The Health Effects Of Pesticide Use

Methods To Conduct Community Studies With School Age Children

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I. Background

There is heavy indiscriminate use of pesticides in rural Thailand which promotes the propagation of resistant pests, degrades the environment, and reduces farmer profit margins. Many products that are in use are highly toxic to human health. For example in the Chiang Rai province one popular pesticide being used on cabbage crops is *methyl parathion* , an organophosphate. This product has been banned by most countries because it has an LD_{50}[1] level of 14mg/kg and is classified by World Health Organization as a Class 1a "extremely hazardous" substance[2].

Efforts to reduce the amount of toxic pesticide use in Thailand through policy on a national level have for the most part failed due to the power and marketing strength of chemical companies. Therefore, the focus of attention has turned to the consumer -farmer and his children. The integrated pest management program (IPM), which promotes traditional non-chemical methods for crop protection, operates in Thailand primarily through grass-roots communities and the educational system. Using adult learning methods, farmers and school children learn to solve pest -control problems by understanding the natural eco-systems through observation and experimentation on their own crops. Using non-chemical pest control strategies, farmers not only witness healthier crops that leave the environment safer but they also assess the economic benefits in spending less of their profits on expensive chemicals.

An additional component to that of ecology and economics in IPM is the issue of health. Previous studies elsewhere demonstrate that up to 21% of all spray operations result in 3 or more signs and symptoms of acute pesticide poisoning. The frequency of spraying, hazard level of pesticides used, and skin contamination while spraying either through direct contact or wet clothing are highly associated to poisonings[3]. Furthermore, unsafe pesticide storage and disposal pose considerable risks of accidental poisonings in children and contaminate water and food supplies.

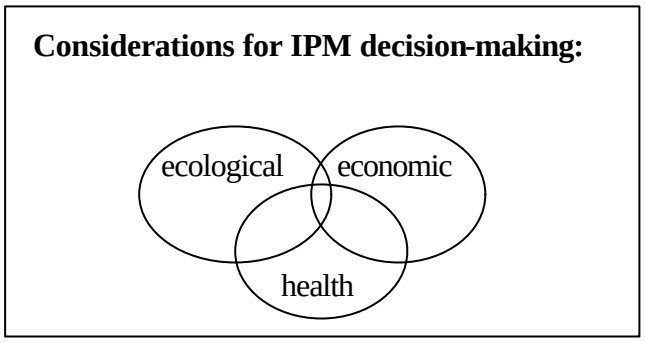
Consumer-farmers and their children need information about these personal and community health hazards in order to make informed decisions about the use of pesticides. Consistent with adult learning, discovery of this issue needs to come through community self assessments of these health hazards and health effects by school children. Health thus can serve as the third component to IPM experiential learning and be integrated into existing

[1] The LD_{50} value is a statistical estimate of the number of mg of toxicant per kg of body weight required to kill 50% of a large population of test animals.

[2] International Programme of Chemical Safety. The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 1996-1997. WHO/PCS/96.3.

[3] Kishi M. et al. Relationship of pesticide spraying to signs and symptoms in Indonesian farmers. *Scan J Work Environ Health* 1995;21:124-33.

IPM training as depicted below:



This paper describes this health component and how it can operated through classroom student projects.

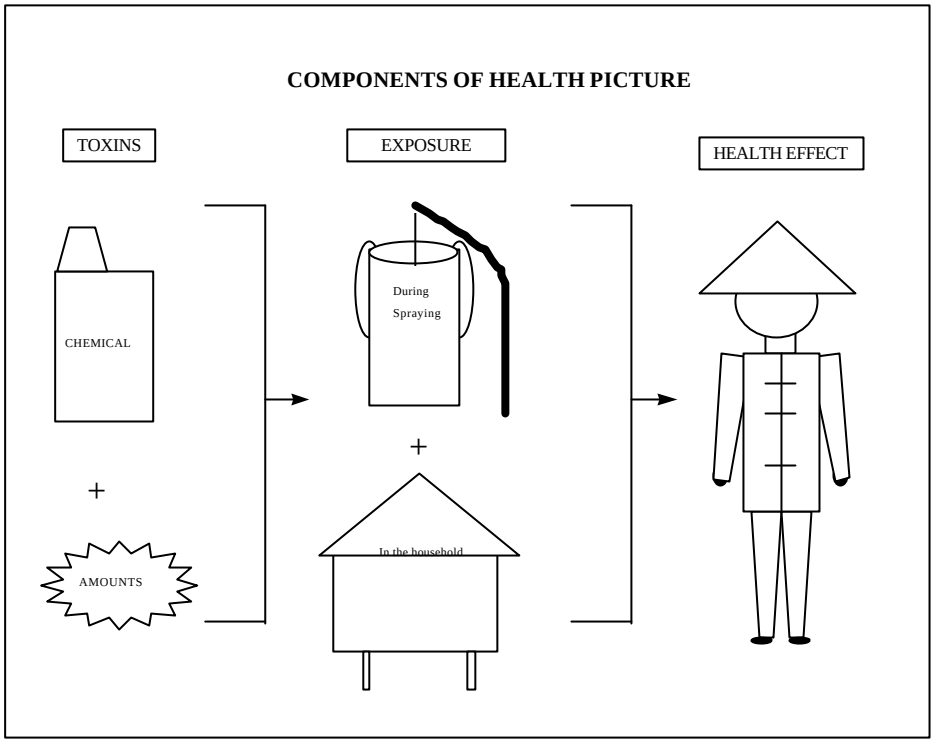
II. Rationale

Activities for this health component will be conducted with school children for a number of reasons. First we are educating a future generation who will be the primary beneficiaries of good personal health, a preserved natural environment, and a sound food-producing economy. Next, children can have an influence on protecting the health of their parents by making them aware of the health hazards of pesticides. In addition, the data generated from these studies remain in the community and will be used by the community for decision-making. Finally, the self-discovery learning that comes through conducting health studies in school children's communities can increase the student's skills in 5 adult learning areas:

* art
* math
* language
* teamwork
* critical thinking

To understand the impact of pesticides on human health, children and their families need to be aware of five different components that make up the health picture. This involves i) knowledge of the human health hazards of the chemical they are using ii) the amounts they are using over time iii) how they are being exposure while spraying iv) how they are being exposed in the household iv) and finally the acute health effects.

These five components make up the health picture on which students will gather information and present to their community. With this additional information discovered through IPM training, communities can make decisions about their own use of pesticides along with the ecological and economic benefits of non-chemical farming.



III. The Process Steps

Data collectors: Children of any age can be involved in these health studies. It is recommended that the older ones (11-12) be teamed up with those that are younger. For data analysis older children will be required to do the analysis. This will involve calculating totals, averages and percentages. Younger children can assist with the observations, recording through drawings, and adding simple totals.

Supervisors: Teams can be supervised by their teachers and or village health volunteers (VHV). The latter cadre will be essential if VHVs intend to collect data on pesticide poisonings as part of their routine active surveillance system.

Trainers: World Education staff with the assistance of the FAO epidemiologist are responsible for the curriculum development and teacher training. This can be in conjunction with a masters in public health student (MPH) from Chiang Mai University, if an interested and suitable candidate is found. Testing and revisions of the curriculum must be in consultation with the involved school teachers. The direct training of the students should be conducted by their teachers (math, science and health) with the assistance of those involved above with the curriculum development.

Steps: Data collection, analysis and presentation of the 5 topics (pesticides, amounts, household storage & disposal, spraying exposure, and health effects) can be done alone or together as a package step by step. For each component of the health picture the following general steps are recommended.

