CROP PROTECTION PROGRAMME

Factors affecting uptake and adoption of outputs of crop protection research in Peri-urban vegetable systems in Kenya

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FINAL TECHNICAL REPORT

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ABREVIATIONS AND ACRONYMS

AAK	Agrochemical Association of Kenya
ABLH	Association of Better Land Husbandry
AIC	Agricultural Information Centre
CABI	CAB International
CRF	Coffee research Foundation (Kenya)
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro International de Mejoramiento de Maiz y Trigo
FFS	Farmer Field Schools
FPEAK	Fresh Produce Exporters Association of Kenya
GoK	Government of Kenya
HCDA	Horticultural Crops Development Association
ICIPE	International Centre for Insect Physiology and Ecology
ICM	Integrated Crop Management
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
ICTs	Information and Communication Technologies
IRM	Insect resistance management
ITK	Indigenous Technical Knowledge
IPM	Integrated Pest Management
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspection Services
KIOF	Kenya Institute for Organic Farming
MARD	Ministry of Agriculture and Rural Development
NGO	Non-governmental Organisation
NRI	Natural Resources Institute (UK)
PCPB	Pesticide Control Products Board
PHI	Pre-harvest intervals
PRA	Participatory Rural Appraisal
SACDEP	Sustainable Agriculture and Community Development Programme
SUP	Safe Use of Pesticides

EXECUTIVE SUMMARY

The study was commissioned by DFID to investigate the factors influencing adoption and uptake of outputs of crop protection research in Kenya focusing on peri-urban vegetable production systems. The study was carried out from November 1999 through April 2000 by a collaborative team of scientists from CAB International, Africa regional Centre (CABI-ARC), the Natural Resources Institute (NRI)-UK, Kenya Agricultural Research Institute (KARI), and extension staff from the Ministry of Agriculture and Rural Development. Stakeholders from public and private sector research and extension organisations, including private agrochemical companies and exporters were consulted. Individual household and focus group interviews were conducted with farmers at three sites, Athi River in Machakos district, Gatanga and Gatuanyaga in Thika district and Nyathuna in Kiambu district. The three sites were selected as peri-urban areas representing smallhoder vegetable farmers. In addition, a review of literature on uptake was also done.

Study findings indicate that peri-urban vegetable farming in Kenya is guided largely by market demand. The production system is resource intensive, often depending on irrigation and agricultural inputs. Farming is intensively done on small plots of land rarely exceeding one acre per crop often under irrigation. Peri-urban farmers are aware of pest control strategies such as pesticide use and cultural control. Most farmers use chemical control methods because they consider them to be more effective. This appears to be driven by profit motives and the costs associated with chemical control rather than ignorance. Ongoing research on alternatives to chemical control and more rational use of chemicals need to be followed to logical conclusion so that farmers can adopt the outputs.

Although Kenya has an institutional set-up for research and dissemination of research outputs, dwindling resources for agricultural research and extension are a constraint to technology dissemination. The study therefore, recommends greater involvement of farmers in research and dissemination activities and establishment of partnerships between stakeholders in the public, private and NGO sectors in order to make the technology generation and dissemination process more responsive to farmers needs.

Furthermore, there are several pathways through which technologies are disseminated to peri-urban farmers, notably, research institutions, NGOs, Agro-input suppliers, exporters and an active government extension system. However, the extension system is largely supply rather than demand driven and is therefore not sustainable. The study also recommends promotion and use of a combination of communication methods such as demonstrations, Farmer Field Schools, Farm visits and Field days, which are seen to be very practical and therefore effective, as well as radio, which reaches many people. Emerging communication methods namely, community theatre and community information centres some using modern communication technologies are also identified as promising channels. The study has recommended interventions for improving uptake of the pest management strategies. Stakeholders are challenged to implement these interventions which should lead to fulfilling of the CPP purpose of improving the volume, quality and seasonal availability of food and crop products through the reduction of physical and economic losses caused by pests thus contributing to improving the livelihoods of resource poor farmers.

1. BACKGROUND

In Kenya, cultivation and sale of brassicas, especially in the Peri-urban areas, is an important source of income to many small-scale farmers (Odour et al., 1998a). A large proportion of fresh horticultural produce consumed in Nairobi is grown in the neighbouring districts of Kiambu, Machakos and Kajiado (Odour et al., 1998b). It is estimated that over 300,000 farm families earn the major part of their income through the cultivation and marketing of export vegetables. Within the vegetable sub-sector, *Brassica olercea* (subspecies *B. capitata and B. ocephala*) are the most important commodity group in terms of production with a national average of about 530,000 tonnes per year (Kamau and Bradford, 1998). Despite this, Anyango et al (1994), Cox (1994) and Oduor et al (1998) report that pests are the major production constraint for farmers that supply Nairobi with fresh produce. Pests and diseases cause serious crop losses and where chemicals are used to control them, the costs are prohibitive. Inappropriate chemical use is also causing environmental damage, promoting the development of pesticide resistance in the pests and causing health problems. A survey around Nairobi found 98% of vegetable farmers use pesticides, but 68% suffered symptoms that were attributed to their use (Harris et al., 1998).

The fact that chemicals are being so widely misused (for example 50% of farmers apply more than 3 times the recommended volume, dose rates vary from 6% to 315% of recommendations, and less than 10% of lower leaf surface is covered (Cooper, 1999) is clear indication that effective uptake of pest management strategies could be a major obstacle in turning research outputs into benefits to poor farmers. This is reinforced by the fact that the problems with pesticides are occurring despite the training of about 100,000 farmers annually by the Safe Use Project (SUP) in conjunction with the Ministry of Agriculture and Rural Development (MARD) extension staff. An evaluation by SUP in 1994 concluded that adoption of safe use practices was less than 30% (quoted in Conroy 1995).

The Department for International Development (DFID) Crop Protection Programme has therefore supported a thematic cluster of research projects designed to address this situation, through the development of improved chemical and non-chemical control methods. In the peri-urban vegetable systems in Kenya, these projects include the following, among others:

- Biocontrol of root knot nematodes (1996/99)
- Pest management in horticultural crops (April 1996 – March 1999; 1999-02)
- Investigation of biorational methods for control of insect pests in vegetables (1996/99)
- Isolation, identification and culture of indigenous entomopathogenic nematodes and preliminary investigations into their use for control of insect pests of Peri-urban agriculture.

Through these projects an impressive array of pest management strategies has been identified and is being researched on. Some, such as improved targeting of chemical sprays using a modified spray lance, are now ready for uptake, while others can be expected to become ready for farmer uptake in the next few years.

Although a wide range of strategies for crop pest management has been developed, there is evidence that the levels of adoption/uptake of these strategies is still low. Research targeted at

the peri-urban smallholder production system indicates a wide disparity between the actual and the recommended pest management practices.

While uptake of improved pest management strategies is critical, it is by no means straightforward. Previous studies indicate that even where appropriate improved pest control strategies are available, constraints in the delivery system can reduce the levels of uptake substantially (Garforth & Usher, 1997; Otieno, 1999). Furthermore, uptake of research outputs in sub-Saharan Africa is constrained by inappropriate policies, farmer socio-economic circumstances, lack of supporting infrastructure and inappropriate technologies (strategies) (Dasgupta and Stoneman 1987; Sanders et al., 1996). Specific constraints will apply in specific cases; for example a study by Harris et al. (1998) lists 14 factors constraining the adoption of organic farming methods (including pest management) in Africa. Analyses of the available delivery pathways for effectiveness and efficiency is thus key to ensuring wider adoption of the available pest management strategies.

Accordingly, this study on uptake of research outputs in and Peri-urban vegetable production systems in Kenya was designed with the aim of identifying strategies and interventions that will enhance the uptake of existing and expected outputs of vegetable crop protection research in Kenya, and so assist in delivering the peri-urban production system purpose. The study was commissioned by DFID to investigate the factors associated with adoption and uptake of outputs of crop protection research strategies with the goal of improving the volume, quality and seasonal availability of crops through the reduction of physical and economic losses caused by pests. As stated earlier, this study was based on the premise that relevant technologies are available or will soon be ready for uptake by farmers.

The study was carried out from November 1999 through April 2000 by a collaborative team of scientists from CAB International, Africa Regional Centre (CABI-ARC), the Natural Resources Institute (NRI) -UK, Kenya Agricultural Research Institute (KARI), and extension staff from the Ministry of Agriculture and Rural Development (MARD), Kenya.

2. PROJECT PURPOSE

To promote uptake and adoption of pest management strategies for peri-urban vegetable growers in Kenya

2.1 Specific Objectives

2.1.1 To identify, describe and/or review the existing and potential or emerging:

a) pest management strategies
b) institutional settings
c) dissemination pathways
d) communication methods

2.1.2 To make a preliminary evaluation of the dissemination pathways and communication methods

2.1.3 To delineate the key factors likely to affect uptake of pest management strategies by farmers

2.1.4 To identify strategies and interventions for enhancing dissemination and uptake/ adoption of crop protection technologies from current, recently completed and future projects

3. RESEARCH ACTIVITIES

3.1 Research approach

A consultative workshop was held at the beginning of project to brainstorm on the factors that influence uptake of crop protection research outputs in peri-urban vegetable production systems. The workshop participants were drawn from a broad spectrum of stakeholders ranging from researchers, extension agents and private agro-chemical companies and non-governmental organizations involved in agricultural research and development. Experiences on constraints to and means of enhancing uptake were discussed. Initial evaluation of different pathways and communication methods were presented.

The research problem and approach was discussed by the stakeholders and suggestions made on the way forward. Of particular relevance to research methodology was selection of sites and operational definition of peri-urban areas. Given the nature of the research problem, the project focused on smallholder farmers producing largely for the local rather than the export market. In addition, it was hypothesized that vegetable production in these sites is driven to a large extent by the existence of ready markets in the nearby urban centres. Accordingly, the peri-urban regions was hypothesized to be an area in the immediate environs of an urban boundary and where the land use pattern, particularly vegetable production is influenced by the presence of a given urban centre. Sites in Machakos, Kiambu and Thika districts were selected on the basis of close proximity to Nairobi in addition to typifying smallholder vegetable production for the market.

Based on the findings and recommendations from the workshop, a checklist was developed and used to elicit information from the secondary stakeholders who are the generators and disseminators of crop protection technologies. From the researchers, information was sought on the past and current on-going work on vegetable crop protection. Criteria for research problem identification and prioritisation, linkages with other organizations and methods of dissemination of research outputs were identified.

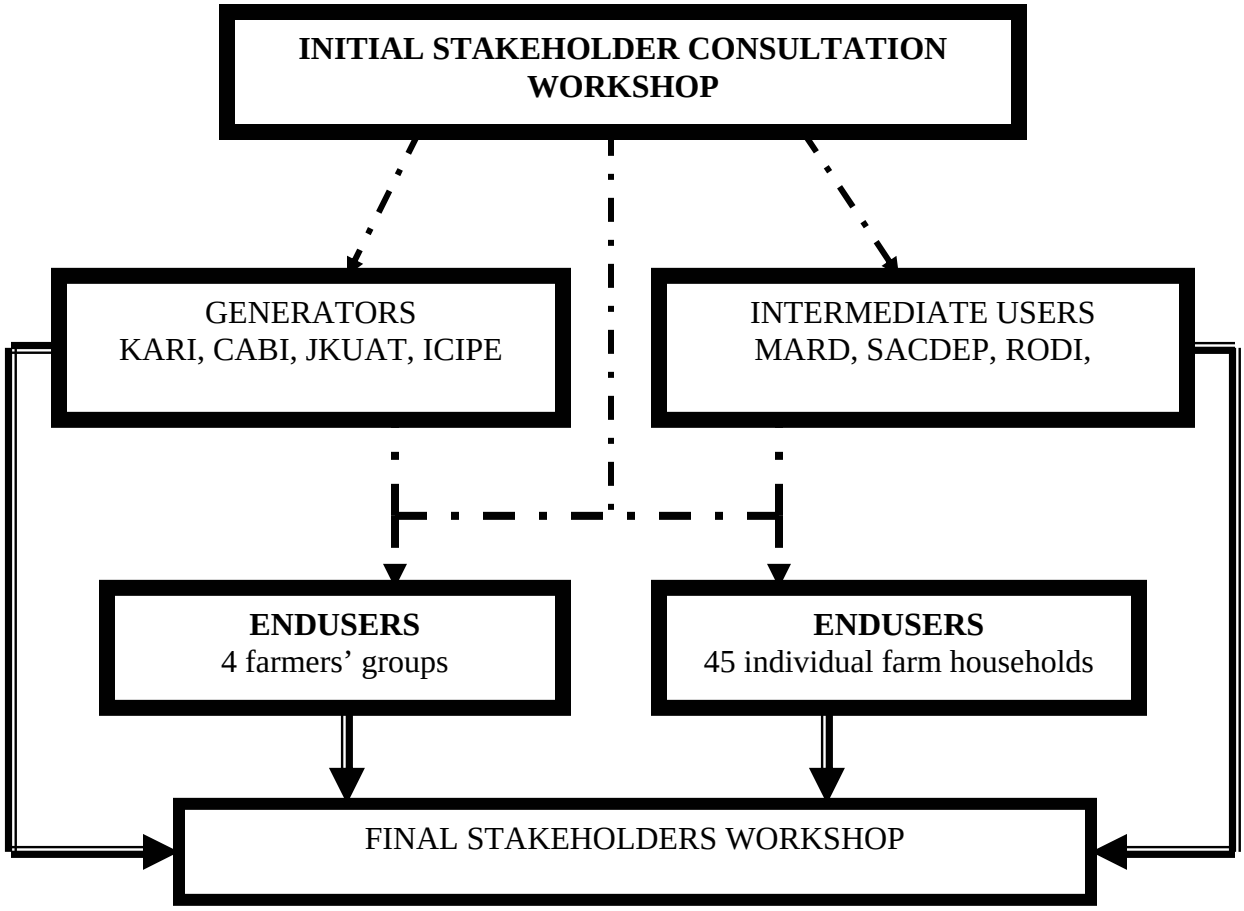
From the disseminators who are considered secondary users of research outputs, the interviews focused on methods of acquiring information and dissemination of the same. Thus, their mode of communication, frequency of contact with end users and the reasons for electing the given strategies were established. Generators and disseminators of research outputs were asked to identify the key constraining factors to uptake in addition to suggesting ways of enhancing the same.

The third level of information gathering entailed consultation with the end users namely peri-urban vegetable farmers. Farmers based at Athi River in Machakos district, Gatanga and Gatuanyaga in Thika district and Nyathuna in Kiambu district were interviewed both as a group and individually. Employing the means-end-chain approach in focus group interviews, information was sought on *which and why* certain crop protection strategies are preferred. Likewise, the farmers indicated their sources of information on crop protection strategies, the communication methods and frequency of contact with the disseminators. Based on their experiences, they set criteria for evaluating crop protection strategies and the communication methods.

Prior to the stakeholder consultations, a review of literature on adoption of agricultural innovations was done. Although there is relatively little published literature on uptake of vegetable technologies specific to crop protection in the peri-urban areas in Kenya, the lessons learnt, together with farmer and secondary stakeholder interviews, contributed towards a better understanding of factors affecting adoption and recommendations for improving uptake.

A final workshop was held at the end of March to share the key findings and develop recommendations on appropriate and sustainable uptake pathways and communication strategies for improving uptake. Figure 1 illustrates the research process that was followed.

Figure 1 The Research Process



4. OUTPUTS

4.1 Agricultural Technology Generation: Historical Evolution and Challenges

During the pre-Independence period, agricultural policies in Kenya encouraged large-scale 'modern' agriculture similar to that practiced in the developed world. Technology generation, to a large extent, focused on the problems of this large scale farming systems. Even though the climatic conditions in the White Highlands approximated those of the temperate regions, there was need to conduct research that adapts the imported technologies. Thus, research in the early 20th century focused on crop and livestock testing for broad agro-ecological zones of Kenya. The Swynnerton Plan of 1954 attempted to integrate the largely smallholder and subsistence oriented into cash crop production. Systematic research that addressed the problems of the African Farmers commenced with the introduction of a research theme that addressed African Areas. Nonetheless, the bulk of the research investments were still directed at the problems of the settler farmers, reflecting the dominant research client of the time (Otieno and Upton 1998, KARI personal communication).

