icipe's results based management framework

2011–2013

icipe

African Insect Science for Food and Health

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icipe's RESULTS BASED MANAGEMENT FRAMEWORK 2011–2013

International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100 Nairobi, Kenya
Phone: +254 (20) 8632000; Fax: +254 (20) 8632001/2
icipe@icipe.org
www.icipe.org

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INTRODUCTION

Members of the CGIAR Consortium of International Agricultural Research Centres, national and international development aid agencies (including UN organisations), as well as international research organisations, are now in the process of introducing or reforming their performance management systems and measurement approaches, and *icipe* is no exception. It is essential to establish an effective performance measurement system, to deal with analytical issues of attributing impacts and aggregating results, ensure a distinct yet complementary role for evaluation, and establish organisational incentives and processes that will stimulate the use of performance information in management decision-making.

Results-based management (RBM) is a way of managing whereby an organisation ensures that all of its processes, products and services contribute to the achievement of the desired results. RBM provides a coherent framework for strategic planning and management based on learning and accountability in a decentralised environment. It is first a management system and second, a progress reporting system. Introducing a results-oriented approach aims at improving management effectiveness and accountability by defining realistic expected results, monitoring progress towards their achievement, and integrating lessons learned into management decisions, self-assessment and reporting on progress.

icipe has adopted RBM as a project planning and monitoring tool. In line with *icipe*'s '*Vision and Strategy 2007–2012*' paper, the RBM framework will provide guidance to programmes and is intended to help establish organisation-wide standards with regard to four main pillars:

(a) The definition of strategic goals which provide a focus for action;
(b) The specification of expected project results which contribute to these goals and align programmes, processes and resources behind them;
(c) On-going monitoring and assessment of progress and integrating lessons learned into future planning;
(d) Improved accountability and continuous feedback on progress.

Applying RBM is the beginning of an on-going process to better define the specific goals of *icipe* and to design mechanisms to ensure the measurement of progress towards those goals. At this stage, *icipe* will track specific performance measures at an institutional level on an annual basis. Projects implemented by *icipe* are the basis of the proposed RBM framework. As such, tracking results begin from a project vantage point. At a project level, results will be tracked during implementation and evaluated upon project completion. While the tracking tools will be utilised during implementation it is important that the three major phases in a project's evolution are linked to: (a) project design; (b) implementation; and (c) evaluation. Breaking down the project cycle into these three phases, highlights the learning and management aspect of *icipe*'s RBM framework and facilitates in attributing outcomes and impacts to a specific project or programme.

RBM is indeed a strategic management approach that will ensure *icipe*'s R&D activities are implemented in collaboration with our partners to contribute to a logical chain of results that are millennium development goals (MDGs) related priorities and provide knowledge-based solutions aimed at equipping the communities in Africa to survive and live within a rapidly changing global environment.

RESULTS BASED MANAGEMENT OVERVIEW

1. Institutional focus of the Results Based Management Framework

The **mission** of *icipe* has been reiterated in its 'Vision and Strategy 2007–2012' paper. It is "*to help alleviate poverty, ensure food security and improve the overall health status of peoples of the tropics by developing and extending management tools and strategies for harmful and useful arthropods, while preserving the natural resource base through research and capacity building.*"

The **mandate** of the Centre as stated in its Charter of 1986 stipulates that "*the primary mandate of* icipe *shall be research in integrated control methodologies for crop and livestock insect pests and other related arthropods, and insect vectors of tropical diseases and the strengthening of scientific and technological capacities of the developing countries in insect science and its application through training and collaborative work.*"

The four principal **objectives** are to: (1) do research on harmful and useful insects and other arthropods and to apply this knowledge to integrated pest and vector management as well as on the beneficial use of insects, (2) establish training in research methods and techniques in insects covering the breadth from scientists to practitioners, (3) establish cooperation with key international centres throughout the world, and with national programmes throughout Africa and other countries in the tropics to facilitate research and application of pest control strategies, and (4) provide an international forum for the exchange of knowledge in insect science and management for tropical regions.

Since its inception in 1970, the mission, mandate and objectives formulated above were the guiding principles within the scope of *icipe*'s subjects in research and capacity building, despite the fact that the question of subject matter scope—arthropods or beyond—was addressed repeatedly with good arguments for both, to limit the scope to arthropods, i.e. respecting the Charter's original mandate, or to widen the scope to related subjects such as disease and weed management, soil conservation and research in plant–plant interactions. The dilemma is obvious and was addressed in several documents including the latest external reviews of 2002 and 2007.

2. Success in implementing the vision and strategy

The 2007 review concluded that the current programme areas reflect well *icipe*'s mission and mandate, and the 4-Hs paradigm (H for health), where targeting the improvements in Human, Animal, Plant and Environment Health have been identified as the most holistic, and cost effective ways to meaningfully engage with the complex development requirements of African communities and to provide the much needed poverty-alleviating solutions, is still up-to-date and relevant to cover the full breadth of *icipe*'s mission. As the only international Centre working primarily on arthropods in sub-Saharan Africa (SSA), *icipe* is at a clear advantage in addressing the complex arthropod-related challenges of food security, vector-borne diseases (of people and livestock) and protection of the environment, including biodiversity conservation. The many integrated pest and vector management and insect-based income-generating technologies should be continued by the Centre, including the capacity building programmes which are of immediate relevance to future strategies for contributing to solutions of food insecurity and malnutrition, disease, poverty and environmental degradation. *icipe* should continue to combine basic and applied research to develop, introduce and adapt new tools and strategies for arthropod management that are environmentally safe, affordable, socially acceptable and applicable by the target end-users.

Stakeholder consultations during the review confirmed *icipe*'s reputation of an African Centre of Excellence in arthropod science from basic to applied research and beyond. As *icipe* has to set programme priorities, it became obvious during the review that not all stakeholders are fully satisfied with *icipe*'s research agenda and that some stakeholder groups are keen to get more immediate results from "problem-solving" research. Despite this conflict, *icipe* shall maintain and strengthen high quality research in modern arthropod science that makes the Centre unique and distinct from other African research centres.

icipe's capacity building and training programmes have an excellent reputation across Africa and were much appreciated by all stakeholders that the 2007 review mission consulted.

3. Core values that pillar *icipe*'s strategic interventions

Having the unique advantage of being an African institution, based in Africa, and mandated to address pest problems at the foundation of poverty, especially in terms of food security and health, *icipe* designs interventions based on a pro-poor set of values that contribute to the achievement of the millennium development goals. These include:

- Consultative engagement with communities as equal partners in the development of scientifically sound, simple and sustainable technologies;
- Offering solutions for improving the quality of life of the people now and in the future, based on informed understanding of the complex interactions of the behaviour, ecology, biological diversity and the environment of pest and beneficial arthropods;
- Targeting worldwide concerns such as deforestation and conservation in global biodiversity hotspots;
- Promoting the commercialisation of research results through creation of new products, thereby creating employment in manufacturing and processing, and thus raising incomes and fighting poverty in a sustainable way;
- Addressing institutional capacity gaps that limit technology uptake, adoption and sustainability;
- Building the much-needed human expertise for research leadership and policy advocacy, as well as skill empowerment through networking with African institutions such as universities.

4. Programme implementation through strategic alliances

Although *icipe* has a comparative advantage in the various disciplines that contribute to the field of insect science and its application, there is also appreciation that development is a cooperative process that must involve all stakeholders working together at all levels, if research results are to move from the laboratory to the beneficiaries level thereby genuinely impacting on peoples' lives.

The 2007 review clearly recommended that *icipe*'s primary geographic focus remain on tropical Africa and that its immediate subject areas concentrate on arthropod science. Activities going beyond arthropods in SSA may best be accomplished by collaboration with high quality partners and linkages that are chosen based on a number of established quality criteria. Cooperation in research and capacity building should be strengthened by jointly developing research proposals with partner universities and to give visibility to partner institutional contributions by apportioning credit in publications and publicity material.

The future plans for the next three years (2011–2013) are ambitious but strategic and would require setting more stringent priorities to the programme plans and to single projects. This will help decision-making under uncertainties of funding and demonstrate stability for the core competences necessary to build the organisation and maintain its purpose.

Wider and rapid dissemination of technologies (up-scaling) is needed in some projects and will only be possible through training of extension staff with stronger involvement of national and local extension services that would in turn train the end users. Widespread dissemination through training of end users is not *icipe*'s core-business, and it should thus seek to achieve this through strategic partnerships.

Rigorous evaluation of projects should be made in relation to core science competences of *icipe* and of competences and roles of carefully chosen partners. Projects with a scope far beyond *icipe*'s competences, for example farming programmes and cropping systems, should not be managed under *icipe*'s leadership.