1. Provide information about each topic and why it is important for health.

2. Develop a list of data collection items with the students.
3. Design with the students the instrument to collect the data (questions, forms, pictures, tables etc)
4. Test the instrument with the students and revise as necessary
5. Select the sample of farmers and corresponding households in the class
6. Gather the data with student- to- student monitoring of the data collection
7. Analyze the data as a class together
8. Student preparation of the data for presentation
9. Present the results to the community for the discussion
10. Student self-assessment of the learning skills each has gained through the health study

IV. Technical Information

1. Pesticides in use

Learning objectives: Of those pesticides available, used , and stored in households, students will learn the brand names, common name, purpose (type), level of toxicity, and to which chemical family they belong (optional). With this information students and their families can be better informed about how dangerous each pesticide is to their health so that they can choose alternatives.

Brand names: the name by which their parents know the pesticide
Common name: the chemical name by which its hazard level is estimated
Type: the purpose for which the pesticide is used

- Insecticides = kills insects
- Fungicides = kills crop fungus diseases
- Herbicides = kills weeds that limit crop growth

LD_{50}: Human toxicity level. It is based on experiments with animals and is the number of mg of toxicant per kg of body weight required to kill 50% of a large population of test animals.(optional information)
WHO Hazard Classifications: World Health Organizations classifies most pesticides by common name in terms of their potential human health effects. These classifications are usually based on the acute oral LD_{50} levels.

- Ia = extremely hazardous
- Ib = highly hazardous
- II = moderately hazardous
- III = slightly hazardous
- O = unlikely if used safely

This table* below can be used optionally:

Class	LD_{50} for the rat (mg/kg body weight)	
	Oral	
	Solids	Liquids
Ia = extremely hazardous	5 or less	20 or less
Ib = highly hazardous	5-50	20-200
II = moderately hazardous	50-500	200-2000

III = slightly hazardous	500-2000	2000-3000
O = unlikely if used safely	over 2000	over 3000

* Adapted from International Programme of Chemical Safety. The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 1996-1997. WHO/PCS/96.3.

Chemical family: Each pesticide generally belongs to a chemical family on which general health effects are known. This information can be optionally presented to the students after data collection:

- **Organophosphates:** disturbs the peripheral nervous system (long acting)
- **Carbamates:** disturbs the peripheral nervous system (short acting)
- **Organochlorines**: disturbs the central nervous system (long acting)
- **Pyrethroids**: irritant to eyes, skin, and respiratory tract
- **Thiocarbamates**: irritant to eyes, skin, and respiratory tract
- **Paraquat:** irritant to skin and upper respiratory tract, if enters blood stream (through skin or ingestion) causes lung and kidney failure

2. Amounts and time pesticides used by farmers

Training objective: This information gives the student an idea about doses over time to which farmers in their community are exposed. Knowing how many liters they are handling per week, month, season, year, or over their lifetime to date may be useful to decide if they want to continue this exposure.

Information: This session can be a discussion asking the students how they would measure (quantify) amounts of pesticides per what units of time. This can be an excellent math exercise in units, starting with:

liters per tank per:

- spray session
- week
- season
- year
- lifetime

A simple matrix can be used to calculate of total life time liters to which the farmer has been exposed as follows:

a. Tank size (liters)	b. # tanks used per session	c. # sessions per week	d. # weeks per season	e. seasons per year	f. years of spraying	Lifetime liters = a*b*c*d*e*f
20 liters	2	1	12	2	10	9,600

If there is a variation from year to year in any of the above figures, then lifetime liters will not be valid. For instance:

- the number of tanks may change week to week depending on how many pests are observed

* spraying frequency may vary depending on how many pests are observed
* seasons may vary depending on the weather
* crops may vary year to year changing all of the above

If this is the case, the class can take just one season, month or week to estimate sample amounts of exposure and also look at years of exposure among their sample of farmers. Ranges (highs and lows) and averages of each can also be calculated.

3. Household Storage and Disposal

Learning objectives: Students will be able to identify hazardous pesticide storage and disposal practices. Specifically if storage and disposal could contaminate :

* food
* water
* livestock
* be within the reach of small children

Students will be able to identify hazardous containers that are:

* open
* leaking
* repackaged
* recycled and used for domestic purposes (e.g. as water containers)

Information:

Food contamination potential hazards:	* If pesticides are stored in the same room where either foods are stored or prepared. * If containers are open in the same room where either foods are stored or prepared. * If containers are leaking and in the same room where either foods are stored or prepared. * If produce that has recently been sprayed is stored close to where food is stored or prepared this is also a hazard. (e.g.Indonesian farmers dry their pesticide soaked shallots over their cooking fires). * If pesticide containers are recycled and used to store or serve food * If pesticide containers are not properly disposed, the left-over concentrate may contaminate food if the garbage site is close to crops
Water contamination	* If pesticides are stored in the same room where either water is stored or used. * If containers are open and in the same room where either water is stored or used. * If containers are leaking and in the same room where either water is stored or used. * If food that has recently been sprayed is stored above where water is stored or used. * If pesticide containers are recycled and used to store or

serve water
* If pesticide containers are not properly disposed, the left-over concentrate may contaminate ground water if the garbage site is close to water supply.

Livestock contamination	* If livestock (e.g.chickens) have access to where pesticides are stored * If livestock (e.g.chickens) have access to open pesticide containers * If livestock (e.g.chickens) have access to leaking pesticide containers * If livestock (e.g.chickens) have access to pesticide disposal sites
Child hazard	* If pesticides are stored on the ground there is the risk that children will find them, use them as toys, and accidentally poison themselves. * If pesticides are not properly disposed and left out in the open there is the risk that children will find them, use them as toys, and accidentally poison themselves. * If pesticides are repackaged into household contains (plastic bags, juice bottles) children may accidentally eat or drink the pesticide and be poisoned.

4. Exposure During Spraying

Learning objectives: The students will learn how pesticides can enter the body and what practices and clothing enhance or diminish exposure.

Information:

The routes of how pesticides can enter the body

* Respiratory system (lungs): Through the mouth or nose by either the breathing in the fumes or spraying upwind
* Eyes: By spraying upwind, rubbing the eyes with contaminated hands, or splashes during mixing and measuring
* Mouth (GI-gastrointestinal) : through the hands by smoking, drinking and eating or blowing out a blocked nozzle
* Skin: touching the pesticide, through clothing wet, or not wearing freshly laundered after last spray session

Protective clothing is:

* Glasses
* Non-permeable mask (a moist mask from breathing may enhance transmission into the lungs)
* Rubber gloves (cotton gloves may enhance skin absorption)

- Rubber boots (cotton socks may enhance skin absorption)
- T-shirt with another long sleeved shirt over it
- Long pants

Practices that increase exposure:

- Wet cloths, mask (if cotton), gloves (if cotton)
- Spraying upwind
- Smoking while spraying or during spray session without washing
- Eating during spray session without washing
- Drinking during spray session without washing
- Rubbing eyes, face, and mouth with hands not washed
- Using clothing not freshly laundered from last spray session
- Not washing body immediately after spraying

5. Health effects

Learning objectives: Students will learn the signs and symptoms of pesticide poisoning. Also the student will learn how to elicit the symptoms and examine for the signs. Information about which signs and symptoms are caused by which pesticide chemical families can be optionally explained later after data collection.

