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Indigenous Pest Management Mechanisms in Ankesha Guagusa Wereda (District), Northwestern Ethiopia

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Abstract:
The objective of this study was to explore indigenous pest management mechanisms (IPMMs) used by smallholder farmers in Ankesha Gugusa Wereda, Northwestern Ethiopia. In order to conduct this study, key informant interviews, focus group discussions, and field observations were used as instruments for primary data collection. Secondary data were also used. The findings of this study show that there are different pests which affect the growth and yield of crops in the study area. These include stalk borer, African bollworm, locust, African army worm, weevil, mice, birds and wild animals. Smallholder farmers also use various IPMMs to protect pest infestation. These IPMMs include, among others, proper cleaning and ploughing of the farmland repeatedly, sprinkling of the mixture of cattle urine, ash and phytolaca dudcandra plant, picking up and throwing away the worm, fumigation of the farm, cracking materials such as corrugated iron, ploughing the surroundings of the farm, smearing the storage with dung and storing crops by massaging with pepper, using poisonous herbs and erecting man's statue on the farmland. IPMMs have merits for sustainable development. They are suited with the ecology, have the power to avert risks, they rely on locally available resources and are cheaper and in most cases cost-free in cash terms. These indigenous methods have also some demerits as well. They require intensive labor, some of them are limited in their area of application and they don't provide an effective and long-lasting solution for pest infestation. Despite potentials to prevent pest infestation at an early stage, IPMMs lack attention and have not been exploited fully in farming practice. Hence, the suggestion of this study is that IPMMs need to be maintained and applied in farming practice a lone(at early stage) or in integration with pesticides (if the pest infestation is serious and wide spread)

Key words: *Indigenous Knowledge, Pest Management, Farming Practice*

1. Introduction

1.1. Background to the Study

Farmers have awareness about their environment in general and farming practices in particular. This awareness is the result of many generations of insights gained through their closer interface with the natural environment (Atte, 1991, cited in Kolawole, 2001). Because of their close attachment to their environment, farmers have detailed knowledge of soil characteristics, soil quality and plot characteristics. As a result, they developed systematic indigenous methods of testing and classifying soils (Netting, 1968, cited in Chambers, 1983; Atteh, 1992). They also have detailed knowledge of plant species, characteristics, soil association and water requirement (Chambers, 1983). Farmers also know very well pest types, characteristics, breeding patterns, life cycles, feeding habits and crops attacked by each pest. In many cases, they also developed pest and disease management mechanisms (Atteh, 1992).

To prevent crops from the damage of pests, smallholder farmers in Ethiopia use both pesticides and indigenous methods. However, extension workers and development agents strongly urge smallholder farmers to use pesticides. They did this to encourage farmers increase their production by using modern technologies and to discourage farmers from using traditional practices in favor of modern once. But, "[t]he pesticides are proven to be extremely toxic and have led to a number of side effects: impact on public health, toxic residue in food and disturbance of local ecosystem" (Khor and Lilin, 2001:141). Lack of appropriate care during application my also expose pesticide sprayers and others for chemical damage. Pesticides may also harm animals when they are sprayed on crops found near pastures (Alemu, 2008).

The emergence of new challenges associated with the application of agro-chemicals, especially pesticides urged planners to devise a new approach for development, which could solve the newly emerging challenges of rural development and improve the living condition of the rural people. With regard to the approaches to be employed to cope with the newly emerging challenges, Workineh (1997:298) states "[I]f humanity is to survive very complex ecological crises, development efforts and environmental protection at

local, regional and global levels should involve people's local practices, experiences and beliefs." One of these local resources to be exploited to cope with the newly emerging challenges to the ecology is Indigenous Pest Management Mechanisms (IPMMs).

1.2. Statement of the Problem

Undertaking a study on IPMMs is necessary for various reasons. Firstly, local farmers in the study area posses more and detailed information about their surrounding in general and farming practice in particular. However, due attention has not been given to farmers as producers and owners of useful knowledge. For instance, some of the extension workers and development agents in the study area assume farmers' knowledge is "simple" and "shallow." As a result, some of them discourage farmers from using IPMMs in favor of pesticides. Secondly, though the study area is rich in the application of IPMMs meaningful efforts are not made by the concerned bodies to study and document the IPMMs found in different agro-ecological zones of the study area. Emphasizing the need for systematic recording of Ethiopian indigenous knowledge, Kinfe states that "[i]ndigenous knowledge symbolizes our identity and also perpetuates our cultural heritage…it should thus be identified, recorded, explained and preserved for use in generation" (cited by Dejene, 2005:5). So, the study of IPMMs is necessary and timely.