5. Institutional responsibility, organisational capability and administrative efficiency

icipe operates within a management structure based on principles conducive to promoting creativity, diversity and efficiency. *icipe* has also an institutional responsibility for ensuring that the incoming generations of African scientists have a strong and holistic science-based training within a socio-economic context that is relevant to the needs of the society. *icipe*'s work is organised through the 4-H paradigm. Feeding into these 4-H themes is disciplinary in-house expertise from important areas such as chemistry, molecular biology, biotechnology, biomathematics and social sciences. Since all of the activities contribute to, and are supportive of, the MDGs, *icipe*'s research is development-related, resulting in knowledge-based solutions aimed at equipping the communities to survive and live competitively within a rapidly changing global environment.

Following the 2007 review, *icipe*'s efforts to strengthen and expand its activities to other African regions such as Central and West African countries to better comply with its mandate and in fulfilling recommendations of the review in 2002 was appreciated. The Centre's strategy to develop integrated pest management (IPM) and integrated vector management (IVM) packages and partnering for holistic approaches for problem solving is fully compatible with its mandate and represents one of the programme strengths if adequate linkages with the right partners are established across Africa. This will ensure that the Centre's output is appropriate, acceptable and affordable for the peoples of the tropical developing world, especially in Africa**.** *icipe's* R&D partnership linkages are with universities, national research and extension systems (NARES) and governments, regional organisations, international research organisations (e.g. CGIAR centres), specialised networks, NGOs and CBOs, as well as with the private sector.

6. Background to development of *icipe's* Results Based Management Framework

In early 2010, *icipe*'s Governing Council (GC) and Management, in consultation with core donors, agreed to develop a Results Based Management (RBM) framework to support the Centre's Strategic Priorities, Policies and Guidelines of insect science research and development. The operational guidelines specifically state that the framework will take into consideration existing good practice and lay out an approach that: (i) incorporates measuring results with widely recognised tools; (ii) assesses risk on an ongoing basis; and (iii) incorporates learning into strategies, projects and programmes. The RBM will be an operational framework that would explicitly link the strategic objectives and priorities of the Centre to the various programmes and projects that it finances so that collectively they help achieve the goals of *icipe.*

This RBM will help to promote efficient management techniques. The systematic approach of gathering and assessing data and results on progress towards objectives is a cost-effective way to diagnose early weaknesses in implementation plans. Periodic and targeted information would help the GC and the *icipe* Management recognise those activities that generate the highest pay-offs in terms of results, or those, which appear to need more support to deliver results aligned with strategic priorities. The Centre would then be able to track and measure progress towards objectives, and make targeted decisions to improve performance on an ongoing basis. Process monitoring will take place on an ongoing basis to track whether portfolios are being implemented as intended, standards are being met, and resources are being used efficiently.

Each of *icipe's* core activity areas has an RBM Framework, which constitutes this document. All projects entail knowledge management and learning, which are the main components for any organisation dealing with adaptation to climate change like *icipe.* The 4-H and Capacity Building frameworks encompass a cycle of planning, periodic performance assessment and organisational learning—all of which are supportive of knowledge creation and sharing. Learning from the R&D activities will influence strategy development and programme/project design, and the lessons will be fed back into programme/project implementation. The learning component is also critical for identifying and managing risks while bearing in mind the expected results and resource levels. This will involve increasing knowledge by learning, knowledge dissemination and feedback into decision making, project design and strategy development.

RESULTS BASED MANAGEMENT FRAMEWORK 2011–2013

PLANT HEALTH DIVISION

1. Divisional narrative

The work of *icipe* in plant health contributes to improving sustainable food security and environmental health through developing IPM options for pre- and post-harvest pests, and for parasitic weeds, such as striga, and biological control (BC) of weeds using arthropods. All technology development involves farmers' participation to ensure their needs are met. The agenda of plant health research covers three domains: Staple Food Crop Pests, which is covered by the Habitat Management (HM) and Biological Control (BC) of Cereal Pests Programmes; Horticultural Crop Pests, which is dealt with by the Vegetable and Fruit Fly Research Programmes; and Locust and Migratory Pests, which deals with African and Madagascar migratory locusts and armyworm.

Wherever possible, priority is given to solutions that minimise the impact on the environment and human health, such as BC (classical and augmentative BC, microbial control), use of baiting stations, and habitat management. Classical BC activities are facilitated by *icipe*'s internationally accredited quarantine facility where imported natural enemies are maintained for pre-release studies once the Kenyan authorities have approved their importation. For more intractable problems, an in-depth understanding of the interactions between soil, plant, pests and natural enemies in their cultivated and natural habitats is required.

Recent activities in the Plant Health Division are related to filling critical gaps in knowledge related to climate change impacts on ecosystem services and developing adaptation strategies towards it by building the capacity of NARES and growers through research, training and dissemination of information.

Further activities in *icipe* plant health programmes analyse the economic impact of developed technologies and assess factors associated with the success/failure of these. Finally, the economic impact of good agricultural practices and international standards on export crop production is assessed as well as the dynamics in farmer training and technology transfer.

2. Goal and broader objectives

Goal: Stabilising horticultural and staple food production by reducing quantitative and qualitative pre- and post-harvest yield losses due to insect pests, mites, weeds and mycotoxin-producing fungi by contributing to the development of economically viable production systems that are less reliant on external inputs, in particular pesticides, and thus environmentally friendly and sustainable.

Objectives: In collaboration with regional and national agricultural research and extension systems and farmers, quantify economic crop losses due to pests, and undertake research leading to sustainable and economically viable IPM solutions, and provide support for their implementation. Through collaborative activities, build national and regional capacity and capability to carry out these tasks independently.

3. Strategic future plans

Horticultural production systems: *icipe* will contribute to the development of horticultural production systems in compliance with international Good Agricultural Practice (GAP) standards, thereby contributing to sustainable environmentally friendly production systems.

Biological control (BC) and habitat management (HM): This focuses on the role and economic value of functional agro-biodiversity in plant protection. Past experience has shown that the variable successes of BC and HM technologies can only be understood in the context of the biodiversity of the wild habitats of pests and natural enemies. Such studies will also include the quantification of the economic value of ecological services such as BC and pollination.

Integrated pest management (IPM): Most IPM techniques are based on agronomy and measures that improve soil fertility and thereby plant health. Thus, a closer linkage to institutes with the necessary expertise will be sought.

Environmental risk assessment of genetically modified organisms (GMOs): Most GMO crops introduced into Africa have been developed and are promoted without technical backstopping by ecologists; thus, the risks to the environment and that of resistance build-up are widely unknown and need to be thoroughly assessed before this technology is widely disseminated.

Food safety and mycotoxins: As insects are vectors of fungal spores and damaged grain is rendered susceptible to fungal attack and mycotoxin contamination, a major IPM solution is needed to lower pre- and post-harvest insect attack and associated losses.

Expansion of IPM research beyond desert locusts: Based on our detailed understanding of the chemical communication systems of desert locusts, similar research will be initiated in collaboration with national/regional locust control organisations for other important locust pests in Africa like the Madagascar migratory and red locusts.

Plant Health Results Based Management (RBM) Framework

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1: Increase horticultural and staple food production by at least 30% by 2020 by reducing pre- and post-harvest quantitative and qualitative losses due to pests in *icipe*'s target areas.					
1. Baseline information on pests' status, farmer practices and their impacts on ecosystem and livelihoods assessed	At least five *ex ante* study outcomes utilised by scientists, policy makers and other stakeholders by 2013	• Pest status of at least five key pests determined by 2013	• Publications • Survey records • Web resources	• Surveys • Growers interviews • Secondary data collection	• Political commitment exists • Social attitude and willingness of stakeholders to cooperate • Availability of funds
Objective 1.1: Develop and create awareness on integrated pest management approaches for *Maruca* infesting cowpea and other legume crops in East Africa in collaboration with international and national partners by 2014.					
1. Biocontrol agents identified 2. *Maruca* IPM strategies based on semiochemicals, biopesticides and biorationals developed	*Maruca* IPM strategy that encompasses at least two IPM components formulated by 2014	• At least one pheromone compound identified by 2014 • At least 1 biopesticide and 1 botanical evaluated by 2014. • No. of peer reviewed publications	• Publications • Project reports • Theses	• Laboratory records • Field experiments and data collection	• No crop failures • Grower acceptance and cooperation
1. Training of trainer's programme organised for cowpea farmers 2. Training materials and curricula developed 3. IPM technology adapted and validated with cowpea farmers	Awareness on *Maruca* IPM strategy created among at least 500 cowpea farmers by 2014	• No. of cowpea farmers aware of new IPM technology	• Training manuals and materials • Survey reports • Training registers	• Pre- and post-assessment of awareness among course participants • Surveys • Farmer interviews	• Stakeholders are willing to participate in the training