Information:

1. **Organophosphates** affect the central nervous system (brain) and peripheral nervous system (nerves found outside of the brain or spinal cord). Organophosphates attach themselves to the enzyme (acetylcholinesterase- AChE) that stops nerve transmission. Therefore, there is suppression of AChE and continuous electrical nerve transmission. This particularly affects the muscles, glands and smooth muscles that make the body organs function. Farmers may have the following symptoms that can appear 30 minutes after exposure and may last up to 24 hours:

General central nervous system	• Fatigue • Dizziness • Headache • Hand tremors • Staggering gait • Convulsions • Loss of consciousness • Coma
From muscle over stimulation:	• Muscle weakness • Muscle cramps • Twitching eyelids
From gland over stimulation:	• Salivary gland- excessive salivation • Sweat gland- excessive sweating • Lacrimal gland-excessive eye tearing
From organ over-stimulation: Eyes Gastrointestinal	 • Blurred vision (constricted pupils) • Stomach cramps • Nausea

Pulmonary (Lungs)	• Vomiting • Diarrhea • Chest tightness • Wheezing • Cough • Runny nose

2. **Carbamates**: behave the *same* way as the organophosphates in that they suppress AChE, and cause over-stimulation of the nerves. The effect comes on *sooner* after exposure (as fast as 15 minutes) and *does not last as long* (3 hours). Symptoms are the same with the exception of these symptoms below which are *rare*:

- Convulsions
- Loss of consciousness
- Coma

3. **Organochlorines**: affect the central nervous system. They are absorbed by fat so they can stay in the body a long time. As the fats cells in breast tissue can store organochlorines, it can measured in breast milk. The effects can occur within one hour after absorption and acute effects can last up to 48 hours. Some organochlorines (endosulfan) are rapidly and easily absorbed through the skin. The nerves stimulating glands are *not* affected so you will not see:

* excessive salivation
* excessive sweating
* excessive eye tearing

(or over-stimulation of small muscles like)

* twitching eyelids

But you will see symptoms that are from disruption of central nervous:

* Muscle Weakness
* Dizziness
* Headache
* Numbness
* Nausea
* Loss of consciousness
* Convulsions
* Vomiting
* Hand tremors
* Staggering gait
* Anxiety/restlessness
* Confusion

4. **Pyrethroids**: are irritants to the eyes, skin and respiratory tract. The symptoms last from 1-2 hours. The symptoms from spraying can be:

Normal use:	* Numbness (hypersensitivity of skin) * Shortness of breath (wheezing) * Dry throat * Sore Throat * Burning nose

	* Skin itching
If ingested:	* Loss of consciousness/coma * Convulsions
High doses:	* Vomiting * Diarrhea * Excessive saliva * Twitching eyelids * Staggering gait * Irritability

5. **Thiocarbamates**: are similar to the pyrethroids in that they also are irritants to the eyes, skin and respiratory tract. The symptoms came appear immediately when spraying and can be:

Respiratory tract:	* Dry throat * Sore Throat * Burning nose * Cough
Eyes:	* Eye irritation (burning, itching) * Red eyes
Skin:	* Skin itching * White spots on skin * Scaling skin rash * Red rash

6. **Paraquat**: is very toxic to the skin and mucous membranes (inside of mouth, nose, eyes). Particles are too large* to get deep into the lungs, but once paraquat is in the blood it collects in the lungs. If ingested (drink) it is very lethal

Skin:	* dryness, cracks * erythema (redness) * blistering * ulcerations
Nails:	* discoloration * splitting nails * loss of nails
Respiratory tract:	* cough * nosebleeds * sore throat
Eyes:	* conjunctivitis (irritation) * ulceration, scarring, blindness
Ingestion:	* lung fibrosis (stiff lungs) * multi-system organ failure, specifically ⇒ respiratory failure ⇒ kidney failure

7. Definitions of the symptoms and examining for the signs

The difference between a sign and a symptom:

* Sign: something you can observe or see that *requires an examination*
* Symptom: something a person feels but you cannot see. So one must ask questions to elicit the story about the symptoms.

For **signs** there are special exams. On the table below, each sign is bolded and next to it are listed ways to look for the sign. In training it is a good idea to either bring in pictures, a video showing the condition, or find a person in the community with the condition. This will be useful in identifying red eyes, the skin conditions, tremors and staggering gait.

* Claims by manufacturer.

For **symptoms** stories are important. One cannot simply ask…"have you felt x, y, or z"……It is important to use probing to get the information with descriptions about how the symptoms feel. So in questioning, use words to probe….."After spraying have you ever felt short of breath *which feels like* you cannot get enough air?"
On the table below an example of 'feels like' is given for each symptom. But the class must develop their *own feels-like list* which is more appropriate to their own experience and language.

SIGNS OR SYMPTOMS	FEELS LIKE /HOW TO OBSERVE
* Fatigue	Feels like after climbing a mountain all day long
* **Staggering gait**	Ask farmer to walk in a straight line heel to toe with his arms out to the side. If he cannot walk straight this is staggering. Looks like he is drunk
* **Loss of consciousness/coma**	Farmer faints, drops to ground and you cannot wake him up
* **Convulsions**	Seizure, all the muscles contract, like babies sometime do when they have a high fever. The eyes roll back and the teeth are clenched, the whole body becomes stiff
* Dizzy	Feels like after you spin around many times
* Headache	A sharp or squeezing pain in the head
* **Excessive sweating**	Look at the forehead and upper lip to see beads of sweat
* Blurred vision	This is like looking at a movie or picture that is out of focus
* Burning/stinging eyes	Feels like smoke or soap in the eye
* Itching eyes	Feels like when you have pollen in your eyes
* **Redness of the eyes**	Both whites of the eye look red
* **Twitching eyelids**	Ask the farmer to close his eyes and pretend he is sleeping. Look for twitching of the eyelids side to side
* **Excessive salivation**	Notice if the farmers spits a lot and ask him if he feels there is a lot of spit, like after one eats a lemon
* **Runny nose**	Look to see if the farmer rubs his nose a lot. This is different than a cold. The discharge should be clear while with a cold it is yellow or green.
* Burning nose	Feels like when you are in the kitchen when someone is frying chilies
* Dry throat	Feels like when you wake up in the morning if you have slept with your mouth open
* Sore throat	It hurts to swallow.
* Chest pain/burning feeling	Like it feels when breathing in chilies or smoke
* Shortness of breath	Look to see if the farmer is breathing in fast or does he feel he cannot get enough air

SIGNS OR SYMPTOMS	FEELS LIKE /HOW TO OBSERVE
* **Wheezing**	The person makes a whistling sound when they breathe
* **Cough**	Listen to hear if he is coughing a lot (this could be from smoking so ask if this is worse after spraying)
* Nausea	the feeling just before you vomit or how you feel if driving on a curvy road or on a boat in rough seas
* Stomach cramps/pain	Pain like you feel just before having diarrhea
* **Diarrhea**	too many stools with water
* **Vomiting**	everything from the stomach comes out
* **Skin redness**	Ask if he has noticed any rashes and look at hands, arms, feet and legs
* **White patches on skin**	Ask if any rashes and look at hands, arms, feet and legs
* **Skin scaling**	Ask if any rashes and look at hands, arms, feet and legs (like fish scales)
* Numbness	Feels like after you sit on your foot too long…like ants or pins and needles in the skin
* Skin itching	Like many mosquito bites
* Muscle cramps	Like after playing football all day and the leg muscles seize up, become stiff and hurt
* Muscle weakness	Cannot grip something well, like difficulty opening a bottle
* **Tremors**	Hands and fingers shake when holding a piece of paper

Some conditions may appear before and after spraying because they could be **chronic** conditions from using pesticides for a long time. The following conditions may be chronic:

- Staggering gait
- Twitching eyelids
- Tremors
- Skin lesions: redness, white patches, scaling etc.

One can also ask if the farmer has ever experienced the sign or symptoms. Because a farmer may not want to admit to getting sick from pesticides the wife can be asked for a more accurate story.

