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INTEGRATED PEST MANAGEMENT: A Case Study of HASP

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ABSTRACT

The degradation of the environment on a global scale has warranted a rethinking of the treatment of pests. The control of pests is heavily weighted on the level of infestation and the concomitant losses in yield and therefore farm family income.The Hillside Agriculture Subproject in its quest to protect the environment from the potential ill effects of in indiscriminate use of chemicals, has been encouraging through onfarm demonstration, the practice of integrated pest management. The IPM strategy emphasizes natural control of pests through the promotion of disease resistant varieties of the major crops cocoa, coffee and coconut to establish and resuscitate hillside farms. The program has been effective through the use of cultural practices such as, land preparation, shade management, crop rotation, and intercropping. Other techniques used emphasize the discriminate use of chemicals and microbial pesticides. Fertilizer usage is done on the recommendations of soil analysis rather than broad spectrum application related to the crop requirements. This practice prevent excessive infiltration of chemicals in the underground water sources. The HASP IPM program is constrained by the reluctance of farmers over sixty years to carry out the cultural practices necessary to enhance the effectiveness of the program.

Brief Description of Subproject Area

The subproject is located in the Northern Rio Cobre watershed area, St. Catherine, Jamaica.

It is aimed at promoting the growth of perennial crops on hillsides and to increase the socio-economic well being of the residents. The specific objective is to develop viable hillside agricultural production systems which will contribute to increasing sustainable income to small-scale farmers, while conserving watershed resources and strengthening farmers organizations which support production and marketing activities.

The project is jointly implemented by the Ministry of Agriculture through the Research and Development Division and the Inter American Institute for Cooperation on Agriculture (IICA). The project is executed by a multidisciplinary team of Plant Protectionist, Agronomists, Economist, and Rural Development Officer headed by a Technical Coordinator with expertise in farming systems research.

The major crops planted in this sub-project are perennial tree crops, legumes and vegetables. The sub-project is testing technologies that have been developed in Jamaica and elsewhere and are being utilized by the Commodity Boards. Such technologies are compared with the practice carried out by the farmers on their holdings. Intercropping and soil conservation measures are incorporated in these trials, using a farming systems research methodology.

The main beneficiaries of the sub-project are grouped in three categories with respect to the type of benefit, and the time period in which the benefits would be realized. The immediate and direct beneficiaries consisting of not less than 168 farmers. Other direct beneficiaries consisting of just over 2,000 farmers and indirect beneficiaries consisting of about five and a half thousand farmers that are outside of the immediate influence of the sub-project.

Major constraints to increased productivity and production include pests and diseases, shortage of high quality Planting materials, transportation, and the absence of effective systems of management for crops and soil conservation among others.

A number of problems have been identified by the farmers which have an impact on their production and income potential. The preliminary findings of the baseline reveal farmers perception of their constraints to farm development as lack of funds, high cost and unavailability of labour as well as praedial larceny.

In terms of the cultural practices, the survey revealed that though 87% of the farmers in the project claimed to have pruned their cocoa fields, a similar percentage reported being plagued by black pod. This justified the project' adoption of an intensive training program emphasizing field sanitation as an important aspect of the Pest Management Program.

The Sub-Project adopts a participatory strategy which includes farmers, farmers organizations, commodity boards and the relevant divisions of the Ministry of Agriculture in the design, implementation and evaluation stages. The strategy used for development, and transfer of technologies generated in the sub-project includes field days, training courses for technical personnel, reports and technical bulletins.

It is quite difficult to develop an Integrated Pest Management Program for the North Rio Cobre Watershed area, though the area is relatively small comprising approximately 2,618 acres (1047 hectares), the climatic conditions vary drastically from very dry to moderate to high rainfall.

Such a situation would suggest that the pattern of pest infestation/infection and the type of pest would vary in these areas, therefore the methods of control would vary.

In this paper the presenter focuses on the definition of Integrated Pest Management (IPM), methods of Integrated Pest Management utilized by the sub-Project as well as the successes and problems of the program.

