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# Health risks assessment for paddy rice farmers during rice crop production in Eastern Tanzania

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**Abstract**
The study was conducted to assess health risks of paddy rice farmers using agrochemicals in System Rice Intensification (SRI) and non SRI farms in Mkindo and Hembeti villages in Mvomero District, Eastern Tanzania. Structured questionnaires and face to face interviews were used for data collection. The majority of paddy rice farmers in the study villages (96.67% and 86.6% of respondents in Hembeti and Mkindo respectively) confirmed using agrochemicals in their paddy fields. Generally, the use of agrochemicals was higher in non SRI than in SRI farms. Most of agrochemicals used in these study villages were found to be in class II hazard with moderate effects on both human and environment health. The storage and disposal systems of pesticide containers in the study villages were observed to be reasonably good and hence risks of pesticides poisoning and contamination of soil and water sources were considered to be limited. It was further noted that most paddy rice farmers do not use complete person protective equipment (PPE) probably due to poverty and limited knowledge on the importance of such equipment in protecting themselves against effects of pesticides on health. Furthermore, the study revealed that there was substantial shortage of extension officers who could educate the paddy rice farmers and agrochemicals shop sellers on the health effects of pesticides used in rice production. On the basis of the findings in the current study, increasing farmer's awareness and training aimed at equipping farmers with knowledge on sustainable agriculture, agrochemicals uses and integrated pest management, so as to lower the potential health effects of such chemicals, is recommended.

**Keywords:** System rice intensification, agrochemicals, health effects, pest management, personal protective equipment

## Introduction
The high population growth and export oriented economy has led to a tremendous intensification of rice production for consumption, which in turn has significantly increased use of agrochemicals in rice fields. Agrochemicals are widely used in agricultural production to stimulate the growth of crops and control of insect pests, diseases, weeds and other plant pathogens in an effort to reduce or eliminate yield losses and maintain high production quality [1].

Most pesticides used in rice fields are herbicides such as 2,4,5-T, 2, 4-D for killing weeds, fungicide e.g. Fentin chloride and Edifenphos for killing fungi and insecticides such as Organochlorines (OC) e.g. Endrin and Endosulfan and organophosphates (OP) e.g. Methyl parathion, Monocrotophos and Triazophos for killing insects [2]. In addition, inorganic and organic fertilizers are applied to boost plant growth. They are applied to the soil to increase the fertility and uptake by the plant roots or by foliar feeding through plant leaves. Common organic fertilizers used in rice fields are farm yard and compost manure which are found locally although they are not widely used. The most commonly used inorganic fertilizer in rice farms include; Urea, Triple Super Phosphate (TSP), Di-Ammonium Phosphate (DAP), Ammonium Sulphate (SA) and Calcium Ammonium Nitrate (CAN) (RLDC, 2009). However, some chemical fertilizers contain environmentally harmful elements such as nitrogen and phosphates, which have negative effects on the air and water quality. Their use causes release of ammonia, nitrogen runoff and eutrophication [3]. The agrochemicals are used in liquid form, concentrates, powder, dust, particles aerosols and fog. They can move and be transferred to the environment through water, wind and absorption process. Some are toxic in nature and highly persistent in the environment as well as in human and animal bodies as bio-concentrations [4]. When agrochemicals come into contact with soil, they may be taken up by plant roots, adsorbed to soil particles or broken down by soil microorganisms. After application, these chemicals also get exposed to variety of factors including evaporation, being broken down by

sunlight and being carried away to surface and/or underground water, depending on the soil features, chemical properties and chemical use practices [5]. Such water may pose potential health hazards to ultimate users. Depending on the nature of the chemical used farmers may also be affected during preparation and actual application of agrochemicals in paddy rice, as they are directly exposed to the chemicals and the latter are absorbed through the skin or inhalation especially, when protective gears are not used. Furthermore, farmers can also be affected when discarding the items and containers of agrochemicals, or when they misuse such materials, e.g. using acaricides intended for killing livestock ticks and mites, on plant crops, wounds and other purpose such as fishing [6].