8. Other conditions that mimic pesticide poisoning

There are other illness or conditions have the same sign or symptoms of pesticide poisoning. Because of this it is useful to interview and examine the farmer before and after spraying to know if these things are related to the pesticide or another condition or illness. If the signs or symptoms appear only **after** spraying they are more likely from the pesticide. Here are some examples of other conditions that can cause the same signs or symptoms that the farmer may have **before** spraying:

SIGNS OR SYMPTOMS	OTHER CONDITIONS OR ILLNESSES
* Fatigue	not enough sleep
* **Staggering gait**	drinking too much whiskey
* **Loss of consciousness/coma**	
* **Convulsions**	
* Dizzy	flu, anemia, heart condition
* Headache	flu, dengue fever, too much whiskey
* **Excessive sweating**	fever, wearing too many clothes on a hot day
* Blurred vision	chronic eye conditions (glaucoma, cataracts)
* Burning/stinging eyes	allergy
* Itching of the eyes	allergy
* **Redness of the eyes**	eye infection
* **Twitching eyelids**	
* **Excessive salivation**	
* **Runny nose**	flu, common cold (discharge yellow or green)
* Burning nose	
* Dry throat	thirsty, dehydration
* Sore throat	flu, common cold, throat infection
* Chest pain/burning feeling	heart condition (occurs with exercise)
* Shortness of breath	too much smoking, heart condition
* **Wheezing**	too much smoking, allergies
* **Cough**	too much smoking, flu, common cold
* Nausea	food poisoning, flu, too much whiskey
* Stomach cramps/pain	food poisoning, flu
* **Diarrhea**	food poisoning, flu
* **Vomiting**	food poisoning, flu
* **Skin redness**	other skin disease (psoriasis)
* **White patches on skin**	other skin disease (psoriasis)
* **Skin scaling**	other skin disease (psoriasis)
* Numbness	
* Itching of skin	scabies
* Muscle cramps	
* Muscle weakness	flu
* **Tremors**	too much whiskey

V. Health Data Collection Items

The information the children will gather are on the kinds of pesticides, amounts used, household storage and disposal practices, exposure conditions during spraying, and acute health effects. What follows is an example list. The students may have other ideas on what should go on this list after they have received the information described in the last section.

PESTICIDES

1. Brand name
2. Chemical name
3. Type
4. LD_{50} level (optional)
5. WHO hazard level
6. Chemical family (optional)

AMOUNTS USED

1. Liters per tank
2. Tanks per spray session
3. Spray sessions per week (or month)
4. Weeks (or months) per crop season
5. Crop seasons per year
6. Years of pesticide use

STORAGE AND DISPOSAL

1. Names of pesticides stored in the home
2. Type of container: original vs. repackaged
3. Condition of container: open vs. closed
   sealed vs. leaking
4. Child safety: stored at ground level vs. high, out of reach
5. Potential food contamination: proximity to food preparation or food storage
6. Potential water contamination: proximity to water supply
7. Disposal: buried/burned vs. left in open
8. Pesticide container reuse for domestic use (e.g. water containers)

EXPOSURE

⇒ Protective clothing worn
- eye shields
- mask (cotton or plastic)
- gloves (cotton or rubber)
- shirt (protective double layers, long sleeves to protect arms)
- pants (long to protect legs)
- shoes (rubber boots to protect feet)

⇒ Measuring:
- skin contact
- body part in contact with pesticide

⇒ Mixing:
- skin contact
- body part in contact with pesticide

⇒ Spraying:
- upwind with respiratory exposure
- upwind with eye exposure
- leaking equipment with skin, respiratory or eye exposure
- wet clothing exposing the skin

⇒ Activities during spraying causing oral exposure

- smoking
- eating
- drinking
- rubbing the eyes
- putting fingers in the mouth

⇒ Clean up

- washing tank: water supply contaminated
- washing the body: how soon after spraying
- washing the clothes
    i. after each spray
    ii. with family laundry or separately

HEALTH EFFECTS (**highlighted** = a sign that can be observed)

General

- Fatigue
- **Staggering gait**
- **Loss of consciousness/coma**
- **Convulsions**

Head

- Dizzy
- Headache
- **Excessive sweating**

Eyes

- Blurred vision
- Burning/stinging
- Itching
- **Redness**
- **Twitching eyelids**

Mouth, Nose, Throat

- **Excessive salivation**
- **Runny nose**
- Burning nose
- Dry throat
- Sore throat

Chest

- Chest pain/burning feeling
- Shortness of breath (feeling out of breath)
- **Wheezing**
- **Cough**

Stomach

- Nausea
- Stomach cramps/pain
- **Diarrhea**
- **Vomiting**

Skin

- **Redness**
- **White patches**
- **Scaling**
- **Numbness**
- Itching

Musculo-skeletal

- Muscle cramps
- Muscle weakness
- **Tremors**

VI. Designing the Data Collection Instrument

For each instrument it is recommended that the students look at the list of the items on which they want to collect information.

Next they can break up into small teams and design the form based on the information list. This can be a questionnaire, a card with boxes for the required information, a picture to fill in, or a matrix chart. (Examples are demonstrated below.)

After each team designs their form, they should display it on the wall like an art gallery. One leader per team should present their form and discuss why it is the best. Finally the whole class walks through the gallery, inspects each one, and casts a vote on the best one. A final form can be adopted with attributes of each one, then field tested.

1. *Pesticides in Use*: There are two opportunities when this information can be gathered:

- In the household when observing pesticide storage
- During observations of spraying conditions

Furthermore the class may want to know what kinds of pesticides are available in the community and for sale. So the class can have information and report:

* Pesticides available in the community
* Pesticides used during spraying
* Pesticides stored in households

A suggested instrument is index cards, one per pesticide.

PESTICIDES IN: Store___House____Used in Field___

Brand name:_____
Common name: _____
Type: _____
Chemical Family:_____ (optional fill in later in class)
LD_{50} value :_____(optional fill in later in class)
WHO class:_____ (fill in later in class)

This makes it easy to alphabetize and or analyze by classification such as by:

◊ Common name: how many brands of paraquat, methyl parathion ,etc…
◊ Type: how many insecticides, fungicides, herbicides
◊ WHO hazard level: how many are extremely, highly, or moderately hazardous,
◊ Chemical family : how many organophosphates, carbamates, organochlorines.

2. Amounts over time that pesticides have been used by farmers:

This information can be gathered at:

◊ the time the student observes spraying (or)

◊ during household visit when looking at storage

A form that allows the student to ask the questions, fill in the numbers and do the calculations all on one work sheet may be useful:

How many liters is your tank?	a
How many tanks do you use in one spray session?	b
How many times a week do you spray?	c
How many weeks are there in a season of your crop?	d
How many seasons do you have each year for this crop?	e
How many years have you been spraying this crop?	f
Total lifetime liters	a * b * c * d * e * f

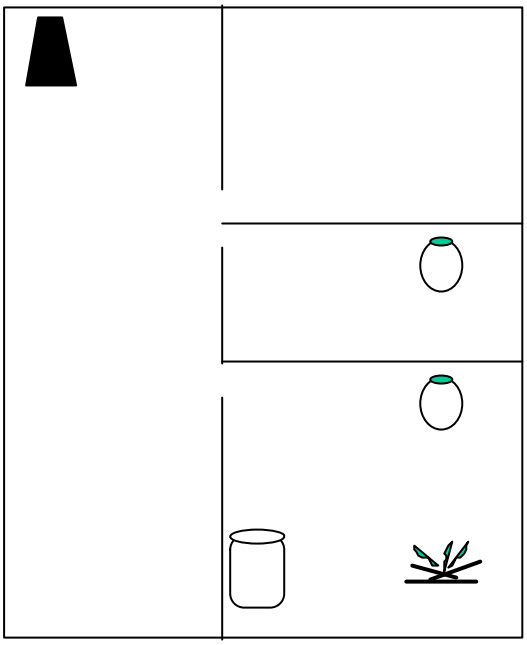
3. Household Storage and Disposal:

To collect information about pesticide household storage and disposal it is suggested to record the data with pictures (for pesticide containers, disposal sites) or household floor plans (locations of water, food, pesticides) as shown in on the next page. Since houses may be two stories, a floor plan may pose a problem as two dimensions are needed. Furthermore, students may want to use symbols to show:

* Water sources
* Food storage
* Food preparation
* Pesticide location

Example of household floor plan:

Household Map



Storage

Is pesticide storage child safe? Y|N

Does pesticide storage prevent water contamination? Y|N

Does pesticide storage prevent food contamination? Y|N

Is pesticide storage livestock safe? Y|N

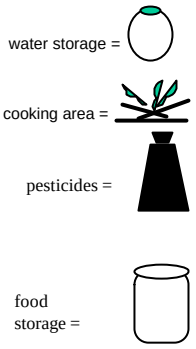
Disposal

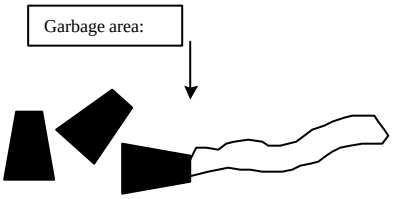
Is pesticide disposal child safe? Y|N

Does pesticide disposal prevent water contamination? Y|N

Does pesticide disposal prevent food contamination? Y|N

Is pesticide disposal livestock safe? Y|N





Index cards again can be used to record the pesticide information with the addition of a picture to show the condition of the container as follows:

HOUSEHOLD PESTICIDES house #____

Brand name:_____

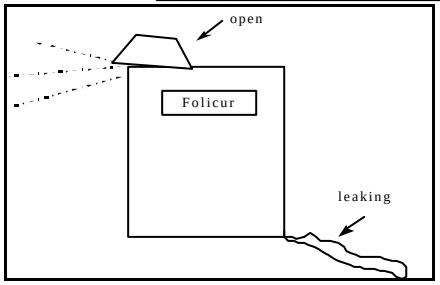
Common name: _____

Type: _____

Chemical Family:_____ (optional fill in later in class)

LD_{50} value :_____(optional fill in later in class)

WHO class:_____ (fill in later in class)



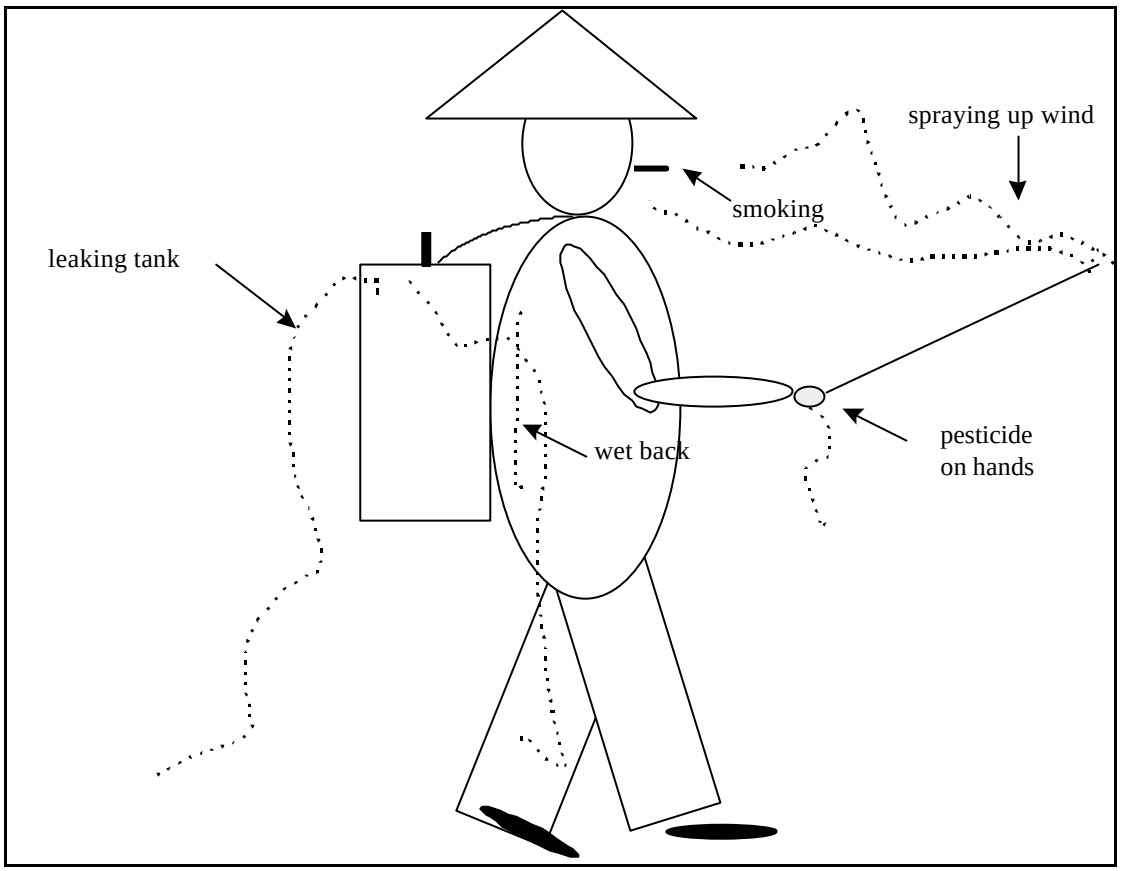
Can you smell it?_____

Is it leaking?_____

Is it open?_____

Is it repackaged?_____

4. *Exposure during spraying*: The same pesticide card can be used to gather information about pesticides used during spraying. Also the same form can be used to gather information about amounts of pesticide used over time. For exposure during spraying, a checklist can be developed to help the students remember what things to observe. These details can be drawn on a blank picture of a sprayer, filling in with a color the places where the pesticide is contaminating the body as follows:

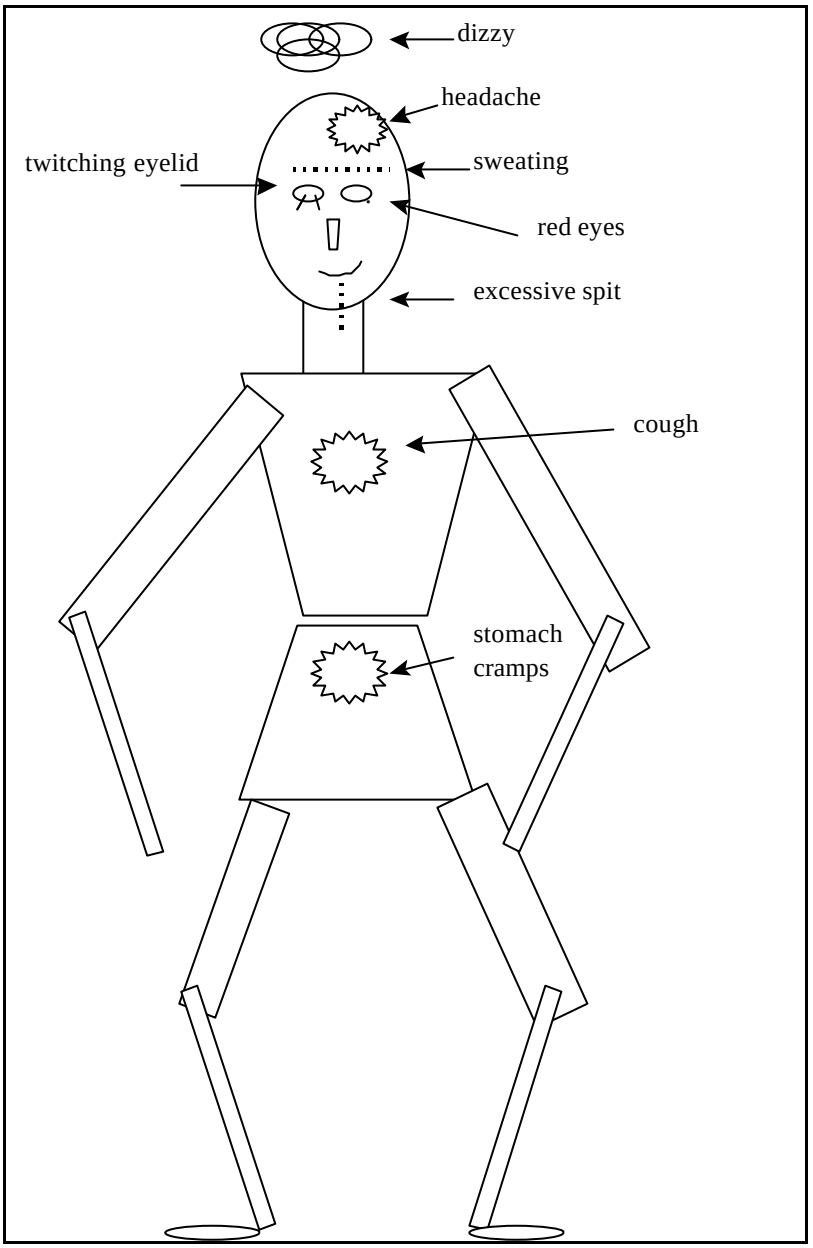


5. *<u>Health effects-signs and symptoms</u>*: A list of questions may need to be drawn up with answers in two columns, one for before spraying the other for after spraying (optionally a third for 'ever experienced after spraying).

Signs or Symptoms (Mark ► if yes)	Before spray	After spray	* Result (only after)	Ever experience
Fatigue				
* **Staggering gait**				
Loss of consciousness/coma				
Convulsions				
Dizzy				
Headache				
Excessive sweating				
Blurred vision				
Burning/stinging eye				
Itching eyes				
Red eyes				
* **Twitching eyelids**				
Excessive salivation				
Runny nose				
Burning nose				
Dry throat				
Sore throat				
Chest pain/burning feeling				
Shortness of breath				
Wheezing				
Cough				
Nausea				
Stomach cramps/pain				
Diarrhea				
Vomiting				
* **Skin redness**				
* **White patches on skin**				
* **Scaling skin**				
Numbness				
Itching skin				
Muscle cramps				
Muscle weakness				
* **Tremors**				

* If farmer has these signs both before and after spraying then include in results as they may be from chronic pesticide use.

The results can be drawn on a blank body picture (the class deciding what symbols to use) If the class chooses to do a before and after test, then only those new signs and symptoms that appear **after spraying** (with the exception of those starred signs) should be drawn on the body picture as shown below



VII. Testing the Instruments and Practicing Collecting the Data

Testing the instrument that will be used to collect the data (forms, questionnaires, picture drawing) not only helps one develop a form that is clear and user-friendly but it is an excellent means of **training**. This means many practice sessions in a number of places.

Also these practice sessions be used to test the instrument in a scientific way as is done in research. Two things are usually tested:

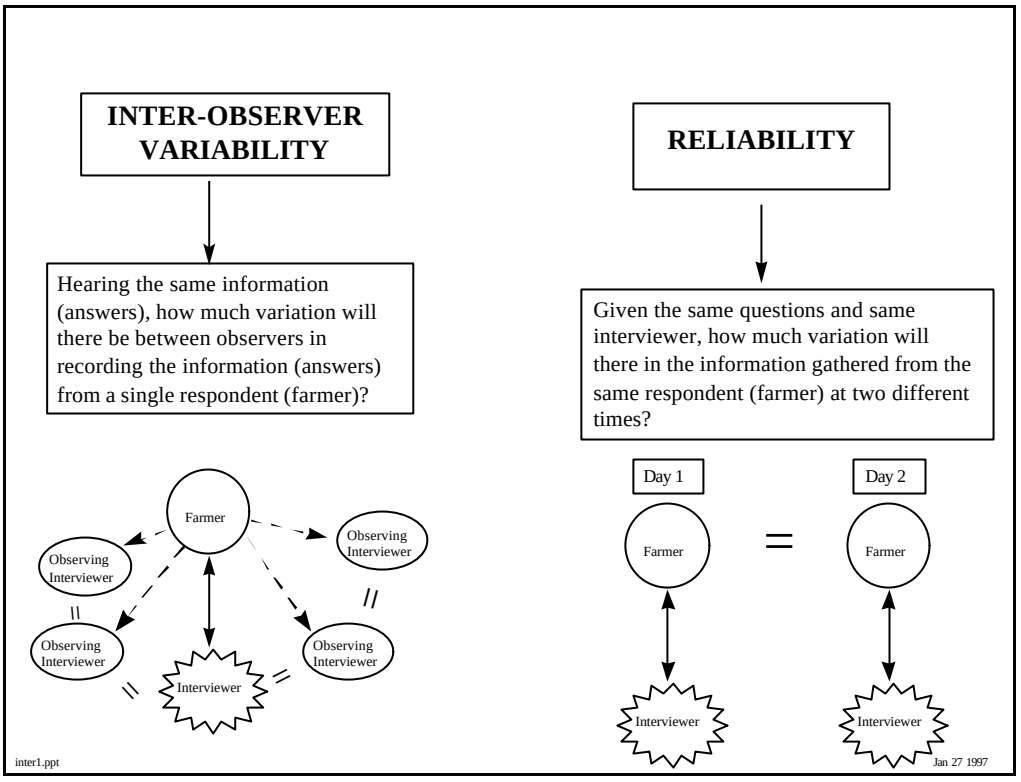
1. Inter-observer variation
2. Reliability

Inter-observer variation means how much variation or difference will there be in student's answers hearing the same information or observing the same thing. This is done by:

1. The class listens to the same interview or observes the same thing
2. Each one writes down the information on their own individual form (**no sharing answers with neighbors)**
3. On a master form (or on the classroom board) compare each answer one by one marking an ✔ if everyone has the same answer (or observed the same thing)
4. Divide the number of items marked ✔ by the total number of items on the form
5. Multiply by 100
6. Subtract this number from 100.
7. This gives you the inter-observer variation score.
8. It should be 0%, there was no difference in what everyone heard or observed and everyone recorded the same information.
9. Keep repeating this exercise until the inter-observer variation score is 5% of less.
10. Change form as necessary

Reliability is used to find out if the information changes when interviewing the same person, with the same questions, about the same information (that should not change-like years sprayed) by the same interviewer, but at **different times**. If it is different day to day then you know the information you are getting is not very reliable.

1. Ask one student to interview one farmer on day 1.
2. Return the next day and have the SAME student interview the SAME farmer with the same questions
3. Compare the answers he gives you on Day 1 compared to Day 2.
4. On a master form (using either day 1 form or day 2 form) or classroom board mark those answers that are the same with an ✔.
5. Divide the total number of answers marked with a ✔ by the total answers marked
6. Multiply by 100.
7. This gives you the *reliability score*.
8. Let's say for example he gives the same answer to only 80% of the questions. This means that 20% of the answers are not valid. The higher the score the more accurate the information is.