Integrated Pest Management (IPM)

For one to understand the concept of IPM, the definition of the term pest must be clear. The definition of a pest can be quite subjective, varying according to many factors, however, it may be defined in the widest sense as any animal or plant which harms or causes damage to man, his animal or plant, crops or possessions, or even just causes him annoyance.

In agriculture we are concerned when there is a loss in quantity and quality of crop caused by plant, insect or disease resulting in a loss of profits to the farmer. When a loss in yield reaches intolerable proportions, the pest can be defined as an economic pest. It was suggested by Edward and Heath (1964) that pest status is reached when there is a loss of 5% in yield, in a particular crop. Stern et al (1959) conceptualized the economic threshold level, which is the population density at which control measures should be initiated to prevent an increasing pest population from reaching the economic injury level i.e. the lowest pest population density that will] cause economic damage, and this varies according to crop, season, and area.

An important point to remember about any pest is that it is only an economic pest at or above a certain population density, and that usually the control measures employed against it are designed only to lower the population below a certain density at which the pest is considered to be an economic pest; only very rarely is complete eradication of the pest aimed at.

Development of Pest Status

The most economic way in which a pest species attains pest status is simply by an increase in numbers. This can be achieved by providing the right environment for breeding, or upsetting the natural control of the population by such practices as agriculture which provides an unlimited supply of food for the potential pest. The population may still be kept in check by the predators and parasites, but often the natural control factors do not act quickly enough to check the pest. Under such conditions control methods must be employed by farmer so as to avoid crop loss.

Seasonal increases in number are usually controlled by climatic conditions and biological pressures. Climatic conditions include temperature, humidity, rainfall and sunlight, whereas the biological factors include competition - intra and interspecific, predation and parasitism.

It is with these factors in mind that one has to develop different Integrated Pest Management strategies at different locations on similar crops within the sub-project.

Definition of Integrated Pest Management

The concept of Integrated Pest management is not new; Stern et al were some of the first to use the term to describe the integration of biological and chemical control measures into a cohesive insect pest management system.

More recently, the definition of Integrated Pest Management was broadened to describe the integration of all methods of controls which include biological, physical, chemical and genetic.

Another definition is that of FAO panel of experts on Integrated Pest Control (FAO 1967) which states that integrated pest control is a pest management system, that in the context of the associated environment and population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintain the pest populations at levels below those causing economic injury.

It should be noted that the two terms integrated control and integrated pest management are now used interchangeably, therefore one should not be confused if either term is used. The concept has also been broadened in recent times to involve different types of pests eg. insects. diseases and weeds.

Based on the definitions used, in discussing Integrated pest management the first consideration should be given to the use of natural mortality factors which include weather, diseases, predators and parasites and all efforts should be made to increase their action (Bottnell - 1979, Brader 1979). Methods that seriously disrupt natural regulation of pest populations should never be used.

The presence of a pest species does not necessarily mean that control methods have to be taken; low level infestations of some pests may be quite desirable, especially levels of pest that are non-injurious to agriculture can provide a source of food, reproductive hosts or shelter for natural enemies (Bottnell - 1979).

The concept of IPM is a management systems not one that eradicates the pest species. Control measures, including chemical pesticides are being used discriminately, when reduction or maintenance of the pest at a tolerable level is required. The need for such a control method is ascertained by determining the economic threshold level which has been described earlier. Measures that pose minimal risks to humans, beneficial to non-target organisms and the environment, are sought (Bottnell - 1979; Brader 1979).

Methods of Integrated Pest Management Utilized by Sub-Project

There are a number of control methods involved in an IPM program. However, not all of these measures are compatible with the sub-project and further more, methods utilized fall in various combinations from time to time, based on the area, technical knowledge, season, and crop. Methods used by the sub-project include the following:

1. Introduction of resistant/tolerant varieties.

Utilization of pest resistant varieties cause a reduction in the pests equilibrium position. Varieties which are tolerant also keep the pest at equilibrium position.

Coffee and cocoa are the main tree crops within the sub project area. More recently coconuts have been introduced and this crop is fast becoming a major crop within the area. The Maypan and the Malayan Dwarf are varieties resistant to lethal yellowing disease and are now being planted extensively as replacement for the old susceptible varieties like the Jamaica Tall.