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1.2: Develop and implement integrated pre- and post-harvest pest management approaches for thrips and tospoviruses infesting vegetables and grain legume crops in East Africa in collaboration with international and national partners by 2015.					
1. Biopesticide for thrips IPM developed and commercialised 2. Thrips IPM strategies based on intercropping, use of biopesticides, semiochemicals and botanical pesticides developed	Thrips and tospovirus management strategies for French bean, onions, tomato and grain legumes encompassing at least two IPM components formulated by 2014	• At least one microbial bio-pesticide commercialised for thrips control by 2013 • At least 1 intercropping strategy for thrips control in French beans, grain legumes and onion evaluated by 2013 • At least one tospovirus resistant cultivar of onion and tomato identified by 2014 • Large scale implementation of IPM strategies for thrips and tospoviruses encompassing at least two IPM components undertaken in at least two key production areas by 2014 • Reduction in use of synthetic pesticides by at least 20% by 2014 • No. of peer reviewed publications • Number of theses	• Publications • Project reports, theses • Private–public partnership agreements • Pesticide use statistics • Residue level statistics	• Laboratory records • Field experiments and data collection • Secondary data collection	• No crop failures • Grower acceptance and cooperation

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
3. Training of trainer's programme organised for agricultural extension officers/plant quarantine inspectors in East Africa 4. Training materials and curricula developed 5. Field demonstration of thrips IPM strategies based on intercropping, use of biopesticides, semiochemicals and botanical pesticides undertaken 6. IPM technology adapted and validated with French bean, tomato, onion, and grain legume farmers *7.* *Ex-ante* and *ex-post* assessment of the introduced thrips and tospovirus management strategies	Awareness on thrips, tospovirus monitoring and management strategies created among agricultural extension officers/ plant quarantine inspectors and French bean, tomato, onion and grain legume farmers enhanced by 2015	• Awareness among at least 150 agricultural extension officers/ plant quarantine inspectors enhanced on thrips and tospovirus monitoring and management by 2013 • Awareness among at least 1000 French bean, tomato, onion and grain legume farmers enhanced for adoption of the thrips and tospovirus management strategies by 2014 • No. of training reports • French bean, onions, tomatoes and grain legume yields increased by at least 15% • Rejection of French beans reduced by at least 10% in local, urban and export markets by 2013 • Popular articles, mass media reports • No. of publications, theses	• Training manuals and materials • Survey reports • Training registers • Impact assessment reports • Crop yield statistics • Domestic and export agro-statistics	• Pre- and post-assessment of awareness among course participants • Surveys • Impact assessment studies • Field • Farmer interviews	• Stakeholders are willing to participate in the training

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1.3: Develop and implement integrated pest management approaches for invasive agromizid leafminer flies infesting vegetables and flower crops in East Africa in collaboration with international and national partners by 2014.					
1. Leafminer flies' (LMF) biopesticides identified 2. LMF natural enemies introduced and released 3. LMF IPM strategies based on use of intercropping, botanicals, biopesticides, trapping and biorationals developed	Agromyzid leafminer IPM strategies that encompasses at least three IPM components formulated by 2014	• The role of at least 1 indigenous parasitoid species in Kenya, Uganda and Tanzania characterised by 2013 • At least 2 exotic leafminer parasitoid species released by 2013 • At least 1 microbial biopesticide identified against LMF by 2013 • At least one botanical evaluated by 2013 • At least 1 intercropping strategy evaluated by 2013 • The role of landscape complexity on LMF incidence and control evaluated in at least 1 country by 2013 • Reduction of pesticide use against LMF reduced by at least 20% by 2014 • No. peer reviewed publications	• Publications • Project reports, theses • Pesticide use statistics • Residue level statistics	• Laboratory records • Field experiments and data collection	• Growers' acceptance and cooperation • National authorities' grand release permits for natural enemies

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
4. Training of trainers conducted 5. Training of French bean, Faba bean, Rose Coco bean, cowpea, tomato, snow peas, sugar snap peas and chrysanthemum farmers conducted 6. Training materials and curricula developed 7. Field demonstration of leafminer management strategies conducted 8. IPM technology adapted and validated with farmers *9.* *Ex-ante* and *ex-post* impact assessment of the introduced technologies undertaken	Awareness on agromizid leafminer IPM strategies created among agricultural extension officers, plant quarantine inspectors, and French bean, Faba bean, Rose Coco bean, snow peas, sugar snap peas, tomato and chrysanthemum farmers by 2014	• Awareness created among at least 100 agricultural extension officers and plant quarantine inspectors by 2013 • Awareness created among at least 500 French bean, Faba bean, Rose Coco bean, snow peas, sugar snap peas, tomato and chrysanthemum farmers by 2014 • No. of training reports • Popular articles, mass media reports • No. of publications and theses • At least 15% yield increase in French bean, Faba bean, Rose Coco bean, snow peas, sugar snap peas and tomato by 2014 • At least 10% reduction in rejection of French bean, Faba bean, snow peas, sugar snap peas and chrysanthemum by 2014	• Training manuals and materials • Project reports • Training registers • Crop yield statistics • Domestic and export agro-statistics	• Pre and post assessment of awareness among course participants. • Surveys • Impact assessment studies • Farmer interviews	• Stakeholders willing to participate in trainings

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1.4: Implement, in collaboration with international and national partners in sub-Saharan Africa, effective approaches to reduce pre- and post-harvest mango losses due to insect infestations leading to improved quality and quantity of production to meet the demands of local, urban and export markets by 2015.					
1. Community-based participatory dissemination of fruit fly and mango seed weevil (MSW) IPM technologies based on baiting and male annihilation technique, application of entomopathogens, *soft* pesticides and orchard sanitation implemented	At least 50% of the mango growers in the benchmark sites get acquainted with the fruit fly and MSW IPM technologies by 2013	• At least 20% of growers in project localities adopt at least 2 components of IPM package for fruit flies and MSW by 2013 • Fruit fly and MSW infestation reduced by at least 70% • Mango yield increased by at least 20% by 2013 • Use of synthetic pesticides for fruit flies management in the benchmark sites reduced by at least 40% by 2013 • Rejection of mango reduced by at least 10% in local, urban and export markets by 2013	• Pest population data • Rate of technology adoption • Yield data • Reports • Questionnaires • Publications	• Farmers interviews • Fruit flies and MSW monitoring • Surveys	• Political situation is favourable • No extreme weather conditions (e.g. drought, flood) • No crop failure • Security situation in target areas does not prevent or interrupt project implementation • Growers willingness to cooperate and avail their farms for demonstrations • NARS cooperate in the project implementation

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
2. Field releases, post release evaluation and impact of *Fopius arisanus* and *Diachasmimorpha longicaudata* for the suppression of *Bactrocera invadens* and native *Ceratitis* species conducted	Establishment of the two parasitoid species in at least two of the target countries leading to at least 30% reduction of fruit flies populations by 2013	• *F. arisanus* and *D. longicaudata* released in at least 15 major mango production localities by 2013 • Impact of released parasitoids and their establishment quantified by 2013 • At least 50% of growers are aware of parasitoid releases and impact, and reduce cover spray of pesticides by 20% by 2013 • Parasitoid species recovery	• Questionnaires • Publications • Theses • Reports	• Fruit sampling for parasitoids recoveries • Parasitism rate • Farmers' interviews	• No extreme weather conditions • No crop failure • No rejection of the parasitoid releases by the communities • Release permits for natural enemies granted by the relevant government authorities of the target countries • Parasitoids and the host are adaptable to rearing • Political stability
3. The role of the weaver ant (*Oecophylla longinoda*) in the management of fruit flies and MSW adapted, validated and disseminated and their conservation promoted	The weaver ant technology adopted as a component of fruit flies and MSW management by mango growers by 2013	• At least 30% of growers become aware of ant importance in fruit flies and MSW management by 2013 • At least 10% of growers become knowledgeable on weaver ant conservation practices • Weaver ants reduce fruit fly and MSW infestation by at least 30% and increase mango yields by at least 30% by 2013	• Theses • Ants establishment and dispersal • Reports • Publications	• Grower interviews • Secondary data collection • Fieldwork	• No crop failure • Ants at right densities, NARS cooperate • No biotic interference between parasitoids and ants • Security is stable

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
4. Parameters for post-harvest treatment based on hot water treatment of mango against *B. invadens* developed and disseminated	Heat treatment parameters required to achieving Probit of 99.9968% for *B. invadens* on at least one mango cultivar developed by 2013	• Parameters established • Opportunity for access to export markets by the mango growers	• Heat treatment data • Theses • Publications • Reports • Export statistics	• Small and large-scale laboratory bioassays.	• *B. invadens* is adaptable to rearing • Heat treatment does not affect quality of produce • Availability of the required mango cultivars • Political stability • Willingness of the policy makers to build hot water treatment facilities
5. Socio-economic impact of introduced control technologies determined	Number of adopters of the disseminated fruit flies and MSW IPM technologies established by 2013	• At least 2 *ex-ante* studies completed by 2012 • At least 1 *ex post* impact assessment of the management package on mango production and livelihood completed by 2013	• Theses • Publications • Reports	• Pre- and post-assessment of awareness among beneficiaries • Surveys • Impact assessment studies • Farmer interviews	• Stakeholders willing to participate in the training