At Independence therefore, Kenya's agricultural sector comprised the large-scale commercial white settler farms and the subsistence oriented peasant sector. In an attempt to redress this imbalance, the Government of Kenya instituted a number of interventionist policies aimed at redressing this imbalance. Of paramount importance to the new administration was the establishment of a thriving smallholder sector comparable in productivity to the former settler sector while, at the same time, maintaining the large scale commercial sector to provide the management expertise and the necessary production technology to the emergent smallholder sector. In response to this, the process of technology generation focused on "transcribing" the existing technologies for large-scale to small-scale production systems.

The 1970's witnessed the dawn of the 'Green Revolution' era. Considered a major step towards the effort to increase the productivity of the smallholder sector, Kenya's agricultural research system captured the spirit of the Green Revolution by refocusing research. The dominant paradigm regarding increased agricultural productivity in the peasant sector was monocropping, use of superior crop varieties, chemical fertilizers and standard crop management practices (Tripp 1992, Otieno 1999). Experience from Asia where the Green Revolution was a success indicates that effective extension services, functional input distribution systems and largely homogenous agro-climatic conditions were the key to the high levels of uptake observed. Kenya's agricultural research system developed high yielding maize varieties for specific agro-ecological zones during this era. In addition, extension services were improved through training of technical staff and increased funding for operations. Augmenting these efforts was the global economic outlook. The world prices of major commodities such as tea and coffee ensured favourable terms of trade for smallholder producers. In areas where these crops were grown, there were spillover effects especially with regard to the use of inputs such as pesticides and fertilizer. Agricultural research in the first 2 decades of independent Kenya attempted to generate scale-neutral technologies with an aim of increasing productivity through intensification and improved husbandry practices.

Despite these efforts, uptake levels were and still are incomparable with what was achieved by the Green Revolution in Asia. As a consequence, questions emerged regarding the suitability of technology generation and transfer strategy (Tripp 1992). The need for greater farmer consultation in technology generation led to the Farming Systems Research. Recognizing the diversity of production environments, farmer resource endowment, social and cultural differences of the farming community, agricultural research in sub-Saharan Africa focused on "target groups" or recommendation domains. With help from the *Centro International de Mejoramiento de Maizy Trigo* (CIMMYT), farming systems research took root in Kenya from the early 1980s. Since then, this approach has evolved and spawned into a variety of participatory methods for technology generation.

During phase II of the National Agricultural Research Project implemented by the Kenya Agricultural Research Institute (KARI), a number of donors notably DFID and the Netherlands government advocated for farmer involvement in problem diagnosis and experimentation for most of their activities. In response to this challenge, the farming systems approach to research extension and training was adopted in most programmes. In addition, greater emphasis was laid on inter-departmental collaboration and new partners in the form of Non Governmental Organisations (NGOs) engaged in grass root development and farmers' organizations emerged. In effect, the line between research and extension got finer as research moved more into technology testing and transfer. In sum, to the extent possible, the research system in Kenya has attempted to respond to the changing needs of its clientele. However, there have been significant developments at macroeconomic level since the beginning of 1980s that have had an impact on agricultural research and development in Kenya.

The last two decades have witnessed substantial cutbacks on government expenditure on services and this has affected agricultural research and extension in Kenya. Aimed at containing a spiraling fiscal deficit, broad based economic reforms that reduce government expenditure have since followed. The public sector has progressively scaled down its activities especially those related to extension. The public sector research system responded to this challenge by sourcing funding externally through bilateral aid or collaborative activities. However, whereas inflow of funds for research from donors increased in the 1990s, the extension system experienced the opposite. Compared to the pre 1980 era, the quality of services provided by the public sector extension has deteriorated. This explains, at least in part, the emergence of a number of non-governmental organizations engaged in agricultural extension activities. Needless to say therefore, some of the observed adjustments and developments in agricultural technology generation and dissemination process have been influenced by these developments.

It is evident that agricultural technology generation and dissemination have evolved over the years in response to the changing client needs and policy expectations. Whilst the summary above is by no means exhaustive, it explains to some extent, the observed institutional arrangement for agricultural technology and dissemination. The section below describes the existing institutional framework for technology generation and dissemination using information from key informant interviews with researcher and extension staff involved in vegetable production. It is within this framework that crop protection research on vegetables operates.

4.2 Current Institutional Set-up for Research

Currently, different organisations are engaged in agricultural research in Kenya. These include international research organisations such as CABI, ICIPE, CIAT, ICRISAT; development oriented NGOs; local universities and other public organisations (Fig 2). The Kenya Agricultural Research Institute (KARI) is the research arm of the Ministry of Agriculture and Rural Development. Accordingly, KARI has a national mandate to conduct research on all aspects of agricultural production in Kenya. Through its network of national and regional centres KARI addresses production constraints specific to different environments. In addition, KARI's research programmes are organised into different commodities and factors. Besides KARI, local Universities, as part of their contribution to national development, also conduct research that address problems related to agriculture.

4.2.1 Linkages

The majority of the international research organisations have formal links with the National Agricultural Research and Extension Systems (NARES). The NARES comprise KARI; Kenyan based universities and the Ministry of Agriculture and Rural Development. Outside of this formal framework, the NARES and overseas-based universities, laboratories or companies undertake joint programme development activities (Fig 2).

4.2.2 Identification of the research problem

Different organisations have devised methods for setting the research agenda. By and large, each organisation involves a major stakeholder in the process. It is widely recognised that the farmers, generators, disseminators and the donors are the main stakeholders in agricultural research. In the past decade, KARI has institutionalised research priority setting exercise across commodities and factors. The priority setting exercise involves consultation with farmers to identify broad production constraints and national development objectives. Based on the identified constraints, a multidisciplinary team of researchers and extension staff sit and identify available technologies and research opportunities. In addition, probability of research success and the payoff to proposed research are estimated. The factors and commodities are therefore prioritised based on all the above factors. Part of the research execution exercise involves regular consultation with farmers through Rapid Appraisals and other methods of diagnosis to ensure greater farmer involvement in research problem identification. In effect, KARI has developed a "shopping list" of priority research areas.

The Government of Kenya and a consortium of donors base their funding priority on national development needs. In the recent past, KARI has been directly involved in the drafting of national development plans. Compared to research organisations in other countries, KARI has been getting a big share of agricultural research funding. Of concern, however, is the heavy reliance on donor funding for operational activities. It is, therefore, possible that donor agenda and priority could supersede the identified local needs. This was felt in the during implementation of this study. Evidence from interviews with researchers indicates that opinions often differ on the research approach even when a clear problem is identified. In sum, although

KARI has institutionalised a systematic method for research problem identification that puts the farmer first, it is still not possible to determine to what extent this strategy has addressed the needs of different categories of farmers. What is evident is that the process facilitates research management in terms of resource allocation and donors are able to identify key priority areas. Table 1 shows the research development process in KARI.

Table 1 Research development process in KARI

Stage	Activity	Stake holder
1	Problem Identification	Researcher, farmer, extension worker,
2	Proposal development	Researcher
3	Technical committee evaluation	Agrochemical companies, NGOs, Farmers, extension, Universities
4	Centre Research Advisory Committee	NGOs, farmers, extension, universities
5	Funding/Implementation	Donor, GoK, KARI, chemical companies

For the international research organisations, the research problem identification is guided by their mandate. The key stakeholders are the donors and the end users. The influence of donors tends to be greater in these organisations (Table 2). In the recent past and largely in response to donor demands, most of the IARCs research is conducted in collaboration with the NARES (Figure 2).

Table 2 Research development process in NGO/IARCs

Stage	Activity	Stake holder
1	Problem identification/justification	Researcher/farmer
2	Development of research proposal	Researcher
3	Call for proposals	Donor
4	Submission of proposals	Researcher

Private commercial companies have strong research and development departments based overseas. Their key stakeholders are the shareholders. Based on an identified problem, the companies asses the potential profits of a given technology before committing resources into research and development. A great deal of their activities in Kenya, however, are limited to testing and validating technologies developed in their laboratories overseas.

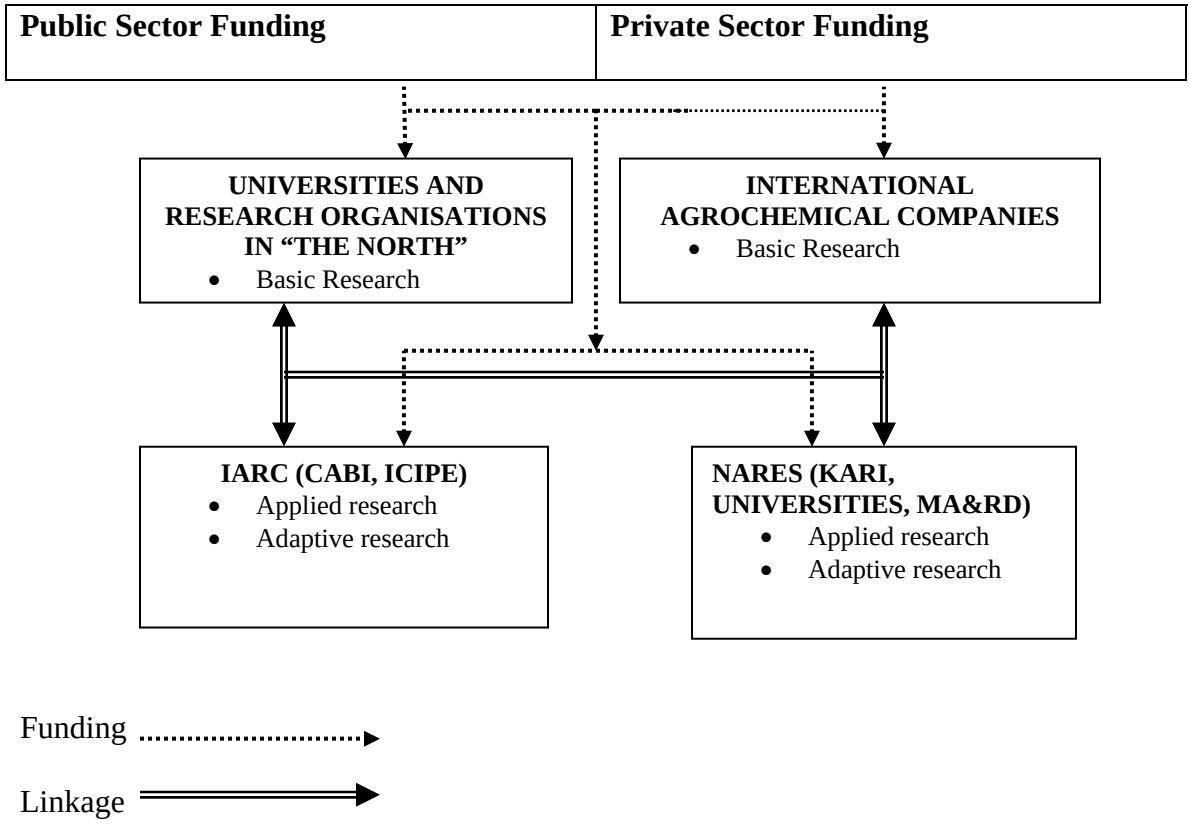
Table 3 Research development process in commercial companies

Stage	Activity	Stake holder
1	Feasibility study/problem identification	Extension officers, sales representatives and farmers
2	Contract research institution for technical evaluation	KARI and company
3	Market survey	Farmers, extension, company
4	Full development of product	KARI/company

Table 4 Stakeholder influence in research agenda articulation

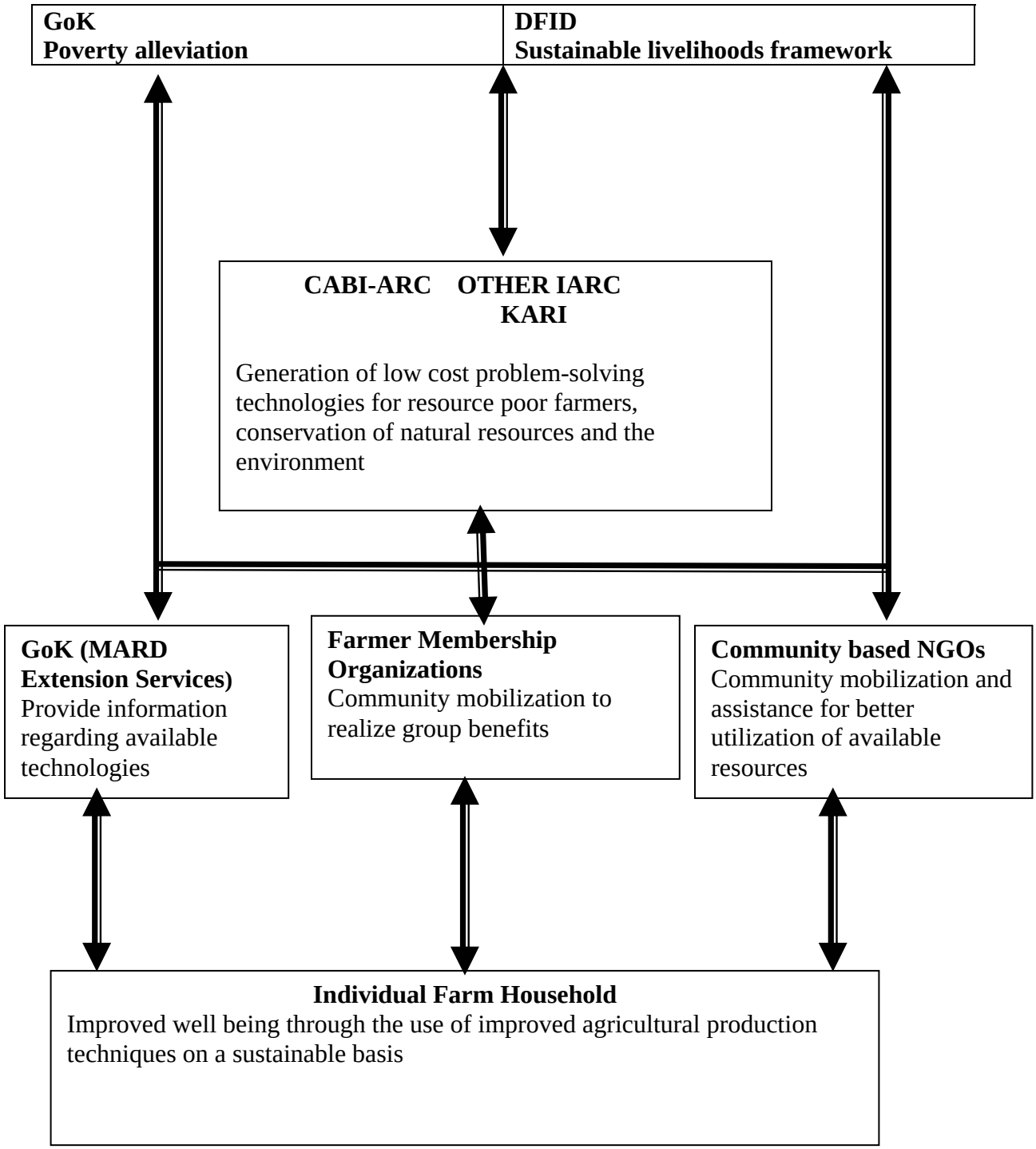
	KARI	IARC/NGO	Commercial Company
Donor/Shareholder Influence	Strong	Strong	Strong
Location Specific Research	Strong	Weak	Weak
Profit Motive	Nil	Nil	Strong
Farmer Influence	Strong	Strong	Strong

Figure 2 Linkages in technology generation



Consultations with stakeholders reveal that in the recent past, there has been a greater effort to coordinate activities. Thus, different organizations address development problems given their mandate and purpose. Figure 3 illustrates how different stakeholders interests link in an effort to solve a given development problem. The roles of different stakeholders indicated in annex 1 are also analysed within a development framework.

Figure 3 Translating Stakeholder Interests into Research and Development Programme



4.2.3 Emerging issues in technology generation process

Although there is a clear effort to address development problems through research, a number of factors still impede this process. There is room for improving the research client identification process and procedures and a number of approaches and methods are available for client constraint identification. However, there is no single best method for identifying client constraints and research needs. A variety of methods depending on available time, client characteristics, resources and expertise should be employed at the diagnostic stage. Regular consultations with the farmers, continuous refinement of diagnostic methods and interdisciplinary approaches to problem solving appear to be the way forward.

