P-ISSN: 2618-0723
E-ISSN: 2618-0731

Impact Factor: RJIF 5.16
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 4; Issue 2; Jul-Dec 2021; Page No. 131-137

Received: 06-05-2021
Accepted: 20-06-2021

Indexed Journal
Peer Reviewed Journal

A guide for farmers participating in on-farm technology trials for stem borer control in Kwale and Kilifi counties, Kenya

Preston O Chitere[1], Fassil G Kiros[2]

[1] Project Coordinator, Mombasa, Kenya

[2] Head, Social Sciences Department, ICIPE, Nairobi, Kenya

Abstract

The Interactive Socio-Economic Research for Integrated Pest Management (ISERIPM) was one of the first projects that was developed by researchers at the Social Science Department of the International Centre of Insect Physiology and Ecology (ICIPE). IPM technologies had been developed by biological scientists in collaboration with social scientists in western Kenya. Incidentally the insect pest damage of food crops was not as severe in the western as it was in coastal areas of Kenya. With financial support obtained from the Rockefeller Foundation, ICIPE launched the project in the coastal area of Kenya. Kwale and Kilifi counties were chosen as the project sites owing to high incidence of insect pest infestation of food crops. A baseline survey was completed in the sites followed by selection of eight (8) villages as sub-sites and 89 participating farmers. Out of the 89 farmers 8 (one from each village) served as Trial Farmers and the others as follow-up farmers. This guide was prepared for the participating farmers by the authors who were social scientists responsible for implementation of the project.

We acknowledge support provided by Grace Goodell of the John Hopkins School, U.S.A. who assisted ICIPE to obtain this project and John Lynam of the Rockefeller Foundation office, Nairobi for his wholehearted support of the project. We also acknowledge the biological scientists Dr. A. Nyarko, Dr. S. Ajala, Dr. M. Odindo and Dr. A.M. Nour for their practical work with farmers and in support in preparation of this handout. The handout was also translated in Kiswahili which was widely spoken by farmers of the project sites.

Keywords: Farmers, technology trials, stem borer control, Kwale and Kilifi

Introduction

The International Centre of Insect Physiology and Ecology (lCIPE) is a research institution engaged in research on insect pests and vectors that affect livestock and damage food crops such as maize. The Centre's Interactive Socio-Economic Research for Integrated Pest Management (ISERIPM) Technology Development project which was implemented in Kwale and Kilifi Districts (currently, counties) at the Kenyan coast covered research work on maize, sorghum, cowpea and cassava, most of which were and continue to be important food crops in the counties. Farmers and frontline extension staff of the then Ministry of Agriculture, Livestock Development and Marketing (MOALM) (currently, Ministry of Agriculture, Livestock and Water Development) were actively involved in the ISERIPM project's research activities as collaborating partners.

The project had two main aims which were to: (1) test the IPM technologies which had been developed in Western Kenya with a view to ensuring their adaptability to local coastal conditions; and (2) develop methodologies of working with farmers, MOALM's extension staff and Kenya Agricultural Research Institute (KARl) researchers that could facilitate adoption of IPM technologies and enhance food production on a sustainable basis (Chitere and Kiros 1993: pages 11-18). Being a participatory research project, its success depended on active participation, especially of farmers in decision making, planning, implementing and evaluating its various activities.

This handout was a reference source for use by farmers participating in the research project. It concerned the stem borers that damaged their maize and sorghum crops and the various ways of controlling them. Most of the information that is presented in the handout had already been discussed with the farmers and the extension staff and they could refer to it whenever they were not sure of certain aspects of the research work. It was important to stress that farmers should not only make their own choices of technological elements, but also introduce any alternatives which they might have considered appropriate.