The variety of coffee being planted in the area is Typica. The variety is not as high yielding as other varieties, but it shows a reasonable amount of tolerance to a number of major pests and diseases of coffee.

It is very difficult to determine the major varieties of cocoa that was planted in the area prior to the intervention of the sub-project. Most of these varieties showed little resistance to the "black pod" disease and at the same time were low yielding. The Hillside Agricultural Project (HAP) and Cocoa Industry Board (CIB) entered into a contractual agreement in which a number of specially bred cocoa varieties were introduced into the sub-project area using the seed-at-stake method of establishment. Other such varieties were introduced by the seedling and budded plant method. These planting materials have been used to underplant existing fields and also to establish new ones. It is expected that through this method, the use of chemicals will be drastically reduced.

2. Cultural Practices

Since the introduction of chemicals, a number of these useful practices have been either ignored or forgotten. Such practices are often proved to be least expensive and at times most effective methods of control.

The sub-project stresses sustainability, and all methods used by the implementors are those that can be maintained and utilized by its beneficiaries, the farmers. Therefore improved cultural practices especially shade management, receive high priority and is an integral part of the Integrated Pest Management Program.

At times it is difficult to get farmers to change, however the Rural Sociologist, whose role includes the study of farmers' behavioral patterns assists in encouraging the adoption of newer and more effective cultural practices.

It should be noted that a number of cropping systems have evolved under the influence of many interacting socioeconomic factors, including pest pressure. In different situations, certain cultural practices may favor one pest while showing deleterious effects on others.

The cultural practices used by the sub-project are:

(a) land preparation - this activity includes (a) land clearings (b) tillage and (c) fallowing.

(a) Land Clearing

In land clearing, the field is cleared of weeds which are at times host plants for harmful pests. Tree trunks, rocks, rooted leaves etc. are also removed to prevent pests such as slugs and snails from finding suitable habitats. In general, proper field sanitation is maintained. This practice is most important as one is dealing with small farmers who have been planting the same crops on the same spot for several consecutive years.

(b) Tillage

This practice is done to a minimum, as the sub- project is emphasizing soil conservation on hillsides and till age would enhance soil erosion. However, minimum till age is done, which exposes the area in which the plant will be placed to the effects of sunlight. This method is effective against some pests, killing them through mechanical injury and or exposure to desiccation. Pest such as fiddler beetle grub that are serious root feeders are controlled in this way.

(c) Timing

Crops are planted so that their vulnerable stages occur when pests are absent or least abundant, or when conditions give them a competitive advantage over the pest, eg spring and fall.

Fortunately there are two (2) planting seasons in the project area -spring and fall. During these periods the rainfall is above average and leaf-miner (   ) are usually absent. Young coffee seedlings are quite susceptible to attack by this pest However, during wet conditions leaf-miners are usually quite rare or absent, therefore the young seedlings are able to establish themselves.

This control method requires the coincidence of planting dates with the rainfall period, as rain fed agriculture is being practiced.

(d) Rotation of Host and Non-host Crops

This often provides an effective and economical means of reducing pest populations to sub-economical levels. However, populations of pest other than the target pest may increase on the alternate crop. Crop rotation is widely practiced within the sub-project especially in areas where there are new establishments of tree crops. It is the sub-projects mandate to find suitable cropping systems that are economically and culturally viable. The relevant data is being collected on a number of cropping systems and these findings are to be published as soon as they are complete.

(e) Intercropping

It has been observed that pest problems are less in fields that are inter-cropped than in monocrops. The reasons suggested are quite complex, but it may involve differences in attractiveness (or predilection) to pests or micro-climatic effects caused by differences in crop structure.

(f) Mixed Cropping

This is encouraged in the sub-project and is pronounced in most of the older fields, where one finds the main crop, banana, plantains, other tree crops, cocoa yams etc. However, in recently established fields, the crop mixed is in a more orderly fashion. A good example is the use of trees with small leaves (legume/coconut) as permanent shade in cocoa. This helps in the control of fiddler beetles lay their eggs between the leaves of plants (large leaves), when the eggs hatch, the larvae fall on ground and attack the roots of the of cocoa plants.