1.3. Objectives of the Study

1.3.1. General objectives

The general objective of this study is to identify and document IPMMs used by smallholder farmers and identifying ways of improving their effectiveness in farming practice.

1.3.2. Specific objectives

- To identify major pests that affect crop production practice in the study area
- To explore major IPMMs used by smallholder farmers to prevent pest infestation in small farms
- To assess the merits and demerits of the IPMMs from the perspective of sustainable development.

1.4. Significance of the Study

This study provides information for governmental and non-governmental organizations, which are engaged in farming practice, about useful IPMMs. Therefore, these organizations can use IPMMs for sustainable agricultural development by incorporating useful ones into farming practice.

2. Methods of Research

2.1. Study Area

Ankesha Guagusa is one of the eleven *weredas* in Awi Zone, Amhara Region, Ethiopia. It is predominantly inhabited by Awi (Agaw) ethnic group, who belonged to the central Cushitic speaking peoples. Its location extends between the coordinates of $36^0$36'18'' and $36^0$59'33'' East longitude and $10^0$31'46'' and $10^0$41'32'' North latitude. The total area of the district is estimated to be 103, 174, 07 hectare (which is nearly 986.37 square kilometers) (Belay, 2014). Based on the information obtained from the Agricultural and Rural Development Office of the study area (2012), the *wereda* has a total population of 214, 169, of which 106, 449 are males and 107, 720 are females.

According to the Basic Statistic Report obtained from Finance and Planning Office of the study *wereda* (2012), Ankesha Guagusa has an elevation varying from 1500-2500m.a.s.l. with 70.8% of the landscape being plateau, 26% mountainous, 2.5% valley, 0.7% water bodies, 0.1% marshy and 0.2% others. The same source further shows that Ankesha Guagusa has varieties of climatic conditions favorable for agriculture, animal rearing and a forestation. There are three ecological zones in the *wereda* namely highland (2300-3200 meters -mts.), midland (1500-2300 mts.) and lowland (500-1500 mts.), which cover 10%, 80% and 10% of the total area of the *wereda*, respectively. Hence, the largest part of it is midland type of agro-ecology zone. Because of its plain nature, this *wereda* has favorable climatic condition suitable for agricultural activity. The *wereda* is well known by its production of cereals, oil seeds, pulses and tuber crops. As a result, Ankesha Guagusa is recognized as one of the productive areas in the Amhara region.

2.2. Sampling Design

Purposive sampling technique was used to select the study sites and knowledgeable key informants. Ankesha Guagusa district was selected for this study because of its relative importance in the application of indigenous knowledge. In this wereda there is tradition of planting living hedges to protect farm lands for sustainable use. There is also wisdom of traditional irrigation to supplement rain-fed agriculture. Farmers of the area are known in their skill of traditional dam construction, system of water intake into farm lands and water resource management. In all agro-ecological zones, there has been an age-old practice of mixed farming, soil and water conservation and pest management practices. There are also traditional beliefs and rituals vital for forest resource management.

The selection of three study sites (*Kebeles*), Den Zuria, Sostu Segno and Dikuna Dereb, one from each agro-ecological zone, highland, midland and lowland, respectively, was undertaken purposively in consultation with extension workers of the *wereda* to investigate the possible variation of the application of IPMMs across different agro-ecologies. The selection of key informants was also carried out (from both sexes) in consultation with chairmen and development agents of each *kebeles*. Accordingly, a total of 48

knowledgeable key informants were selected purposively based of the ability of individuals on narrating details of the application of IPMMs.

2.3. Instruments of Data Collection

This study was undertaken using qualitative research method. This research method was selected because the study is an account of different opinions and views of farmers, extension workers and development agents who have relations, directly or indirectly, with IPMMs. Therefore, the main research instruments used to collect the necessary data for this study were in-depth key informant interview, focus group discussion, field observation and document analysis.