In addition, human beings directly or indirectly exposed to agrochemicals are likely to develop ill-health problems in their brains, skins, eyes as well as their neurological, cardiovascular, hematological and gastrointestinal tract systems and cancer. Furthermore, use of water and plants resources contaminated with chemical residues is risky to human adults and infants as well as to animals. Generally, prolonged and frequent exposure to agrochemicals can impair farmers' health and hence their productivity. The more the frequencies of agrochemicals applications, the higher costs of treatment and opportunity cost of time lost.

Rice irrigated producing areas are known to use substantial chemical inputs including pesticides and inorganic fertilizers in order to increase yield. The use of water and plant resources grown in water logged soils pose potential health hazards to the farmers and other community members in those villages since most of the available water is recycled through rice farms which are intensively treated with agrochemicals. Although, the use of agrochemicals effectively controls pest and diseases, and eventually enhances production of rice, it poses high risks on environmental, human and animal health in the treated and surrounding areas. In some areas in Tanzania, for instance, farmers reportedly complain about skin irritation after bathing washing or getting contact with water from irrigated rice fields an observation which is probably attributable to the fact that such water is contaminated with a number of agrochemicals used for protection and growth of rice.

Prior to the current study, rice farmers in Mkindo and Hembeti villages (Mvomero district), were not aware of the types and amounts of agrochemicals used in the area. It was also not known whether farmers used the agrochemicals properly, used appropriate protective gears when applying the insecticides, and properly discarded contaminated items and containers. The study was therefore, intended to fill these gaps of knowledge in selected paddy growing areas. The study will facilitate improvement of farmers' awareness on proper preparation and actual application of agrochemicals as well as personal protective equipment. Consequently, the study will enable the relevant extension personnel to assess health risks for paddy rice farmers in Mkindo and Hembeti villages and hence provide appropriate links between farmers and the government. Under such links therefore the government can facilitate provision and availability of appropriate agrochemicals retail shops in the villages and employ experienced agricultural extension officers who will practically train farmers on the actual and safe applications of agrochemicals including proper use of protective gears and disposal of agrochemical containers and leftovers.

## Materials and Methods

### Description of the area and climatic condition

The study was conducted in 2013 in two selected villages of Hembeti and Mkindo in Mvomero district, one of the six districts of Morogoro region. The villages are situated at the foot of Nguu mountain ranges along the newly constructed Mikumi - Turiani - Korogwe highway. The coordinates for Mkindo village are 6°15'S and 37°32'E and those for Hembeti are 6°16' S and 37°28' E. The two villages were selected on the basis that farmers are practicing rice irrigation.

The area experiences high and bimodal rainfall with a relatively short dry spell between June and September. Heavy rainfall is experienced from March to May and from October to December. The average annual rainfall is 1,146mm. The mean maximum temperature is 31 °C, which is experienced from October to March, whereas the mean minimum temperature is 19 °C and is usually experienced between June and September. The presence of Nguu mountain ranges and its climatic conditions make the area favourable for agriculture activities due to sustainable availability of water. The major crops cultivated in the two villages are rice, maize, beans and sorghum, which are, on other hand, the main food crops in the country. The villages therefore sustainably contribute to the national food productivity and security.

### Data collection

Simple random sampling technique was used for selection of paddy rice farmers as respondents in the study villages. Information from extension officers in both villages was used to generate the list of respondents that include both System Rice Intensification (SRI) and non SRI practicing farmers in Mkindo and Hembeti villages. A total of 60 (30 farmers only practicing rice irrigation from each village) paddy rice farmers were involved in the study. A standardized questionnaire with structured and semi structured questions was used as the main instrument for collecting data. The questionnaire was written in English and translated into Kiswahili, a national language which is understood by majority of the respondents in the study villages. Face to face interviews were conducted with the extension officers in the area in order to obtain information on governmental and non-governmental organizations which offer support to paddy rice farmers in the study villages. The questions were mostly meant to seek information on, methods use in giving information to farmers concerning agriculture and difficulties experienced when performing their work. Interviews with the agrochemicals sellers in Mkindo village were also conducted to determine the types of pesticides used by most of paddy rice farmers in the study villages, misuse of pesticides done by farmers and their support to farmers.