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
6. Capacity of NARS and other partners in the transfer of IPM technologies strengthened	Knowledge on fruit flies and MSW IPM technologies enhanced at all levels	• At least 50 NARS personnel trained on fruit fly and MSW management by 2013 • At least 6 IPM technology learning sites/FFS established for grower training by 2012 • At least 1000 leaflets, manuals and posters on management printed and distributed by 2013 • At least 3 PhD and 5 MSc students trained on fruit fly and MSW management and post-harvest treatments by 2013	• Theses • Training manuals and materials • Survey reports • Training registers • Impact assessment reports • Crop yield statistics	• Surveys • Impact assessment studies • Field • Farmer interviews	• Stakeholders are willing to participate in the training
Objective 1.5: Develop and create awareness on integrated pest and disease management approaches for key insect pests and diseases of cashew in coastal ecosystems of East and West Africa through collaboration with international and national partners by 2013.					
1. Control agents based on entomopathogenic fungi, botanicals and *soft* insecticides for the control of mirid and coreid bugs identified 2. Semiochemicals of key insect pests identified 3. Efficacy of weaver ant *Oecophylla longinoda* in the management of mirid and coreid pests evaluated, fine-tuned and disseminated	IPM strategy based on at least 2 components for the control of mirid and coreid bugs formulated by 2013	• At least one semiochemical compound identified by 2013 • At least 1 biopesticide and 1 botanical evaluated by 2012 • No. of peer reviewed publications	• Publications • Theses • Reports • Field data	• Grower interviews • Secondary data collection • Fieldwork • Laboratory bioassays	• No crop failure • NARS and farming community cooperate • Security is stable

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
4. Alternatives to management strategies for powdery mildew, leaf and nut blight 5. The impact of new strategies on beneficial pollinators and natural enemy complex determined	Alternative strategies for the control of powdery mildew, and leaf and nut blight in cashew formulated by 2012	• At least 1 hyperparasite fungus and 1 environmentally friendly fungicide evaluated by 2012 • Resistant varieties identified • No. of peer reviewed publications	• Publications • Theses • Reports • Field data	• Grower interviews • Secondary data collection • Fieldwork • Laboratory bioassays	• No crop failure • NARS and farming community cooperate • Security is stable
6. Training of trainer's programme organised for cashew farmers *7.* *Ex-ante* of the impact assessment of potential cashew IPM strategies	Awareness on insect pests and diseases of cashew IPM strategy created among at least 50 cashew farmers by 2012	• No. of cashew farmers aware of new IPM technologies	• Training manuals and materials • Survey reports • Training registers • Impact assessment reports	• Pre- and post-assessment of awareness among course participants • Surveys • Impact assessment studies • Farmer interviews	• Stakeholders are willing to participate in the training

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1.6: Develop and create awareness on integrated pest and disease management approaches using insecticide treated and untreated nets for management of key pest of vegetables in collaboration with international and national partners by 2014.					
1. Circadian behaviour of red spider mite and its predator elucidated in the laboratory 2. Greenhouse and field evaluation of treated and non-treated net placement based on the circadian movement of red spider mite and its predator undertaken 3. PhD and MSc students training on behavioural research with red spider mite and its predators	Understanding on the circadian behaviour of the red spider mite and its predator used by scientific community to refine the use of treated and non-treated nets for pest management in solanaceous vegetables by 2014	• No. of publications • No. of theses • At least 1 PhD and 1 MSc student trained by 2014	• Project reports • Theses • Greenhouse and field data • Laboratory data	• Laboratory bioassays • Greenhouse and field experiments	• No extreme weather conditions. • *Tetranychus evansi* and predatory mite *Phytoseiulus longipes* exhibit circadian movement with *Tetranychus urticae*

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1.7: Promote adoption of push-pull technology for effective management of striga and stemborers infesting maize, sorghum, millet and rice, and also for effective management of cotton insect pests, through collaboration with international and national partners by 2014.					
1. Push-pull technology implemented by over 55,000 farm households, and indirectly benefit d over 0.5 million people East Africa	Food sufficiency and household incomes of 50,000 push-pull farmers increased by at least 50% by 2013 through higher and sustained crop, fodder and milk yields	• Acreage of farmland under Push-pull • Household income levels attributable to Push-pull • Number of households having cereal food sufficiency • Number of farmers having improved dairy animals • Number of Push-pull farmers utilizing fodder from Push-pull in their dairy production • Number of dissemination channels optimized and employed • Cereal and fodder yields and milk production levels among target farmers • Number of partnerships formed • Number of stakeholders trained	• Baseline data, maps and reports • Ex-ante and ex-post impact assessment reports on household food security, nutrition and incomes • Project reports • Country sub-programme • Reports by development partners	• Baseline surveys • Ex-ante and ex-post surveys	• Commitment and cooperation of national institutions, extension networks, and participating NGOs, CBOs, farmers and their support groups assured • Technical expertise is available for developing new technological innovations and a backstopping framework • Conducive weather conditions

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
2. Push-pull IPM approach developed for the management of cotton insect pests in western Kenya and North East Brazil	Improved cotton productivity and incomes of at least 2,000 farmers by 20% in western Kenya and North East Brazil by 2013	• Number of cotton farmers using the push-pull IPM approach in the target areas • Number of push-pull cotton stakeholder networks in place in Brazil and Kenya • Number of publications in refereed journals • Number of partnerships formed	• Baseline data, maps and reports • Ex-ante and ex-post impact assessment reports on household food security, nutrition and incomes • Project reports	• Baseline surveys • Ex-ante and ex-post surveys	• Commitment and cooperation of national institutions, extension networks, and participating NGOs, CBOs, farmers and their support groups assured
3. An integrated management approach for Napier stunt disease	Improved incomes and livelihoods of at least 2,000 Napier farmers in Western Kenya by at least 50% through adoption of an integrated Napier stunt disease management strategy, characterised by increased fodder and milk production by 2013	• Quantity of Napier grass and milk produced • Number of alternative fodder grasses in use • Number of farmers using the integrated disease management approach • Number of partnerships formed • Number of stakeholders trained on integrated disease management • Number of peer-reviewed publications	• Stemborer and striga data • Published data • Published papers • Soil sampling data • Project reports	• Field and laboratory data sheets • M&E instruments • Surveys	• No overwhelming confounding factors (e.g. unusually extreme weather conditions, political instability) affect interpretation of the results • Good cooperation and effective communication between stakeholders

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
4. Stemborer management approach developed by exploiting early herbivory traits and plant signalling	Staple food sufficiency achieved by at least 3,000 farmers in Western Kenya by 2015 though grain yield increases by 30% Novel scientific knowledge on early herbivory and plant signalling generated and applied in crop protection by scientists, extension agents and policy makers by 2015	• Number of 'smart' maize varieties with early herbivory traits identified • Number of farmers adopting the use of 'smart' maize varieties • Increase in grain yields • Number of food sufficient households as a result of use of 'smart' maize varieties • Number of peer-reviewed publications on early herbivory and plant signalling • Number of stakeholders trained in stemborer control by exploiting inherent plant defence traits	• Project reports • Scientific papers • M&E reports	• Field and laboratory data sheets • Scientific journals • M&E instruments • Surveys	• Partners remain supportive • Farmers willing to adopt the cultivars • Conducive weather conditions
5. Effectiveness of participatory video in disseminating push-pull technology established by 2013	Food sufficiency and household incomes of 5,000 push-pull farmers increased by at least 50% by 2013 through higher and sustained crop, fodder and milk yields	• Number of farmers effectively learning push-pull through video and computer technology • Number and effectiveness of farmer-generated participatory videos produced • Number of partnerships formed	• Project reports • M&E reports • Reports by development partners	• PM&E instruments • Surveys • Farmers' interviews	• Farmers are willing to learn and actively participate in the development, implementation and evaluation of the push-pull technology • Active participation of local communities is secured