Key informant interviews were held in each agro-ecological zone with 8 male household head farmers, 8 female household head farmers, 2 development agents, and 6 extension workers to collect information about the pests that affect farming practice in the study area and the application of IPMMs to cope with pest infestation. Two focus group discussions, one with 6 male and the other with 6 female farmers, were also held at each study site to collect information about merits and demerits of the IPMMs and on ways of improving their effectiveness in farming practice. Field observation was also undertaken to collect information how the IPMMs were applied in the study area. Various documents were also collected from the study area and used in this study. The information obtained from key informant interviews, focus group discussions, field observation and documents were analyzed using qualitative description.

3. Results and Discussions

3.1. Major Pests That Affect Crop Production Practice in the Study Area

Farming is an activity challenged by various constraints having direct impact on productivity. There are different pests, diseases and weeds, which affect the growth and yield of crops in the study area. Though the degree of infestation and invasion varies, pests, diseases and weeds appear in all agro-ecology zones of the study area. According to the informants obtained from the Agricultural and Rural Development office of the *wereda*, some of the common pests in the study area include stalk borer, African bollworm, locust, Africa armyworm, and rodents and vermin, such as mice, birds, apes, colobus monkeys and porcupines. Moreover, weevil is a common pest that widely affects crops in storage.

Stalk borer /busseolafusca/, locally also know as *etsi* (Awngi- the language of Awi ethnic group) *and Ageda Korkur* (Amharic- the national language of Ethiopia), is a field pest which mainly infests maize during the growth of the shoots, (i.e., in July and August) and on heir maturity time, (i.e., October). In addition to maize it also occasionally infests sugarcane and finger- millet in the lowland parts of the study area. African Bollworm (Helicoverpa armiqera), locally known as *etsi* (Awngi) *and Til*(Amharic*)*, is a field pest which infests crops such as pepper, maize, finger- millet, *tef*, niger- seed and wheat. Its main infestation time is October, with sudden raining. It is common in the lowland area of the district. Locust (locusta migratoria migratorioides), locally known as *kumiti* (Awngi) and *Anbeta* (Amharic), is a field pest that feeds on all types of flora. However, according to informants, the main crops damaged by locust are *tef*, finger- millet, maize, niger- seed, wheat, barely and pepper. Locust inflicts heavy damage on crops in the period from June to November. First, starting from the beginning of June, locust damages the shoots of crops and grasses, and then partly ripe (fresh) fruits and the flowers of the shoot of crops. Locust mostly appears in the lowland parts of the district.

African Armyworm (spodoptera exempta), locally known as *taamch* (Awngi) and *temch* (Amharic), is a field pest which, according to informants, usually affects crops like *tef* and finger- millet. Its main infestation months are May and June. In some cases, months of September and October also experience an infestation of armyworm. It infests with sudden coming of rain and damages green leaves of plants. African Armyworm widely infests in the lowland areas of the district. Weevil (curculionidea), locally know as *niqizi* (Awngi) and *neqez* (Amharic), is a storage pest which inflicts heavy damage on crops by infesting and reproducing itself in storage devices. Weevil highly damages pulses and cereals. It highly infests in the lowland and midland areas of the district.

Of the animals categorized under rodents, the one, which highly damage the agricultural produce, is the mice (mus musculus). In all agro-ecology zones of the study area, the mice inflict heavy damage upon agricultural produces on the field and during storage. The other wild animals that destroy agricultural produces in the study area are birds, apes, baboons, colobus monkeys and porcupines. Birds mostly eat irrigated crops such as barely and wheat. Other wild animals also damage crops throughout the year. Wild animals exist in all agro-ecology zones of the district *and* destroy large amount of yearly agricultural produce.

Apart from the pests already mentioned, there are also diseases that highly affect the growth of shoots of crops in the study area. These include potato leaf bright, root roch, rust and smut. There are also newly emerging weeds (such as cuskuta and striga) and local weeds which affect the growth of shoots of crops in the study area.