The ISERIPM research project had three phases (Chitere and Kiros, 1993: page 14-15)

Phase 1 - Researcher-managed on-station trials
Phase 2 - Researcher-managed on-farm trials
Phase 3 - Farmer-managed on-farm trials

The farmers played an important role in the first two phases by evaluating the various components of the Integrated Pest Management (IPM) technology and selecting the options they preferred (Kiros, Lako and Nyarko, 1996). Out of the original 10 cultivars of maize and 20 of sorghum tested, 2 maize and 2 sorghum cultivars were selected with the

participation of farmers for the third phase of the project. In the third phase of the project, the farmers were to be the key players since they were to manage all the activities of the trial according to the options they had selected. The primary role of the researchers in this phase was to monitor the technology adoption process and to assess its impact.

Life cycle of the spotted stem borer, *Chilo partellus*

In order to control the stem borer effectively, it is important for the farmer to understand its life cycle and to know what stage of it is destructive (refer to fig. 1).

There are two Chilo species at the Kenyan coast, namely Chilo partellus and *C. orichalcociliellus*, but for the purpose of this manual we shall mainly refer to Chilo partellus (or simply Chilo) (Pers. Comm. of first author with project's biological scientists).

a) The adults are pale brown moths bearing four wings. They migrate from the stems to look for their mates so as to produce subsequent generations.

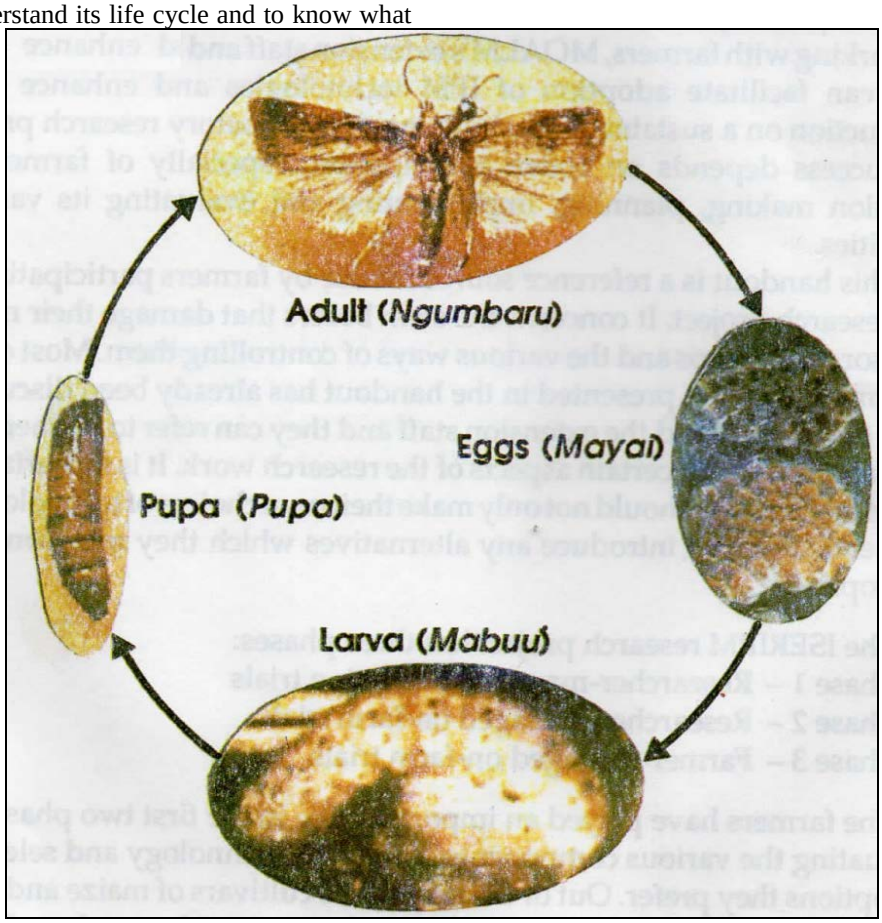


Fig 1: Life-cycle of stem borer

The adult Chilo is a free-living moth that does not feed on crop tissue. It only takes liquid (water) from plants and any other source, preferably one that is sugary. It lives for only about seven days and its main function is to mate and produce the next generation.