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
6. An integrated management approach developed and implemented for striga control in maize in Western Kenya and Nigeria	Food sufficiency and livelihoods of at least 15,000 smallholder farmers improved by at least 50% by 2014 through efficient control of striga resulting in increases in maize yields by at least 50%	• Number of farmers practising integrated striga control methods • Acreage under integrated striga control methods • Grain yield increases attributable to integrated striga control • Number of stakeholders trained on integrated striga control • Number of peer-reviewed publications • Number of partnerships formed • Number of partners' joint field days conducted	• Reports and published papers of Napier stunt pathogen transmission studies • Project reports • Scientific papers • M&E reports	• M&E surveys • Project reports	• Napier grass continues to be the choice fodder crop for smallholder dairy farmers • Resistant/tolerant Napier grass cultivars can be found • Partners remain supportive • Farmers willing to adopt the cultivars • Screened Napier cultivars remain resistant to stunt phytoplasma

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Specific objective 1.8: Scaling-up technologies and successful experiences in biological control of diamondback moth (DBM) in cruciferous crops in Eastern Africa to other African countries					
1. Surveys of DBM and its indigenous natural enemies in Mozambique, Malawi, Zambia and Rwanda conducted by June 2013 and June 2015 respectively	Functional DBM biocontrol structures established in target countries before end of 2015	• MoUs with respective governments prepared and signed by February 2013 • 2 researchers from each country trained in baseline survey methodology before end of 2012 • Baseline surveys conducted by trained national researchers in Mozambique and Malawi by June 2013 • Baseline surveys conducted jointly by *icipe* and national researchers in Zambia and Rwanda by June 2015	• Copies of MOUs • Names of NAREs staff trained • Country and project reports • Reports of baseline survey data in each target country	• Baseline country reports • Project progress reports	• Current political stability persists • Minimum staff deployment to other projects • Governments willing to cooperate
2. Effective and functional rearing facilities and systems for biological control agents of DBM established in Mozambique and Malawi before end of 2013		• Members of staff from Mozambique and Malawi (2 from each country) trained in mass rearing of DBM parasitoids • Trained staff members set up mass rearing facilities and production of parasitoids in Mozambique and Malawi by June 2013 • Field releases of DBM parasitoids piloted in selected areas in Mozambique and Malawi before end of 2013	• Copies of parasitoids import/ export permits • National DBM/ parasitoids rearing facilities • Consignments and shipment dates documents • List of parasitoids release sites • Field release dates and sites	Project progress reports	• No extreme weather changes • Governments willing to cooperate • Current political stability persists

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
3. Extension agents and farmers trained in locally adapted bio-control IPM approaches for crucifer pests	Locally adapted bio-control IPM technologies promoted in Malawi and Mozambique by 2015	• Country specific report of key crucifer pests and current farmer practices • At least 15 master trainers trained in vegetable IPM in each of Mozambique and Malawi by June 2013 • At least 2,000 farmers trained through at least 80 FFSs by June 2015 • At least 10 field sessions /FFSs conducted during each growing season • Country specific end user friendly IPM information packages produced and distributed by June 2015	• Number and names of FFS trainers trained in each country • Number and locations of FFSs established or updated • IPM crucifer FFS curriculum • Field coordination unit reports	Project progress reports	
4. Policy makers and general public sensitized on vegetable IPM methodologies		• Biological control and locally adapted IPM methodologies that reduce insecticide use and improve food safety promoted by July 2015	• Copies of policy briefs and TV/ Radio programmes transmitted	Project progress reports	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
5. Impact of *Cotesia plutellae* in semi-arid Eastern province of Kenya assessed and disseminated to other countries	Knowledge enhancement for further scaling up of DBM biological control in new areas of project countries compiled by 2015	• Impact assessment data collected and analyzed by end of 2013 • Information shared in stakeholder and annual planning meetings • Awareness material produced and distributed	• Impact assessment report • Copies of awareness material produced • Stakeholders' workshop reports	Project progress reports	
6. Knowledge products developed from field experience in Mozambique and Malawi by end of 2014		• Updated FFS curriculum • Documented lessons learned from field surveys	• FFS curriculum documents • Project progress reports	Project progress reports	
7. Preparatory planning for scaling up of the activities in Mozambique, Malawi, Zambia and Rwanda with the IFAD projects and respective Ministries based on lessons learned		• Mid-term stakeholder meetings conducted in Rwanda and Zambia with policy makers and IFAD country officers by June 2015 • Annual planning and stakeholder meetings in Mozambique and Malawi • Final regional stakeholders' meeting for sharing of lessons learned and planning of scaling up in July 2015	• Project progress & final reports • Stakeholders' workshop reports • Annual work plans and budget produced • Final action plans for scaling-up prepared	Project progress reports	Willingness of governments and IFAD projects to cooperate

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Specific objective 1.9: Responses of tropical insects to global changes.					
1. Baseline information on Lepidoptera stem borers and parasitoids diversity in Sub-Saharan Africa on Poaceae, Thyphaceae and Cyperaceae, community structure of Lepidoptera stem borers and parasitoids on wild and cultivated habitats, host plant selection mechanisms by Lepidoptera stem borers (Noctuidae), host selection mechanisms by parasitoids (Braconidae) 2. Study of the genetical basis of *Busseola fusca* resistance to the *Bt* maïs	At least four study outcomes utilized by scientists and students by 2015.	• Phylogeny of the noctuid stem borer. • Descriptions of new Lepidoptera stem borer species and genera. • Descriptions of new parasitoid species. • Identification and preparation of new pheromone blends of new Lepidoptera stem borer species. • Biological control of *Sesamia nonagrioides* in France by a new parasitoid species. • Identification of new candidate genes involved in the chemoreception of *S. nonagrioides* and in host acceptance by *Cotesia sesamiae*. • Prediction of the spreading of *Busseola fusca* resistance to *Bt* maize • First screening of the genetical markers involved.	• *ex ante* reports • Theses publications • Manuscripts • Student Reports	• Project reports • Laboratory data • Progress reports	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 2: Minimise the vulnerabilities of horticulture and staple crops to climate change-induced pest problems by at least 10% by 2020.					
Specific objective 2.1: To eliminate gaps in knowledge of climate change impacts on ecosystem services and food security in Eastern Afromontane Biodiversity Hotspots by 2015.					
1. Baseline information on ecosystem services (pollination and pest management, biodiversity, habitats and water resources) established	Study outcomes utilised by scientists, policy makers, extension workers and other stakeholders by 2015	• Effects of climate change on biodiversity and habitats explored through modelling by 2015	• Publications • Survey records • Predictive models • Data from Automatic Weather Stations	• Surveys • Voucher specimens • Secondary data collection (maps and reports)	• Quality of existing data • Willingness of stakeholders to cooperate • Security situation for fieldwork • Extreme weather events
2. Use of Remote Sensing and Geographic Information Systems (GIS) for land cover and land cover change monitoring	Geospatial datasets developed for the three target areas (Taita Hills in Kenya, Kilimanjaro in Tanzania and Jimma in Ethiopia) are widely utilised by stakeholders by 2015	• GIS platform established for sharing geospatial datasets among at least 25 East African stakeholder organisations by 2015 • Geospatial datasets developed for target areas on 8 different themes by 2015 • MSc and PhD training on GIS organised for at least 25 staff members of the stakeholder organisations	• Satellite images and GIS databases • Basic maps (printed and digital) • Aerial photos • Atlases • Training reports and certificates	• Remote sensing • Aerial photography • Secondary data collection	• IT capacity of stakeholder institutions • Local budget contribution available • Retaining of trained project personnel

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
3. Modelling and economic valuation of the benefits of ecosystem services	Beneficiaries and benefits of ecosystem services identified, characterised and quantified, and future scenarios developed for target areas in EABH by 2015	• 4 assessment tools identified • Gender disaggregated stakeholder analysis and reports completed by 2015 • Stock values of ecosystem goods and services defined by 2015	• Reports • Statistics • Publications • Models • Databases	• Survey questionnaires • Grower interviews • Secondary data collection • Fieldwork	• Security situation in target areas does not prevent or interrupt fieldwork
4. Effects of climate change and land cover change on biodiversity and habitats explored	Reliable models and maps for each target area available for stakeholders by 2015	• Species envelopes completed for three target areas • Regionally tailored climate change projections completed by 2015 • Maps and models available for all known species for major biodiversity trigger taxa; 4 most important crops (maize, coffee, avocado and crucifers); carbon storage and sequestration rates; main pollinators and pests by 2015	• Agriculture ministry records • Publications • Grower reports • Maps and models	• Survey • Grower interviews • Fieldwork	• Security situation • Quality of species distribution • Environmental datasets adequate for the purpose

