EXPERIENCES IN ADOPTION OF INTEGRATED PEST MANAGEMENT (IPM) STRATEGIES IN ZANZIBAR

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 ISSN 1923-6654 (print)
ISSN 1923-6662 (online). Available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

Abstract: Integrated Pest Management (IPM) was adopted by Plant Protection Division of the Ministry of Agriculture, Zanzibar to improve agricultural production on major crops (rice, banana, cassava and vegetables) at small scale farming system. The multi-disciplinary group of IPM facilitators created awareness to farmers by conducting seminars, workshops and discussions. The IPM groups were formed through Participatory Rapid Rural Appraisal (PRRA). PRRA was also used to identify problems and training needs. Farmer field School approach was introduced using the adaptation of the methodology adapted from South East Asian Ecosystem. Farmers were empowered on environmentally sound practices such as disease free planting materials certified seeds, botanical control, etc. On-farm trials within Participatory Action Research (PAR) was also conducted by participatory technology development method. A total of 52 farmers' groups involving 1,038 farmers (549 males and 489 females) have been trained. There was a yield increase for all the crops with the adoption of IPM practice, irrigated rice was from 2.2 - 4.4 tons/ha, rainfed rice 2.3 - 3.4 tons/ha, tomato 9.5 - 33.7 tons/ha, amaranthus 4.2 - 11.7 tons/ha , bananas 11.3 - 17.6 tons/ha, and cassava 15.9 - 33.6 tons/ha. The results had a good impact in terms of adoption of technologies by the IPPM farmers and the neighboring farmers.

Keywords: Agro eco-system, Food security, Mono-crop, Pest management,

I. INTRODUCTION

More than 90% of farmers in Zanzibar are resource-poor with no access of input or credit (Abubakar, 2005). They depend on subsistence agriculture for their livelihood, traditionally the cropping system is on small scale farms averaging 3 acres (1.2 ha.) of arable land and very complex. Rice was ranked an important staple food crop followed by bananas and cassava (Saleh, 2007). Vegetables are considered as a cash crop rather than food crop. Farming is being practiced is all over the island due to its adaptation to diverse soil and environmental conditions. As a mono-crop, rice is grown in paddy areas whereas vegetables, cassava and banana were mostly grown on infertile soils or as an intercrop with sweet potato, yams or permanent trees such as cloves and coconuts. This practice serves several purposes such as ensuring food security, optimal use of soil and space, erosion control and weed management. Food security is unstable due to rapid population growth of 3.1% (Mzee, 2000) , economic growth is insufficient to keep up with population growth.

Most of the local cultivars were abandoned, their disappearance was linked with low resistance to pests and diseases, drought stress, market demand. The overall trend in production has been decreasing due to number of factors, depletion of soil nutrients, population pressure. Yield losses caused by pest and diseases can be up to 80%. This has forced farmers to increase the production by increasing acreage. However the average yield is still very low of 2-7t/ha.

In response to these agro ecological and socio economic problems, alternative production systems were tried e.g. pesticide application, use of chemical fertilizers, but resource poor farmers cannot afford them unless they get subsidies from the government. Therefore, to attain an increase in food production for the improvement of rural livelihood, strategies for environmentally safe pest control measures have to be adopted. The strategies could be developed based on a thorough knowledge of traditional cultural control methods or IPM. Integrated Pest Management seem to be the best approach to increase production and decrease poverty in Zanzibar An Integrated Pest Management (IPM) approach was adopted to reduce pest problem and excessive use of pesticides (Sharma et al. 2009). The Farmer Field School (FFS) approach, a model for IPM program worldwide, with spectacular results in South East Asia (Erbaugh et al,

2002) was also adopted. Plant Protection division with its mandate on crop protection issue in Zanzibar implemented IPM on four crops (rice, banana, vegetables and cassava).

The objective of introducing IPM program was: (a) To empower farmers with the capacity to observe innovate or create solutions to their own constraints rather than expecting external inputs from the government. (b) To increase production by developing farming technologies using locally available resources. (c) To increase food security and income of the rural livelihood, thus alleviating poverty.