b) The adult moth lays eggs in masses of 50-100 on the lower surface of maize and sorghum leaves (and sometimes on the leaves of non-host plants in an intercropping situation). The eggs are arranged like the scales of a fish, and are creamish-white in colour. They hatch within 5-11 days, depending on weather conditions (temperature and relative humidity) in the area.

c) Eggs hatch into *larvae*. The growth of the larvae is divided into stages called instars, which are the characteristic age-groups. The first instar larvae migrate from the lower surface of the leaves to the inner whorl of the plant to feed on the tender parts. The subsequent instars result from the insect shedding its skin (moulting) to give room for further growth. At the 3rd to 4th instar, the larvae migrate and burrow into the stem where they live and feed until they tum into pupae. It should be noted that the larva is the destructive stage of the stem borer, and is the best stage to target for control.

d) The *pupa* is a resting stage of the stem borer while living in the stem without feeding. It is brown in colour and looks very different from the larval stage. It stays in this stage for about 7 days, and then emerges into an adult.

Technological options for stem borer control

Researchers with the participation of farmers have identified certain integrated pest management (IPM) technological options for stem borer control (Kiros, Lako and Nyarko 1996). The farmers are now expected to select those options which they consider appropriate for their circumstances. The options offered are the following:

1. Planting maize and sorghum varieties with improved levels of pest resistance;
2. Strip relay cropping (a planting pattern); and
3. Application of Bt. *(Bacillus thuringiensis).*

Integrated Pest Management (IPM) Components

The above technological elements have been discussed with farmers and frontline extension staff, and field demonstrations were made on a number of occasions. They are now expected to be applied by the farmers in combinations and with such modifications which they consider appropriate in their circumstances. The basic menues or choices offered are the following (Kiros, Lako and Nyarko, 1996: pages 1-2):

a) Maize cultivars with improved levels of pest resistance:
   ICZS
   or
   ICZ2-MS.
b) Sorghum cultivars with improved levels of pest resistance:
   GADDAMELHAMAM
   or
   DRIV-1
c) Strip relay cropping of each of the above cultivars with the following cowpea variety and cassava:
A) Cowpea variety icv2
B) Cassava without signs of mosaic disease.

Planting during long rains is expected to be made at about the same time as follows:
2 rows of cowpea
4 rows of maize or sorghum
3 rows of cassava (Refer to Fig. 2 for details)
If farmers consider it appropriate, they are free to experiment by using for example, cowpea varieties other than ICV2 which can be supplied, or other crops.

After the harvesting of cowpea another planting is to be made in July. Two crops of cowpea will then have been obtained.
During the short rains, maize and sorghum are to be planted again with another planting of cowpea while the cassava continues to mature.
If the above planting pattern is followed, it would potentially be possible not only to minimize pest damage but also to obtain 2 crops of maize, 2 of sorghum, 3 of cowpea and 1 of cassava during a single year.
Clean seeds of maize and sorghum cultivars that can resist stem borer damage will be provided to farmers. Seeds of cowpea cultivars will also be made available by the researchers.
Some farmers may wish to purchase and use chemical fertilizers such as DAP and CAN to increase their output. Those who may not afford to buy chemical fertilizer have the option to fertilize their land by the use of composts as will be explained later.
d) The application of Bt is justified by the level of pest infestation. Bt should be applied at specific stages of the plant. Maize and sorghum leaves should be checked for stem borer damage regularly between 3 weeks after plant emergence and 6 weeks. Refer to Fig. 3 for symptoms of stem borer damage. But should be sprayed on the crops if it is found out that 30 out of 100 plants randomly observed show stem borer leaf damage. This is a monitoring task which can easily be performed by farmers. One to two applications may be required depending on the level of damage. (Refer to Box 1 for details of the methods of mixing and spraying Bt).