The other issue arising from a series of stakeholder consultations relates to funding agricultural research. Agricultural research is a long-term investment. Furthermore, there are uncertainties associated with the generation of research outputs that directly address the clients' constraints. Even where the output appears to address the needs of a given segment of the clientele, the diversity of end-user needs influences the rate of adoption. There is need for sustained investment by the public and private sector into the generation of new technologies that continuously meet the changing needs of farmers. Refocusing of agricultural research in order to develop better technologies could at least in part, reverse the recent trend of declining investment. A realistic assessment of the future trends of agricultural research funding appears to be more work for the same or lower levels of funding. This can be achieved through a more efficient use of available national research resources, forming functional linkages with the private sector and other NGO's and, demonstrating greater positive impact of research activities. The following section summarises ongoing research activities in peri-urban vegetable production system in Kenya.

4.3 Ongoing Research on Pest and Disease Control Strategies for Vegetables in the Peri-Urban Production System

Interviews with crop protection specialists in research organizations revealed five broad areas of research. These include:

- Plant host resistance
- Alternatives to chemical control
- Integrated pest management (IPM)
- Optimal chemical application levels
- Testing of introduced chemicals

Currently, the majority of the organisations are engaged in testing different IPM strategies (Annex 1). CABI in collaboration with KARI has spearheaded this effort for a number of years. ICIPE is also working with KARI in this area. In addition, KARI has been conducting varietal adaptation trials to screen some pest and insect resistant varieties. Other research activities have involved alternatives to chemical control and testing of introduced chemicals. Organisations such as KIOF have focused largely on testing different botanical mixtures and other alternatives to chemicals. CABI in collaboration with KARI and NRI is also investigating biological control strategies. An assessment of the current research activities indicates that most of IPM research is already at validation stage. Likewise the chemical validations tests reflect adaptive research

whose outputs can be applied directly to farming situations. The other kinds of trials namely, the alternatives to chemicals are yet to be validated and require further research. The key question remains whether these initiatives have been responsive to farmers needs.

4.4 Key issues from literature review

The available literature indicated that the major factors affecting adoption of technologies in peri-urban vegetable systems in Kenya were farmer characteristics and their resource endowment as well as farmers' perceptions of the benefits of using the technologies. Farmer characteristics include, education, farming experience and information on the technologies. The latter is influenced by access to extension services or contact with other information sources including other (contact) farmers. The key factor affecting technology uptake was the farmers' income which influences their ability to pay for the technologies e.g. pesticides and new 'resistant' varieties. Farmers' perceptions of the benefits of the technology include potential increase in yield and market demand for the commodity (crop). A detailed report entitled "Factors affecting the uptake of crop protection research in peri-urban vegetable production systems in Kenya: a review of the literature and analytical framework for the study" is presented under separate cover.

4.5 Farmer Consultations

Two levels of farmer interviews were conducted to determine farmer perception of pests and diseases. The first one entailed focus group interviews (Annex 2). The second involved individual household interviews with 45 farmers. A key feature of smallholder peri-urban vegetable production system is irrigation in the dry season. Athi River and Gatuanyaga sites are located along the banks of River Athi. Gatanga lies in further inland with no major river close by. Streams, wells and boreholes are the sources water for irrigation. Pests and diseases rank highly as constraints to vegetable production across the sites. In addition, capital constraint limits the degree of investment on irrigation equipment and other inputs.

Table 5 Thika: Main Pests and Diseases of Vegetables

	Gatuanyaga		**Gatanga**	
	Main insect Pests	**Main diseases**	**Main insect Pests**	**Main diseases**
Kale	Cutworms, Aphids,	-	Aphids, sawfly, Diamondback moth	Bacterial rot
Tomatoes	Bollworm, Aphids	Blight, Bacterial wilt; Blossom end rot	Whiteflies, Bollworm, Cutworms Spider mites	Bacterial wilt, Blossom end rot Blights

Table 6 Athi River: Main Pests and Diseases of Vegetables

	Farm managers		Farmers	
	Insect pests	**Diseases**	**Insect pests**	**Diseases**
Kale	Diamondback moth, Aphids	Root rot	Diamondback moth, Aphids, Nematodes	Leafspot, powdery Mildew, Blackrot
Tomatoes	Bollworms	Bacterial wilt, Blights, leaf roll Blossom end rot, bacterial canker	Spider mite Bollworm, Thrips, Aphids	Blights, leaf roll and Blossom end rot

In Kikuyu and Limuru divisions of Kiambu, Diamondback moth and aphids are the main pests for the brassicas while blights are the main disease constraints in tomatoes production.

4.5.1 Criteria for Determining the Importance of Pest and Disease Damage

The importance of a pest or disease is based on a given set of criteria. Bacterial wilt in tomatoes for example with no readily available control strategy is considered a serious threat to increased tomato production. Also, resistance to pesticides in the case of diamondback moth, high cost of chemicals for control of pests and prevalence of diseases that result in total yield loss are equally important criteria. Farmer consultations summed the criteria into the following.

- **Control strategies not readily available** - Bacterial wilt
- **Resistant to most pesticides** - DBM
- **Total high prevalence and possibility of total yield loss** - Blights in tomatoes
- **High cost of control strategies** - efficacious chemicals for DBM

4.5.2 Control Strategies

The majority of farmers use chemical control strategies for pests and diseases. Although KIOF and SACDEP promote botanical mixtures and other alternatives to chemical use, evidence of their use remains anecdotal. Chemicals remain the most efficacious strategy against pests and diseases. Cultural practice such as crop rotation is used to control bacterial wilt in tomatoes. The general trend of chemical use is in part a consequence “demonstrable efficacy” and repeated exposure to this strategy. Whilst ongoing research into alternatives to chemicals appears to address this problem, few alternatives actually exist for the peri-urban farmers. The farmers are generally aware of the adverse effects chemicals have on the environment. However, save for illnesses associated with chemical use, which are considered a private cost, environmental pollution is regarded as an externality.

Both the group and individual farmer interviews revealed that farmers are aware of the recommended chemical application strategies and levels. In practice, however, they sometimes deviate from these recommendations. For example, strategies involving alternate use of chemicals to prevent insect resistance are often ignored. Likewise, spraying regimes and dosages

prescribed on the chemical packages are varied depending on the severity of disease outbreak or pest infestation.

The behavioral pattern observed above is attributable to a number of factors.

- Production plans in terms of crop choice, levels of input use and cropping season are largely market driven (Annex 2). Maximising returns on investment appears to be a key objective. The optimal production levels therefore involve some degree of cost minimization and reduction of yield losses associated with pests. In essence, following the recommended chemical application levels, given the resource constraints does not maximize returns.
- A number of farmers genuinely lack cash to purchase the recommended chemicals. Consequently, they opt for the cheapest chemical in the market, often not very effective.
- The local vegetable market does not always pay a premium price on quality products. In the dry season for example, consumers are forced to make do with whatever is available since demand outstrips supply. The peri-urban vegetable producers target the dry season for production of most commodities. This is the period when they are price competitive compared to the large-scale rain fed production systems.
- Institutional and market failure also contributes to the observed behavioural pattern. Whereas the consequences of insect resistance and the associated costs to the society are clearly understood by the policy makers, enforcing the recommended chemical use strategies is constrained by inadequate funding and expertise. In the same vein, there are no market-derived mechanisms to discourage incorrect or misuse of chemicals. By contrast, the export market requires stringent adherence to quality, which is a function of crop production practices. The local vegetable market provides a conducive environment for opportunistic behaviour among the peri-urban vegetable producers given their production objective.

4.6 Evaluation of Pathways

Four broad pathways appear to exist in the regions, the traditional ones being the public sector extension system and the private chemical companies. Organised to provide services in most parts of the country, government extension officers are posted to specific administration units. The Government policy is to post officers according to demand for their services. Level and nature of agricultural activity largely determine this demand. For example, where vegetable growing is predominant, the Government assigns an officer in charge of horticultural activities. In the peri-urban systems analysed in this study, there are public sector frontline extension officers at location level.

The private chemical companies are organised to cover larger geographic areas and focus on specific crops. Using a network of sales representatives or technical representatives, they provide information on available chemicals and their use. Traditionally, the chemical companies work with the public sector extension system. Besides the chemical companies, private exporters also provide crop protection information to farmers specifically on green beans and Asian vegetables.

In response to their mandate and areas of operation, a number of NGOs such as PLAN International and CARE Kenya have expanded their activities to include promotion agriculture.

Other local NGOs have been set-up purely to promote sustainable agriculture. In the present study, KIOF and SACDEP were noted for their promotional activities in vegetable production.
The other crop protection information delivery pathway identified in the peri-urban vegetable production system is a consortium of organizations in the form of research and extension collaborative activities ranging from on-farm trials to farmer field schools.

Institutionally therefore, the pathways can be classified into 4 broad categories namely; the Private sector, the Public sector, the NGOs and the Consortia. Traditional institutional pathways include private chemical companies and government extension system. The emerging pathways are the NGOs, the consortia and the export companies. Despite the constraints faced by the government extension system, it remains highly rated by the majority of peri-urban vegetable farmers. The government extension system is considered accessible and reliable although costly at times. This rating could be attributed to a number of factors.

- The majority of farmers are aware of its existence.
- Most private companies and NGOs work together with the government extension system.
- They address a wide spectrum of agricultural production problems.
- There are more government extension officers in the Peri-urban system.

The NGO sector appears focused and has adequate funding for their operations. Given their mandate (Figure 2), they are also held in high esteem by the farming community. The greatest limitation to the NGO pathway appears to be their scope of operation. Thus, although considered reliable and less costly, accessibility is limited to areas of operation.
The private sector pathway remains an important source of information not only to farmers but also to secondary users of information (see Annex 3). In Kenya, they appear to be almost the exclusive generators of chemical control strategies.

The consortia appear to be a sustainable pathway given the recent trends in agricultural technology generation and dissemination. Besides the synergy derived from different skills and approaches, the cost implications are clearly favourable. It is perhaps this approach to dissemination that has kept the Public Sector operating in the wake of serious funding cuts in the recent past.

Table 7 Sources of information

Source	**Athi 1 Farm managers**	**Athi 2 Farmers**	**Thika1 Gatanga**	**Thika2 Gatuanyaga**
GOK Extension	Present	Present	Present	Present
NGO	Absent	Absent	Present	Present
Private	Present	Present	Present	Absent
Consortia	Absent	Absent	Present	Present

Farmers ranked the pathways based on what they considered to be desirable attribute
1) Public sector extension- found in all sites and included in most joint activities. They address multiple problems **BUT** sometimes inaccessible
2) Neighbours/parents/fellow farmers and friends-most accessible **BUT** sometimes provides outdated and therefore inappropriate information.

3) NGOs - employ suitable communication methods, highly accessible **BUT** limited in geographic distribution and scope.

The criteria given by farmers were combined with information from secondary stakeholder consultations to arrive at the following attributes considered desirable for a pathway to remain effective.

- **Geographic distribution-** a pathway or institution that is available in most areas
- **Accessibility** -Physical distance, knowledge of location and good rapport were considered
- **Reliability of information**- Specifically reliability of information given in terms of currency. In case of crop protection, when prescribed strategies always work.
- **Extensiveness or versatility of source-**ability to address multiple problems in farming
- **Employment of appropriate communication methods**- Methods such as demonstration preferred for crop protection technologies.

Table 8 Sources of Information by Site

	Athi 1 Farm Managers	**Athi 2 Farmers**	**Thika1 Gatanga**	**Thika2 Gatuanyaga**
KARI			Few	All
GOK Extension	All*	All*	All*	All*
HCDA		Few		
ICIPE				All
SACDEP			Most	All
KIOF			Few	
PLAN INT.				All
Manor house			Few	
Neighbours/Other farmers/Friends	All*	All*	All*	All*
Chem. Companies	All			
Stockists	All			
Exporters	Few		Most	
Manuals/Pamphlets	All	Most		
Children's School books			All	
Agric. Shows		Most*		

4.7 Communication Methods

Consultations with stakeholders who are involved in dissemination of technologies and farmers, revealed that they use a number of communication methods, some of these methods are more effective than others. The key factor in communication was language, however this was not much of a constraint among peri-urban farmers since most of them were literate (could read and write in either English or Kiswahili) or had literate neighbours or children who could read and translate messages for them. The methods used fall into two broad categories namely:

4.7.1 Traditional methods

- Demonstrations – mostly used by extension and research workers to introduce new technologies and how they (technologies) should be used effectively.
- Printed material (Posters, handbooks e.g. Standards in organic production), farmers' magazines/ bulletins (in Kiswahili), Leaflets (in Kiswahili), fliers, Product labels and Manuals, (Kiswahili and English); Newspaper articles. This category is mostly used by Agro-chemical companies, extension workers and private sector stakeholders such as exporters to convey messages on available technologies, markets for commodities, regulation issues and many more.
- Farm visits are mostly used by extension staff but also by for farmer–to-farmer visits
- Farmer exchange visits – farmers from one areas visit another area to learn form the experiences of other farmers.
- Field days - normally organised by extension workers. Farmers visit specific farms and learn from demonstrations and other farming activities
- Barazas - these are community meetings in which various subjects are discussed including farming.
- Farmers visiting extension staff (in their offices)
- Radio programmes – this method is used by the Agricultural Information Resource Centre to disseminate information on technologies and other farming practices from research. Agro – chemical companies and exporters also use this method often
- Seminars/training courses – many stakeholders organise training seminars and courses for extension workers and often for farmers.

4.7.2 New/emerging methods

- Farmer Field Schools (FFS) – This is an emerging communication channel (and a variation from demonstrations). FFS involves intensive field-based courses where farmers learn about IPM approaches by carrying out their own experiments. This method was being used successfully in one of the project sites.
- On-farm trials – this method is used by researchers alone or researchers in collaboration with other partners e.g. Agro-chemical companies on selected farms.
- Training and Visit (T & V)
- Advertisement in the mass media
- Videos/Documentaries – mostly through public shows and during training

- Community theatre – this is an emerging activity, are mostly organised on market days
- Group Listnership - this is an emerging activity where groups of people get together to listen to Radio programmes and then discuss how best they can utilise the knowledge acquired.
- Advertising of own technologies through sponsorship of events such as Golf tournaments.

4.7.3 Use of the communication channels by disseminators

Seminars are the most commonly used communication method, followed in descending order by demonstrations, farm visits, printed material, on-farm trials, barazas (group meetings), field days, FFS, video and radio (See table 9).

4.7.4 Evaluation of communication methods:

Communication methods were evaluated for their importance. The criteria used (identified by farmers and stakeholders) include:

- Effectiveness - how successful the method is in delivering information
- Extensiveness of information (ability to address many farming problems)
- Accuracy (of information)
- Geographical coverage (most known and used by farmers)
- Networking opportunities

Demonstrations, Farm visits, FFS and Radio are rated as the most effective communication methods.

- **Demonstrations** offer practical means of learning about technologies and the farmers are involved so take are able to understand and appreciate the benefits of the technologies. This method is closely followed by **farm visits** (this includes visits by extension staff to farmers, farmer-to-farmer and farmer exchange visits) and seminars or courses which involve both theoretical and practical "learning by doing".

- **Farmer Field Schools (FFS)** are considered to be very effective by research and extension workers. The method focuses on letting farmers learn about the role of natural enemies in the field. The farmers trained in these schools go out and teach other farmers, so it has a multiplier effect and the extension workers do not have to provide technical support to the farmers all the time since they are able to advise one another. FFS may require heavy initial investment in training facilitators who in turn train farmers but are very sustainable afterwards, as farmers take charge of their own affairs with little external support.

- **Field days, seminars/courses** were evaluated as leading in terms of extensiveness of information i.e. covering many subjects on farming. Many technologies were learnt through these channels.

- **Printed matter, especially books, product manuals and pamphlets** were considered to be leading in terms of accuracy since most of them came from reliable sources such as the AIC and reputable Agro-companies.

- **Radio** was considered the leader in terms of geographical coverage. It had an added advantage of being a direct source of information (no intermediary), followed by printed matter (posters, handbooks, farmers' magazines/ bulletins, leaflets, fliers, product labels and manuals and, newspaper articles).

- **Seminars and Baraza's** were best at offering farmers opportunities for networking and therefore learning new ideas.

Overall, radio and demonstrations-based methods were preferred by most key stakeholders and all farmers.