II. METHODOLOGY

(a) Workshops/Seminars to create awareness to policy makers, heads of departments field agriculture officers and farmer. **(b)** Multi-disciplinary teams of group of facilitators were formed consisting members from different specialization of agriculture in the Ministry of Agriculture, Livestock and Environment. **(c)** Participatory Rapid Rural Appraisal (PRRA) was conducted to establish baseline information on farmers indigenous knowledge, problems encountered. The activities employed were: **(i)** Meetings, the first meeting discussed the objectives and why work on participatory manner. **(ii)** Semi Structured Interview (SSI): was based on checklist from which the questions were addressed to farmers to solicit their responses. Individual interviews were also conducted. The information collected from different informants was used for comparing the information to avoid confusion. **(iii)** Transect walk was made across the village. The purpose was to acquaint the group with the farming system of the area, agro ecological situation and socio-cultural characteristic of the people. **(iii)** Group Discussions: The group discussions were conducted after the individual interview. Findings and information were gathered presented and discussed.

Training and Participatory discussions: A plan of action was formulated based on problems and training needs identified during the PRRA. Training was done through discussions involving relevant subject matter specialist (SMS). Some topics were covered when need arises.

Farmer Field School Approach (FFS): FFS was adopted with the establishment to FFS, the concept of holistic approach was practiced without being restricted to the control of pests and diseases. The principles followed were to grow healthy crop, monitor field periodically, analyze the agro-ecosystem (AESA) and do on-farm trials.

III. RESULTS

3.1 Problem Identification

The major problems identified were from 4 major crops. The general problems for all 4 crops were poor crop management, use of diseased seeds and planting materials, depletion of soil nutrients, continuous cropping on the same land on verifying SSI and ranking methodology on participatory discussion; the main constraints became; (i) pests and diseases (ii) poor soil fertility (iii) unavailability of seeds (iv) lack of technical know how.

For rice very few pests were present and the remaining insects were natural enemies which does not have any loss; the major problems were soil fertility and crop management. Nematodes, banana weevils and black sigatoka were the problem for banana. High number of pests were present in vegetable fields but the important ones were African bollworms, fusarium wilt and bacterial wilt which is a big constraint. Cassava brown Streak Disease (CBSD) and Cassava Mosaic Virus (CMV) for cassava

3.2 Depletion of Soil Nutrients

The decline of crop yield was a consequence of increased nutrient stress which might have been resulted in crop susceptibility of pests attack and reduce capacity to recover from pest damage (Spittel. 1997). Farmers claimed poor yield was caused by continuous cropping, and some of them is due to global warming, soil erosion and scarcity of rains. Most of the farmers did not exactly describe the constraints of poor oil fertility. To verify, if the assumption was correct, soil samples were collected randomly at a depth of 25 cm and thoroughly mixed. They were sent for analysis at Sokoine University of Agriculture, Morogoro in 2007. The result of the Soil Analysis is as follows: 3.6% organic matter, pH (H20) 4.7, 0.06% total N, 0.36 meq/100g of Exch base 3.8meq/100g available P (Brays PI) and textural class of sandy clay (Sokoine University of Agriculture, 2007).

In all soil pH, the organic matter content, nitrogen content and available phosphorous were very low. Even cassava and banana grows well at ph 6.0 – 7.5.Low pH may lead to toxicity especially for rice and vegetables (Spittel, 1997). Therefore together with farmers, it was decided to improve soil fertility through crop husbandry.

3.3 Prioritization

The tools for prioritization were semi-structured interview, ranking (matrix pairwise) and seasonal

calendar. The farmer group identified its constraints and limitations. In food crop ranking, all the four crops were important since intercropping is the methodology practiced by resource poor farmers in Zanzibar. In group discussions, SSI results and matrix, the problems were ranked according to their importance. The ranking was: (i) depletion of soil nutrients (ii) shortage of certified planting materials. (iii) pest and disease (CBSD for cassava, banana weevils for banana, fusarium wilt for vegetables and excessive use of pesticides for rice)

3.4. Community Training and Participatory Discussion

The training program was focused on constraints identified by farmers. They were trained and empowered on different approaches of resolving by selecting options which they thought would be appropriate in their locality. Planning was done with participation of the farmers

The community were empowered on recommended agricultural practices, e.g. Compost preparation, Agriculture Ecosystem Analysis (AESA), use of biopesticides for control of pest and disease, biofertilizers to increase fertility and other demand driven training. It was conducted during the cropping season to synchronize with the activities

For most of the problems, crop management was found to be the best option. On-farm Trials were conducted on; Banana Technology Transfer Trial. The effect of paring banana corm on nematode management and the effect of trapping on weevil management. For banana sigatoka disease, the technology adopted were the use of tolerant cultivars and field hygiene. For CBSD, on farm trials were conducted on tolerant cultivars thus, Mahonda, Kizimbani etc., For Fusarium Wilt, the use of tolerant cultivars eg. Salma, tegeru 99 was adopted. Other trials were on Cultivar Trial: Trials were conducted on planting several varieties improved, local, infected and non infected cultivars. It somehow convinced farmers that were no symptoms on improved cultivars.