Here are some ways each of the five components can be tested:

1. Classroom

Pesticides:
1. Buy or borrow a few sample pesticides
2. Set up each pesticide at a station
3. Divide the class into small teams
4. Ask each team to visit each station and write down the information on the pesticide cards
5. Compare the answers of each team (calculate inter-team variation for fun)
6. Repeat the whole process using another 4 pesticides, this time by individual student (to be sure everyone can do it)
7. Each student passes their card to the left
8. Correct the cards as a group (calculate inter-observer variation score)
9. Add other information(WHO level, chemical family, LD_{50}value)

Amounts:
1. Bring one parent farmer to the classroom
2. Ask one student to demonstrate the interview
3. Other students write down answers
4. Compare answers and calculate inter-observer variation
5. Calculate lifetime liters
6. Repeat the same process a day or two later
7. Calculate again the inter-observer score
8. Calculate the reliability score

Health Effects: Define symptom terms

1. Break up into small discussion teams. Each team should be given the list of symptoms. Each team has to come up with a story that describes the symptoms…..it feels like x when y happens.
2. As a class then discuss each example from the small teams and decide which situation describes the symptom the best. This definition will be the study *working definition* that should be used in eliciting the information from the farmer.

Demonstrate examining for signs:

* Ask the class how they think they could observe each sign, then demonstrate how it can be done (if the class does not on their own come up with a method)

Practice in Pairs

1. Break up into partners and ask about symptoms (ever experienced with another illness) and have each examine the other.(the person playing the farmer must make up a story)
2. Record the findings
3. Check validity with partner

Classroom Role Play / inter-observer variation test

1. Ask one student to play the farmer
2. Help the student come up with the story of symptoms and acting out the signs
3. Ask another student to interview the acting farmer
4. Other students to record answers and findings
5. Compare answers and calculate inter-observer score

2. Homework

Amounts:

1. Ask each student to interview their father or neighbor about amounts
2. Calculate the lifetime liters the next day in class per student
3. Put all the figures on the classroom board
4. Repeat the interview the next day
5. Repeat lifetime liters calculations per student
6. Each student calculates reliability score (day 1 vs. Day 2)
7. Put all the figures up and the classroom board

Health Effects:

1. Ask each student to interview their father or a neighbor about signs and symptoms 'ever experienced' after spraying
2. Tally up numbers and percents the next day in class on the board
3. Repeat interviews the next day
4. Each student calculate reliability score on her father or neighbor
5. Tally up numbers and percents the next day in class on the board

3. Field Trips: Household

Storage and Disposal:
1. As a class visit one household
2. Inspect and list information about pesticides, using pesticide cards
3. Draw maps
4. Compare results back in the classroom
5. Calculate inter-observers scores

Exposure: Field-Red Dye Demonstration
1. As a class go out to a field
2. Ask a volunteer father farmer to perform the red dye demonstration
    * Fill tank with water and red dye
    * Clothe the sprayer with all white clothing
    * Ask him to spray a full field
3. Inspect clothing noting what parts are red
4. Students record findings on questionnaire or fill in blank picture of sprayer
5. Compare results and calculate inter-observer scores

Real Sprayer Practice
1. Observe a full spray session
2. Record pesticides used
3. Record exposures observed
4. Ask about symptoms and sign before and after spraying
5. Compare results back in the classroom
6. Calculate inter-observer scores
7. Repeat until scores ≤ 5 %

Pesticides: Pesticide shop
1. Class to visit one shop
2. Divide up shop by shelves, assigning one student or team per section
3. Record results on pesticide cards
4. Tally up results back in classroom assigning WHO classes etc….
5. Practice grouping cards, tabulating totals and percent by classifications of interest (WHO hazard, type, common names etc)
6. Develop a master list

VIII. Selecting the Sample

A list of all households with a farmer who sprays in the community should be made assigning a number to each farmer-household. From a pile of small pieces of paper each of which has a household number on it, the students should RANDOMLY select from 40-60 households. This sample size is based on a symptom prevalence rate of 21% in a community with from 100 to 700 families.

Hold a meeting with these families to explain the study and ask for consent from each farmer and his household. Replace those farmers and households that refuse to participate by randomly selecting from the pile again. (Eyes closed and NO peeking) Make up a map of each household participating and their corresponding field.

IX. Gathering the Information and Monitoring

Using the map and list of farmers and households to be observed/interviewed, be sure to assign each a number. Assign the students to the farmer (either randomly or by location for convenience). Write up an interview/observation schedule. Decide on the teams to do the interviews consisting of :

- Older student
- Younger student
- Student monitor
- Village health volunteer (optional observer-supervisor)
- Teacher (optional observer-supervisor)
- W.E. staff member (optional observer-supervisor)

Monitoring:
In any study usually the data is monitored (checked) while it is being collected. Usually a minimum of 10% is observed to assure quality control. Criteria is developed to check the data collection. In a small student study this can easily be done by different people; supervisors and or the data collectors themselves. The most effective is to have the students check **each other** and set their **own** criteria for quality control.

After the forms have been designed and tested but before data collection starts:

- Gather the class and break up into small teams
- Each team develop a check list of things they expect the data collectors to do during their interviews and observations (e.g.)
    1. introduces self politely to farmer
    2. explains about the study to farmer
    3. asks permission to conduct interview
    4. observes mixing and measuring
    5. performs exams correctly (e.g. staggering gait, hand tremors exams)
    6. asks about all symptoms with good probing examples
    7. fills out forms/pictures correctly
    8. explains the results of the data collection to the farmer (e.g. observed hazards)
- Each team presents their ideas about the criteria (check list) to the whole class
- The class decides on the final checklist
- Students practice monitoring each other using the list and scoring each other (number correct / total number of items x 100)

Each interview/observation can be monitored by one student peer. A supervisor (VHV, MPH student, teacher or W.E.) can further monitor a minimum of 10%.

X. Data Analysis

Data analysis should be done as a classroom math exercise, tabulating totals and percentages. Worksheets can be developed by the teachers for the students to calculate the results.
Below are samples of tables that can be used to summarize the data analysis for each health component.

PESTICIDES	**Number**	**Percent of total pesticides**
Number of pesticides- available in community # (or) found in households) # (or) used in tanks) #	average	range (low-high)
WHO Hazard levels- number that are:		
• Ia - extremely hazardous	#	%
• Ib -highly hazardous	#	%
• II - moderately hazardous	#	%
• III -slightly hazardous	#	%
• O- unlikely if used safely	#	%
Types used-number that are:		
• Insecticide	#	%
• Fungicide	#	%
• Herbicide	#	%
Chemical family groups (optional)-number that are		
• Organochlorines	#	%
• Organophosphates	#	%
• Carbamates	#	%
• Pyrethroids/Thiocarbamates	#	%

PESTICIDE STORAGE AND DISPOSAL IN HOUSEHOLDS	**Number**	**Percent of Total Houses**
Total households surveyed	#	100%
Houses with pesticides repackaged	#	%
Houses with pesticides leaking	#	%
Houses with pesticides left open	#	%
Houses with pesticide storage not child safe	#	%
Houses where pesticides may be contaminating the water	#	%
Houses where pesticides may be contaminating the food	#	%
Houses where pesticides may be contaminating the animals	#	%

Houses where pesticides are not disposed safely	#	%
Houses using pesticide containers for domestic purposes	#	%

EXPOSURE TO PESTICIDES DURING SPRAYING	**Number**	**Percent of Total Farmers**
Total number of farmers observed	#	100 %
Tanks leaking pesticides	#	%
Skin exposed during measuring	#	%
Skin exposed during mixing	#	%
Skin exposed directly during spraying	#	%
Skin exposed through wet clothing	#	%
Oral exposure from eating	#	%
Oral exposure from putting fingers in mouth	#	%
Oral exposure from drinking	#	%
Oral exposure from smoking	#	%
Eye exposure from upwind spraying	#	%
Eye exposure from rubbing eyes	#	%
Respiratory exposure from upwind spraying	#	%
Does not wash exposed skin after spraying	#	%
Does not wash body as soon as arrives at home	#	%
Does not use freshly laundered clothing	#	%
Washes clothes with family laundry	#	%
Washes tank in ditch, contaminating water	#	%
Does not wear		
• glasses	#	%
• mask (impermeable)	#	%
• long sleeve shirt with T-shirt underneath	#	%
• long pants	#	%
• rubber/plastic gloves	#	%
• rubber boots	#	%