### Data analysis and presentation

The collected data were summarized and analyzed by using Statistical Package for Social Sciences (SPSS) and Excel and presented in the form of tables and graphs. The collected data were computed in SPSS to obtain appropriate the proportions and frequencies. Though in both villages farmers were involved in rice farming Mkindo farmers practiced both SRI and non SRI while in Hembeti village farmers practices non SRI only. The farmers in the two villages were therefore considered as two different populations during the analysis process and the results obtained in these villages were compared.

## Results and Discussion

### Use of Agrochemicals

It was found that farmers from Hembeti and Mkindo villages who participated in both SRI and non SRI farming use both common and scientific methods for controlling pests and diseases, and stimulation of crop growth. Tables 1 below show the response of paddy rice farmers on the use of agrochemicals on SRI and non SRI farming system in the study villages. In Mkindo village where 30 responded were involved, 100% of the farmers practicing the SRI system were found to use agrochemicals while only 60% of non SRI farmers use such agrochemicals, and 40% were not using it contrarily in Hembeti village only 3.33% of non SRI farmers do not use the agrochemicals compared to Mkindo village where 13.33% of non SRI farmers do not use (Table 2).

It's clear that majority of respondents practicing non SRI system use the pesticides compared to those practicing the SRI system but with comparison to worldwide data the use of pesticides in these study villages is low though could have some effects on the farmers health and the surrounding environment. These results are comparable to the published findings by Nonga *et al.* [7], Ngowi *et al.* [8] in rice in Tanzania, Obopile *et al*.[9] in maize in Botswana and Ntow *et al.* [10] in vegetable farmers in Ghana. The increase use of commercial pesticides in these villages which are in tropical region for increasing crop production are suggested to be due to the magnitude of pests problem. The type and amount of agrochemicals that are used in paddy rice farms, handling and disposal are further explained below;

### Type and amount of agrochemicals

According to responses of respondents in the study villages, amounts and type of pesticides used depend on the size of the farm, pests and diseases to be controlled, nature and condition of the soil. Routine and frequency of pesticide use depend on presence of diseases and pests in rice plants and potential damages as well as farmers' perception regarding pest management practices. The commercial agrochemicals that are mostly used by the paddy rice farmers in the area are soluble liquids and pellets crystals of fertilizers (Table 3). It was generally found that majority of rice farmers in the study villages use commercial pesticides which are in WHO hazard class II with moderate effects to human health and environment if used as instructed and appropriate concentration (Table 2).

The farmers involved in non SRI system in Mkindo village use large amount of insecticides and herbicides than their counterparts involved in SRI farming systems (i.e. 0.2817L/acre and 0.0656L/acre per season as compared to 0.0312L/acre and 0.0656L/acre in the SRI system). As regards use of it was observed that farmers in both SRI and non SRI systems use an average concentration of 0.118L/acre in a season. Likewise, those farmers reportedly use little amounts of fertilizers especially in SRI system. Indeed farmers in non SRI systems mostly depend on natural fertility of the soil. The larger concentrations of pesticides used in non SRI farming systems at least partly, contributive to increased concentrations of chemicals in the soil compared to SRI system in the study villages.