3.5. Farmer Field School (FFS)

Plant Protection Division has been empowering staff and farmers through training to implement IPM-FFS in sustainable manner. The methodologies adopted from were from West African and South East Asia Ecosystem of FAO. This approach should fit the subsistence and multi-cropping systems of Zanzibar farmers. The objective of FFS to empower farmers to reduce the cost of production and maximize profit (net returns), use of farm inputs judiciously and timely, protect crop production environment and minimize health hazards caused by excessive use of pesticides.

At the FFS, the four key principles: growing a health crop, monitoring fields regularly, conserving natural enemies, and making farmers IPM experts were emphasized. Farmers were facilitated to manage their fields through regular observations, conduct on-farm participatory trials and eventually made rational decisions about managing their fields.

The methodologies of training farmers at the IPM farming system was season long and it involved Agro-Ecosystem Analysis (AESA), Participatory Action Research (PAR) and Special Topics, Group dynamics and Evaluation. The ultimate aim of this approach was the empowerment of farmers to make appropriate decisions as to expertly manage their field problems.

Therefore Participatory Technology Development (PTD) which is the outcome of Participatory Action Research (PAR) which is a research conducted together with farmers on solving field problems. This was promoted by on-farm trials by testing tolerant varieties, crop management and improvement of soil fertility. The results were evaluated and empowered for adoption if they were promising.

IV. Evolution of IPM

During the formation of FFS, an evaluation was done regarding the adoption of IPM activities. The limitations identified were:

(a) ***South East Asia Approach:*** IPM in S.E. Asia started to counteract the indiscriminate use of pesticides and pest resurgence in green revolution agriculture (Van de Fliert, 2006). For the farming situation in Zanzibar, farmers were hardly using any pesticides, and the farming systems was characterized by small-scale farmers wilt low soil fertility, pest and disease and socio-economic status. The IPM Program should consider the aspect of Crop production and improvement of crop through different farming practices. Thus, the approach should be an integrated crop management (ICM) rather than IPM because of its holistic nature. The FFS approach of weekly IPM training session was not very attractive for some crops (banana and cassava). It appeared that farmers of high-value crops such as rice and vegetables were more enthusiastic than banana and cassava farmers (Van Huis and Meerman 1997).

(b) ***Facilitation skills:*** At the beginning of IPM development in other developing countries, poor adoption activities were observed due to lack of training in facilitation skills in managing and developing IPM packages (Alteiri 2000; Morse and buhler, 1997). In Zanzibar, most of the facilitators were researchers or crop production specialists with few extensionist. There was a need for training, facilitation, participatory and socio-economic issues

to have effective approaches. Consequently, this will improve the learning capacity of farmers and decision makers (Van de Fliert, 2006). Most of the members of farmers group were semi-illiterate. The techniques introduced did not involve active participation by farmers. To ensure adoption, farmers should participate and understand the objective of on-farm trials. How ever, it may be necessary to carry out on-station trials as the idea should be obtained about the potential of a certain practice before introducing it to the farmers, particularly when the outcome is uncertain (Van Huis and Meerman, 1997).

(c) ***Farmers expectation and Commitments:*** The group consisted of 20 farmers at the initial stage, but 10 farmers remain after a year. Follow-up was done by probing from their fellow farmers. The 10 farmers drop out because their expectations were not met, though tit was clearly explained prior. There were few influential farmers who influenced the attitude of other farmers. However the attitude of remaining farmers was cohesive and very participatory during implementation.

V. ACHIEVEMENTS

With this approach farmers were empowered by agro eco system analysis to be the decision makers, by being innovative and create solutions in their fields. The production was increased by adopting participatory technology development (PTD). Hence there will be potential to increase food security and income of the rural livelihood, thus alleviating poverty. The progress have been observed through different aspects; collaboration is multi disciplinary, farmers were organized, committed and participatory. Moreover, there is a considerable improvement of their knowledge.