There are opportunities to maximise use of the most important communication methods. The way forward seems to be the use of a combination of communication methods that bring together a number of important attributes. The choice of which communication method to use will depend on resources available to the disseminators and the literacy level of the target farmers. Fortunately, in the peri-urban areas surveyed, nearly all farmers benefit from most of the methods. Besides, methods such as demonstrations, farm visits, seminars/courses that are commonly used by disseminators, were identified as most effective by the farmers (Refer to table 9). New/emerging communications methods such as FFS, video, on-farm trials, radio listening groups, community theatre seem to offer new opportunities for improving technology dissemination and adoption in agriculture. Furthermore, there is untapped potential for improving dissemination of technologies through the use of new information and communication technologies (ICTs). A recent development is the use of telecentres (i.e. community resource centres equipped with computers, telephones and other communication tools) to disseminate agricultural information to communities. This has been done in countries such as South Africa and Uganda and is so far proving beneficial, provided the needs of the farmers are correctly addressed. Thus, both traditional and new technologies could be harnessed to disseminate technologies.

Table 9 Use of communication methods by various stakeholders

	COMMUNICATION METHODS																	
	FSS	Demo	On-farm trials	Farmer-to-Farmer	Field days	Farm visits	News letters	News-papers	Hand Books	Manuals	Posters/ Fliers	Seminars /Courses	Baraza's	Agric. Shows	T & V	Radio	Video	Sponsored Events
ORGAN.																		
KARI	X	X	X		X		X	X	X			X		X				
ICIPE		X	X	X	X			X				X						
CABI	X	X	X				X	X			X	X						
MARD	X	X			X	X			X		X	X	X					
AIC									X		X	X		X		X	X	
HCDA		X				X	X					X	X	X				
KEPHIS							X	X						X				
ABLH	X	X				X	X		X			X						
SACDEP		X				X						X			X		X	
KIOF	X	X		X	X	X	X				X	X			X	X	X	
TWIGA		X	X		X	X				X	X	X	X	X				X
AVENTIS			X			X				X	X	X	X	X				

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The present study aimed to identify the key factors influencing uptake and adoption crop protection technologies. The following factors were hypothesized to influence uptake and adoption.

- The institutional set-up for research and dissemination.
- Available crop protection strategies or technologies.
- Dissemination methods employed.
- Farmer circumstances.

It is evident that the institutional set-up for research and dissemination does exist. In the majority of cases, inadequate resources appear to be a constraint for both research and extension. There is therefore need to form partnerships in order to make the technology generation and dissemination process more responsive to farmers needs. The public, private and NGO sectors, working as service providers together with the farmers, ought to be involved in the research and dissemination process. This would appear to be a feasible arrangement given the dwindling resources for agricultural research and extension.

It is also evident from the present study that the key attribute of any given crop protection technology is demonstrable efficacy. For that reason, the majority of peri-urban vegetable producers in Kenya employ chemical control methods since there are very few alternatives with comparable levels of efficacy. Given the costs associated with chemical control strategy, there is an even greater need for research on alternatives to chemicals. Currently, the ongoing research on alternatives to chemical control and those addressing the issues of more rational use of chemicals need to be followed to logical conclusion since the outputs are not ready for adoption by farmers.

The present study revealed an array of pathways for disseminating crop protection outputs. The peri-urban Nairobi appears to have adequate and functional extension system. Contrary to conventional wisdom, the public sector extension system is rated highly by the farmers. The unique feature of the peri-urban system could possibly explain this rather startling finding. Borrowing from Chambers (1989), the peri-urban Nairobi is not peripheral. It is therefore accessible to most “rural tourists” and urban-based extension agents. In addition, the activities of NGO and private sector extension agents include government staff by design. Most field days and demonstrations organized by the private and NGO sector include the public sector extension system thereby facilitating contact with farmers. It is also evident from the present study that although different communication methods exist, practical demonstrations are the preferred mode for crop protection strategies.

Finally, the present study attempted to define the characteristics of the peri-urban vegetable producer. To a large extent, the crop choice and enterprise mix is guided by market demand generated by a nearby urban center. Often, the climatic conditions do not favour the prevailing production system. Irrigation is therefore a common feature of the peri-urban system and production plans target periods of supply shortfall from the traditional and

climatically favourable vegetable growing areas. Also, plot sizes per crop rarely exceed 1 acre.

The majority of the peri-urban farmers have functional levels of literacy. Given their proximity to urban centers, they have access to agricultural input outlets and the communication system is relatively well developed compared to the rural areas. Compared to their rural counterparts, the majority of the peri-urban vegetable producers are aware of most effective crop protection strategies. The observed deviations from the recommended practices are direct responses to their ultimate objective to maximize returns on investment.

5.2 Recommendations to all stakeholders

A Regulation and Registration

1. The PCPB should address inefficiency in the procedure for registration of Agro-chemicals.
2. Regulatory procedures for local markets (for vegetables) should be stipulated and reinforced

B. Technology generation

1. A nationally co-ordinated framework (policy body) for all stakeholders involved in research should be set up in Kenya. This body should:

- Provide for regular interaction among stakeholders.
- Ensure more involvement of stakeholders in technology generation.
- Allocate research activities to member organisations according to their comparative advantage.
- Ensure involvement of farmers in influencing research priorities (currently research priorities are not always farmer driven).

2. Alternative sources of financing for research should be sought. It is also recommended that research should be funded by those who need it e.g. exporters, agro-industry, HCDA.

3. To ensure sharing of information among stakeholders, a data bank of available agrochemical
   Companies giving information on areas of interest should be established.

4. A fast force/committee comprised of stakeholders should be set up to ensure constant monitoring of pests, diseases and related problems.

5. Farmer – extension – research linkages should be improved through:

- Training farmers in pest problem identification
- Refining technologies (at research stations) before they are taken out to the farmers. This will address the problem of misconceptions by some farmers as such equating ‘on-farm trials’ to demonstrations.
- Establish a national research and extension reference database. This will provide information on on-going and completed research as well as available technologies.

6. Researchers should be given the necessary resources and motivation to enable them do their work in a way that matches the research needs.

C. Technology dissemination

1. Public sector extension should be strengthened through:
   - Provision of resources such as means of transport.
   - Routine training of staff to enable them keep up with the changing technologies.
2. Coordination between disseminators should be improved so that they can work closely:
   - KARI/universities should play a more active role in dissemination/training activities while SUP could strengthen its work with schools.
   - Linkages between KARI/Universities /HCDA should be strengthened to avoid duplication and competition.
3. The flow of information to farmers should be improved by involving farmers who can contribute to development of uptake strategies e.g. retired civil servants.
4. More resources should be allocated to research institutions and AIC to enable them disseminate information/technologies to all stakeholders including farmers.
5. A dissemination forum which will formulate/harmonise messages on technologies prior to dissemination should be established. KARI should take the lead on this initiative.
6. All research projects should have dissemination components.
7. Both new and traditional ICTs should be used appropriately to disseminate information. Examples:
   - Repackaged information on technologies could be provided in telecentres /community centres.
   - Radio programmes and features in newspapers should also be increasingly used. For radio, the group listnership approach to programmes should be explored.
8. Effective communication methods, which employ demonstration techniques such as field days and FFS, should be used more often for disseminating technologies.
9. Demonstrations of technologies should be conducted in schools as children are a special focus group for future generations
10. Projects should address food security.
11. The information disseminated to farmers should be simplified
12. Innovative approaches to the existing extension strategy should be adopted. These include:
    - Farmer field schools
    - Village/Community approaches
    - Training of stockists/other input providers countrywide
    - Commercialising of certain activities (e.g. extension activities in horticulture)
13. Public and private sector financial institutions should establish group approaches for accessing credit in order to redress the cost of technology problems
14. Technologies should target the right groups in extension e.g. the youth, women, etc.

5.3 Recommended topics for future research

5.3.1 Socio-economic research

- Production economics in vegetables.
- Influence of farmer characteristics/circumstances on uptake.
- Studies on ITK to identify effective strategies for pest management.

5.3.2 Scientific Research

- Structured research on botanicals i.e. to determine the mode of action for botanicals/organic pesticides and also address the following issues:
  - Problem of reproducibility and standardization
  - Biosafety
  - Shelf life
- Step up research on plant-host resistance
- Studies on application rates of various chemical pesticides (address underdose/overdose issues)

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ANNEX 1
SUMMARY OF SECONDARY STAKEHOLDER CONSULTATIONS

TABLE 1: Roles of key stakeholders in vegetable farming in Kenya

POSITION	ORGANISATION	ACTIVITY
1.Programme Coordinator, Horticulture Research Programme 2.Plant Pathologist 3.Agricultural Entomologist	Horticulture Research Programme, KARI-Thika	**Technology generation:** • Development of disease resistant varieties • Variety release performance • Multiplication of breeders seed • Screening of pesticides (on behalf of agrochemical companies) • Trails of IPM packages **Technology Dissemination:** • Identification of pest and diseases and advising farmers on their management
Social Anthropologist	ICIPE	**Technology generation:** • Integrated Pest Management • Technology dissemination • Tracing of technologies for uptake
1. Senior Agricultural Officer Extension 2. District crop protection officer Machakos	Ministry of Agriculture and Rural Development	**Technology Dissemination:** • Coordination of extension programmes • Monitoring pests and diseases and advising on their control
IPM Specialist	Association for Better Land Husbandry (ABLH)	**Technology generation** • On –farm trials, in collaboration with ICRAF and KARI • FFS on French beans and tomatoes • ITK (Kakamega) **Technology Dissemination:** • Promoting IPM through FFS • Introduction of new varieties • Promotion of organic pesticides

Technical Manager	TWIGA Chemicals	**Technology Dissemination:** • Sales and marketing of Agro and Industrial chemicals in central Kenya • Toll manufacturing - mostly pesticides • Field trails of pesticides
Deputy Director	Kenya Institute of Organic Farming (KIOF)	**Technology generation:** • Efficacy trials e.g. Investigation on the efficacy of ashes on control of aphids on Kales in KARATINA **Technology Dissemination:** • Training farmers (and multipliers) in organic farming • Promotion of vegetable production especially at Kitchen garden level
Programme Manager	Sustainable Agriculture Community Development Programme (SACDEP-Kenya)	**Technology Dissemination:** • Promotion of better farming through use of organic technologies and participatory farming activities
Area Development Manager	AVENTIS Crop Science Kenya Limited (formerly Rhone Poulenc)	**Technology generation:** • Trials of new product in country Promotion • Carry out market surveys when products are to be introduced
*Assistant Director, Plant Protection Services[1]	*Kenya Plant Health Inspectorate Services (KEPHIS)	**Regulatory** • Ensuring bio safety of pesticides • Phytosanitary Certification (for exporters) of main export vegetables • Inspection service (for imports, e.g. seed and planting material)

[1] * KEPHIS is a regulatory organization

Director	Agricultural Information Resource Centre (AIC)	**Technology Dissemination:** Radio & Video and Publishing Subject Scope: Agriculture (Field crops, Animal production, Veterinary medicine, Environment & Natural resources) but recently has broadened to include other social issues e.g. health
Technical Services & Nurseries Manager	Horticultural Crops Development Association (HCDA)	**Technology generation:** • Carry out adaptive research on farmers fields (e.g. testing new varieties, chemicals) **Technology Dissemination:** • Provide technical advisory services to farmers through extension team **Regulatory:** • Carry out market intelligence mainly focusing on export crops • Recommend exporters for registration

TABLE 2: Dissemination methods used by key stakeholders

ORGANISATION	DISSEMINATION METHODS	CONSTRAINTS TO DISSEMINATION & ADOPTION
Horticulture Research Programme, KARI-Thika	• On-farm trials; • Collaboration with: MARD (extension services), Agro-chemical companies, ICIPE and others. • Farmer Field Schools (FFS) • Demonstrations of IPM strategies /safe use of pesticides, • Use of posters, handbooks, etc. • Training of trainers –farmers, extension and NGO representatives: Courses on: • Integrated Crop management (ICM) • Pest identification and scoring • Pesticide application methods • Post harvest technologies	**Policy level** • Need for broader scope of pesticides • Dependency on standards (e.g. pesticide residue levels) from other countries **Institutional level**: • Low capacity of KEPHIS • Low capacity of the Pesticide Control Board (PCPB) therefore unregistered chemicals /seed come into the country **Research level constraints:** • Budget limitations • Remuneration of scientists is based on how many papers they have published rather than how many technologies have been taken out to the farmers **Farmer level constraints:** • Lack of credit facilities to farmers • Stockists (of agro-inputs) often far from farmers • Misuse of technologies • Overuse of pesticides; **Technology-inherent:** • Initially some wrong packages and /or dissemination strategies were used; • Lack of alternative control strategies e.g. resistant varieties

ICIPE	• Lab –on-station • On-farm- managed and financed by scientist • On-farm – managed and financed by farmer • Farmer-to-farmer	**Farmer level constraints** • Farmers are only ready to put their resources in problems that they consider to be severe
Ministry of Agriculture and Rural Development	• Field days- organised by chemical companies - demonstrations • Farm visits by extension staff • Farmers visit extension offices	**Policy level constraints:** • Fake chemicals and seed and lack of mechanisms to protect farmers' interests • Disjointed information flow between chemical companies and agricultural extension workers (Staff) • Procedure for introducing new chemicals and varieties are not always followed **Farmer level constraints:** • Farmers do not always accurately implement the recommended practices regarding under doses; spraying regimes and pre-harvest intervals • Technologies too expensive for most farmers • Some technologies not understood by farmers
Association for Better Land Husbandry (ABLH)	• IPM through FFS • Training of farmer specialists (farmers who in turn train others) on safe use of chemicals, and other areas • Training seminars by Safe Use Project (SUP) • Consultant from the MARD • Quarterly Farmers magazine	**Institutional level constraints:** • Lack of continuity when donor funds for projects run out • Technologies are often donor driven • Lack of extension and regulatory arms for information dissemination. **Farmer level constraints:** • Lack of knowledge on plant protection such

	(Kiswahili) • Standards (Guidelines) on organic farming	as integration of the different components of crop protection e.g. natural enemies and chemicals • High costs of labour and chemicals not conducive to technology adoption; • Often, circumstances not conducive to applying the technologies e.g. use of tobacco leaves require protection for the person spraying.
TWIGA Chemicals	• Promotion using Sales representatives and Technical Assistants • Demonstrations to farmer groups • Posters • Training • Field days • Farmers' meetings • Sponsorship of events e.g. Golf days	**Policy level constraints:** • Duty on pesticides too high (10%) • Stringent quality requirements by the European Market **Institutional level constraints** • Process for registering of products takes too long – possibly because PCPB is understaffed • Lack of equipment to check residual levels in crop • Pirating of drugs is common yet penalties for pirating are very small. **Farmer level constraints** • Misuse of chemicals by farmers (aggravated by lack of follow up after the use of chemicals); • Illiterate farmers not able read product labels • Farmers not aware of some technologies and cannot identify pests and diseases

Kenya Institute of Organic Farming (KIOF)	• Training sessions • Quarterly Bulletin – used to disseminate findings on Pest Control • Demonstration gardens (Juja, Malaba, Embu) – very effective • Publications/Information materials e.g. fliers in local languages • Videos for students and extension staff • Farmer exchange visits • Follow up on trained farmers for 6 months • Field days • FFS • Radio (not regular)	**Institutional level constraints:** • KIOF's mandate does not always tally with that of other relevant organisations e.g. SUP, KARI; • Lack of ample time to test the technologies before disseminating them to farmers **Technology- inherent constraints** • Lack of approved application rates for most botanical (organic) pesticides

Sustainable Agriculture Community Development Programme (SACDEP-Kenya)	• Farmers training (once a week);
	• Training of trainers (ToT);
	• Training and Visit (T &V)
	• Demonstrations on farmers' farms
	• Use of documentaries as training materials
		Farmer level constraints
		• Farmers inconsistent in carrying out pest/disease control strategies and other farming practices. Farmers decisions are influenced by:
		  • Availability of labour at household level
		  • Cost of the technology e.g. chemicals
		  • Other market forces

AVENTIS Crop Science Kenya Limited (formerly Rhone Poulenc)	• Labels (English and Kiswahili) • Radio • Demonstrations • Leaflets • Barazas • MoA extension workers and distributors and stockists given training	**Farmer level constraints** • Even when farmers know what the recommended practice is, they cannot always afford to pay for it • No effective micro-finance in Kenya • Ignorance – for example, a lot of Karate is still sold despite the fact that crops have