3.2. Indigenous Pest Management Mechanisms (IPMMs)

Because of their constant presence in the field, farmers are in a better position to determine which problem affects them directly. In the face of these constraints, "farmers are keen to seek solutions to old and new problems" (Rhoades and Bebbington, 1995: 300). To prevent crops from the damage of pests, diseases and weeds, smallholder farmers use both modern technologies (pesticides and herbicides) and indigenous methods. They use the latter practice for two main reasons. Farmers have a well established traditional wisdom of preventing pests, diseases and weeds which are inherited from forefathers. There is also problem of access to modern technologies which include inadequate supply and high price of pesticides and herbicides. As a result, now a day, smallholder farmers in the study area use local remedies as alternative means to cope with problems caused by pests, diseases and weeds. The two main indigenous methods used by farmers to prevent crop diseases and weeds are uprooting and removing the infected plant and hand

weeding. Farmers in the study area also use various IPMMs, the main focus of this study. The well known and commonly practiced IPMMs in the study area are discussed as follows.

3.2.1. Indigenous Stalk Borer Management Mechanisms

Informants mentioned that the infestation of stalk borer /busseolafusca/, is mostly caused by the failure of cleaning past year's maize residue. Hence, farmers believe that proper cleaning of past year's maize residue, at least two months before the sowing time, would drastically decrease the infestation of maize stalk borer. Ploughing of the farmlands repeatedly is also believed to kill the worm by exposing it to the sun.

3.2.2. Indigenous African Bollworm Management Mechanisms

Farmers in the study area use different indigenous methods to prevent African bollworm (Helicoverpa armiqera). As the infestation of African bollworm occurs with sudden coming of rain, local farmers believe that irrigating crops (e.g. pepper) when the crop is lacking rain prevents the manifestation of African bollworm. But once the bollworm is manifested, farmers believe that, the spilling of water over the crop and the sprinkling of cattle urine, ash and phytolaca dudcandra plant - locally known as *sibite* (Awngi*)* and *Endod* (Amharic) - by mixing together and socking for 15 days, causes the African bollworm to fall-off. Besides, picking up and throwing away the bollworm using human labor and cracking of materials such as corrugated iron, stones, etc., are also considered by farmers as local remedies to prevent the infestation of African bollworm.

3.2.3. Indigenous Locust Management Mechanisms

In order to prevent locust (locusta migratoria migratorioides), farmers in the study area use different management mechanisms which are passed down from generations. As locust uses weeds and bushes found around the farms as a place of stationing, farmers in the study area believe that the clearing of weeds and bushes from farms and the surrounding area would minimize the damage. Besides, farmers consider the chopping-off and killing of locusts, in their place of passing the night, early in the morning, as a local remedy for minimizing the damage of locust. Farmers also believe that the locust would leave the plot when the farm is fumigated by smoke. Hence, they undertake the fumigation of the farm by smoke early in the morning. Chasing away locust from the farms by cracking materials such as corrugated iron and whip, and throwing a stone with sling are some of the widely used local preventive mechanisms.

3.2.4. Indigenous African Armyworm Management Mechanism

Smallholder farmers in the study area use different methods to prevent the African armyworm (spodoptera exempta). The Africa armyworm first appears in grasses grown on the side of the farmland. Hence, farmers tread or graze cattle on the grass found in the surrounding of the farmland, so that the armyworm easily dies. Farmers also consider ploughing the surroundings of the farm as a good local remedy for the prevention of African armyworm. If the surrounding area of the farm is kept weed-free by ploughing, farmers believe that the armyworm would not easily enter into the crops sown.

As the African armyworm walks on its foot, the digging of a hole in the surrounding of the farmland also prevents the armyworm because it cannot pass into the farmlands as it falls into the hole. Farmers also kill the accumulated armyworm inside the hole by dragging the trunk or branch of trees over the armyworm. Placing thorn on the side of the farms is the other local remedy used by farmers to prevent armyworm. This practice prevents the armyworm from entering the crop. However, once the armyworm infested the crop, farmers believe that a good solution is cleaning the farmland or making the farmlands weed-free by undertaking various agronomic practices. If it is not widespread, farmers also consider hand picking and killing of it as a local preventive mechanism.