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
5. Baseline data and monitoring protocols for functional ecosystem pest management and pollination established along altitudinal gradients in three research areas	Historical data on pollinators, pests and natural enemies of target crops compiled by 2015 Species distribution maps available for stakeholders by 2015 Species composition and abundance on target crops available by 2015 Predictive models generated by 2015 Number of MSc and PhD level staff trained, especially females by 2015	• Identification of study transects across the altitudinal gradient in the Taita Hills, Kilimanjaro and Jimma Highlands undertaken • Field sites for monitoring pest and natural enemy dynamics identified • Selection of 6 PhD Students and 1 MSc student to undertake research on climate change impacts on pest management and pollination selected • Upgrade of laboratory to undertake research on Climate Change with incubators undertaken. • Sites selected for 11 Automatic Weather Stations, MOUs with National Meteorological Agencies signed. • Weather stations placed in four locations of the Taita Hills and three locations on Mt. Kilimanjaro.	• Voucher specimens • Publications • Reports • Maps • Datasets • Theses	• Survey • Grower interviews • Models • Fieldwork	• Quality of existing data • Extreme weather conditions do not interrupt data collection

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
6. Effects of climate change on water provision services explored and documented	Likely impacts of climate change on access to water identified and documented with key stakeholders in the three study areas by 2015	• Water basin maps, hydrological datasets and hydro-meteorological station network established by 2015 • Predictive models for target areas completed by 2015	• Reports • National statistics • Maps and datasets • Hydro-meteorological models • Publications	• Survey • Statistics • Secondary data collection	• Quality of existing data is adequate for the purpose • Security situation in target areas does not prevent or interrupt fieldwork
7. Adaptation strategies to changes in ecosystem services elaborated and Adaptive Management Framework (AMF) tools developed	A set of AMF tools available by 2015 Tools for vulnerability assessment prioritised, susceptibility index and vulnerability maps completed by 2015 Action plans and reporting mechanisms completed by 2015	• 3 MSc students to carry out research on available adaptation strategies to climate change in Taita Taveta selected. • Project website to share information among the partner organisations and other stakeholder developed. • Community sensitization on climate change effects and need for research undertaken.	• Baseline data, maps and reports • Workshops • Project reports • Literature • Reports • Maps and models • Action plans • Databases • Training material	• Baseline surveys • Interviews • Course reports • Secondary data collection • Fieldwork	• Quality of data adequate for the purpose • Security situation in target areas does not prevent or interrupt fieldwork

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Specific objective 2.2: Adaptation and Dissemination of the Push-Pull Technology (ADOPT): A conservation agriculture approach for smallholder cereal-livestock production in drier areas to withstand climate change					
1. Push-pull technology adapted to dry weather conditions associated with climate change by smallholder cereal-livestock farmers in eastern Africa.	Food sufficiency and household incomes of 5,000 smallholder farmers in drier areas vulnerable to effects of climate change increased by at least 50% by 2013, through adoption and practice of climate-smart Push-pull	• Acreage of farmland under climate-smart Push-pull • Number of farmers practicing climate-smart Push-pull • Cereal and fodder yields and incomes among target farmers in drier agro-ecologies	• Baseline data, maps and reports • *Ex-ante* and *ex-post* impact assessment reports on household food security, nutrition and incomes • Project reports	• Project reports • Surveys and reports on perceptions of target farmers of the climate smart push-pull technology • *Ex-ante* and *ex-post* assessment reports • Peer-reviewed publications	• Technical expertise is available for developing new technological innovations in response to climate smart push-pull and the establishment of a backstopping framework
2. Identification and utilisation of drought-tolerant companion plants for Push-pull technology	• At least three outcomes of the technology adaptation process utilised by scientists, policy makers and other stakeholders by 2013	• Number of stakeholders trained • Number of partnership formed • Number of publications on farmer perception of the adapted Push-pull technology	• Baseline data, maps and reports • *Ex-ante* and *ex-post* impact assessment reports on household food security, nutrition and incomes • Project reports	• Project reports • Surveys and reports • *Ex-ante* and *ex-post* assessment reports • Peer-reviewed publications	• Drought-tolerant plant used in climate smart push pull to be adapted by farmers

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Specific objective 2.3: Predicting climate change that induced vulnerability of African agricultural systems to major insect pests through advanced insect phenology modelling, and decision aid development for adaptation planning					
1. Baseline information on pests' life table according to the temperatures, on maize stem borer communities densities along altitudinal gradients, on soil and plant silicon levels influencing the stem borer density and communities, stem borer competitions, soil characteristics along altitudinal gradients, farmer practices and their impacts on agro-ecosystem.	At least three study outcomes utilized by scientists and students by 2015.	Development of predicting models combining different parameters evaluated by the group by 2015.	• PhD theses • MSc theses • *Ex-ante* studies		

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 3: Post harvest research and development programme initiated in *icipe* by 2013					
Specific objective 3.1: Provide evidence Postharvest Losses of various commodities in Sub-Saharan Africa and to help decision-makers in governments to optimize their post-production policies and strategies in order to prevent food losses at different levels of the supply chain					
1. Postharvest Losses (PHLs) review conducted in six countries Benin, Ghana, Kenya, Malawi, Mozambique and Tanzania) in 2013	Evidences on PHLs provided by 2013 At least one manuscript of journal article completed by 2014 At least one policy brief completed by 2013 At least one working paper on methodology of PHL completed by 2013	One technical report of the review completed by 2013 Manuscript of journal article submitted by 2014 Policy brief by 2013 Working paper by 2013	• Reviews conducted in six countries in the Africa • Drafts of manuscript prepared for the six countries in the Africa • First draft of the working paper produced	• Review reports • Draft manuscripts • Policy briefs • Working papers	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Specific objective 3.2: Provide evidence for alternative uses of Purdue Improved Cowpea Storage (PICS) bags					
1. Performance of PICS bag tested and documented by 2013	At least 4 commodities are tested for storage in PICS bag in at least 2 countries by 2013 At least 2 manuscripts of journal article completed by 2014	Research reports Manuscripts of journal article submitted	Experiments reports	• Laboratory data • Field data	

ANIMAL HEALTH DIVISION

1. Divisional narrative

Over two-thirds of the population in the developing world is small-scale farmers, many of whom are dependent on livestock for their everyday survival. Improvement of livestock health and productivity, therefore, provides a significant opportunity to improve the livelihoods of these poor people and to help them escape the poverty cycle. It is also important to improve livestock productivity to meet the increased demand for livestock products and to enhance traction power of oxen for improved agricultural productivity.

Over the years, the Division has developed capacity along the full research continuum, from strategic basic research to adaptive research and finally to technology development and transfer through strategic partnerships. It has considerable expertise in quantitative vector ecology, behavioural and chemical ecology, bio-control and integration of this basic knowledge in developing technologies that farmers can use. Our research and experience in tsetse and ticks have generated technologies which enable farmers to undertake better ecological management of these major livestock disease vectors and help in intensifying and diversifying smallholders farming systems to generate more cash income and enhance food security. The emphasis has been on developing environmentally safe methods that can be applied together in tailor-made, site-specific packages. Components of such a package include *icipe*'s well-known NGU tsetse trap whose efficacy is enhanced by odour baits, biological control and the use of repellents. *icipe* is also one of the few organisations, despite its limited funding, that continues to conduct research into the control of ticks and tick-borne diseases, to develop Integrated Parasite Vector Management (IPVM) approaches which rely on biological control, use of botanicals and anti-tick pasture plants, repellents and behavioural modification of the cues ticks use to find hosts and preferred feeding and mating sites. Indigenous knowledge of communities in management of ticks is also being incorporated in developing appropriate strategies for tick control.

In the case of tsetse, the Division has considerable experience in community mobilisation, empowerment and organisation for undertaking tsetse and trypanosomosis control in different agro-ecosystems and animal husbandry practices. Capacity building at all levels of society is an integral part of all Division activities.

2. Goal and broader objectives

Goal: *icipe*'s animal health research aims to improve livestock health and productivity through the development of integrated strategies and tools for livestock vectors' control, thus leading to greater availability of meat and milk, hides and draught power.

Objectives: Research activities focus on developing simple technologies based on detailed understanding of vector behaviour, population ecology, and vector–host and vector–parasite interactions. The research focus has been on two important vectors affecting livestock productivity in SSA: tsetse flies, vectors of animal and human trypanosomiasis, and ticks, which, among other diseases, transmit East Coast fever. Research on arthropod vectors with zoonotic potential and responsible for trans-boundary animal diseases is planned.

Capacity building to create cadres of research, vector control specialists and managers in livestock IPVM will continue to be given a high priority. Communities will also be capacitated to ensure sustainability of control efforts. Through this RBM the objective is to reduce by 50% the disease constraints caused by

vectors of animal diseases, and poor nutrition for enhancing livestock health, productivity and welfare of livestock keepers in *icipe* project areas in Africa, particularly pastoralists and agro pastoralists by 2020.

3. Strategic future plans

Focus on vectors of trypanosomiaisis, of both humans and animals, and tick-borne diseases will continue.

Greater use of genomics and bio-informatics, and behaviour and chemical ecology will be made for technology development and implementation.

Research will be extended to other arthropods of medical and zoonotic importance to develop technologies for the integrated management of these vectors and the diseases they transmit.