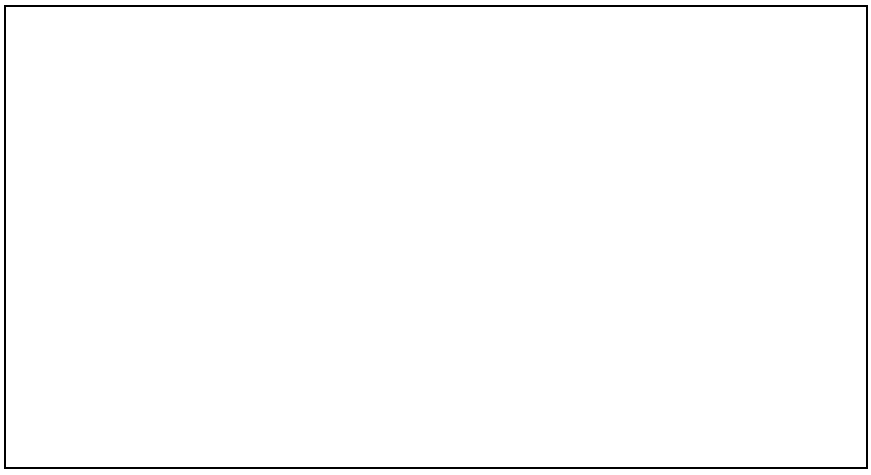
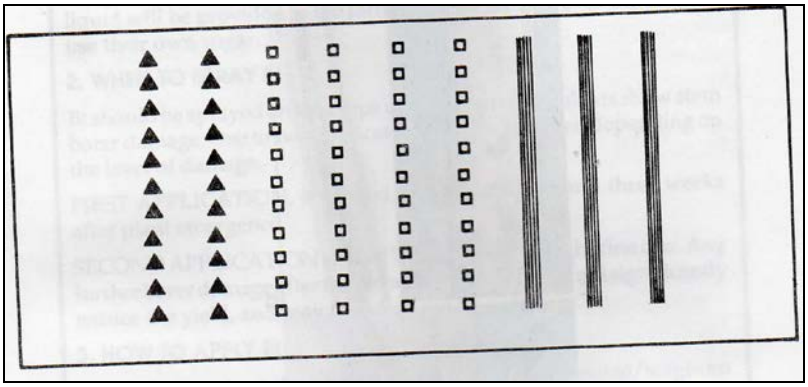


Fig 2: Spatial arrangement for ICIPE strip relay cropping of maize, cowpea and cassava.

Rows 75 cm apart.
Cowpea plant, within cowpea row spacing. 30 cm. 2 plants/hill.
Maize/sorghum plant, within row spacing 32cm, 2plants/hill.
Cassava plant, within cassava row spacing 50 cm.