3.2.5. Indigenous Weevil Management Mechanisms

Smallholder farmers in the study area minimize the damage of weevil (curculionidea) by applying different indigenous preventive mechanisms. They smear the storage by dung and store grains first by massaging crops by pepper, because both the dung and pepper have the potential to prevent weevil infestation. During FGDs, female participants mentioned that most farmers use both pesticides and pepper massage to attain maximum combined preventive effects. Besides, women farmers also store crops, which are kept for house consumption (e.g. maize and field beans) by lightly roasting through fire. According to informants, the technique of roasting crops by fire is more effective to prevent weevil than other local remedies. The storing of grains, by mixing crops which are vulnerable and non-vulnerable to weevil, is also the commonly used technique of minimizing the damage. The main crops stored by using this technique are finger- millet with maize and *tef* with maize. According to informants, weevil do not eat finger- millet and *tef*, where as maize is easily eaten by weevil.

3.2.6. Indigenous Mice Management Mechanisms

Farmers apply various mechanisms to prevent their produces from the damage of the mice. There are poisonous herbs used by farmers in the study area to minimize the damage of the mice (mus musculus). The well-known herbs are leaves of broad-leaved croton *(*Croton Macrostachyus*)*-locally known as *assesse (*Awngi*) and bissana (*Amharic*)*-and euphorbia-locally known as *Kulkuli* (Awngi) and *Kulkual* (Amharic), which are believed to have the potential to kill the mice. According to informants, first farmers fill up or close the hole of the mice by using these leaves. In trying to go out of the hole, the mice eat some of the leaves of these poisonous herbs which are likely to kill them. Besides, farmers kill mice by providing food mixed with the milk of euphorbia, which have the potential to poison and kill the mice.

The use of trap is the other coping mechanism to prevent the damage of the mice. Farmers in the study area use two types of traps. Those are traps made from iron and stone. Iron traps, bought from shops are mostly used to prevent the mice inside the house in all agro-ecology zones. But stone traps, made by farmers themselves, are used mainly in the lowland areas of the *wereda*. According to informants, in order to make a stone trap, first flat stone is prepared. Then a pole like structure is made from locally growing plant known as *gramti* (Awngi) *and gramta* (Amharic), a kind of grass from which basket etc are made, to slightly erect the flat stone on a leaning position on one side. Then, crops are attached with pole like grassy structure. When the mice cut the *gramti*, in its effort to eat the attached crop, the flat stone will fall upon the mice and kill it.

Farmers also consider the clearing of farmlands as a good local remedy for the prevention of the damage of the mice. According to informants, the mice frequently damage the crop if there are veils or curtains by the presence of bushes and weeds in the farmland. As a result, farmers believe that the clearing of weeds and bushes from the surrounding would minimize the mice damage. Hole is the main fortification of the mice. To force the mice to come out of the hole and kill it, farmers use the technique of flooding the whole through water and suffocating the hole by smoke. Because, according to informants, once the hole is flooded and suffocated by smoke, the mice could not stay inside the hole.

3.2.7. Indigenous Birds and Wild Animals Management Mechanisms

Small-scale farmers use different indigenous methods to prevent the damage of wild animals such as birds, apes, baboons, colobus monkeys and porcupines. They place materials such as corrugated iron and thin stretching plastics (e.g. strings of tape) believing that the noise created by these materials, with the coming of wind, would bolt the wild animals eating or damaging the crop. This method is very important to drive/chase away wild animals attacking (eating) crops at night (e.g. porcupine). They also use methods of erecting man's statue on farmlands since the wild animal, which comes to eat the crop, will bolt considering the statue as a man guarding the crop. Making smoke near the farm is the other method used by farmers to prevent birds from damaging crops. As a result, farmers often make a smoke early in the morning to expel the birds out of the farm. The other widely used method of protecting crops from wild animals is guarding. Farmers in the study area watch the crops sown by assigning a member of a family, usually the boys, and by using various aids such as sling (for throwing stones), whip (for making a noise) and dog (for chasing away). They also shout to scare crop attacking birds/wild animals.

To sum up, farmers in the study area use various IPMMs to prevent their crop from pest damage. Thus, rather than viewing farmers as being passive and vulnerable to factors affecting farming practice, it must be recognized that many farmers use their ingenuity to develop systems to mitigate whatever challenge they face.