	• Provide funds to Safe Use Project (SUP) which trains and disseminates info; • Use of contact farmers/demonstrations and radio (particularly for brand awareness) – considered most effective • Market surveys before introducing the products	developed resistance to it • Fraudulent practices such as fake, illegal repackaging and unethical competition among Agro-chemical companies e.g. misinformation about others' products • Extension staff often demotivated. • Stockists have poor product knowledge and they don't go out to the field
Kenya Plant Health Inspectorate Services (KEPHIS)	• KEPHIS News - a newsletter on specialised subjects (e.g. Importation of plants and plant breeders rights, distributed freely to potential importers); nothing done on exportation because the regulations are very different, depending on the destination • Newspaper articles • Shows – e.g. Horde flower Show – last year KEPHIS gave a talk on their role in horticulture Note: Ad hoc dissemination of information as this is not a responsibility of KEPHIS	**Policy level constraints:** • Prolonged process for registering chemicals, especially dressed seed shouldn't need registration in-country if already registered in other countries e.g. US **Institutional level constraints:** • Poor extension services– good technologies not widely known in the field
Agricultural Information Resource Centre (AIC)	• Radio • Video • TV • Publications (technical hand books, pamphlets)	**Institutional level constraints:** • AIC not technically self-sufficient - rely on input from Research-Extension –Liaison Unit of the MARD • Bureaucracy results in slow response to clients needs **Farmer level constraints:** • Lack of funds to buy technologies (inputs) and information products,

		• Ownership of equipment such as radio and video playback machines is low in rural areas • Language limits dissemination - rural people prefer their own local languages to Kiswahili or English
Horticultural Crops Development Authority (HCDA)	• Technical extension team –conduct demonstrations on farmers' fields • Seminars/ workshops organised for farmers on production and marketing – • Bimonthly newsletter to all stakeholders, farmers, extension workers. Also sent to Kenya embassies abroad • Frequent Barazas, up to sub-location level • Agricultural shows	**Institutional constraints:** • Inadequate funding, Example: Seminars/workshops supposed to rotate in different areas, but currently not frequently held due to lack of funding. • Poor access to information especially when it is required quickly (e.g. from KARI) **Farmer level constraints:** • Farmer illiteracy • Lack of adequate funds/resources

TABLE 3: Stakeholders Recommendations

ORGANISATION	OPPORTUNITIES FOR DISSEMINATION	RECOMMENDATIONS
Horticulture Research Programme, KARI-Thika	• Control strategies available to farmers. Examples: Cabbage varieties that are resistant to black rot; IPM package is being adopted faster that previous packages as is depicted by the demand from farmers • New/appropriate technologies required by farmers due to market demand (mostly the export market)	• Strengthening the capacity of KEPHIS and PCPB • Strengthen extension so that they can reach the farmers; • Address research-level constraints such as remuneration, etc.
ICIPE	• Dissemination methods such as on-farm – managed and financed by farmer and farmer-to-farmer appear to be more effective and should be used	• Disseminators should share their knowledge with farmers but also listen to them • Farmers should be given knowledge that directly leads to behavioral change – this is necessary for transformation • Need for researchers to trace the technologies that have been released from research stations and ensure that they are scaled up e.g. Large-scale replication as in Indonesia • Need to quantify indigenous knowledge
Ministry of Agriculture and Rural Development	• Strategies for control of pests and diseases are available; • Extension staff is active	• Increase farmer training • Re-allocate resources to extension services to increase contact with farmers

Association for Better Land Husbandry (ABLH)	• Collaborates with several public and private sector extension services	• Recommendations on technologies to be adopted should be realistic – depending on the level /status of the farmer
TWIGA Chemicals	• The Pesticide Chemical Association of Kenya is handling pesticide issues.	
Kenya Institute of Organic Farming (KIOF)	• There are collaborative activities between KIOF and other partners. • KIOF has initiated collaboration to test field performance of some botanical pesticides	• Main stream research and extension organisations to address farmers' problems • Institute a clear policy on organic farming • Streamline marketing/storage facilities • Intensify extension activities • Train farmers in pest control strategies • Improve communication between researchers and farmers e.g. a forum where researchers and farmers share ideas • Involve farmers in research problem identification • Need for farmers and researchers to be more resource oriented
Sustainable Agriculture Community Development Programme (SACDEP-Kenya)	• Farmers' knowledge of the technologies can be built to improve uptake	• Involve farmers, extension workers researchers, policy makers in developing a sound extension system; • Research is required in organic (and other alternative) crop protection strategies;
AVENTIS Crop Science Kenya Limited (formerly Rhone Poulenc)	• One policy constraint, which has been removed, is the need for registration to be carried out by the public sector. Now PCPB are	• Need more help from the public sector in dissemination –as it is not the role of the company to do extension • More expenditure needed on extension

	encouraging private companies and individuals to do their own registration trials (e.g. Homegrown and CropWatch). This is good in terms of cost (trials are expensive), competition and quality; • AVENTIS' headcount could be a bit bigger, especially for horticulture and smallholder sectors (but they are still in their first 12 months as a new company)	• The smallholder market is difficult and if a larger workforce is needed to get into the market, then it is not going to be promoted (particularly as companies like Aventis have headcount targets) • • Should start up farmer field schools again • Group Africa Regional Reach – could provide an interesting insight to adoption and may be worth following up with farmers
Kenya Plant Health Inspectorate Services (KEPHIS)		• A merger between PCPB and KEPHIS as there is some overlap between the two on biosafety and environmental issues, registration and issues like fake pesticides being sold –would suggest random testing. Merging the two institutions would streamline the processes and under one management
Agricultural Information Resource Centre (AIC)	• ICTs have increased opportunities for dissemination; • Radio is effective in terms of geographical coverage;	• Involve more stakeholders (other than govt.) in extension and repackaging of information through collaboration and/or private sector initiatives • Multimedia approach more effective • Set up listening groups in various areas backed by publications e.g. case of Kikuyu-based NGO (Prof. Mukunya /Mrs Ngaho)

Horticultural Crops Development Authority (HCDA)	• Can influence adoption of technologies: • Through their role of promoting horticulture development. • As they link farmers to exporters	• Improve funding to HCDA • Improve linkages between research –extension – farmers • Farmer groups can source for credit or pull up resources to buy inputs such as pumps, sprayers, etc. • Need to demonstrate technologies before their introduction

ANNEX 2

FOCUS GROUP INTERVIEWS

FOCUS GROUP INTERVIEWS IN THIKA DISTRICT

GROUP OF VEGETABLE GROWERS AT GATANGA DIVISION THIKA DISTRICT

The research team interviewed a group of 10 farmers comprising 7 men and three women. The key agricultural enterprises in the region include crop and livestock production. Crops grown range from tea, coffee to maize to beans. The vegetable crops include, cabbage, kale tomatoes, spinach, capsicum, passion fruits and French beans.
Based on set criteria derived from vegetable production problems, the group ranked vegetable enterprises in order of importance as shown in Table 4.1.

Table1: Constraints to vegetable production

Rank	Problem /Constraint
1	Diseases and pests with no remedy e.g. bacterial wilt of tomatoes
2	Capital constraint especially for the purchase of inputs
3	Water for irrigation
4	Marketing system not streamlined for the export crops- reflected in constantly fluctuating prices of French beans

Table 2: Ranking of vegetable crops

Rank	Crop	Reason for ranking
1	Kale	• Very few pest and disease problems • Used for home consumption • Crop takes longer in the field compared to cabbage hence few husbandry problems • Ready market locally
2	Cabbage	• More diseases than Kale given that farmers prefer the susceptible varieties to Gloria which though tolerant to diseases and pests takes a longer time.
3	Tomato	• Until the onset of Bacterial wilt, was the most profitable crop for local market. • Still has a ready local market all the year round
4	French beans	• Was number one crop for the export market but fluctuating prices, many middlemen and lack of seed have jointly acted as a disincentive.

The group identified pests and diseases for Tomatoes and Kale. In addition, the pests and disease were ranked based on identified criteria.

Table 3: Pests and diseases of Kale and Tomatoes

Crop	Pests	Diseases
Tomato	• Whiteflies • Bollworm • Cutworms • Spider mites	• Bacterial wilt • Blossom end rot • Blights
Kale	• Aphids • Sawfly • Diamondback moth	• Bacteria rot

Table 4: Ranking of pests of Kale and Tomatoes

Pest	Rank	Crop	Reason
• Whitefly • Bollworm • Cutworms	1 2 3	Tomato Tomato Tomato	• Can infest the whole field • Spreads fast but can be controlled • Prevalent but can be controlled
• Aphids • Cabbage Sawfly • Diamondback moth	1 2 3	Kale Kale Kale	• Resistant to chemicals • Crop not marketable •

Due to lack of ready control strategies, Bacterial wilt was the greatest threat to tomato production followed by Blossom end rot. Though prevalent in the area, chemical control strategies exist for early and late Blight.

Control Strategies

Chemical control is the preferred strategy for most diseases and pests. Given that no chemical control strategy exists for Bacterial wilt in tomatoes, farmers generally practice crop rotation especially relaying maize and sweet potatoes with tomatoes. Cultural practice is also used to control blossom end rot, in addition to spraying Ridomil and Diathane M45.

Table 5: Control for diseases of vegetables

Pest	Crop	Chemical used	Botanical and Biopesticide	Others
Whiteflies	Tomatoes	Karate, Diazinon		
African bollworm	Tomatoes	Malathion		
Aphids	Kale	Fastac	*Kiroro*-hot paper, Mexican marigold, tobacco powder, Amaranthus	Spray with soap solution
Cabbage sawfly	Kale	Fastac		
Diamondback moth	Kale	Fastac	*Kiroro*-hot paper, Mexican marigold, tobacco powder, Amaranthus	Spray with soap solution

Table 4: Control strategies for pests of vegetables

Disease	Crop	Chemical used	Botanical and Biopesticide	Others
Bacterial wilt	Tomatoes	*Furadan	Ash	Crop rotation with sweet potatoes and Maize
Blight	Tomatoes	Diathane M45 and Ridomil		
Blossom end rot	Tomatoes			Remove the infested plants

Sources of Information On Crop Protection

The following were identified as the main sources of information

Table 7: Sources of information

Source	Technology
Government extension system	Use of conventional chemicals
Neighbouring farmers	All aspects of production
SACDEP	Use of concoctions
KIOF	Use of concoctions
FPEAK/Export companies	Spray methods, pre-harvest intervals and residue levels largely on export crops

The group was asked to rank the sources of information in order of importance. Two key attributes emerged as the critical ones for ranking.

1 Accessibility- Besides physical distance, the element of being permanently placed in a given location was also considered. In addition availability for contact when needed constituted accessibility.

2. Communication method- Methods such as demonstration preferred for crop protection technologies.

Table 8: Ranking of information sources

Rank	Source of information	Remarks
1	Public sector extension	• Point of contact for all other sources • Always available, others come and go • Always accessible
2	Neighboring farmers	• Accessible • Practical demonstration of the crop
3	NGO (SACDEP, KIOF)	• Facilitate visits to other areas
4	Export company	• Trained a lot of farmers on french beans production

The group assessed the various communication methods employed by different disseminators. Given their experience, farm visits was the most preferred strategy for passing crop protection information. Both the specialist and the farmer assess the problem. In addition, practical demonstration of the solution is possible. The other methods used are group approaches through farmers meetings and general village meetings also referred to as *Barazas.*

ORGANISED GROUP OF WOMEN FARMERS IN GATUANYAGA LOCATION THIKA

The second focus group interview in Thika District was held with eight women and one man belonging to group known as Mothers Choice based in Mbagathi village, Gatuanyaga location. This group farms along the banks of River Athi and was selected on the basis of previous exposure to intensive research and demonstration activities through a KARI/ICIPE project.

Farmers were asked to rank the vegetable crops in order of importance. They did this by identifying criteria for ranking the crops. Potential for cash income generation, followed by the importance of the crop as a source of food were the main criteria for the rankings. Table 4.9 below shows ranking of the main vegetable crops grown.

Table 9: Criteria for ranking main vegetable crops grown

Rank	Crop	Remarks
1	French beans	Export crop, hence high returns on investment
2	Kale	Grown for home consumption and for local markets
3	Tomatoes	Grown for home consumption and for local markets
4	Capsicums	Grown for export market

The group was also growing other crops such as maize, beans and Irish potatoes and was involved in other farming enterprises such as livestock farming.

Farmers were also asked to identify and rank in order of importance constraints to vegetable production and they indicated that lack of water for irrigation was their biggest constraint followed by poor markets. The criteria for this ranking was:

1) Influence of climatic and environmental conditions on crop
2) Potential for marketing and profitability
3) Effects of pests and diseases

Table 10: Constraints to expanded vegetable products

Rank	Problem	Reasons
1	Lack of water/facilities for irrigation	High costs of obtaining water from river /lack of facilities for irrigation
2	Poor markets for the produce	Fluctuating prices Dependency of exporters
3	Pests and diseases	Increase production costs, reduce yields
4	Expensive seeds	Increase production costs
5	Farmers lack knowledge	

Following identification of pests and diseases as a major constraint to vegetable production, farmers ranked them in order of importance using criteria which they themselves selected. The criteria was:

1. Availability of control strategy
2. Severity of infestation
3. Cost of controlling pests/diseases

Table 11: Main pests and diseases to vegetable production

Main vegetable crops	Main pests (ranked in order of importance)	Main diseases
KALE	Cutworms, aphids, hippos, porcupines, wild pigs	-
French beans	Bollworm; aphids, hippos, porcupines, wild pigs	Rusts
Tomatoes	Bollworm; aphids, hippos, porcupines, wild pigs	Blight, Bacterial wilt; Blossom end rot
Capsicums	Aphids, hippos, porcupines, wild pigs	Blight; Bacterial wilt

Table 12: Control strategies for pests and diseases in Kale

Main pests and diseases of Kale	Strategies for controlling pests and diseases of kale	Effectiveness of these strategies and reasons for adopting them
PESTS		
Aphids	Use Dimethoate, Karate, Ash	Chemicals more effective than ash but farmers modify application rates/ frequencies
Cutworms	Use Dimethoate, Karate, Ash	
Hippos/ Porcupines	Trenches; Wire Fencing	
DISEASES		
Black Leg	Uprooting, rotation	Chemicals more effective than ash but farmers modify application rates/ frequencies; rotation also effective
Black Rot	No knowledge of control of black rot	

Table 13: Control Strategies for pests and diseases in tomatoes

Main pests and diseases of tomatoes	Strategies for controlling pests and diseases of tomatoes	Effectiveness of these strategies and reasons for adopting them
PESTS		
Bollworm	Bollworms, Flies & Aphids Sprayed with Dimetoate, Karate, Ash	Chemicals more effective than ash but farmers modify application rates (by up to 10%) and frequencies by up to 50%;
White Flies		
Aphids		
Nematodes	No knowledge of control of nematodes	

Table 14: Control Strategies for pests and diseases in tomatoes (continued)

Main pests and diseases of tomatoes	Strategies for controlling pests and diseases of tomatoes	Effectiveness of these strategies and reasons for adopting them
Diseases		
Bacterial Wilt	No control measure for bacterial wilt	Chemicals more effective than ash but farmers modify application rates/ frequencies
Blight	Spraying with Delan, Dithane, Antracol, Green Copper	
Blossom End Rot		

Other strategies that farmers are aware of

Farmers were aware of other control strategies such as use of botanicals like Neem and mixtures of pepper, soap and Mexican marigold but are not using them because it was time consuming to prepare the mixtures.

Information Sources on Available Pest and Disease Control Strategies in Vegetables

Like for previous groups, farmers were asked to identify their sources of information and the communication methods used to disseminate this information, as well as attributes of good communication methods and pathways. They then used these attributes to evaluate the communication methods and pathways. Tables 4.14- and 4.15 show the outcome of the farmers' brainstorming session on sources of information and evaluation of these sources (pathways), respectively.