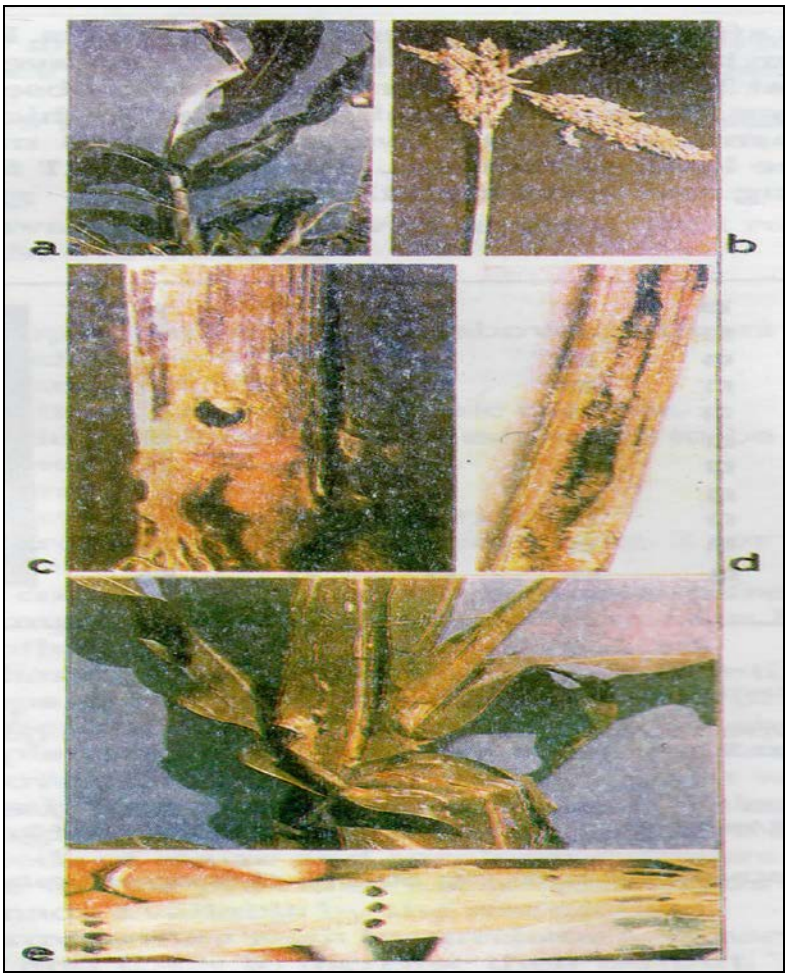


Fig 3: Shows symptoms of stem borer damage which are: Dead heart damage symptom of emerging shoot; sorghum head breaking; stem showing exit hole of larva; stem tunneling; and leaf damage.

Box 1

How to prepare and apply Bt

How to mix Bt for application

Dissolve sugar in water at the ratio of 0.5grams to 99.5ml of water. Add 2 ml of Bt to every 98ml sugar solution and mix well. For ease of measurement, pre-marked cups will be given to the farmer to measure the quantity of sugar and Bt to a given quantity of water in litres. Bt liquid will be provided to the farmers. They are however expected to use their own sugar.

When to spray Bt

Bt should be sprayed on the crops when 30 out of 100 plants show stem borer damage. One to two applications may be required depending on the level of damage.

First application, if needed, should be at around three weeks after plant emergence.

Second application should be two weeks after the first one. Any further borer damage after the second application may not significantly reduce the yield, and may therefore not be necessary.

How to apply Bt

Direct the nozzle of the sprayer to the whorl of the maize/ sorghum plant and spray a puff inside. The plants should be sprayed individually. After spraying the equipment should be washed with soap and dried.

Additional Methods of Pest Control

Plant Residue Management

Remains of plants after harvest may harbour insect pests that come back to attack newly planted crops. Such remains should be disposed of constructively. They can be used for feeding cattle or for making compost manure. By making compost out of plant residue, you not only reduce pest attack but also increase soil fertility. Extension staff and ISERIPM researchers will explain how to prepare and use compost.

Grain Storage

The researchers recognize the problem of storage pests and the amount of damage they cause. The Ministry of Agriculture extension staff who have been collaborators in the ISERIPM project have detailed information about storage pests and their control, and they are always ready to assist farmers with information and expertise. (Refer also to Box 2 concerning control of cowpea storage pests).

Management of Cowpea Pests

Cowpeas are attacked by many different pests at various stages of plant growth. In the past it has been the practice to use chemical insecticides to manage these pests, or alternatively farmers would have to plant cowpeas later in the season to avoid the pests.

Box 2: Control Of Cowpea Pests

a) Use of neem seed powder on plants

The use of neem products is recommended in the management of cowpea pests especially when the local varieties are planted early in the long rains season.

i) Collect freshly fallen neem seeds and dry in the sun for 3-5 days.

ii) Pound the seeds in a mortar with pestle into fine powder.

iii) Mix the powder with water in the ratio of 1 handful (100 grams) powder to 1litre of water, (that means 5 handfuls or 500grams of powder to 5 litres of water) and soak overnight.

iv) Use a broom to sprinkle the solution on the cowpea plants three times at 4, 5 and 6 weeks intervals after planting. (If you are using a sprayer to apply the extract, use a piece of cloth material to filter before use).

b) Use of edible oil for control of cowpea storage pests

Cowpea storage pests can be controlled by using any edible oil as follows:

Put any type of edible oil on the cowpeas to be stored and mix well.

This preserves the grains for a period of up to six months.