More holistic projects in collaboration with other *icipe* divisions will be developed to catalyse sustainable agriculture and rural development, improve livestock and human health, and ensure food security and reduce poverty.

Capacity building to create cadres of research, vector control specialists and managers in livestock IPVM will continue to be given a high priority. Communities will also be capacitated to ensure sustainability of control efforts.

Animal Health Results Based Management (RBM) Framework

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1: Reduce trypanosomiasis risk by 50% in cattle of pastoralists and agro pastoralists by 2013 by development and optimisation of tsetse repellent technology					
1. Robust dispensers developed for field use for both synthetic and waterbuck repellent blend (WRB). 2. Patent application for identified WRB. 3. Patent application for dispensers	Tsetse repellent technology patented by 2012	• 2 patents awarded • Favourable assessment undertaken by participating livestock keepers • Publications produced	• Patents awarded • Publications produced • Journal index • Project reports	• Reports • Secondary data collection • Fieldwork	• Effective partnership with national systems maintained • Effective support from livestock keepers and extension services of NARs
4. Repellents and their dispensers evaluated	Drug use by farmers and disease incidence in cattle reduced by > 50% using tsetse repellent technology by 2013	• 50% decrease in drug use • 50% decrease in disease incidence • Favourable assessment by participating livestock keepers and veterinary staff • Publications produced	• Monitoring reports • Impact assessment surveys • Publications produced • Journal Index • Project reports	• Surveys • Farmer interviews	• No overwhelming confounding factors (e.g. unusual weather conditions) affect interpretation of the results • Stable political environment in project countries • Active participation of communities secured • Effective partnerships maintained with NARs and extension services • Project sites not affected by other area-wide tsetse control techniques

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
5. Awareness created among stakeholders to support introduction of repellent products and their application in integrated control strategies at regional level	Agreement signed with at least three key stakeholders for wider dissemination and trials of repellent technology in other African countries by the end of 2013	• No. of MoU's signed • No. of stakeholder workshops held • No. of Technical Advisory Notes (TANs) produced • Media articles • No. of workshops held • No. of training courses held • >400 farmers attend dissemination sessions	• Stakeholders' meetings minutes and reports • MoU's signed • TANs produced • Media articles published • Reports of workshops held • Report on training courses • Project reports	• Reports • Secondary data collection • Fieldwork • Stakeholder interviews	• Respective stakeholders willing to cooperate • Representatives from regional organisations attend meetings and workshops on a regular basis • Good cooperation with farmers and extension staff
6. Training farmers in use of repellent technology 7. Training manuals and brochures produced	>50% of trained farmers willing to adopt tsetse repellent technology in Kenya and Uganda by 2013	• No. of farmers trained • Training reports • Assessment reports • No. of training manuals and brochures produced	• Training reports • Assessment • Reports by NARES	• Farmer interviews • Reports • Secondary data collection • Fieldwork	• Good cooperation with farmers and extension staff
8. Technology for large-scale production of dispensers and repellent compounds passed over to local entrepreneurs	Number of agreements signed with entrepreneurs for commercialisation of tsetse repellent technology by 2013	• No. of expressions of interest from commercial/ local companies to explore development of dispensers and repellents • No. of agreements signed • No. of meetings held with entrepreneurs	• No. of agreements signed • No. of meetings held with entrepreneurs. • Project reports	• Feedback from entrepreneurs • Assessment reports	• Repellent technology can be successfully converted into a viable commercial venture • Potential markets are sufficiently large and lucrative to attract commercial interest. • Stakeholders interested in up-scaling, and assist in wider dissemination

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 2: Reduce by 50% the disease constraints caused by vectors of livestock by 2014 by development of site-specific animal health packages in different livestock production systems in selected countries in West and East Africa.					
1. Animal health package to protect dairy cows in zero grazing units from vectors of livestock developed	Milk production in zero grazing units doubled in two selected areas in Kenya by 2013	• Documentation on animal health package made available • No. of on-farm trials undertaken • Cases and technical reports produced • Milk production doubled • Up-scaling and replication of package in other production systems • Publications produced	• Project reports • Publications • Journal index • Technical Advisory • Notes • Independent evaluation by NARES	• Surveys • Fieldwork	• Acceptance of identified stakeholders to actively participate in project activities • Favourable environment for project replication • No competitive public/ private interventions take place
2. Animal health package to protect livestock from biting flies developed in selected countries	Biting fly populations in zero grazing units reduced by 80% by 2012	• Documentation on animal health package made available • No. of on-farm trials undertaken • Cases and technical reports produced • Biting flies population reduced by 80% • Up-scaling and replication of package in different production systems • Publications produced	• Project reports • Publications • Journal index • Technical Advisory • Notes • Independent evaluation by NARES	• Farmer interviews • Reports • Secondary data collection • Fieldwork	• Acceptance of identified stakeholders to actively participate in project activities • Favourable environment for project replication • No competitive public/ private interventions take place

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
3. Training of farmers and NARES in management of zero grazing units to minimize vector-borne diseases	400 farmers trained in eastern and western Africa in management of zero grazing units by the end of 2013	• No. of farmers, rural communities and NARES participating in project activities in different countries • No. of training courses held • No. of trained farmers and community leaders • No. of women trained	• Documentation on no. of training courses/ workshops held • No. of participants trained	• NARS interviews • Reports • Secondary data collection • Fieldwork	• No competitive public/ private interventions take place • Political environment conducive for training and implementation of new packages
Objective 3: Develop molecular tools for identifying sources of blood meals in tsetse flies (Diptera: Glossinidae) by 2012					
1. New tools for identifying tsetse fly blood meals developed	A new tool for identifying bloodmeal sources in hematophagous vectors available for field use	• One peer reviewed publication available and project report complete. • No. of students projects are applying the tools for their studies	• Laboratory experiments • Field reports	• Laboratory data • Secondary data reports	• Cooperation among partners • Availability of blood-fed tsetse flies in the field

HUMAN HEALTH DIVISION

1. Division narrative

Vector-borne diseases remain a significant public health problem throughout SSA. Diseases such as malaria, leishmaniasis, human African trypanosomiasis, onchocerciasis and schistosomiasis are among the most prevalent parasitic diseases in the region. In addition, some arboviruses such as dengue, yellow fever, plague, typhus, and Rift Valley fever are among the re-emerging infectious diseases that pose a threat globally. *icipe* recognises that an increase in productivity cannot occur without a healthy workforce. The Centre's Human Health Division (HHD), therefore, focuses on improving the health of people so that they can be more active in economic development. Though efforts have been made to reduce morbidity and mortality due to these diseases, they continue to increase in intensity and geographic coverage because of insufficient action to break the transmission cycle. Since the 1970's, little attention was given to vector control that resulted in a dramatic decrease in human and financial resources in many countries in Africa. However, a series of significant events over the last decade have underlined the growing interest and commitment to stepping up efforts to control these diseases. Six years ago, the World Health Organization (WHO) launched the Roll Back Malaria (RBM) Programme, with the main goal of reducing mortality due to malaria by half by the year 2010. Recently, other similar foundations and the US based Presidential Malaria Initiative are indicative of the (hitherto unknown) support and goodwill from donors and political Africa, and this has now paved way for both the research community and implementing bodies alike to make an improvement in Africa's disease burden.

The support of an integrated approach for vector-borne diseases will supplement other efforts such as vaccines and drug development as well as existing vector control tools. *icipe* is contributing to an integrated vector management (IVM) approach by developing environmentally friendly tools and strategies to control the vectors at all life-stages, including the use of botanicals like neem and bio-pesticides like *Bacillus thuringiensis israeliensis* (Bti), biological control and attractants identified from preferred plant/human/animal hosts, while at the downstream research, we involve the communities to break the cycle of disease transmission.

2. Goal and broader objectives

Goal: Contribute to the reduction of malaria and other vector-borne diseases by developing tools and strategies that control the vectors and break the cycle of transmission, and which can be integrated with other disease management efforts.

Objectives:

- To contribute to the national disease control programmes by focusing on the ecology and behaviour of arthropod vectors;
- To strengthen linkages and networks with national research and teaching institutions in Africa;
- To develop integrated vector management strategies for use in different ecological settings;
- To contribute to the WHO/AFRO initiative of strengthening vector control capability for the national disease control programmes in Africa.