Farmers selected what they regarded as important attributes of pathways and then ranked them in order of importance. The attributes selected were:

1. **Incentives**– refers to pathways that provide incentives to farmers e.g. agricultural inputs/technologies free of charge
2. **Extensiveness (or completeness) of information** – refers to information sources that cover a number of subjects not only vegetable farming but also various crops and livestock farming techniques.
3. **Reliability** – reliability of information given to farmers in terms of currency and response to need when required.
4. **Accessibility** – refers to physical distance, knowledge of location of information and good rapport between the farmers and the disseminators of information/technologies

Based on each attribute, each pathway was given a score of 1 to 3 where 1 is least and 3 is most (highest). The ranking is shown in Table 4.14

Table 15: Information sources on available pest and disease control strategies in vegetables

Source Of Information.	No. Of Farmers Using Source	Frequency Of Use Of Source	Communication Methods Used	Technology Learnt
Govt. Extension Staff (MARD)	All	Very frequent (2 or more times a month)	Demonstrations; Seminars; Farm Visits (As a group of farmers); Farm visits by extension staff	Crop husbandry; safe use of Chemicals; Farm Planning
SACDEP	All	Last used in 1998/99	Demonstrations; Seminars; Farm Visits (As a group of farmers); Farm visits by extension staff	Double digging; Farm planning; Kitchen gardening; Compost making; Liquid manure from animals; Soil conservation; Water harvesting; Food security; nutrition;
ICIPE	All	Monthly	Demonstrations; Seminars; Farm Visits (As agroup of farmers); Farm visits by ICIPE/ KARI/ Extension Staff	Use of Agro-chemicals; Production of French Beans; Use of Neem to control pests and diseases in vegetables
KARI	All	Monthly		
Plan International	All	Monthly	Demonstrations; Farm visits	
Parents/ Friends	All		Demonstrations; Farm visits	Farming as a tradition

Table 16: Farmers' evaluation of their sources of information

ATTRIBUTES (ranked in order of importance)	SCORE FOR INFORMATION SOURCE (1= LEAST, 3 = MOST)					
	SACDEP	Govt. Extension Agent (MARD)	ICIPE	KARI	Neighbours / Friends	Parents
Incentives To Farmers	1	1	1	1	2	3
Extensiveness Of Information Source	3	3	2	2	1	2
Reliability	2	3	3	3	1	2
Accessibility	2	3	1	2	2	2
Total Score	**8**	**10**	**7**	**8**	**6**	**9**

FARMER FOCUS GROUP INTERVIEWS IN MACHAKOS DISTRICT

A GROUP OF FARM MANAGERS IN ATHI RIVER

A group of 10 farm managers comprising seven men and three women were interviewed. Individuals engaged in off-farm employment own the farms in this region. Thus, the farm owners employ farm managers who are in charge of day- to -day farm operations. With the principal objective of maximizing returns, crop enterprises in this area largely reflect market demand. Consequently, the main vegetable crops grown include tomatoes, Kale, Spinach, French beans, Cucumber, Okra and Baby corn**.**

The Group of farm managers was asked to rank the vegetable crops in order of importance. In order to achieve this, the group debated and identified the criteria for ranking the crops. The overriding factor in setting up the criteria was the market demand for a given product. This was followed by suitability of the crop to the environment hence resistance to pests and diseases.

The following ranking and criteria was obtained from this exercise

Table 17: Ranking of vegetable crops in order of importance

Rank	Crop	Remarks
1	French beans	• Export crop hence high returns on investment when prices are favourable
2	Tomatoes	• Ready local market all the year round
3	Cabbage	• Ready local market
4	Onions	
5	Kale	

The group cited a number of constraints to expanded vegetable production. The principal constraint was pests and diseases specifically rust in French beans. Since all the farms irrigate, availability of water is the next major constraint. Although all the farms obtain water from River Athi, salinity level increases significantly in the dry season rendering the water unsuitable for irrigation. Problems associated with market demand are felt mainly on the export crops. Price fluctuation and information asymmetries arising from the structure of the export market are the key constraints in the marketing chain.

The last problem cited is that of irregular supply of labour. Although in the majority of cases it is the Farm Managers who make decisions related to production, the wage rate is largely determined by the farm owners. Thus, the set daily wage rate of Ksh 70-75 per day is not competitive. Consequently, labour supply for vegetable production is erratic since it is an income source of the last resort.

Table 18: Constraints to vegetable production

Rank	Problem	Reasons
1	Diseases and pests	• Significant production costs
2	Water	• Salinity in the dry season
3	Market	• Fluctuating prices • Information asymmetrically held by the middlemen • Limited market for the Asian vegetables
4	Labour supply	• Erratic supply of labour

The Farm managers identified a number of diseases and insect pests.

Table 19: Pests and diseases of vegetables

Crop	Pest	Disease
Tomato	• Bollworms	• Bacterial wilt • Blights • Leaf roll • Blossom end rot • Bacterial canker
Kale	• Diamondback moth • Aphids	• Root rot
Cabbage	• Diamondback moth • Aphids	• Root rot

The group ranked diseases and pests in order of importance. The following criteria was used to rank diseases and pests.

1. Availability of control strategy
2. Severity of infestation
3. Cost of control

Table 20: Ranking of pests and diseases

Rank	Kale and cabbage pests	Tomato pests	Kale and cabbage diseases	Tomato diseases
1	Diamondback moth	Bollworms		Bacterial wilt
2	Aphids			Blights

Control strategies for pests and diseases

In the majority of the cases, chemical control was the preferred method of pest and disease control (Tables 4.20-4.21).

Table 21: Control for diseases of vegetables

Pest	Crop	Chemical used	Botanical and Biopesticide	Others
African bollworm	Tomatoes	Karate, Dimethoate		
Aphids	Tomatoes	Benlate		
Diamondback moth	Kale and Cabbage	Karate, Actelllic	Ash and water Thuricide	

Table 22: Control for pests of vegetables

Disease	Crop	Chemical used	Botanical and Biopesticide	Others
Blight	Tomatoes	DM45 and Ridomil		Smoke generated from certain plants
Fusarium wilt				
Bacterial wilt				Crop rotation with an non Solanacea

The group of Farm Managers was aware of other pest and disease control strategies but was not employing these strategies due to a number of reasons.

Table 23: Other pest and disease control strategies not employed

Strategy	Reason for not using the strategy
More potent chemicals for control of pest and diseases	The cost of these make them uneconomical to apply
Use of ash or smoke against Blight	Not effective leading to a risk of total crop failure
Use of Mexican marigold against Blight	Not effective leading to a risk of total crop failure
Use of crop barriers e.g. Maize around Tomatoes	Does not fit well with the farm plans

Sources of Information on Crop Protection Strategies

The group of farm managers identified a variety of sources of information or pathways on vegetable production and specifically pest and disease control. In addition, the group identified the methods of communication for each pathway.

Table 24: Sources of crop protection information

Source of information	Number of farmers using source	Frequency of use of source	Communication methods used	Technology learnt
Government extension	All	Very frequent	Demonstration during farm visit	Crop husbandry
Exporters	Few	Rarely	Verbal and literature	Residue levels and quality
Parents	Few	Initial crop production technique	Demonstration	Crop production
Stockists	All	Frequent	Publications and pamphlets	Crop protection
Chemical companies	Very few	Infrequent	Demonstrations	Crop protection

Information pathways were ranked in order of importance according to selected attributes. After debate, a consensus was arrived at on the following as the important attributes of a pathway.

Accessibility- Physical distance, knowledge of location and good rapport were considered important attributes of accessibility.
Reliability- Specifically reliability of information given in terms of currency and response to need when called.
Cost- Both monetary and time cost. Physical distance to source of information was thus a major determinant of cost.
Based on these attributes, each pathway given a score ranging from 3 for the best to 1 for the worst.

Table 25: evaluation of information sources by farmers

	Government extension	Neighbouring farmers	Stockists
Accessibility	2	3	1
Reliability	3	2	1
Cost	2	3	1
Total	**7**	**8**	**3**

Neighbouring farmers appeared to be the most important information pathway followed by the public sector extension staff. The group also identified 3 communication methods namely;

demonstrations, farm visits and publications. Demonstrations were the preferred method of communicating crop protection strategies. Farm visits were ranked second and publications third.

FOCUS GROUP INTERVIEWS WITH A GROUP OF FARMERS IN ATHI RIVER

This group of farmers comprised five women and seven men who farm on the banks of Athi River. This group was chosen because they were exposed to technologies related to vegetable farming as they had frequent contacts with extension workers from the MARD. The interviews sought to identify the available crop protection technologies focusing on vegetables, sources of these technologies and the dissemination pathways used.

Farmers were asked to rank the vegetable crops in order of importance and to identify the criteria for ranking the crops. The most important criteria was income generation, followed by the importance of the crop as a source of food. Table 4.26 shows ranking of the main vegetable crops.

Table 26: Criteria for ranking main vegetable crops grown

Rank	Crop	Remarks
1	Tomatoes	Grown for the local markets and for home consumption
2	French beans	Export crop, hence high returns on investment
3	Kale	Grown for local markets and for home consumption
4	Cabbages	Grown for local markets and for home consumption
5	Onions	Grown for local markets and for home consumption

Other minor vegetable crops that were identified for their growing importance as export crops but were not ranked are Capsicum, Chilies, Cauliflower, Brinjals, Okra, Coughates
Other important farming enterprises are maize cultivation and livestock farming, mainly diary, goats, sheep and poultry.

Table 27: Constraints to expanded vegetable production

Rank	Problem/Constraint	Reasons
1	Low investment capital in farming	Farmers have low capital to invest in farming due to prevailing economic situation
2	Pests and diseases	High costs of controlling pests and diseases
3	Lack of farm labour and high costs of labour when available	High costs of hiring labour
4	Low water levels; Water pollution resulting in high salinity	High salinity levels
5	Poor (low) markets for export crops	Poor prices; markets not well organised, exploitation by middle men

Following identification and ranking of pests and diseases as the second most important constraint to vegetable production, farmers were asked to identify and rank the major pests and diseases of Kale and Tomatoes in order of importance. They came up with the following criteria for ranking:

1. Severity of infestation including how fast the diseases/pests spread and how fatal they are to the crop
2. Availability of strategies for controlling the pest/disease
3. Cost of control of the pests/diseases
4. Affect on quality of the vegetables/ reduction in marketability of the crop

Table 28: Main pests and diseases of vegetables

Main Vegetable Crops	Main Pests (Ranked in order of importance)	Main Diseases (Ranked in order of importance)
Kale	1)Diamond Back Moth (DBM) 2)Aphids (Black and White) 3)Nematodes	1) Leaf spot 2) Powdery Mildew 3) Black rot
Tomatoes	1)Spider Mite 2)Bollworm 3)Thrips 4)Aphids	1) Blight (Late and early) 2)Leaf roll 3) Blossom end rot

Table 29: Pests and diseases of Kale

Main Pests and Diseases of Kale	**Strategies for cntrolling Pests and Diseases of Kale**	**Effectiveness of these strategies and reasons for adopting them**
Pests		
1) DBM 2) Aphids (black and white)	Use of Thuricide (Used by 50% of farmers) Dimethoate Karate (All farmers) Crop rotation	Chemicals 90% effective but expensive 75% Effective but Cheap 30% effective but cheap Effective in reducing pests and diseases
Diseases		
1) Leaf spot 2) Powdery Mildew 3) Black rot 4) Nematodes	Chemical Control -Diathane M-45 Field Hygiene Crop Rotation	Fairly Effective Effective Effective

Table 30: Pests and diseases of tomatoes

Main Pests and Diseases of Tomatoes	Strategies for controlling Pestsand Diseases of Tomatoes	Effectiveness of these strategies and Reasons For adopting them
Pests		
1) Spider Mite 2) Bollworm 3) Thrips 4) Aphids 5) White Fly	Sprayed With Thuricide Dimethoate Karate Ash Crop Rotation	Chemicals Effectiveness Varies (With Chemical); Farmers Often Modify Application Rates Effective
Diseases		
1) Blight (Late And Early) 2)Leaf Roll 3) Blossom End Rot	Chemical Control - Control -Diathane M-45 Ashes /Botanicals Field Hygiene Crop Rotation	Chemicals Effective; Fairly Effective Effective

Other pest control strategies that are known but rarely used by farmers:

1) Use of ash to control DBM in Kale.
2) Concoctions of red chilies ash and Mexican marigold to control pests and diseases in general.
3) Use of tobacco, chilies and ashes against pests and diseases

At least 25% of the farmers have used the above concoctions

Information sources on available pest and disease control strategies

Like for previous groups, farmers were asked to identify their sources of information and the communication methods used to disseminate this information, as well as attributes of good communication methods and pathways. They then used these attributes to evaluate the communication methods and pathways. Tables 4.31-4.33 show the outcome of the farmers'

brainstorming session on sources of information, evaluation of pathways in general, evaluation of exporters as sources of information and ranking of the communication methods, respectively.

Evaluation of Information sources (Pathways)

Farmers brainstormed about what they considered to be important criteria for evaluating pathways and came out with the following criteria**:**

5. **Accessibility** – refers to physical distance, knowledge of location of information and good rapport between the farmers and the disseminators of information/technologies
1. **Extensiveness (or completeness) of information** – refers to information sources that cover a number of subjects, not only vegetable farming but various crops and livestock farming techniques.
2. **Cost** – refers to the total expenditure incurred in acquiring the information/technologies

3. **Reliability** –specifically, reliability of information given to farmers in terms of response to need when required.

Table 31: Sources of information on available pest and disease control strategies in vegetables

Source of Info. (Ranked In Order Of Importance)	No. Of Farmers Using Source	Frequency Of Use Of Source	Communication Methods Used	Technology Learnt
1) Govt. Extension Staff (MARD)	All	Very frequent (Several times a month)	Demonstrations; Seminars; Farm Visits (Farmer To Farmer; & Extension Staff); Barazas Printed Material; Field Days	Crop Husbandry; Safe use of chemicals; Farm Planning
2) Books /Manuals Provided With Chemicals	Most Farmers	Frequently	Printed Material e.g.. Posters; Calendars	Safe use of chemicals;
3) Other Farmers	All	Frequently	Demonstrations; Farm Visits	Crop Husbandry; Safe use of chemicals;
4) Agricultural Shows	Most Farmers	Once a year	Demonstrations; Printed Material	High Yielding Varieties; Safe use of chemicals; Crop Husbandry
5) Exporters	All	Fairly frequently	Printed Material e.g. Posters; Barazas; Seminars; Radio	High yielding varieties; Safe use of chemicals; Marketing of crops
6) Parents	All	Occasionally	Demonstrations; Farm Visits	Farming as a tradition
7) HCDA	A Few Farmers (2)	Occasionally	Printed Material e.g. Posters; Barazas; Seminars	Crop Husbandry; Safe use of chemicals; Marketing of crops
8) Neighbours/ Children	All	Occasionally	Demonstrations	

Table 32: Farmers' evaluation of sources of information (Pathways)

Desirable Attributes of Info. Source (Ranked in descending order of importance)	Scoring of Information Source(1= Least; 3 = Most)							
	MARD (Extension staff)	Other Farmers	Neighbours	Agric Shows	HCDA	Parents	Children (Schools)	Books /Manuals
Accessibility	2	3	1	1	1	1	1	1
Extensiveness of source	3	2	1	3	1	1	1	2
Cost	-	-	-	1	-	-	-	1
Reliability	3	2	2	2	2	2	1	2
Total Score	**8**	**7**	**4**	**7**	**4**	**4**	**3**	**6**

Table 33: Farmers' evaluation of exporters as information Pathways

Desirable Attributes of Info. Source (Ranked in order of importance)	Scoring of Information Source (1= Least; 3 = Most)			
	Kibwezi Growers	**Everest**	**East African Growers**	**Maina Exporters**
Accuracy	2	2	3	3
Currency	1	3	2	3
Accessibility	2	3	3	3
Extensiveness of Source	1	2	2	3
Cost	1	2	2	-
Practicality	1	2	3	3
Reliability	2	3	3	3
Total Score	**10**	**17**	**18**	**18**

ANNEX 3

PROCEEDINGS OF THE 1st WORKSHOP ON UPTAKE AND ADOPTION OF OUTPUTS OF CROP PROTECTION RESEARCH IN PERI-URBAN VEGETABLE PRODUCTION SYSTEMS IN KENYA

2nd DECEMBER 1999

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ABBREVIATIONS AND ACRONYMS

AAK	Agrochemical Association of Kenya
ABLH	Association of Better Land Husbandry
AIC	Agricultural Information Centre
CABI	CAB International
CRF	Coffee research Foundation (Kenya)
CIAT	Centro Internacional de Agricultura Tropical
FPEAK	Fresh Produce Exporters Association of Kenya
GoK	Government of Kenya
HCDA	Horticultural Crops Development Association
ICIPE	International Centre for Insect Physiology and Ecology
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IRM	Insect resistance management
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspection Services
KIOF	Kenya Institute for Organic Farming
NGO	Non-governmental Organisation
NRI	Natural Resources Institute
PCPB	Pest Control Product Board
PHI	Pre-harvest intervals
PRA	Participatory Rural Appraisal
SACDEP	Sustainable Agriculture and Community Development Programme
SUP	Safe Use of Pesticides

EXECUTIVE SUMMARY

The main aim of the workshop was to brainstorm on the factors influencing uptake of crop protection research outputs in peri-urban vegetable production systems of Kenya. Drawing from a broad spectrum of stakeholders ranging from researchers, extension agents and private agro-chemical companies, constraints to and means of enhancing uptake were discussed. The workshop participants felt that the level of adoption of the recommended crop protection strategies in peri-urban vegetable production systems is relatively higher than in the rural areas. Also, there was need to develop a functional definition of the peri-urban vegetable production system.

