietnam was mapped-out.

The survey revealed that in farmer households, traditional methods of insect management were employed, and women play an important role in post harvest activities. Off the farm traders and millers and at the national level, phosphine is used to control insects in maize and dried cassava at a dosage of 3 g/ton, and paddy at a dosage of 9 g/ton. However, the use of phosphine in storage is strictly controlled by the Government. It was found that insects usually make their appearance 3 months after maize and dried cassava enter into storage. Some insects are resistant to phosphine such as *Rhyzoperha dominica, Cryptolestes sp.,* and *Tribolium castaneum.*

INTRODUCTION

Location: The country of Vietnam lies from 23^{O} 24' North-latitude to $8^{O}35'$ South–latitude and from 102^{O} to 109^{O} longitude. Its area is 331,700 km^2, with 3,200 km of coast-line. Vietnam lies in the tropical zone and its climate is influenced by the rest of the Asian continent and the Pacific ocean. There are 2 seasons a year - a dry one and a wet one. From the Hai Van Pass, in the middle of the country ($16^{O}20'$ north) and northwards, a non-typical tropical climate predominates, with low temperatures in the dry season (sub-tropical in nature) with average temperatures of about $20^{O}C$ and average humidity of about 85-90%. From the Hai Van Pass to the south a typical tropical climate predominates, being hot all year round, with average temperature of about $25^{O}C$ and average humidity of about 85%. Rice is the major crop in Vietnam, which is self-supporting and is the second largest exporter of rice in the world. Second to rice is corn, followed by cassava, sweet potato, and other plant crops. In terms of yield: rice production is above 34 million tons per year, maize above 2.4 millions ton per year, cassava above 4 millions ton per year, and soybeans above 0.2 millions ton per year. (Statistics from 2002).

The purpose of the survey undertaken in 2001-2002 was to determine the current status of post harvest technologies with emphasis on storage facilities and storage duration. The time of insect appearance and their density during storage, and methods of insect management including the use of phosphine and the role played by women in postharvest activities were also investigated. In addition a study into the distribution system of grain and of pesticides in Viet Nam was carried-out under ACIAR project 137/98. Interviewed people were selected at random and information was collected based on a questionnaire.

RESULTS AND DISCUSSION

TABLE 1 Key information

Items	Total	Northern and central	Southern
Number of interviewed persons	272	228	44
– On-farm	210	188	22
+ Farmers	200	180	20
+ Location officers	10	8	2
– Off-farm enterprises	40	25	15
+ Traders	25	15	10
+ Milling companies	5		5
+ Feed companies	10	10	0
- Central storages	22	15	7
Number of provinces surveyed	10	8	2
Key information of interviewees (average values)			
- Age of interviewee		40	43
- Number of people/family		4	4
- Area of agricultural cultivation (ha/person) for on-farm households			
Paddy		0.12	1.21
Maize		3.3	
- Paddy productivity (kg/crop season) for on-farm households		950	4,335

ON-FARM HOUSEHOLDS AND THE COMMERCIAL SECTOR

On-farm households

Kinds of stored product

Rice paddy: 100% of the interviewed households stored paddy. Of the household interviewees, 60% stored rice at below 13% m.c., and 10% at 14% m.c.. The remainder stored rice at above 15% m.c..

Maize: The farmers usually sell about 80% of their maize immediately after harvesting at a moisture content of about 19-20%. The rest of the yield is stored at about 13%-14% m.c.

Storage facilities

The storage facilities in households varies, and includes iron drums, steel boxes, gunny bags and large earthenware jars. The capacity of gunny bags (jute sacks) and wooden boxes is smallest (200-500kg/unit) while steel boxes have the highest capacity (100kg/unit). PP bags contain 40kg grain.

In on-farm households, most of the agro-products are stored inside the home.