AMOUNT OF PESTICIDES USED BY FARMERS							
Farmer name	a. Tank size lt.	b. tanks /session	c. sessions per week	d. # weeks per season	e. seasons per year	f. years spraying	Lifetime liters a*b*c*d*e*f
Lek	20	2	1	12	2	10	9,600
Noi	15	4	2	12	2	5	14,400
Wichai	14	3	2	12	2	3	6,048
Average	**16.3**	**3**	**1.6**	**12**	**2**	**6**	**10,016**

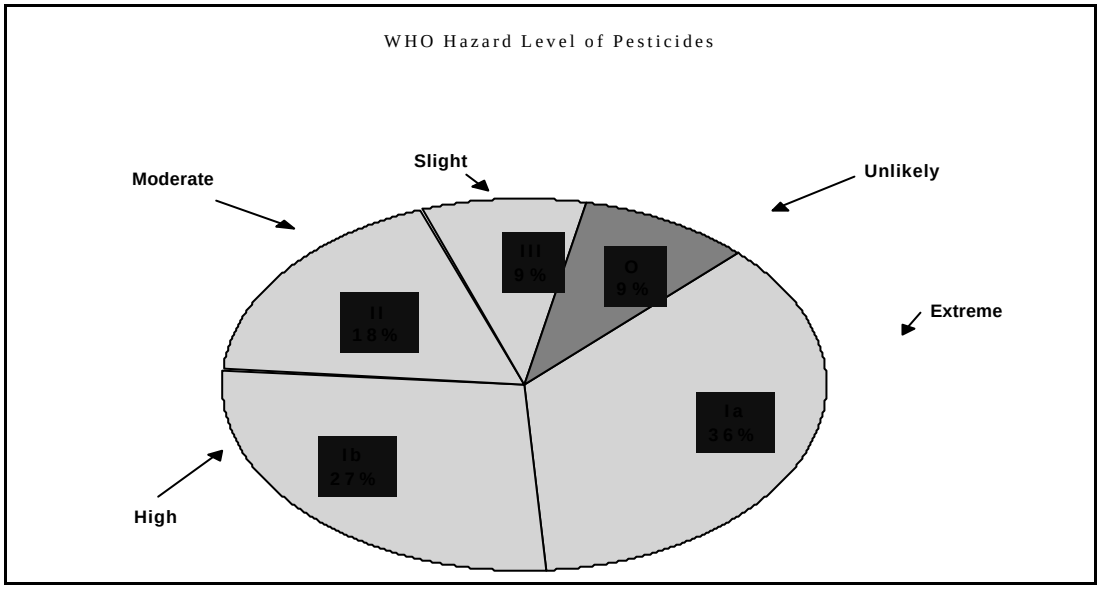
Signs and Symptoms of Pesticide Poisoning	Before spray # (%)	After spray # (%)	Next day # (%)	Ever experience # (%)
Total farmers interviewed and examined				
* Fatigue				
* **Staggering gait**				
* **Loss of consciousness/coma**				
* **Convulsions**				
* Dizzy				
* Headache				
* **Excessive sweating**				
* Blurred vision				
* Burning/stinging eyes				
* Itching eyes				
* **Redness of eyes**				
* **Twitching eyelids**				
* **Excessive salivation**				
* **Runny nose**				
* Burning nose				
* Dry throat				
* Sore throat				
* Chest pain/burning feeling				
* Shortness of breath				
* **Wheezing**				
* **Cough**				
* Nausea				
* Stomach cramps/pain				
* **Diarrhea**				
* **Vomiting**				
* **Redness of skin**				
* **White patches on skin**				
* **Scaling of skin**				
* **Numbness**				
* Itching of skin				
* Muscle cramps				
* Muscle weakness				
* **Tremors**				

XI. Presentation

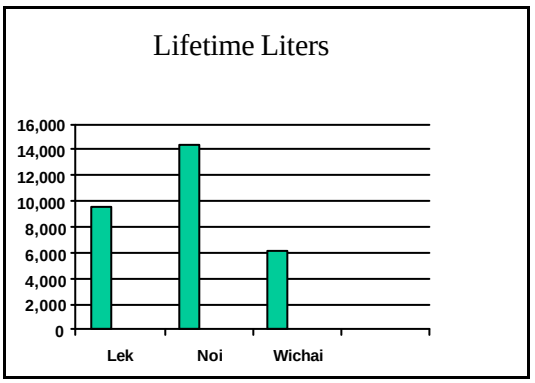
When the data has been analyzed, the next step is for the students should come up with ideas on how to educate their parents and community members. Organize a community meeting or hold a "Pesticides and Your Health" fair day . Here are some ideas about presentations, but likely the class will better and more ideas.

Presentations:

- Display 2 model houses, one showing good pesticide storage and disposal and the other showing hazardous practices.
- Set up a table of pesticides, grouped by WHO Class displaying a pie chart like the one below:



- Display on tables pesticides grouped by chemical families. With each group show pictures of the symptoms associated to the chemical family. (e.g. organophosphates and carbamates together with pictures of sweating, twitching eyelids, tremors etc…)
- Show amounts of pesticides used over time (possibly by farmer) on a bar chart like below:



- Conduct the red dye spray demonstration to show community how much pesticide can get on their bodies during spraying
- Display pictures of sprayers being exposed (like the data collection instrument) with labels and percentages of farmers who were observed with the particular hazard (e.g. % spraying upwind, % with contaminated hands)
- Display pictures of signs and symptoms, similar to the above.

Community Discussion:
After the presentation there could be a panel discussion between a team of students and team of community members. During this discussion the students could present their recommendations on what measures the community could take to protect their health. The community team could then discuss the findings and recommendations of the students and respond. Finally the panel can make up a plan of action based on the recommendations and discussions.

XII. Student Self Evaluation of Skills Learned

At the beginning of the study, perhaps after the information sessions, the teachers could ask each student to decide on their own learning goals. Using the 5 adult learning areas each student can decide what they would like to improve. They can keep their own folders with examples of their progress (e.g. pictures, calculations, or completed data collection instruments that have been marked during the inter-observer exercises). At the end the student with the teacher can evaluate themselves.

The activities in these health studies that can increase students skills:
:

⇒ Team work
- Designing data collection instruments
- Designing monitoring checklist
- Gathering pesticide information from pesticide shop
- Developing symptoms "feels like" stories
- Calculations of inter-team variability
- Selecting study sample
- Data collection (if done in pairs or teams)
- Designing presentations for community

⇒ Language
- Reading pesticide information
- Interviewing farmers about amounts and symptoms
- Recording all information on forms
- Designing questions to ask farmers

⇒ Math
- Deciding WHO class from LD_{50}values (optional)
- Adding totals
- Calculating percents
- Multiplying to estimate lifetime liters of pesticide exposure

- Calculating inter-observer variability scores
- Calculating reliability scores

⇒ Critical thinking:

- Deciding on best data collection forms
- Deciding which questions are reliable (e.g. amounts and symptoms from reliability scores)
- Deciding how to compare and quantify amounts of pesticide exposure over time
- Assessing how many dangerous pesticides are available, used and stored in households
- Assessing household storage and disposal hazards
- Assessing exposure hazards
- Assessing health effects
- Deciding how to present results to community
- Deciding on what to recommend to the community
- Evaluating own progress in learning skills

⇒ Art

- Drawing maps
- Designing symbols for maps
- Drawing disposal sites
- Drawing pesticide containers
- Drawing protective spraying clothing
- Drawing pictures to demonstrate exposure
- Drawing signs and symptoms
- Role playing during practice sessions
- Drawing bar graphs and pie charts