The commercial pesticides which are mostly used includes herbicides that are listed under class II hazards and which contain 2,4 dichlorophenoxy acetic acid (2,4-D). The later persists in the environment for many years and may spread its toxicity to food chain and cause harmful effects on human and/or animal health. Endosulfan for instance is an organochloride is class II hazard is known to persist in the environment for a long time and it undergoes very little degradation compared to other classes of pesticides. Furthermore, the pesticide may accumulate in rice plants and animal tissues [11-13]. Due to the high toxicity, Endosulfan was banned in many countries including Tanzania where its use was restricted to cotton only. However, the pesticide is due to its positive effect in paddy rice fields controlling golden snails in such farms. It was further observed that boosters as well as organic and inorganic fertilizers used in the study villages contain Phosphorus, Nitrogen and trace elements, and that the latter accumulated in the soil and rice plants after being used in larger amounts for a long time.

Generally, in non SRI systems, farmers use larger amounts of commercial pesticides compared to SRI farmers. Such chemicals have positive impacts on controlling weed growth and the dead weeds are eventually converted to organic manure that increases soil fertility and consequently promotes healthy growth of plants. Furthermore, the wide spacing of plants in non SRI farming system reportedly to reduces the incidence of pests and diseases. Contrarily however, SRI paddy is more resistant to pests, weeds and diseases. In both systems however, it is recommended to take immediate action to eliminate such pests when they occur and to adhere to relevant advices given by Extension officers and to relevant guideline[14]. Further observations in the current study revealed that farmers use chemical fertilizers but occasionally some organic fertilizers are also used to improve the soil structure and increase nutrients such as nitrogen and phosphorus.

### Pesticide application

As regards pesticides application techniques, all respondents explained that they use plastic knapsack sprayers of 15 – 20 liters (Plate 1). For spraying, special 30 mls tin or 25g laser container for measuring appropriate amounts of the chemical prior to mixing in the same with water in knapsack as required, although some use locally equipment to measure the amount needed to spray (Plate 2). It was also reported that a few farmers own a sprayers, while most of them borrow the same from agrochemical retail shops or other owners in the village. The pesticides sprayers are young men aged 18 years in average. Pregnant and breast feeding mothers were reportedly not allowed to spray pesticides. When asked about times of spraying, it was reported that the activity is usually done early in the morning and in the evening if necessary (Table 4). As shown in Table 4, 80% and 40% of Hembeti and Mkindo farmers respectively spray in the early morning, Likely wise 13.3% of Hembeti farmers and 10% of Mkindo farmers spray during early morning and late evening while 6.7% and 3.3% of Hembeti and Mkindo farmers respectively spray pesticides randomly at any time of the day. It was further reported that in Mkindo village 33.3% spray in the evening alone while 13.3% spray around noon-early afternoon. As regards application of pesticides, majority of respondents responded that they spray when preparing farms before plantings while boosters and insecticides are applied during germination to promote growth of rice plants and to kill insect pests spreads in the farms. It was also noted that during spraying, sprayers face with wind direction in order to avoid blow back of pesticides to their faces. When asked about areas of pesticides mixing and container washing, most respondent said that such undertaking were in rice fields using water from the canal. Such information possibly justifies the

reported deterioration of water quality that leads to skin itching and other related illnesses when the water in the canal is used for bathing.

Furthermore, it was reported that the great number of farmers in study villages, spray pesticides during dry conditions when insect population densities are high. Such season is also advantageous since the applied pesticides have minimal chances of running off from the treated rice fields and plants as it could otherwise occur in wet season. It was observed further that some farmers in Mkindo and Hembeti villages (38.46% and 36.67%, respectively Table 5) spray pesticides during the wet season so as to facilitate absorption in soil and plants for effective functioning. The remaining group (7.69%) of respondents in Mkindo village sprays the pesticides during any season depending on occurrence of pests and diseases in rice plants. However, most extension officer's advice farmers to apply pesticides during dry condition so as to ensure that the chemicals work effectively and are not washed away from the rice field (Swai, personal communication Jan. 2013).