On-farm households in the uplands

Kind of stored products

Paddy: In the uplands (Including the provinces of: Son la, Ha giang, and Quang ngai) 100% of interviewees from the ethnic minority households stored paddy at very high moisture contents of about 19%-20% The Viet household stored paddy at about 14%-15% m.c.

Maize: The ethnic minority households stored corn-on-the-cob above the the kitchen at moisture contents of 16-20%. The Viet household stored shelled maize in gunny bags or metal drums with moisture at 14-16%

Cassava: In the uplands the farmer uses about 10% of the crop for animal feed as a fresh root crop available all year round. The rest of the yield is sold as fresh root crop for processing by starch companies, or is sold to traders as dry cassava at 15%-17% moisture content.

Storage facilities

On-farms storage facilities are different depending on the customs of the local people .

Paddy: 100% of the ethnic minority households store paddy at the top of the kitchen

The Viet households store paddy and milled rice in the iron drums (20%), steel boxs (50%), Wooden boxes (20%), large jars (5%), and gunny bags (5%).

Maize: 100% of the ethnic minority households store corn-on-the-cob at the top of the kitchen, while 85% of the Viet households store shelled maize in iron drums and 15% in gunny bags.

Cassava: was stored after being cut into slices and dried, usually in gunny bags or in iron drums.

Off-farm commerce

(small traders, cattle breeding households, rice processing companies, animal feed companies and private enterprises)

a. Kind of stored products:

Four major products are stored in commerce: paddy rice, milled rice, dried cassava and maize. In the animal feed sector most products for everyday use have a moisture content of about 14%-16%. The products for storage have moisture contents of about 13%-14%. In the rice processing companies moisture contents are about 13.5%-14%.

b. Storage facilities:

- Most of the small traders and cattle breeders use simple warehouses to store their products with capacities of from about 10 to 100 tons

Storage purpose and duration in different households

a. On-farm storage**:**

Paddy: There are big differences in the storage purpose and storage duration between households. Besides keeping their product for food, almost all those interviewed use it for feedings animals and sale as seed. The storage durations are for 4-6 months (70%) and 2-3 months (30%) respectively.

Maize: Maize in the household is stored for sale (60%), and for feeding to animals (40%). Duration of storing is 3-6 months (30%) in the lowlands and 6-8 months in the uplands. They use maize for feeding to animals with moisture contents of about 9%-14%.

Dried cassava: 70% of households are using it for feeding to animals, and 30% sell it at favorable prices.

b**.** Off-farm commerce

Small traders: store products for sale (milled rice, paddy, maize and other products), for processing, and for animal feed. Storage duration by the traders is usually less than one month,

Cattle breeders: store products with moisture of 13%-14% for feeding to animals. Storage duration may last until about 6 months.

Insect appearance and it's population density in different storage facilities

In paddy stores: five insect species appear in paddy storage at different times, namely: *Sitophilus.oryzae, Sitotroga.cerealella, Rhyzopertha.dominica Cryptolestes .pusillus, and Oryzaephilus .surinamensis*. *S. oryzae* appears earliest usually in the third month of storage in gunny bags and in storage under plastic sheeting.. By the fifth month of storage, all types of storage containers had been attacked by insects. Except for storage under plastic, paddy may become damaged as early as in the first

month because of storage at high moisture contents. Large jars being used for storage of seed were very successful.

In maize stores: The two species of insects attacking maize in storage were *Sitophilus zeamays* and *Tribolium castaneum* Insects appeared very early, even in the first month of storage in gunny bags. Density of insect populations increased during storage duration.

In the uplands corn crops were stored in the top of the kitchen, (kitchen ceiling) where insects appeared during the first month.