It was noted that the process of technology generation has changed in the recent past from being that of a "top down" to "bottom up" through widespread consultation with stakeholders especially farmers. However, the donors or researchers themselves without adequate involvement of the farmers, sometimes set research priorities. Thus, not all research outputs are responsive to farmers' needs. In addition, until recently, the Public Sector Agricultural Research Department was administratively under a separate Ministry from that of the Public Sector Extension Division. This institutional arrangement interfered with the coordination of the technology generation and dissemination cycle. Furthermore, scaling down of dissemination activities arising from reduced budgetary allocation to the Public Sector Extension Division resulted in reduced level of contact with farmers. Nonetheless, other non-governmental organizations and community-based organizations have engaged in dissemination activities in the recent past.

Finally, inadequate resources and risk averse behaviour of a certain category of the farming community, poor infrastructure leading to high cost of production and marketing, collectively act as a disincentive to adoption of new technologies. In order to overcome these constraints, linkages between all the institutions involved in technology generation and dissemination should be strengthened. Methods for analyzing farmer constraint and involvement of all stakeholders in the research process, from conceptualization to dissemination should be improved. The above coupled with communication methods that are relevant to farmer circumstances such as demonstrations are the key to enhancing the levels of uptake**.**

1. ABOUT THE WORKSHOP

1.1 Workshop Purpose

The purpose of the workshop was to discuss the aims and methods of a proposed study on "Uptake and adoption of outputs of crop protection research in Peri-urban vegetable production systems in Kenya" and to share experiences that would provide input into the study. This one-day workshop brought together 19 key stakeholders in the horticultural sector, mainly those responsible for generation and dissemination of research information and technologies (See Appendix 2). Stakeholders came from both the public and private sector.

1.2 The Research Problem

Past and on-going studies continue to develop technologies intended to address farmers' problems such as crop pests and diseases. This study which was commissioned by the DFID Crop Protection Programme, aims at looking into ways in which results of on-going research could be disseminated and taken up effectively. The study will investigate the factors associated adoption and uptake of outputs of crop protection research in Peri-urban vegetable production systems in Kenya.

1.3 Participants Expectations

Participants gave the following as their expectations of the workshop:

- Sharing of experiences in vegetable crop protection
- Sharing of research findings from the Peri-urban project
- Identification of new technologies/alternative (best) strategies for pest management
- Identification of relevant uptake pathways
- Identification of reasons for low adoption rates
- Identification of potential solutions to constraints to technology uptake
- Comparisons of adoption rates under different circumstances or by different stakeholders
- Creation of partnerships among stakeholders
- Identification of crop protection strategies that would contribute to poverty eradication in Peri-urban areas

2. PROJECT OVERVIEW

2.1 Background

- The DFID Crop Protection Programme is funding a number of research projects in the peri-urban vegetable system in Kenya. They include Biocontrol of root knot nematodes; Pest management in Horticultural crops; Investigation of biorational methods for control of insect pests in vegetables; Isolation, identification and culture of indigenous entomopathogenic nematodes and preliminary investigations into their use for control of insect pests of Peri-urban agriculture. These projects are aimed at promoting pro-poor strategies to reduce the impact of key pests, improve yields and quality of crops and reduce pesticide hazards.

- Yet there is evidence that uptake levels of pest management strategies, both in Kenya and more generally, is low. Furthermore, improper use of chemical control strategies has led to pesticide resistance and damage to the environment.

- DFID has commissioned a number of studies to look at the factors affecting uptake and adoption of crop protection research

- This study aims to identify and analyse the key constraints to the uptake of pest management strategies in the Peri-urban smallholder vegetable production systems of Kenya. The goal is to improve the volume, quality and seasonal availability of crops through the reduction of physical and economic losses caused by pests.

2.2 Implementation

- Study collaborators: CABI, KARI, NRI
- Stakeholders:
  - International and Government research and extension organisations
  - Non-governmental organisations
  - Agrochemical companies
  - Farmers
- Study period: November 1999 – April 2000

2.3 Project Purpose

To promote uptake and adoption of pest management strategies for peri-urban vegetable growers in Kenya

2.4 Study Objectives

- To identify and/or review the existing and emerging pest management strategies, institutional settings, dissemination pathways and communication methods
- To evaluate the dissemination pathways and communication methods
- To identify the key factors likely to affect uptake of pest management strategies by farmers
- To identify and recommend interventions for enhancing uptake of crop protection technologies from current, recently completed and future projects

2.5 Activities

- Stakeholder workshop
- Literature review – broad uptake literature and Kenya vegetable pest management literature
- Interviews with key stakeholders
- PRAs with farmer groups in Athi River, Thika and Kiambu – to determine those factors likely to influence uptake of pest management practices
- Individual household interviews in the three locations
- Analysis of the information and data collected from the workshop, key informants and PRAs, literature and extension materials
- A second workshop near the end of the study to present the key findings to stakeholders and develop recommendations
- Final report preparation

2.6 Outputs

The main outputs from the project will be recommendations on delivery pathways, communication methods and institutional changes that would promote uptake of pest management strategies. Broadly, these outputs will be of immediate use to managers at project, programme and policy levels. Specifically, the outputs will assist in the execution of ongoing work on vegetable IPM within the Crop Protection Programme and elsewhere and all stakeholders aiming to promote uptake of vegetable information and technologies. The final

report will be shared with all relevant stakeholders.

2.7 Questions on the project overview

- **What is the definition of peri-urban?**

It was acknowledged that there is no clear definition of the Nairobi peri-urban area and the project has not yet established a working definition.
Criteria used by others to define Peri-urban areas were mentioned. They include:

- Market where produce is sold (i.e. Peri-urban areas are those supplying urban centres)
- Area on the fringe of an urban centre
- Distance from an urban centre (kilometres or time, e.g. 1 to 1.5 hours by road)

It was also suggested that farmer characteristics be used to define peri-urban farmers and that the differentiation between urban and peri-urban areas be clarified.

The issue was given as a point for discussion during the group sessions

- **How do we know that the level of adoption of vegetable pest management technologies in Peri-urban areas is low?**

There is a wide disparity between the recommended and the actual pest management practices. A recent study around Nairobi for example reveals that, whilst 98% of vegetable farmers around Nairobi use pesticides, 68% suffered symptoms attributable to the misuse of these chemicals. In addition, some farmers have been found to apply more than 3 times the recommended volume and dose rates.

- **Is there an assumption that adoption of technologies in rural areas is less of a problem than in Peri-urban areas?**

No. The focus of the project on Peer-urban areas was set by DFID who commissioned the research. However, this is an issue that could be explored in the future.

- **How representative are the project areas (Thika, Kiambu and Machakos) of peri-urban vegetable production?**

This project draws from the ongoing peri-urban vegetable production projects funded by DFID. The said project identified Kiambu, Machakos and Thika as the main peri urban areas supplying the Nairobi urban market. The regions also typify small holder production systems producing largely for the local market.

- **What information will the farmer interviews and key stakeholder interviews be seeking?**

Interviews with farmers will seek information on farmer knowledge and use of crop protection information and technologies. Household and location specific - factors affecting-adoption will also be investigated from the farmer interviews.
The key stakeholders in this project are the service providers. These include the Agro-chemical companies, public sector research and extension service and the Non-governmental organisations involved in the promotion of vegetable production. Interviews with key stakeholders will seek information on broad policy and institutional issues constraining uptake of crop protection

technologies. Issues such as mandate, research and extension activities regarding vegetable farming, modes of communication within and outside the institution and collaboration with other institutions will be explored.

3. GROUP DISCUSSIONS

3.1 Group One: Technology generation

a) How is the research agenda set (process and stakeholders)?

- Demand driven:
  - Involvement of stakeholders (farmers) through PRAs and other methods of diagnosis
  - Commercial sector
- Donor driven
- Individual researcher bias (pet research)

STEP	PROCESS	STAKEHOLDERS
CABI/NGOs		
1	Problem identification/justification	Farmer
2	Preparation of research proposal	Researcher/farmer
3	Call for proposals	Donor
4	Submission of proposals	Researcher
Private/Commercial sector		
1	Feasibility study/problem identification	Extension officers, sales reps and farmers
2	Contract research institution for technical evaluation	KARI and company
3	Market survey	Farmers, extension, company
4	Full development of product	KARI/company
KARI		
Case	Same as for CABI/NGOs	
1	Problem Identification	Researcher, farmer, extension worker,
2	Proposal write-up	Researcher
3	Technical committee evaluation	Agrochemical companies, NGOs, Farmers, extension, Universities
4	Centre Research Advisory Committee	NGOs, Farmers, extension, Universities.
5	Funding/Implementation	Donor, GoK, KARI, Agrochemical companies

b) What are the main pest management problems in peri-urban vegetable production?

- Resistance to pesticides
- Inappropriate pesticide application methods
- Little understanding of IRM (insect resistance management)
- Non-adherence to pre-harvest intervals (PHIs) and safe-use instructions
- Fake agrochemicals
- Poor problem diagnosis

- Poor control of early and late blight in tomatoes
- Poor selection of pesticides
- Inappropriate methods and timeliness for weed control

c) What are the available pest management strategies for addressing the above problems?

- Chemical use
- Cultural methods
  - Crop rotation
  - Intercropping
  - Mulching
  - Weed control
- Development of pest resistant varieties
- Biological control
- Quarantine

d) Are there any problems with the technology generation process and if so, how can it be improved?

Problems with the technology generation process:

- Problems may be identified and not addressed immediately due to various constraints e.g. funding
- Poor problem diagnosis and communication by farmers
- Misconception by farmers of 'on-farm trials' as demonstrations
- Motivation for research does not necessarily match the research needs
- The setting of research agenda– donors' research agenda may not meet farmers needs and is not always gender sensitive

How technology generation process can be improved:

- Seeking alternative sources of financing – establishment of a databank of possible sources of funding. These could include available agrochemical companies and their areas of interest
- Constant monitoring of farmer problems by a stakeholder task force/committee
- Improving farmer-extension-researcher linkage.
- Farmer training on pest problem identification
- Refining the technologies in the research stations before holding on-farm trials.
- Greater farmer involvement in setting up the research programmes particularly at the stage of identifying problems and determining research priorities.

3.2 Group Two: Dissemination

a) Which organisations are involved in pest management strategies and information dissemination and in what way (from technology generation to end-users)? Give examples for specific pest management strategies

Organisations	Disseminators/ Generators	Pest Management Strategies
Research Institutions • KARI • ICIPE • CIAT • ICRISAT • CABI • NRI	 D & G D & G D & G D & G D & G D & G	Research (CPP) and training
Extension Institutions • Ministry of Agriculture	D	Plant protection services branch • Control of migratory pests • Training of farmers on pest management strategies
NGOs • KIOF • SUP (AAK) • ABLH • OXFAM • SACDEP • KEPHIS	 D & G D D & G D D & G D	 Training and research (biological and cultural control and botanicals) Training in safe use of chemicals Plant quarantine, biosafety, certification and publications
Others • HCDA • FPEAK • PCPB • Universities • Agrochemical companies	 D D D D & G	

b) Which dissemination methods are used (for researcher-extension and extension-farmer dissemination)? Examples: workshops, training, leaflets, radio, farmer field schools, etc.

Researcher-Intermediate user (extension, NGOs etc.)

- Workshops
- Publications
- On-farm trials
- Field days

- Regular visits to research stations by extension staff

Intermediate user – farmers
- Field days
- Demonstrations
- Farmer training
- Leaflets
- Radio
- Newspapers
- Shows
- Farmer Field Schools
- Farmer tours/exchange visits
- Farm visits (by extension workers)
- Conferences

c) Which dissemination routes and methods have enhanced the adoption of pest management strategies by farmers in peri-urban vegetable production systems and why?

Discussion in the group prior to identifying dissemination methods leading to good adoption raised the following points:
- The validity of the underlying assumption, that adoption of vegetable pest management technologies is poor, was questioned by some participants
- The key factors affecting adoption are not dissemination routes and methods, they are farmer factors and the fact that farmers are market oriented drives them to get pest management information and technologies
- Peer-urban farmers are more literate, they are more aware of where to get extension information and they actively look for information

Methods that *may* have enhanced adoption of pest management practices by farmers are:
- Mass media (radio, newspapers and leaflets) – market oriented peri-urban vegetable farmers have more money to access this information and their awareness and literacy levels are considered higher
- Agricultural shows or trade fairs

Researcher-intermediate user dissemination methods considered more effective:
- On-farm trials – practical method and farmers involved in adoption of technologies during the research stage
- Leaflets and magazines – they reach a wider audience and faster

There was some discussion of the success of Farmer Field Schools as a dissemination route/method. The point was raised that although the method has proven successful elsewhere there has been poorer performance of FFS in areas such as Kiambu. Reasons for this were that farmers in the Peri-urban areas are involved in more activities and therefore had less time for FFS. Also, there is more competition/less willingness to collaborate and share information.

d) What are the key constraints to effective dissemination?

Researcher-Extension dissemination:

- Previously a key factor was the separation of Ministries (research and extension) but they combined earlier this year
- Resource availability and distribution – problem of how to reach all staff
- Documentation of research results – not always done effectively and in good time
- Inadequate communication method – repackaging of scientific information needed for end-users

Extension-farmer dissemination:

- Inadequate resources (although some participants mentioned that the resource constraints are no worse than was previously the case)
- Inadequately trained staff
- Poor infrastructure
- Poor staff motivation
- Inappropriate dissemination methods (relates to education level of end-users and also gender sensitivity)
- Cultural barriers

3.3 Group Three: Factors affecting uptake

a) What pest management strategies have been successfully taken up?

1. Plant host resistance
   - Potato blight (Tigoni, Asante)
   - Tomato bacterial wilt (Rodade)

2. Pesticide use
   - Botanicals
   - Biopesticides
   - Synthetic chemicals

3. Cultural practices
   - Crop rotation
   - Destruction of crop residues
   - Rouging
   - Disease free planting material (certified)
   - Weeding

b) What are the key factors affecting effective uptake of pest management technologies?

- Efficacy of the strategy
- Complexity of the technology
- Costs and benefits
- Availability (distribution system)
- Divisibility (packaging)
- Farmer resource endowment (e.g. land, capital etc.)

- Market outlet/product opportunities
- Information and promotion

c) What are the key constraints to effective uptake of pest management technologies?

- Information – access, bias and cost
- Relevance of the strategy/technology
- Weak institutional linkages
- Risks involved with uptake of new technology
- Cost of strategy/technology
- Complexity of the technology
- Market restrictions (export)
- Resource endowment

d) Suggestions on how constraints could be overcome?

- Simplify the content of the information
- Innovative approaches to the existing extension system:
  - Farmer Field Schools
  - Village/community approaches
  - Training of stockists/other farm input providers
  - Commercialise certain activities (horticultural extension activities)
- Include dissemination component in all research projects
- Group approach to access credit in order to address the cost of technology problem
- Targeting the right groups in extension e.g. youth in Peri-urban vegetable production

3.4 Plenary comments and questions (for all three group presentations)

- Farmer knowledge needs to be improved before extension can be more effective. Example given of CRF and coffee growers paying a levy which goes towards farmer training (regular courses) and research. Can HCDA do a similar thing?
- Others mentioned that farmers involved in peri-urban vegetable production are more knowledgeable compared to other farmers
- NGOs provide training for farmers who then train others. It was argued that horticulture is a self-propelling industry
- Farmers will continue to use the same technologies they currently have and know best because they use them as a 'safety blanket'
- Research priorities are dynamic
- The need for alternative funding sources for research possibly local especially in the case of research issues not addressed directly by donors (where research priorities are different from donor priorities)
- Agrochemical companies are also crop protection technology generators and disseminators. They are not only involved with chemical production and distribution
- Need to remember that researcher-extension-farmer linkages are two-way/triangular and not a one-way process

- Need to establish whether the Peri-urban vegetable farmers are resource poor or not – diverging opinions on this emerged during the presentations and discussions. Is Peri-urban farming crop or location specific or both?
- One suggested solution to the problem of lack of resources for dissemination is to charge farmers for the "disseminated outputs". However, an example was given of "Kilimo News" which the Ministry of Agriculture was giving out free but has started selling at a nominal fee. However, farmers and other users have complained about the cost and sales have been low
- Agrochemical companies would become more involved in pest management training if there was a more professional and reliable forum for this activity.