It is now possible to plant cowpea varieties at the beginning of the long rains together with other crops and get good returns without using chemical insecticide. This would necessitate the use of improved varieties and the application of neem products for the control of pests (Refer to Box 2).

IV. Ensuring the sustainability of ipm technology

Some years back, farmers were hardly thought about in discussions of problems of farming. Today it is widely believed that the farmer should play the key role in farm improvement activities. It is the farmer who must identify the problems and needs of farm development, who must seek new knowledge and resources, and make decisions relating to such development (Chambers, Parcey and Thrupp, 1989: pages xvii-xx). Thus, if a farmer is motivated and keen to improve his or her farming, no doubt development will take place. With determination and hard work, the farmer can produce not only enough food for the family but also a surplus for sale.

The ISERIPM project considers the farmer as the central resource in the improvement of his/her farm through adoption of IPM technology. It holds that farmers know best what their problems and needs in farming are. As partners in this project farmers not only learn from the project team as to how to tackle farming problems, but the team can also learn from them. This learning is effected through intensive interactions taking place between the farmers and the research team through meetings, evaluation sessions, visits to their homes and group education sessions.

For this partnership to be fruitful, there are a number of factors which need to be recognized as highlighted below.

Perception of Need: Ask yourself whether you feel the urge to work with the research team. Often this urge comes when you are able to perceive some benefit from a project (Si Kahn, 1982). Thus as you work with the research team, ask yourself the following questions: In which way am I going to benefit from the project? If I were to adopt IPM components, can pest damage of my crops be reduced so that I can have enough farm produce for my family's consumption and even surplus for sale?

Farm Resources: As a farmer, you have land, but perhaps you may lack certain farm resources such as ox-plough, fertilizer, etc. This should not discourage you from trying out new ideas in farming. Once you have made up your mind to try an idea, use whatever resources you have at your disposal. When growing a new crop, for example, you can do it on a smaller acreage that your resources permit. If you cannot afford chemical fertilizers, you can make compost and apply it to your fields.

Farm Organization: It is said that "unity is strength". As farmers of one village, you can do a lot on your own if you join hands into some farm organization such as a cooperative, club, workgroup or village committee. You can, as a group, purchase or hire ploughing equipment, buy farm inputs such as improved seeds and chemical fertilizers, find a better market for your produce and so on. Where community organizations such as village committees already exist, they may serve the purpose. For a new farm organization to be created, farmers of a particular area (e.g. village) have to perceive the need for it and its likely benefits, and hold one or several meetings at which (Chitere, 1994: pages 99-102):

- Aims of the organization are outlined
- Rules and other regulations are formulated
- Leaders are chosen

- Sources such as MOALM's and community and "cooperative development officers able to provide advice and leadership training are identified
- A plan of what needs to be done is prepared
- Responsibilities are assigned to various members of the group
- Supervision is made of the activities in implementing the plan of work.

Sometimes an organization does not work smoothly. Mistakes may be made: some members who are assigned certain responsibilities may not carry them out as expected and there may be many other problems. However, if the members persist on working together and if they strive to overcome problems by learning from past mistakes, gradual progress will be made and the organization will grow slowly and mature to a point where it can benefit them greatly.

Farmers as Leaders: Farmers who are determined to overcome their farming problems and are prepared to work with-others to improve their farming can very likely become '1eaders" (Si Kahn, 1982). You can feel this potential in yourself when you strongly perceive that something has to be done about a particular problem. You might then talk to other farmers about the problem, or invite them to a meeting, or volunteer to initiate an activity of mutual interest to overcome the problem. When you do any of these, you are acting as a leader.

Farmers as Teachers: Can farmers learn from one another? If you do not know something, can you check with another farmer? Can some farmers assist others by showing them, for example, how maize and cowpea strips should be arranged in a field? The answer to all these questions is "yes" (Matthai, 1985, pages 3-8). Farmers are expected to take initiative to seek information "from other farmers, as they are from the ISERIPM research team or from other sources such as MOALM's agents. All farmers are likely to have information which they can share with other farmers. As teachers they also become leaders in their village.