TABLE 2
Insect appearance and density in storage facilities

Period of Storage *(Month)*	**Kind of insect in the different facilities and density**				
	Iron drum	**Steel box**	**Wooden box**	**Big jar**	**Gunny bag**
Paddy					
2nd	-	-	-	-	*S. oryzae* +
3rd	*S. oryzae* +	*S. oryzae* +	-	-	*S. oryzae* ++
4th	*S. oryzae* + *S.cerealella* + *R. dominica* +	*S. oryzae* + *S. cerealella* +	*S. oryzae* + *S. cerealella*+	-	*S. oryzae* +++ *S. cerealella* + *R. dominica* +
5th	*S. oryzae* ++ *S. cerealella* + *R. dominica* +	*S. oryzae* ++ *S. cerealella* + *R. dominica* +	*S.oryzae* ++ *S.cerealella*+	*S.oryzae*+	*S. oryzae* +++ *S. cerealella*++ *R. dominica* +
> 7th	*S. oryzae* + *S. cerealella*++ *R. dominica* + *C. pusillus* + *O. surinamensis*+	*S. oryzae* + *S. cerealella*++ *R. dominica* + *C. pusillus* + *O. surinamensis*+	*S. oryzae* + *S. cerealella*++ *R. dominica* +	*S. oryzae*++	*S. oryzae* +++ *S. cerealella*++ *R. .dominica*+++ *C. .pusillus* + *O.surinamensis*+

TABLE 2 (continued)
Insect appearance and density in storage facilities

Period of Storage *(Month)*	Kind of insect in the different facilities and density				
	Iron drum	**Steel box**	**Wooden box**	**Large jar**	**Gunny bag**
Maize 2nd	-	-	-	-	*S. zeamays* +
3rd	*S. zeamays* +	*S. zeamays* +	*S. zeamays* +	-	*S. zeamays* ++
4th	*S. zeamays* ++	*S. zeamays* ++	*S. zeamays*++	-	*S. zeamays* ++ *T. castaneum* +
5th	*S. zeamays* ++ *T. castaneum* +	*S. zeamays* ++ *T. castaneum* +	*S. zeamays*++ *T.castaneum* +	*S. zeamays*+	*S. zeamays* ++ *T. castaneum* +
6th	*S. zeamays* ++ *T. T. castaneum*	*S. zeamays* ++ *T. castaneum* +	*S. zeamays*++ *T. castaneum* +	*S. zeamays* +	*Sy. zeamays* ++ *T. castaneum*++

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

+++ = high level (more than 10 adult/kg)

At the central storage level (for paddy, milled rice and maize)

Kind of stored products:

In the National Grain Reserve Storage: there are two main kinds of grain - namely paddy and milled rice.

In the other types of storage: including storage on State Farms, rice processing companies, private enterprises etc., three main types of grain are stored namely, paddy, milled rice and maize.

Storage facilities:

Almost all the stores are very old and simple. Consequently in these types of storage, the stored grain quickly absorbs moisture from the environment.

- ***In the North***: There are three main types of storage facility

Domed warehouses: these are made from bricks and tiles with capacities of about 100-300tons.

Sec-warehouses: The framework and roof are made from steel, and the walls are made of bricks. Capacity about 1000-3,000 tons.

Tiled roof warehouses: made from bricks and tiles with a capacity of about 1000 tons.

Paddy and milled rice are stored with moisture contents of less than <13.5%. Paddy is stored in bulk.. Maize is stored at less than 14% m.c.

- ***In the South***: 100% of storage facilities are "Sec-warehouses".

Paddy and milled rice are stored at moisture contents of less than 13.5% m.c. in bag storage. Most rice processing companies, animal-feed companies and private enterprises keep their products in "Sec- warehouses" with capacities of about 1,000 - 3,000tons.