A total of 52 farmers group with 1,038 farmers (549 males and 489 females) have been trained. A total of 52 FFS were run, 26 in Unguja and 26 Pemba as planned. Crops covered were irrigated rice 14 FFS (Unguja 8 and Pemba 6), rainfed rice 8 FFS (Unguja 4 and Pemba 4), vegetables 6 FFS (Unguja 4 and Pemba 2), bananas 13 FFS (Unguja 5 and Pemba 8) and cassava 11 FFS (Unguja 5 and Pemba 6). A considerable yield increase for all the crops has been achieved with IPM practice compared to farmers practice. For example, yield increase for irrigated rice was from 2.2-4.4 tons/ha, rainfed rice 2.3-3.4 tons/ha, tomato 9.5-33.7 tons/ha, amaranthus 4.2-11.7 tons/ha, bananas 11.3-17.6 tons/ha, and cassava 15.9-33.6 tons/ha (see Table 1). The results were promising had a good impact in terms of adoption of technologies involved by the IPM farmers as well as some of the neighboring farmers outside IPM program.

Table 1: Farmer Field School Study Plots For Major Crops (IPM and Farmers' practice)

Crop	**Farmers' Practice (tons/ ha)**	**IPM Practice (tons/ ha)**	**Increase in yield (%)**
1. Irrigated rice	2.2	4.4	100 %
2. Rainfed rice			
- Katrin	1.9	3.0	57.9 %
- BKN – Supa	1.1	1.5	36.4 %
- Supa	2.0	2.4	20 %
- Subang	2.7	3.7	37 %
3.Vegetables			
- Tomatoes	9.5	33.7	254.7%
- Amaranthus	4.2 (8,333 bunches)	11.7 (23,333 bunches)	180 %
4. Banana			
- Mtwike	11.3	17.6	55.8%
- Mzuzu	7.8	16.5	111.5%
- Mkono mmoja	14.3	15.6	9.1%
- Pukusa	13.1	13.6	3.8%
5. Cassava			
- Kibiriti mweusi	18.5	31.3	69.2%

VI. CONCLUSION

IPM is a focus in research and extension approach, it has been well developed in the past decades. IPM was first developed into conventional, top-down extension activities with its aim of adoption of inputs or recommendation. But, it had a low level of success (Bruin & Meerman, 2001). Traditionally, IPM was being practiced by resource-poor farmers before the term existed. The introduction of pesticides displaced previous integrated pest control approaches (Van de Fliert, 2003). However, Zanzibar farmers do not use large amount of pesticides because they cannot afford expensive pesticides, unless subsidized by the government. The recent developments of IPM seem highly applicable to all aspects of sustainable agriculture. We need to focus what is achievable under the farmer circumstances rather than what is technically perfect. IPM had a very successful history in terms of its adoption by farmers from S.E. Asian countries, with limited success of adoption among African farmers (Van Huis, 2009). IPM is site and condition specific The S.E. Asia model could not be an adoptable package in Zanzibar since the problems were different, such as socio-economic situation and the type of farming system. The adoption was on socio-economic and ecological parameters associated with principles and development of IPM. The way forward is to adopt the technology developed at community level for long term basis. FFS is a good starting point for the development of sustainable agricultural system

ACKNOWLEDGEMENTS

Many thanks to Strengthening Plant Protection Division Project of Zanzibar for supporting and promoting this program, Commissioner of Agriculture Mr. M.R. Said for the encouragement and guidance. I am deeply indebted to farmers, IPM group for their invaluable help and collaboration for the work reaching this stage, not forgetting Omar for his great help while preparing this paper.

REFERENCES

[1] Abubakar, Z.M. (2005). Report of integrated pest management, Plant Protection Division, Ministry of Agriculture, Livestock and Environment, Zanzibar.

[2] Altieri, M.A.; Nichols, C. (2000). Agroecology: Indigenous and modern approaches to IPM in Latin America. London: IT Publications.

[3] Bruin,G.C.A & Meerman, F (2001). New ways of developing Agricultural Technologies: the Zanzibar Experience with Participatory Integrated Pest Management.

[4] Erbaugh, J.M; Donnermeyer, J & Amujal, M. (2002). Assesing the impact of Farmer field School Partici[ation on IPM Adoption in Uganda.

[5] Gurr, G; Wratten, S.D.& Barbosa,P. (2000). Success in conservation of biological control. In Gurr,G & Wratten,S (eds.). *Biological control measures and success*. Kluwer Academic Publishers, Boston, Massachusetts pp. 105-132.

[6] Hashemi, S.M; Mokhtarnia,M; Erbaugh, J.M & Asadi,A (2008) Potential of extension wortkshops to change farmers knowledge and awareness. Science of the total environment, vol 407, issue1: pp. 84-88.

[7] Khamis, S.A. (2001). Sustainable agriculture in small-scale farming. Facilitating technology development with farmers- A case study of the IPM programme in Pemba. M.Sc. thesis. Wageningen Agricultural University, Wageningen.