**Storage and disposal**

Storage and disposal practices by Hembeti and Mkindo farmers showed that the majority of paddy rice farmers have safe pesticides storage. In Mkindo, 60% of the farmers were found to store the pesticides in a special room (store) compared to Hembeti where only 50% of farmers were found to store such chemicals safely. These farmers were considered to have lower probability of accidental exposure to chemicals than those who store the chemicals in bed room (36.67% and 26.67% in Mkindo and Hembeti villages respectively). In fact these chemicals especially that with fumes course substantial health risks to humans especially children who easily get access to the same. As regards disposal of pesticides containers it was noted that the procure was safe in Mkindo village, 3.33% of respondents reported that burn the sturf, 40% dispose in open or latrine pits and 43.33% burry them under the ground. In Hembeti village, 33.33% of farmers burn and while 33.33% burry the containers under the ground. Only few farmers (26.67% and 23.33%) in Mkindo and Hembeti villages respectively were found to be either ignorant or little knowledgeable about disposal of pesticides containers as well as health and environmental effects of such chemicals. Indeed such farmers reportedly throw the pesticide containers in paddy ecosystem. Although the disposal of pesticide bottles into open latrine pits was considered to be safe, it is risky since children could easily reach and take them unless such latrines are properly fenced. It is worth noting here that such unsafe and indiscriminate disposal of pesticides containers can facilitate contamination and quality deterioration of river water which is used in the villages, where communities have low or no knowledge about health effects of pesticides. Furthermore, it was noted that some communities, especially livestock keepers use empty pesticides containers for storage of feed and drinks for their nutritional purposes. Warburton *et al*.[15] found that paddy rice farmers in Laguna and Nueva Ecija in Philippines were at high risks of accidental exposure to pesticides due to poor storage and disposal. Likewise, similar hazards or accidental exposure can easily occur among Hembeti and Mkindo villagers due to their poor knowledge of pesticides storage.

**Misuse of agrochemicals**

The current study observed that there were people in the study villages who use agrochemicals for purposes other than agricultural activities. According to reports from local seller of agrochemicals in Mkindo, the pesticides, especially Karate and Thionex, which normally washed in the ponds and eat substantial number of fish. In Hembeti village however, farmers reportedly organize themselves to identify people who use the pesticides for other purposes such as killing fish and ducks and subsequently report them to the village authorities. The habit of using agrochemicals for non-agricultural activities is reportedly used in Leyte, Philippines where farmers commonly spray Endosulfan to ladybirds (*micraspis* spp.), Predators and pollen feeders in rice fields [16].

**Awareness on the health effects caused by the pesticides**

It was observed that numbers of farmers' who were aware on health effects caused by pesticides and those who were not aware were nearly the same (53.3%) as compared to (40.7%) in both Mkindo and Hembeti villages (Table 6). The non-awareness of health effects among some farmers is probably attributable to ignorance, limited or no knowledge of the language (English) used in labeling the pesticides containers, and adequate number of extension officers who could educate the farmers on appropriate and safe use of agrochemicals. However, it was reported that most farmers in the study villages have no habit of consulting the few extension officers who are available in their areas.

These findings are mostly in consistence with those of Nonga *et al*.[7] who reported that there was substantial shortage of Extension officers in the villages who could effectively advice the farmers on the health effects of pesticides. Kumar *et al*.[17] shows that most farmers knowledge on such effects is low in many developing countries including Tanzania, Senegal and Mali where communities are poor and depend on subsistence agriculture as the main source of income.

The tendency of some paddy rice farmers to ignore instructions provided on the pesticides labels and consultative advices provided by Extension officers put them in high risk of being affected by the pesticide. The effect is not to their health only but even the surrounding community and environment at large.

**Effects of agrochemicals to paddy rice farmers**

Pesticides are toxic to both pests and humans. However appropriate precautions should be taken in order to prevent hazardous outcomes in humans. In the current study however, it was observed that the majority of farmers at the study villages (Mkindo and Hembeti) reported to have been affected by pesticides (83.33% and 93.33% for Mkindo and Hembeti villages respectively Table 7). It was further noted that adults were more affected than children despite low immunity in the latter group compared to the former group. This observation can be attributed to the fact that adults especially men of around 18 years of age, are the ones mostly involved in spraying farms with pesticides. It was also reported by respondents that some farmers in both villages get affected by the pesticides but they did not report to health authorities (20% and 3.33% in Mkindo and Hembeti villages respectively, Table 7).