When legumes/coconuts are used as permanent shade, the fiddler beetles are unable to lay their eggs between these types of leaves, therefore the infestation is reduced, if present at all.

(g) Pruning

Black Pod (***Phythopthora palmivora***) of cocoa is a major disease in the cocoa areas of the sub-project, where susceptible varieties were planted. This disease can be controlled using a copper based fungicide or by changing the micro-climate of the fields to one that is to the detriment of the disease pest.

Change of the micro-climate is achieved by the process of pruning. Pruning allows more air and sunlight into the fields. It is also done to remove dead plant materials that provide habitat for termites and infected cocoa pods that are a source for the potential spread of the black pod disease. Pruning also assists in the control of rats. Fields that are very crowded and over shaded are good breeding grounds for rats. It is noted that pruned fields are less infested with rats than unpruned fields.

3. Fertilization

Plants that are healthy tend to resist and recover from pest attack quicker than those that are unhealthy and nutritionally deficient.

A fertilizer program has been instituted within the sub project. Soil analysis is being carried out in conjunction with the Rural Physical Department of the Ministry of Agriculture, so that the correct fertilizer recommendation and rate of application is used.

There is no empirical information at present on the effects of the fertilization programs however data have been collected and are being collated. Visual observations (qualitative) can justify the use of fertilizer. Fields that are fertilized look healthier than those that are unfertilized.

The use of fertilizers can be termed a prophylactic treatment; in that, it prepares the plants for adverse conditions it might have to withstand if and when there is an outbreak of pest infestation.

4. Outbreak Control of Certain Pests

Under normal conditions, when there is a balance between natural enemies, resistant varieties and cultural practices, further actions against certain pest may not be necessary. However, certain changes such as climate, or even cropping pattern may cause a flare up of certain pests. At the point when one considers it to be of economic importance, remedial measures may be taken.

Remedial measures are taken in the form of:

1. Selective use of chemical pesticides to avoid disruption of the natural enemy complex through:

(a) Use of Specific Chemicals.

At times there is the flare up of caterpillars (Lepidoptera sp) on crops such as corn, cucumber etc. which are used as intercrops. A good type of chemical that is used or recommended is the Pyrethroids. However, in using this type of chemical indiscriminately, there is always an upsurge in mites. This is due mainly to the fact that pyrethroids destroy the natural enemies of mites. therefore favoring a situation for an increase in the mite population.

It is always borne in mind when making recommendations for use of chemicals what ill-effects they have on natural enemies of certain pests therefore before any chemical is used, adequate information of its actions is checked out from dealers, researchers.

(b) Use of Minimal Dosage.

In using minimal dosage it is less likely that the natural enemies of the pest will be adversely affected. Minimal dosages are usually more specific to the pest than the natural enemies of the pest.

(c) Application of Pesticides to Restricted Areas.

This method is being used specifically for soil-borne pests. In fields where soil-borne pests such as nematodes, fiddler beetle, grubs etc. are detected and warrant control measures, chemicals such as Furadan and Mocap (Nematicides/Insecticides)are used restrictively. Such chemicals are not broadcasted over the entire field, but are placed in and around the root zone of affected plants. This method of application proves quite effective in controlling such pests, and at the same time is less costly and does not destroy a lot of beneficial soil-borne organisms.

(d) Use of Poisonous Baits

Rats are controlled by two (2) methods, such as field sanitation and poisonous baits.

The main type of bait used is Warfarin which is used at a rate of eight (8) lbs/acre in cocoa fields. These baits are placed in a Joint of bamboo at a rate of 12-16 sites/acre. The joint of bamboo is opened at either end so as to allow the pest free entry and exit. It is then securely fastened in the cocoa tree. Regular checks are carried out to see that adequate bait is in place at all time. Baits are usually set at the time the cocoa pods are maturing and not year round.

In setting the baits as mentioned above, domestic animals are not placed at a risk of consuming such and dying from its effect. Baits are also used to control pests such as slugs and snails. This method is used mainly after field sanitation has failed to control these pests.