[8] Morse, S. and W. Buhler. (1997). IPM in developing countries; the danger of an ideal. Integrated Pest Management Reviews 2: 175-185.

[9] Mzee, A.Y. 2000. The EFA (2000) Assessment Country Reports, Zanzibar (Tanzania).

[10] Saleh, H.H.; Zahor, O.T. (2007). Farmers perception and varieties acceptability of orangefleshed sweetpotato in Zanzibar. Proceedings of the 13th ISTRC Sympsoium, pp. 801-806.

[11] Sharma,O.P; Lavekar, R.C; Murthy, K.S. & Puri, N (2009). Habitat diversity and Predatory Insects in Cotton: Case study of Maharasthra Cotton Ecosystem. National Centre for Integrated pest management IARI Campus, New Delhi, India.

[12] Spittel, M.C. (1997). The need for organic farming research in a cassava IPM programme to maintain or to get sustainable cassava fields in the zones Makangale, Gando, Muambe and Kiuyu Minungwini on Pemba Island of Zanzibar. Pemba (Unpublished report).

[13] Van de Fliert, E. (2006) The role of the Farmer field School in transitiontowards sustainable Agriculture. In Van den ban, A.W. & R.K. Samantha (eds.) *Changing roles of agricultural extension in Asian nations*, New Delhi. B.R. Publishing Cooporation, p 325-342.

[14] Van de Fliert, E. (2003). Recognising a climate for sustainability; Extension beyond transfer technology, Australian Journal of Experimental Agriculture 2003, 43: 29-36.

[15] Van Huis, A (2009) Challenges of Integrated Pest Management in Sub-Saharan Africa.In *Integrated Pest Management: Impact and Dissemination.* Vol 2 , pp395-417.

[16] Van Huis, A. and F. Meerman. (1997). Can we make IPM work for resource-poor farmers in sub-Sahara Africa? International Journal of Pest Management 42(4): 313-320.

ANNEX 1

Total number of farmers trained in each crop and each Farmer Field School, Unguja and Pemba:

Island/ crop	FFS site	No. of farmers trained	Males	Females
Unguja:				
1.Irrigated rice	1.Cheju A	20	14	6
	2. Cheju B	16	11	5
	3.B/Mambosasa A	21	9	12
	4. B/Mambosasa B	14	5	9
	5. B/Popo	22	7	15
	6. Mwera	20	10	10
	7. Mtwango A	14	9	5
	8. Mtwango B	20	11	9
2. Rainfed rice	9. Kibokwa A	23	6	17
	10. Kibokwa B	24	14	10
	11. kilombero	21	12	9
	12. Bumbwisudi	16	11	5
3. Vegetables	13. Mangapwani	23	13	10
	14. Mwera	18	12	6
	15. Bambi	20	10	10
	16. Mtende	23	8	15
4. Bananas	17. Tazari	21	12	9
	18. Muyuni	19	15	4
	19.Bandamaji	15	1	14
	20. Mitakawani	25	----	25
	21. Donge	21	15	6
5. Cassava	22. Fujoni	20	12	8
	23. Kikungwi	20	11	9
	24. Cheju	19	11	8
	25.Maungani	17	10	7
	26. Mgambo	19	10	9
	Sub total	**511**	**259**	**252**
Pemba:				
6Irrigated rice	27. Kinyakuzi A	20	7	13
	28. Kinyakuzi B	21	11	10
	29. Tibirinzi A	20	6	14
	30. Tibirinzi B	17	6	11
	31. Mangwena A	20	6	14
	32. Mangwena B	22	8	14
7. Rainfed rice	33. Vitongoji	20	8	12
	34. Pujini	19	3	16
	35.Ole – Bandani	23	5	18
	36. Ole – nguomaji	27	8	19
8. Vegetables	37. Weni A	20	10	10
	38. Weni B	20	7	13
9. Bananas	39.Konde kilimani	18	12	6
	40.Ukutini	20	16	4
	41.Vikunguni	20	13	7
	42.Shengejuu	16	16	----
	43. Mkanyageni	19	17	2
	44.Mtambile	18	18	----
	45. Konde Manda	18	12	6

	46.Gando	18	8	10
10. Cassava	47.Mbuzini	22	16	6
	48. Pujini- Matale	25	10	15
	49. Ukutini	25	16	9
	50.Wingwi	21	19	2
	51.Gando – junguni	20	15	5
	52. Kiuyu Kipangani	18	18	----
	Sub total	**527**	**290**	**237**
	Total	**1,038**	**549**	**489**