3.3. Assessment of Some Merits and Demerits of Indigenous Pest Management Mechanisms

One of the main objectives of indigenous knowledge research is to create favorable condition for the improvement of the wellbeing of the people and its ecosystem and to transform them into more sustainable human-ecosystem integration (Griener, 1998). Hence, it is reasonable to make an assessment of merits and demerits of IPMMs based on the essence of sustainable development. This is because, according to Alau (1995, cited in Kolawole, 2001:14), "[d]evelopment may be said to be sustainable when it has become self-perpetuating, self-regulatory and beneficial for the coming generation". So, the assessment of merits and demerits of the IPMMs vis-a- vis pesticides is undertaken as follows based on some sustainable development assessment criteria, such as the potential to provide optimum solution for farmer identified problems, suitability with the ecosystem, the ability to reduce risk, utilization of locally available resources, affordability, labor utilization and effectiveness.

In most cases, indigenous knowledge is generated and applied in response to certain problems and constraints people are facing in their interaction with their immediate environment. IPMMs have the potential to provide optimum solution for problems identified by farmers as constrains of farming practice. It is by the use of this local remedy that farmers first try to cope with the damage inflicted by pests. When the infestation is serious, farmers also use pesticides. However, because of inadequate supply and high price of pesticides, farmers largely depend on IPMMs to cope with pest infestation particularly in the lowland parts of the study areas.

Indigenous knowledge system applied in the study area to solve constraints of crop production experience minimum risk compared to pesticides. IPMMs are widely applicable in the study area to minimize pest damage. Their application has no harmful effect on human and animal health as well as the ecology an attribute which makes IPMMs suitable for the ecosystem in general and human beings and animals in particular. On the other hand, according to informants, despite their effectiveness, the application of pesticides has harmful effects on human beings, animals and the ecosystem. Firstly, lack of appropriate care during application may expose individuals for chemical damage. Secondly, pesticides may harm animals when they are sprayed on crops found near pastures. They also harm the bee during their sipping of the flower of crops sprayed by pesticides. Thus, IPMMs are advantageous in terms of reducing risk as compared to the application of pesticides.

One of the advantages of indigenous farming knowledge over modern ones is the utilization of locally available resources. IPMMs are also applied using locally available plant resources and animal waste, such as animal urine, dung and ash. However, some resources useful for IPMMs are not readily available for all farmers (e.g. animal urine). On the other hand, in most cases, pesticides are imported items, which require large sum of money to buy. They also require highly trained manpower and managerial skill for their application and management.

The other advantage of indigenous farming knowledge over the modern one is affordability. From this angle, most IPMMs do not require additional financial expense, for they are applied by the use of locally available resources, easily available instruments and farmers' labor and know-how. Most farmers can easily fulfill them without much difficulty. However, in some cases, the affordability

of IPMMs is limited. Some of these indigenous methods require the availability of livestock, purchasing cost and abundant labor. Therefore, farmers would have difficulty in using some of the IPMMs if they lack cattle, money and incapacitated physically.

One of the major attributes that make indigenous farming knowledge less advantageous than modern ones is labor utilization. The application of IPMMs are tiresome that require wide and intensive use of both household and communal labor during their application. Some IPMMs such as hand picking of pests and clearing of farmlands require sufficient labor. This is especially true if the farmland is large. Thus, pesticides are advantageous than IPMMs in terms of labor utilization, since they can be applied in a few hours of time by a single person.

Effectiveness is another key element to assess merits and demerits of IPMMs. IPMMs can play a role in minimizing the impact of pest damage in farming practice, if they are applied at early stage. However, they do not provide effective and long lasting solution if the pest infestation is serious and wide spread. On the other hand, despite their harmful effect, pesticides have high effectiveness (potential) to protect crops from pest, as compared to the indigenous ones.

4. Conclusion and Recommendations

- Indigenous pest management mechanisms are practices highly embodied in the farming practice of smallholder farmers in the study area. So, these local remedies need to be maintained and promoted as alternative means to cope with pest infestation.
- Agricultural and Rural Development Office of the study *wereda* need to advocate the use of IPMMs at early stage of pest infestation as much as possible. This may help to control pest damage without using pesticides, which are harmful for human beings, animals and the ecology.
- Useful indigenous methods of pest management used by smallholder farmers need to be applied in integration with pesticides, if the infestation is serious and widespread, to develop more effective and sustainable system to cope with pest infestation.

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