MOALM's Extension Service: In Kwale and Kilifi, as is the case in other Kenyan districts (currently, counties), the Ministry of Agriculture's extension agents are employed to serve you. These agents have attended some of the meetings the researchers held with the farmers and contributed useful insights. Do not hesitate to contact them to seek new information, to clarify an issue, and so on. ISERIPM being a research project, the researchers will be able to work with you for a limited time. It is with the extension agents that you can continue to work when the project winds up.

Managing Your Farm: Record keeping is one of the essentials of better farming. Many farmers often have clear ideas about the various farm resources they use and their costs, e.g., amount of money spent to hire ox- ploughs or tractor, purchase of seed, etc. For better farming, a farmer needs to have a note-book in which he/she keeps financial records (RoK, MoA, 1996). The records help the farmer to know whether he/she is making a profit or loss. Below is an illustrative example of a simple hypothetical record which may be kept by one farmer. The expenditures, output and returns are from one acre (0.405 ha) planted with maize under mono cropping.

Table 1: Input-output data for maize crop

Item	Cost (Kshs)
Cash expenditures:	
Labour for clearing the field	1,000.00
Hire of ox-ploughs: Breaking the land	2,500.00
Harrowing	2,000.00
Purchase of Improved maize seed	1,250.00
Purchase of one 50 kg packet of chemical fertilizer (DAP)	3,000.00
Labour for weeding: 1st weeding	2,500.00
2nd weeding	2,000.00
Labour for harvesting and threshing	1,500.00
Other minor expenses.	500.00
Total expenditures	16,250.00
Gross Value of Production:	
15 bags of 90 kgs each realized (shelled) @ Kshs.2,500/-	37,500.00
Returns (Kshs.7,500 minus 3,800)	21,250.00

This simple record shows that the farmer earned some benefit from his/her maize crop. There are, however, many other details which may be included in the calculations.

Some Questions to ask yourself

As you prepare to adopt the new technologies, there are a number of questions that you can think about including:

1. How can I benefit from the project and the free services and materials provided by the researchers in the best way possible since I was selected to do so from among thousands of farmers in this county?
2. How can we as farmers of one village who are faced with common problems in farming, work together for our own benefit?
3. As a farmer I must have certain leadership qualities. What are these qualities? How can I use them to improve my farm and those of others around me?
4. What farm resources do I have and which ones do I lack? How can I make the best possible use of these resources and even increase them? Can I use whatever resources I have to adopt new farm technologies?
5. How can I know whether I am gaining or losing from my farming? Can I learn to keep simple farm records to show me how I am doing in farming?

6. How can I apply what I already know to make the technological options available more suitable and sustainable?

   Remember that researchers and agricultural agents are here to help you improve your farming. But the determination to do so has to come from you, your spouse and your whole family and village. Remember also that the researchers and extension agents will always be at your side to assist you and to answer any questions which you may have. Do not hesitate to consult with them.

References

1. Chambers R, Pacey A, Thrupp LA. Farmer first: Farmer innovation and agricultural research. London Intermediate Technology Publications. 1989.
2. Chitere PO. Community development: Its conceptions and practice with emphasis on Africa. Nairobi: Gideon S. Were Press. 1994.
3. Chitere PO, Kiros FG. New directions in interactive socio-economic and crop pests research at the ICIPE, Social Science Interface research Unit, Research Paper, ICIPE, Nairobi. 1993.
4. Kiros F.G. Lako, G.T. and Nyarko, A.K., 1996 Economic analysis of farmer-managed integrated pest management technology trials, Research methodology report No. 9 ICIPE
5. Matthai RJ. The Rural University: The Jawaja experiment in educational innovation. Bombay: Popular Prakashan. 1985.
6. Ro K. Ministry of Agriculture, Kilifi District Farm Management Guidelines. 1996.
7. Si Kahn. Organizing: A guide for grassroots leaders. New York: McGraw-Hill Book Company. 1982.