Further interactions with respondents revealed that most farmers who were affected by pesticides but did not report to health authorities considered such effects as minor problems and they occasionally purchased medicines from local pharmacies and successfully treated themselves. It was also reported by responses that most symptoms of acute pesticide

poisoning by pesticides are similar to those of some common diseases such as influenza, coughing, skin itching and headache thus making it difficult for either specialist or non-specialist medical practitioners as well as users to easily recognize health problems caused by pesticides exposure thus leading to underestimation of instances of pesticides poisoning. As regards pesticide that mostly of affected farmers' health, most respondents reported that Karate affected more people than other pesticides possibly due to the presence of a very active ingredient at a concentration of 350g/L. Other pesticides which were also reported to affect farmers health include 2,4-D which is known to cause eye irritation, and thionex that causes cardiovascular, respiratory, gastrointestinal and neurological problems [18].

**Incidents of accidental poisoning by pesticides**

Globally, incidents of accidental poisoning by pesticides commonly occur in farmers' communities and children comprise the most affected group, possibly due to their unawareness on the effects of such agrochemicals. In this study however, the incidents of accidental poisoning by pesticides were witnessed by 33.3% and 6.7% of respondents at Mkindo and Hembeti villages respectively where the affected people were relatives family members or friends (Table 8). It was further reported that the affected people were mostly adults probably due to intentional use of the pesticides for committing. Despite the low rates of reported incidents of poisoning with pesticides in our study villages, the possibility of under reporting cannot be ruled out. London [20] urged that occupational cases were are normally under reported while suicides and risks to women were under estimated. The author argued that there could be 10 fold increase of poisoning rates if intensive surveillance were conducted rather than using routine methods. It was also reported that during the current study that victims of pesticide poisoning were first of all given fresh milk to drink in order to reduce the poison activity in the abdomens blood, tissues and other parts of the body, prior to taking the patient to hospital.

**The use of person protective equipment (PPE)**

Generally, the fate of using PPE among rice farmers in our study villages is fairly low, while some of those using the sturf do so insufficiently. In Mkindo village 9 farmers responded that they use agrochemicals and wear PPE, 17 use agrochemicals without wearing PPE, and 4 farmers do not use the agrochemicals. At Hembeti village 15 famers confirmed to use agrochemicals while wearing PPE, 14 farmers use the agrochemicals without wearing PPE and one farmer does not use agrochemicals (Table 9). Further discussions with respondents revealed that failure of some farmers to use protective gears was mostly due to poverty (thus unable to purchase the sturf), limited knowledge and lack of access to appropriate information on the use of PPE. It was further reported that most farmers who were using PPE were not doing so sufficiently since some were wearing plastic bags instead of gloves made of rubber or chemical resistant material and respirator respectively. It was further reported that none of the farmers wore overall.

Despite the fact that non-compliance to proper use of PPE increases the probability of being affected by pesticide when mixing and actual application, the number of respondents using the facility in SRI system in Mkindo village was less than those in non SRI system in Hembeti village, despite the fact that the former had a better knowledge on health effects of pesticides than the latter, due to several seminars conducted at the village. This is observation probably attributable to the fact most farmers in Mkindo village use casual laborers to spray their farms and they do not provide protective gears for the latter (i.e. sprayers). High costs of PPE sturf such as boots, masks and gloves were also reported to be prohibitive to the farmers despite the availability of such materials in local shops. In fact overalls were the only PPE materials that were not available in such shops.

These findings are consistent with the Kumar *et al*. [17] reveals that the number of farmers in Tanzania who use PPE when working with pesticides is relatively small when compared to farmers in Mali and Senegal. The report further argued that farmers in Tanzania do not own PPE and fail to use them due to lack of information, prohibitive costs and non-availability.