TABLE 3
Kind of store products and storage facilities

Type of facility	Northern & Central stores		Southern stores	
	Capacity (tons/unit)	Applied store (%)	Capacity (tons/unit)	Applied store (%)
Kind of stored product				
- Paddy		73.3		14
- milled rice		26.7		86
Kind of storage facility				
- Domed warehouse	100-120	80		
- Sec- warehouse	2,500-3,000	15		100
- Tiled roof warehouse	300	5		

Purpose and duration of storage

For the National Grain Reserve Storage: 100% of the central storage is paddy and milled rice for with long storage durations of 24 months in the north and 12 months in the south

For the other owners: Including storage on State Farms, rice processing companies, private enterprises etc. the percentage of paddy in store for trading and processing for food and export is 71%, and the rest are products used for local food consumption. Storage duration is less than 6 months

100% of maize is stored for feeding animals with storage durations of 6-8 months.

Initial insect appearance and population density during storage

The times of initial infestation, species and population density of insects attacking central stores are similar to those of on-farm households and off-farm enterprises mentioned above.

TABLE 4
Insect appearance and frequency of insects in storage

Period of storage (months)	Insect species in different warehouses			
	Domed warehouse	Sec-warehouse	Tiled roof warehouse	Others
1st	-	-	-	-
2nd	-	-	-	-
3rd	*S. oryzae* +	*S. oryzae* +	*S. oryzae* +	-
4th	*S. oryzae* +	*S. oryzae* +	*S. oryzae* +	*S. oryzae* +
5th	*S. oryzae* +++ *S.cerealella* +++ *R. dominica* ++	*S. oryzae* +++ *S. cerealella*+++ *R. dominica* ++	*S. oryzae* +++ *S.cerealella* +++ *R.dominica* ++	*S. oryzae* +++ *S. cerealella*+++ *R. dominica* ++
6th	*S. oryzae* +++ *S.cerealella* +++ *R. dominica* ++ *C .pusillus* + *O. surinamensis*+	*S. oryzae* +++ *S. cerealella*+++ *R .dominica* ++ *C .pusillus* + *O.surinamensis*+	*S. oryzae* +++ *S.cerealella* +++ *R. dominica* ++ *C. pusillus* ++ *O.surinamensis*+	*S. oryzae* +++ *S. cerealella*+++ *R. dominica* + *C. pusillus* + *O.surinamensis*+
>7th	*S. oryzae* +++ *S.cerealella* +++ *R. dominica* ++ *C. pusillus* ++ *O. surinamensis*+	*S .oryzae* +++ *S .cerealella*+++ *R. dominica* ++ *C .pusillus* ++ *O. surinamensis*+	*S.oryzae* +++ *S.cerealella* ++ *R.dominica* ++ *C.pusillus* ++ *O.surinamensis* +	*S. oryzae* +++ *S. cerealella* ++ *R. dominica* ++ *C. pusillus* ++ *O.surinamensis*+

Note: + = low level (less than 5 adult/kg); ++ = medium level (5-10 adult/kg);
+++ = high level (more than 10 adult/kg).

INSECT MANAGEMENT BY DIFFERENT STORAGE OWNERS

There are very few storage owners that use physical or biological methods for controlling storage insects

Chemical methods were not used in stores of on-farm households either in the northern or southern provinces. They control insects by employing traditional methods

Twelve percent of off-farm enterprises in the north and 48% of off-farm enterprises in the south used different chemicals to control insects.

In the National Grain Reserve Storages, 100% of central stores in the north and 73% in the south employed chemicals to control insects including phosphine fumigation and Actellic or Sumithion as residual treatments.

Almost all stores were sprayed with residual insecticides at 2% concentration (Actellic and Sumithion) before harvested crops were taken into storage.

Usually after 6 months of storage infestations are controlled using phosphine fumigation at 9g/ton for paddy and 3g/ton for maize. Fumigation exposure periods are 5 days (in summer) or 7 days (in winter) after which, 3 days of ventilation are commonly allowed. Phosphine effectiveness is considered to be about 100%, and its effectiveness lasts about 5-6 months.