Metaldeyhyde and cornmeal mixed at a rate of 1:10 respectively have proved quite effective as a control. However, as with **Warfarin,** this chemical mixture is always placed out of the reach of domestic animals .

5. Microbial Pesticide

We have been using only one of these pathogens - **Bacillus thuringiensis,** a bacterium. It is specific for a wide range of pests and is commonly used on cabbage crops which are used in the intercropping of the main program. This pesticide does not destroy other beneficial insects, therefore there is hardly any likelihood of a shift in the equilibrium position of other pests.

High Points of the Project

(a) Staff

The sub-project has the technical capability to monitor the on-farm trials making good reports as to the status of particular pests. Regular field inspections are carried out by the field team under the guidance of the Plant Protectionist. The reports from the field team is critically assessed and the necessary remedial action taken.

The Core Team of Rural Sociologist and Economist lend respectively their skills to facilitate technology transfer to cost the various technologies, advising both staff and farmers of which is most economically viable.

(b) Political Commitment

There is political commitment to the sub-project indicated in the support of activities as well as popular mobilization of interest in the sub project.

(c) Enthusiastic Farmers

Very few farmers have shown any reluctance to change. There are still a few farmers who are using "wood ash" to control insect pests, and are unaware of the difference between a fungicide and an insecticide, however, with regular training programs through field days and visits to demonstration plots, it is envisaged that the necessary change will eventually come.

(d) Low Volume of Chemicals being Used

The sub-project is a Watershed Management project, therefore large scale usage of chemicals could contaminate major aquifers in the area.

So far, we have been fortunate to have used over the past two years, quite a small amount of chemicals over an estimated 168 acres of land.

Fungicide	-	2.6 kg
Insecticide	-	1243.86 ml
Nematicide	-	65.99 kg
Slugocide	-	8.075 kg.
Rodenticide	-	55.22 kg.
Herbicide	-	155.75 l.

e) Produce Quality

Farmers under the sub-project are able to sell produce of high quality to higglers, wholesalers and consumers. There is a monthly Market Fair put on by the sub-project farmers where their ground provisions, vegetables, market cane, fruits etc. are sold. This started with the guidance of the sub-project staff and it has proven quite successful. Consumers have not complained about the quality of the produce even though at times they complain about the price.

(f) Close Association with other Organizations

The sub-project is very fortunate to have the cooperation of all the Commodity Boards that it impinges on. There is never any problem in harnessing the expertise from any of these organizations.

6. Problems

(a) A major problem is that of the sustainability of the technologies that are being transferred to the farmers.

At present there is quite a high rate of adoption, but will it be so after the sub-project has been phased out? It is the first time that farmers in these areas are getting the quality extension service but will they revert to their traditional methods after the phasing out.

(b) Getting Farmers to Change

For some farmers it is difficult to adopt new technologies. Various ingenuous ways have to be worked out to achieve this. Farmers were taught prior to the sub-project's intervention that they should spray at the first sign of any pest or more so to spray as a preventative method of control. This sort of indoctrination is quite difficult to change at this point in time.

(c) Types of Chemicals Used/Purchased by Farmers

Farmers are purchasing a number of quite toxic and out dated chemicals from firms that are not up-to-date on the types of chemicals that are available presently

Farmers are still using chemicals such as Chlorodane, D.D.T. and others that have serious ecological effects on the food chains among other effects.

(d) Farmers Age

There is the need for younger farmers to come in the system. More than 60% of the farmers in the sub-project are above the age of 60 years. Farmers at this age tend to be less inclined to adopt new methods and proof more difficult to influence, as they are at the point where they are scaling down their farming activities.

CONCLUSION

The Hillside Agriculture Subproject as a watershed management project has to find ways of controlling the various pests that affect crops being produced in the area and at the same time minimize the use of harmful pesticides that can contaminate major aquifers. In trying to achieve this the use of pest control measures compatible with the subprojet environment is critical.

Pest management methods will change from time to time based on a number of factors, however it is of great importance that proper records are kept and operations documented, so that one is able to draw on the past experiences of similar projects. This is what the Hillside Agriculture Project seeks to achieve.

SEASONAL CALENDAR