4. RECOMMENDATIONS AND WAY FORWARD

4.1 Summary of key issues

The key issues raised from the group and plenary discussions were summarised towards the end of the workshop, and are listed below.

a) General

- Is adoption of pest management strategies a problem in Peri-urban vegetable production in Kenya? Opinion was divided on this issue. Some participants felt that the levels of adoption by Peri-urban vegetable producers could be higher than in other production systems.
- Need to understand the characteristics of Peri-urban vegetable farmers. Parameters such as resource endowment, production objective and main enterprises could form the definitive criteria.

b) Technology generation constraints:

- Gaps in research problem identification and articulation process.
- Weak institutional links in the technology generation and dissemination process.
- The need to involve all stakeholders in the technology generation process. This leads to clear identification of research clientele (technologies need to be demand driven).

c) Dissemination:

- Dissemination methods and strategies vary. By and large, demonstrations and farmer field schools, which are more interactive and participatory, appear to enhance uptake of new technologies. Compared to other methods of dissemination, these participatory methods are more effective.

d) Farmer constraints:

- Farmers' resource base
- Targeting the right research clientele. Going beyond the recommendation domains and examining other attributes such as gender, age, level of formal education and previous experience.
- Is farmer knowledge a key constraint? This is the major research question.

e) Others

- Adoption is affected by:
  - Product market demand (pesticide residue levels affect adoption of available strategies in addition to market price)
  - Gender Issues –who does what in the household and implications for the division of labour
  - Environmental issues – pesticide residues in products
- It was also recognised that the horticultural industry is dynamic. Thus, new entrants into the industry include university graduates who are better educated farmers
- Stronger partnerships are required to generate appropriate technologies

4.2 The definition of Peri-urban production system

The definition of Peri-urban vegetable producing areas was a key issue raised during the workshop. From discussions, it was apparent that there is no clear understanding of what constitutes the Peri-urban area. The issue was discussed further during the group sessions and the following criteria were suggested for use in defining the Peri-urban area:

- Geographical considerations (i.e. starting just outside the urban area and possibly extending to a certain radius)
- Farmer characteristics (small scale, ½ acre)
- Limited land size and thus highly intensive
- Market considerations – farmers producing largely for the market
- Use purchased inputs in production (e.g. pesticides, irrigation, fertiliser)
- Dependent on hired labour
- Increasingly practised by educated youth
- Subsistence or more market oriented?

Clearly one important activity for the project is to establish its working definition of the Peri-urban area. Organisations such as ILRI with a functional definition of Peri-urban production system will be consulted in addition to land use planning classification of Urban and Peri–urban centres.

4.3 List of key informants

The workshop participants were asked to identify other key informants who would be included in the project's stakeholder interviews. Those recommended are listed below:

Universities (Jomo Kenyatta University of Agriculture and Technology, Moi Univ., Ergerton Univ.)
HCDA
SACDEP
Seed companies
ICIPE
ICRISAT
CIAT
PCPB
FPEAK
Agricultural Information Centre (AIC)
Farmer co-operative societies

5. CONCLUSIONS

Participants endorsed the project methodology with recommendations to the research team to carry out a literature search on vegetable production in Kenya and to use the PRAs to characterise farmer groups.

The expectations of the stakeholders expressed at the beginning of the workshop namely, sharing of experiences in vegetable crop protection, including sharing of research findings, identification

of relevant uptake pathways, constraints to technology adoption as well as potential solutions to these constraints, were largely met. The research team thanked the stakeholders for sharing their experiences, which provided a valuable input into the project methodology. The workshop was also very successful in building a team spirit, which will be required during the implementation phase.

APPENDIX 1 - LIST OF DEFINITIONS

Adoption: same definition as uptake by end-users (application of pest management strategies by end users)

Pest management strategies: outputs of pest management research, including both information and technologies

Technology: application of knowledge derived from research to achieving human goals. It can comprise hardware (tools, equipment, machines) as well as software (knowledge, experience, skills)

Information: facts provided or learnt about something, which are in a particular arrangement or sequence, in order to give meaning

End-users: farmers and others (individuals, households, communities, etc.) involved in vegetable production

Intermediate users: use the outputs of vegetable pest management research to produce information, technology and products for end-users (includes researchers in IARCs, NARs, NGOs, extension agencies, and educators)

Technology and information dissemination: transfer of technologies and information from the originator to a secondary user (intermediate or end-user)

Promotion: making potential users aware of information and technology and increasing its accessibility

Dissemination pathways: route or channel by which information and technology reach the user (intermediate and end-users)

Uptake: application of pest management strategies by end-users (both intended and unintended users) and use of pest management strategies by intermediate users

APPENDIX 2 - WORKSHOP ON UPTAKE AND ADOPTION OF OUTPUTS OF CROP PROTECTION RESEARCH IN PERI-URBAN VEGETABLE SYSTEMS IN KENYA, 2ND DECEMBER 1999

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ANNEX 4

KEY FINDINGS FROM THE SECOND WORKSHOP ON UPTAKE OF CROP PROTECTION RESEARCH OUTPUTS IN PERI-URBAN VEGETABLE SYSTEMS IN KENYA, HELD ON 31ST MARCH 2000

Key Findings from the Second Workshop on Uptake of Crop Protection Research Outputs in Peri-Urban Vegetable Systems in Kenya

1. Workshop Goal

To present key findings from the study and develop recommendations for increasing uptake of crop protection technologies in peri-urban vegetable systems in Kenya.

2. Participants expectations

Thirty-seven (37) stakeholders representing public and private sector research and extension, Agro-industry, exporters, farmers, as well as representatives of development and of donor agencies and scientists from the project implementing institutions namely, CABI, NRI, KARI and MARD participated in the workshop. A list of participants is given in Section 9 of this Annex. At the beginning of the workshop, participants were asked to state their expectations and these were given as follows:

- To learn about new pest management strategies/ technologies in horticultural farming
- To identify problems that prevent farmers from using technologies
- To obtain a better understanding of peri-urban systems
- To reflect on actual situation in the field and identify solutions to problems
- To identify opportunities and progress e.g. how uptake studies could contribute to poverty eradication
- To develop a comprehensive business plan (technology generation and dissemination)

3. Keynote Address by Dr. Kedera (Director/ KEPHIS)

Dr. Kedera underscored the poverty situation faced by the majority of farmers in Kenya. He argued stakeholders to identify and fulfill their exact roles in alleviating this situation. The need to involve farmers in research problem identification and dissemination was emphasised.
Stakeholders were informed that the Kenya Government has already started addressing the problem of poor communication by putting research and extension under one ministry. In addition, there is now an extension Liaison department that repackages research results for extension workers and farmers.

4. Literature Review

Key factors affecting effective uptake

The available literature indicated that the major factors affecting adoption of technologies in peri-urban vegetable systems in Kenya were farmer characteristics and their resource endowment as well as farmers' perceptions of the benefits of using the technologies. Farmer characteristics include, education, farming experience and information on the technologies. The latter is influenced by access to extension services or contact with other information sources including other (contact) farmers. The key factor affecting technology uptake was the farmers' income which influences their ability to pay for the technologies e.g. pesticides and new 'resistant' varieties. Farmers' perceptions of the benefits of the technology include potential increase in

yield and market demand for the commodity (crop). A detailed report entitled "Factors affecting the uptake of crop protection research in peri-urban vegetable production systems in Kenya: a review of the literature and analytical framework for the study" is presented under separate cover.

5. Summary of issues from Group Discussions

5.1 Regulation and Registration

- New EU regulations on pesticide residual levels will influence farmers practices (i.e. those who are producing for export)
- Dependency on regulations/laws from other countries for example. Kenya is using USA regulations on Maximum residual levels (MRLs).
- Registration and regulatory systems for agro-chemicals/inputs is in place but the registration process takes too long (in Kenya)

Recommendations

- Improve registration procedure
- Regulatory methods for local markets should be stipulated and reinforced

5.2 The technology generation process

A The process of setting research agenda

i) Stakeholder involvement – farmers through PRAs
ii) Donor driven
iii) Individual researcher's bias
iv) Demand driven (Commercial Sector)

STEP	PROCESS	STAKEHOLDER
CABI/NGO		
1.	Problem	Farmer
2.	identification/justification	Researcher/farmer
3.	Writing of research proposal	Donor
4.	Call for proposals	Researcher
	Submission of proposals	
COMMERCIAL SECTOR		
1.	Feasibility study/problem	Ext. officers/sales reps/farmers
2.	identification	KARI/Agro Chem Co.
	Contract Research institution for	
3.	technical evaluation	Farmers/Ext. officers/Co.
4.	Market survey	KARI/ AgroChem Co.
	Full development of product	
KARI		
Case 1 as in NGOs	Problem	
	identification/justification	
Case 2		
1.		Researcher/farmer/Ext. officer

2. 3. 4. 5.	Problem identification Proposal write-up Technical committee (evaluation) Centre Research Advisory Committee Funding/implementation	Researcher Agrochem Co. /Universities /NGOs /Farmers Agrochem Co. /Universities /NGOs /Farmers Donor/Government of Kenya/ KARI/ Industry

B. Problems faced by farmers

- Resistance to pesticides
- Inappropriate application methods
- Lack of understanding of IRM (Insect Resistance Management)
- Non-adherence to Post harvest Intervals (PHI's) and safe use instructions
- Fake agro chemicals on the market
- Poor problem diagnosis
- Poor selection of pesticides

C. Available pest management strategies

1. Chemical use
2. Cultural
   - crop rotation
   - intercropping
   - mulching
   - weed control
   - varietal
3. Biological control
4. Botanicals
5. Host resistance
6. Pheromones

D. Successful Strategies

1. Plant Host Resistance
   a) Potato blight (Tigoni, Asante varieties)
   b) Tomato bacterial wilt (Rodade)
2. Pesticide use
   a) Some Botanicals
   b) Biopesticides
   c) Synthetic chemicals
3. Cultural practices
   d) Crop rotation
   e) Destruction of crop residues
   f) Roguing
   g) Disease free planting material (certified)
   h) Weeding

E. Key issues in technology generation

- Need for a research plan that builds into the national plan
- Need for a nationally coordinated process for planning research activities
- More involvement of stakeholders in Technology generation
- Involving farmers in determining research priorities (currently farmers have little influence on research priorities setting).
- Problems of technology generation:
  - A problem may be identified and is not immediately addressed due to various constraints such as funding and poor information transfer
  - Poor problem diagnosis and communication by farmers
  - Misconception by farmers of 'on-farm trials' as demonstrations
  - Motivation for research does not necessarily match the farmers needs

F. Stakeholders in technology generation

- Public and Private Sector Research Institutes
- Universities
- Farmers/vegetable growers/farmer cooperative society
- HCDA
- SACDEP
- Seed companies

G. Recommendations

- Set up a nationally coordinated framework for all stakeholders involved in research. (Example of Ethiopian Research Policy body). This body would provide for regular interaction and allocate research activities to members organisations according to their comparative advantages
- Alternative sources of financing - research should be funded by those who need it e.g. exporters, Agro-industry, HCDA
- Set up of data bank for available agrochemical companies and their areas of interest
- Set up a fast force/committee comprised of stakeholders for constant monitoring of the pest/disease and related agricultural problems
- Improve farmer – Extension – Research linkage
- Train farmers in pest problem identification
- Refine the technologies in the research stations before taking them out to the farmers
- Develop research projects on ITK and botanicals
- Establish a national research and extension reference database

5.3 Technology dissemination

A. Methods and constraints

Dissemination Methods	Constraints to effective Dissemination
Researcher – Extension - Workshops - Publications - On-farm trials - Field days - Visits	**Researcher – Extension** - Inadequate resources - Inadequate Documentation & Communication - Research priorities not farmer driven therefore farmers not interested in technologies (often not aware)
Extension – Farmer - Field days/Demonstrations - Farmer training - Leaflets - Mass Media - Shows - Farmer field schools - Farm visits - Farmers tours (national/ regional exchange visits)	**Extension – Farmer** - Inadequate resources (including staff) - Poor infrastructure - Poor motivation - Resource poor farmers - Inappropriate dissemination methods - Gender insensitivity - Cultural barriers

Other sources of technologies: Farmers (Indigenous Technical Knowledge (ITK))

B. Key issues on pathways and communication methods

- Extension culture should change from being supply driven to being demand driven.
- Routine training of stockists (countrywide) to be initiated soon.
- Extension personnel are widespread and well represented on the ground countrywide, so the constraint in dissemination is not due to lack of representation but because technologies are changing very fast and extension staff may not be in keeping with these changes.
- Extension personnel not adequately funded, not mobile.

C. Recommendations on Pathways

- Strengthen the Public sector extension through provision of resources
- Improve coordination between disseminators so that they can work closely.
  - KARI/Universities should play a more active role in dissemination/training activities while SUP could strengthen its work with Schools.
  - Strengthen linkages between KARI/Univ. /HCDA to avoid duplication and competition.

- Improve flow of information to farmers – involve farmers e.g. retired civil servants who can contribute to development of uptake strategies.
- Privatise extension services (i.e. only those sectors that can function on commercial basis such as horticulture).
- Allocate adequate resources to research institutions and the Agricultural Information Resource Centre (AIC) to enable them repackage and disseminate information/technologies.
- Establish a dissemination forum for formulating/harmonising messages on technologies before dissemination. KARI should take the lead on this initiative.
- Include dissemination components in all research projects.

D. Recommendations on communication methods

- Promote use of communication methods that use demonstration techniques such as FFS and field days
- Promote use of radio programmes (15 minutes) and features in newspapers since they are effective communication methods. For radio, explore the group the listnership approach to programmes.
- Conduct demonstrations for school children, as these are a special focus group (the future generation).
- Use of both new and traditional ICTs to disseminate information on technologies. The latter technologies may be relevant where farmers' sophistication is increasing and/or where telecentres /community centres have been established.

6. Recommended topics for future research

6.1 **Socio-economic research**

- Production economics in vegetables.
- Influence of farmer characteristics/circumstances on uptake.
- Studies on ITK to identify effective strategies for pest management.

6.2 Scientific Research

- Structured research on botanicals i.e. to determine the mode of action for botanicals/organic pesticides and also address the following issues:
  - Problem of reproducibility and standardization
  - Biosafety
  - Shelf life
- Step up research on plant-host resistance
- Studies on application rates of various chemical pesticides (address underdose/overdose issues)

7. List of organizations involved in generation and dissemination of pest management strategies and information

I. Public Sector
   i) Research based
      a) Government of Kenya - KARI
      b) Universities

   ii) Dissemination of information
      a) MARD (Extension Dept., AIC)
      b) Parastatals e.g. AVENTIS (An Agro-chemical Company)

II. Private Sector
   i) Research based
      a) Crop protection companies
      b) Exporters

   ii) Dissemination of information
      a) Crop protection companies e.g. PCPB
      b) Stockists
      c) Exporters e.g. HCDA, FPEAK

III. NGOs and CBOs
   i) Research based e.g. KIOF
   ii) Dissemination of information e.g. CRS, AACC, KIOF SUP (AAK), ABLH, OXFAM, SACDEP

III. Internationally funded institutions
   i) Research based e.g. CGIAR, ICIPE, CABI, NRI, (ICRISAT, CIAT, CYMMIT, and ICRAF).
   ii) Dissemination of information e.g. CABI, CGIAR, ICIPE etc. through National partners

8. Activities of local stakeholders in pest management

MARD
Plant protection services branch
- Control of migratory pests
- Training on pest management

KIOF
Training and research
- Biological control
- Cultural control
- Botanicals

SUP
- Training in safe use of chemicals

KEPHIS
Plant quarantine
- Biosafety issues
- Certification (seed and plant material)
- Publications – leaflets, brochures

KARI
- Research (Crop Protection Programme)
- Training

Second Workshop on Uptake and Adoption of Outputs of Crop Protection Research in Peri-Urban Vegetable Systems in Kenya, 31st March 2000 at CABI-Africa Regional Centre ICRAF Complex, United Nations Avenue, Gigiri

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