**Government support to paddy rice farmers**

It was generally reported by respondents in the current study that the Tanzania government support to paddy rice farmers in Mkindo and Hembeti villages was limited to provision of Extension officer in each village. Such numbers of Extension officers however, were reportedly too few for appropriate provision of advice and/or training of farmers on better methods of planting the crop (rice) and consequently improve the quality and quantity of the produce.

Furthermore, the amount of pesticides provided by the government (two litres of insecticides, herbicides and boosters) to each villages are insufficient for all the farmers in the village where each one owns at least one acre of land, thus making it difficult for extension officers to distribute the materials equally and fairly. It was also reported that some retail shops sell expired and banned pesticides to farmers probably due to lack of monitoring and supervision by government agents. Despite availability of a published report on pesticides and poverty (2006) which shows regulations governing manufacture, importation and distribution of pesticides in Tanzania, poor enforcement of laws and poorly restricted borders lead to presence of adulterated products in the market that can results in low productivity when used. Furthermore, the fact that most retail shops selling pesticides are scattered all over the country and they operate un-registered premises, leads to lack of proper business records in authorized departments for counterchecking the pesticides available in such shops. As such, tracing of pesticides bought by farmers becomes fairly difficult.

**Table 1:** Response of respondents on the use of agrochemicals in Mkindo village

| Response | SRI system | | Non SRI system | |
|---|---|---|---|---|
| | Number of respondents | Percentage | Number of respondents | Percentage |
| Use agrochemicals | 30 | 100 | 18 | 60 |
| Do not use agrochemicals | 0 | 0 | 12 | 40 |
| Total | 30 | 100 | 30 | 100 |

**Table 2:** Response of respondent on the use of agrochemicals in Hembeti and Mkindo villages

| Response | Hembeti village | | Mkindo village | |
|---|---|---|---|---|
| | Number of respondents | Percentage | Number of respondents | Percentage |
| Use agrochemicals | 29 | 96.67 | 26 | 86.67 |
| Do not use agrochemicals | 1 | 3.33 | 4 | 13.33 |
| Total | 30 | 100.00 | 30 | 100.00 |

**Table 3:** Summary of agrochemicals used and their average concentration in SRI and Non SRI farming system

| Type of agrochemical | Trade and Common name | Chemical group | WHO hazard class | Target pests and/or purpose | SRI Concentration (L/acre) | Non SRI Concentration (L/acre) |
|---|---|---|---|---|---|---|
| Insecticides | Thionex (Endosulfan) | OC | II | Insects | 0.0312 | 0.2817 |
| | Karate (Cyhalothrin) | P | II | Insects | | |
| Herbicides | Round up | OP | III | Weeds | 0.059 | 0.0656 |
| | Twiga amine | AA | II | Weeds | | |
| | Sanaphen | | | Weeds | | |
| | Pro amine | AA | II | Weeds | | |
| Boosters | Foliar | | | | 0.118 | 0.118 |
| Fertilizers | NPK (Kg) | | | Nutrients (nitrogen and phosphorous) | | |

**Table 4:** Duration of pesticide spraying in Mkindo and Hembeti village

| Duration | Mkindo village | | Hembeti village | |
|---|---|---|---|---|
| | Number of respondents | Percentage | Number of respondents | Percentage |
| Morning | 12 | 40 | 24 | 80 |
| Noon | 40 | 33.3 | 0. | 0.0 |
| Evening | 4 | 13 | 0. | 0.0 |
| Any time | 1 | 3.3 | 2 | 6.7 |
| Morning and evening | 3 | 10 | 4 | 13.3 |
| Total | 30 | 100.0 | 30 | 100.0 |