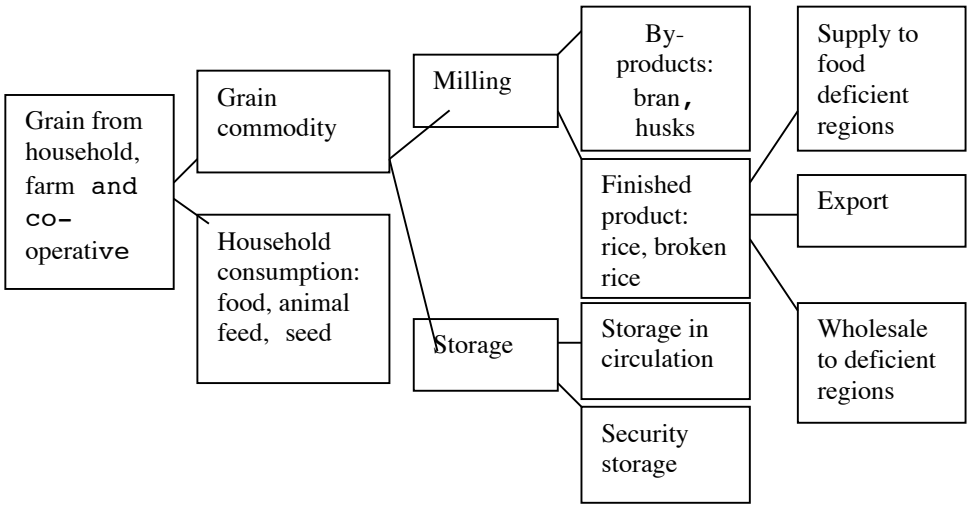
WEIGHT LOSSES

On-farm households: 3% per year for paddy; and 5,6% per year for maize. For on-farm households in mountainous areas (Ethnic minority households) weight losses are about 20%-25%, and in some places reach 35%-40%

Off-farm enterprises: Weight losses are approximately 1-3% per year.

Central storages: here weight losses are 1% per year for paddy and are close to 0% for milled rice storage, where storage is under CO_2

THE GRAIN DISTRIBUTION SYSTEM IN VIETNAM



CONCLUSIONS

1. Storage facilities for paddy and maize at all levels (on-farm, off-farm/agro-cooperative and central stores) are very old and simple. Most facilities were not able protect the products from being attacked by insects, rats, and birds. Products in containers were found to absorb moisture quickly from environment.

2. Insect attack the products at a very early stage of storage, usually from the 3rd month of storage for paddy and 2nd month for maize. The insects *S. oryzae, S. cerealella, R. dominica, C. pusillus and O. surinamensis* are the main insects in paddy stores and *S. zeamays* and *T. castaneum* are the main insects in maize stores

3. About 30-50% of households re-dry paddy for insect management in storage, but this method is very difficult during the wet/summer season. No on-farm households used chemical for controlling insect

4. Off-farm enterprises use different insecticides to control insects

5. At central stores, 100% of storages in the north and 73% of storages in the south used phosphine for controlling insects. But there are insects that are resistant to phosphine and Sumition which is used for controlling residual infestations.

6. There is a clear system of grain distribution as well as plant protectant distribution. Insect control by phosphine fumigation is very cheap and convenient . However, use

of phosphine in grain stores is controlled strictly by Government regulations. Farmers cannot buy or use phosphine without receiving guidance from professional staff and the investigators found that appropriate phosphine fumigation dosages should be applied when fumigating stored grain..

RECOMMENDATIONS

1. Further research and appropriate fumigation technology transfer should be carried out for control of insects in paddy and maize stores in following sectors:

All central stores (old stores)

> *For paddy*: On-farm households or off-farm enterprises and agricultural cooperatives where grain is being produced or stored in large quantities.
>
> *For maize*: Households in mountainous areas which store large quantities of maize separated from the living quarters so that it is safe to apply phosphine fumigations.

2. For on-farm households with smaller quantities of grain for storage, suitable techniques including air-tight containers, bio-protectants, small dryers, procedures for infestation management after harvesting, etc., should be researched, evaluated and transferred to farmers.