**Table 5:** Seasons preference of paddy rice farmers for pesticides spraying

| Season | Mkindo village | | Hembeti village | |
|---|---|---|---|---|
| | Number | percentage | Number | percentage |
| Dry | 14 | 53.85 | 18 | 63.33 |
| Wet | 10 | 38.46 | 11 | 36.67 |
| Any | 2 | 7.69 | 0 | 0.00 |
| Total | 26 | 100.00 | 29 | 100.00 |

**Table 6:** Response of paddy rice farmers on awareness of health effects caused by pesticide

| Response | Mkindo village | | Hembeti village | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| Aware | 16 | 53.3 | 16 | 53.3 |
| Not aware | 14 | 46.7 | 14 | 46.7 |
| Total | 30 | 100.0 | 30 | 100.0 |

**Table 7:** Number of paddy rice farmers reporting pesticide effect on human health

| Response | Mkindo village | | Hembeti village | |
|---|---|---|---|---|
| | Count | percentage | Count | percentage |
| Affected and report | 5 | 16.67 | 1 | 3.33 |
| Affected and do not report | 6 | 20.00 | 1 | 3.33 |
| Not affected | 19 | 63.33 | 28 | 93.33 |
| Total | 30 | 100.0 | 30 | 100.00 |

**Table 8:** Responses of paddy rice farmers on incidents of accidental poisoning by pesticides

| Response | Mkindo village | | Hembeti village | |
|---|---|---|---|---|
| | count | Percentage | count | Percentage |
| Witness accidental poisoning | 10 | 33.3 | 2 | 6.7 |
| Never witness accidental poisoning | 20 | 66.7 | 28 | 93.3 |
| Total | 30 | 100.0 | 30 | 100.0 |

**Table 9:** Numbers of farmers wearing PPE

| Response | Mkindo village | Hembeti village |
|---|---|---|
| Wearing PPE while using agrochemicals | 9 (30%) | 15 (50%) |
| Not wearing PPE while using agrochemicals | 17 (56.67%) | 14 (46.67%) |
| Do not use agrochemicals | 4 (13.33%) | 1 (3.33%) |
| Total | 30 (100%) | 30 (100%) |

**Plate 1:** A knapsack at the local agrochemicals retail shop for lending (photo: Mkindo, 2013)


**Plate 2:** A vestline container used by farmers to measure pesticides before mixing (photo: Mkindo, 2013)

## Conclusion

Basing on the current observations, it can concluded that intensive agricultural activities in Mkindo and Hembeti villages calls for use of agrochemicals in order to reduce the incidents of pests and diseases as well as improving the growth and production of rice. It can also be concluded that most of farmers in these villages are aware of the health effects of pesticides used and the importance of using personal protective equipment during mixing and actual application of such chemicals, and that they obtain the knowledge through attending various seminars, education provided by relevant Extension officers and reading the material safety data sheet provided on the pesticide containers by the relevant manufacturers. Occasionally farmers also obtained knowledge from local agrochemicals sellers. In view of the afore-going means of obtaining knowledge therefore, it seems that the few farmers who were not aware of the importance of using PPE were just negligent.

It can be further concluded from the current studies that although the majority of farmers are aware of health hazards caused by pesticides, they do not use PPE, probably due to poverty and negligence. It can also be conclusively argued from these studies that even the few farmers in Mkindo and Hembeti villages who use PPE, or are still at risk of contracting health problems since they do not use the equipment sufficiently, while their handling, storage and containers disposal methods are fairly poor. Furthermore, it can be concluded, on the basis of the current observations that the practice of using expired and/or banned pesticides by some farmers exposes the latter, the ecosystem and the environment to health risks.

It is justifiably recommended on the basis of the afore-going observations and conclusions that farmers should be encouraged to consult Extension officers regarding proper ways of handling, application and disposal of various pesticides for controlling various pests on various crops. It is further recommended that the government should establish special poisons information centers for provision of appropriate knowledge on handling and treatment of suspected poisoning cases e.g. use of appropriate antidotes for relevant pesticides.

## Conflict of Interest

There is no conflict of interest to disclose under this project.

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