3. Strategic future plans

- Develop capabilities for monitoring and evaluation of interventions and control strategies of vector-borne diseases in SSA.
- Conduct research leading to development of new and improved malaria control tools including: (i) the combined use of attraction of mosquitoes to traps baited with different attractants (identified from plant and blood meal sources) and repulsion from households with potent plant fumigants; and (ii) similar tactics to manipulate and control oviposition.
- Capacity building within the existing study sites, expansion of activities in other regions and continuing education of African vector control specialists.
- Establish malaria early warning system in epidemic prone areas by coordinated data collection and surveillance at selected sentinel sites in sub-Saharan Africa.
- Coordinate system-wide initiative on malaria and agriculture in Africa and South East Asia.
- Identify novel target sites for arthropod management, including bio-rational pesticide compounds, attractants and repellents detrimental to disease vectors.
- Expand human health activities to cover not only malaria, but also other arthropod-borne diseases, including emerging infectious diseases.
- Become a WHO Collaborating Centre on IVM and capacity building.
- Strengthen collaboration for vector research and training programmes in Africa.

Human Health Results Based Management (RBM) Framework

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
Objective 1: Contribute towards malaria elimination through the development of effective vector control strategies and public health initiatives by 2020.					
1. Understanding of the link between livelihoods, ecosystem health and malaria in 50% of target community populations developed by 2020	At least 30% of the community members are embedding safety measures in their livelihood seeking activities	• Presence of malaria self-help groups • Increased demand of education about malaria control • Agenda for taking collective action against malaria, through adoption of safer livelihood practices • Peer-reviewed publications • Books	• Reports • Publications on social practices aggravating malaria	• Field interviews	• Community embraces the programme

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
2. A comprehensive evaluation of ongoing IVM sub-projects undertaken and a 5-year (2013-2017) strategic plan for a new IVM programme developed 3. Development of a proposal to explore funding for the new IVM programme.	At least 30% increased awareness on IVM strategies for vector-borne disease control At least 200 stakeholder workshops held on mosquito and malaria control At least 10 IVM outreach meetings/activities targeting countries in East and Central Africa At least 50% decrease in mosquito densities	• Comprehensive evaluation report of *icipe* IVM projects in Kenya and Ethiopia published; • *icipe* Malaria IVM Strategic Plan 2013-2018 drafted • Proposal document entitled: "Integrated Vector Management (IVM) for Sustainable Malaria Control in Eastern Africa" developed. • Number of community members trained • An IVM utility model for decision makers available • Number of workshops • Number of mosquitoes collected in houses and larval habitats examined • Effective mosquito control methods and strategies used by decision makers • Number of articles published in peer reviewed journals	• Regional training workshop report • Five-year strategic plan of IVM R&D activities	• Active IVM sites in Kenya and one in Ethiopia • Outreach meetings with participants from ministries of Health/ Environment in Kenya, Ethiopia, Zambia, Tanzania, Rwanda, Malawi and Uganda	• Funding availability
4. A potent lure derived from screening three mosquito preferred plants developed	Field trial of lure executed at one malaria endemic site in Kenya	• One peer publication available • Project progress report • Lure in use by project scientist	• Publications	• Field interviews • Laboratory experiments	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
5. At least five scientists based at *icipe* working on aspects of mosquito vector competence with regard to malaria by 2015	At least 4 scientists able to compete for research grants in GMM At least 20% of human health research at *icipe* in the area of *Anopheles* mosquito vector competence	• Number of proposals • Number of peer-reviewed publications • Number of employees • Number of funded studies • Graduate theses	• Publications • Theses • MoU terms and conditions	• Field studies • Interviews • Secondary data	• Partners establish MoU • Postdoctoral fellow recruited • Consultant available with appropriate expertise
6. At least two chemical-based technologies for surveillance and/or disruption of malaria transmission developed by 2015	Odour-baited traps used for malaria control in at least one community- Use of odour-baited traps for mosquito surveillance by at least five locally active government and/or non-governmental agencies	• Presence/use of attractant baited traps by researchers and national malaria control programmes • Availability of a potent spatial mosquito repellent or repellent principle • Presence of a working push-pull concept for mosquito control • Number of publications in peer reviewed journals • Project progress reports • Theses • Posters	• Publications • Theses • Posters • Repellent strategy	• Field studies • Laboratory experiments • Secondary data	• Funding availability

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
7. Understanding of oviposition response of *An. gambiae* to aquatic habitats that differ in their chemical and bacterial profiles for vector control purposes developed by 2015	Synthetic or bacteria-derived semiochemicals used by national vector control agencies for surveillance of oviposition site seeking Synthetic or bacteria-derived attractants used for malaria/ mosquito control targeting oviposition site seeking mosquitoes and their offspring (larvae) Larval control strategies targeted in space and/or time based on females habitat preferences developed	• Presence/use of attractant- baited traps by national malaria control programmes (NMCPs) • Peer-reviewed publications • Books • Theses	• Publications • Book chapters • Theses	• Laboratory bioassay experiments • Semi-field assessment of laboratory results in greenhouse setting • Simulated open-field trials and field tests under natural conditions • Systematic and desk reviews	• Favourable climatic conditions
8. Innovative application strategies of novel, persistent insecticides for *An. gambiae* developed by 2020	Optimum concentration of insecticides for malaria control used by the communities in western Kenya An 'attract and kill' strategy adapted by combining oviposition attractants with long-lasting larvicides developed and used by communities	• Increased interest in larval source management by national malaria control programmes (NMCPs) • Rationalised larval source management strategies for malaria control • Use of novel insecticides in national programmes • No. Peer-reviewed publications • Books • No. Theses produced	• Aquatic habitats in the intervention areas • Field interviews	• Laboratory bioassays • Semi-field assessment of laboratory results in greenhouse setting • Simulated open-field trials and field tests under natural conditions • Systematic and desk reviews	• National programmes embrace the technology

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
Objective 2: Develop a clear understanding of circulation and maintenance of arboviruses that contribute to human, wildlife and livestock disease in East Africa to inform public health and disease surveillance and mitigation approaches by 2020.					
1. An arboviral surveillance and response system for early warning and response in East Africa established by 2013	Network of surveillance partners in Kenya, now engaging with *icipe* on multiple surveillance projects	• Sequencing and diagnostics in place, 30 trained personnel • Early detection and response to arboviral outbreaks in the region • Files of the project proposal • Virus databases • Taxonomic keys • Diagnostics manuals	• Reports • Detection and response strategy • Field studies • Databases • Manuals • Publications	• Sequencing and Mass Tag training for staff done	• Favourable climatic conditions in the programme sites
2. Twenty field and lab officers from East African countries trained on lab diagnostics, field sampling and biobanking by 2012	Awareness created on the arbovirus diagnostic platforms available in *icipe* and their applications in 5 East African countries. Enhanced collaboration	• Inquiries on use of platforms for research • Log of trained personnel and contacts maintained • Files of the project proposal • Taxonomic keys • Training folders	• Training manuals • Project proposals • Publications	• Field sampling and biobanking • Laboratory experiments	• Completion of Phase 2-(Laboratory training on multiplex PCR and second generation sequencing) training in 2012
3. 20 known (arbo-) viruses and 5 new pathogens or their variants detected, 10,000 samples screened by multiplex PCR or ELISA by 2015	Over 70 virus isolates identified from mosquitoes and ticks, 66 of which are known viruses of public health significance. Sequence data available for 40 strains	• Three peer reviewed publications accepted. • Thesis and capacity built. • Sequences in gene bank • Number of publications in peer reviewed journals • Files of the project proposal • Virus data bases • Taxonomic keys	• Gene banks • Publications • Proposals • Databases	• Laboratory gene sequencing • Laboratory testing and analysis tools	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
4. A vector map associated with the transmission of different arboviruses in different East African regions developed by 2014	Virus detections and associated vectors mapping in process	• Published vector/arbovirus map that is used by other East African institutes when considering vector control initiatives	• Published vector/ arbovirus map	• Molecular tools identification	
Objective 3: Contribute to an improved Rift Valley fever (RVF) forecasting and response plan by improving understanding of RVF virus maintenance, and epidemic transmission dynamics in East Africa by 2020.					
1. Odour-bait trapping system for RVF vectors developed	Utilisation of the trapping system for surveillance and monitoring of RVF vectors by stakeholders in RVF research by 2015	• Lure for trapping RVF vectors available • Progress report • Number of peer-reviewed publications • Theses	• Trapping devices • Publications • Reports • Theses	• Laboratory identification of potential odour-bait • Field trials	• Continued field trials

ENVIRONMENTAL HEALTH DIVISION

1. Divisional narrative

The Environmental Health Division (EHD) carries out research on biological and related factors impacting species behaviour in landscapes, especially in the forest ecosystem through GIS (geographical information systems) services. Our mission covers the assessment and control of those environmental factors that can potentially affect the forests' and species' physical conditions. It is targeted towards identifying species, preventing diseases and creating healthy environments to develop insect-based enterprises for the livelihoods of the rural community. This also includes genetics and bioprospecting of the natural resources. Recently *icipe* incorporated carbon sequestration and carbon credit activities through collaborative programmes with the forestry and energy sectors in several African countries. Through donors' support, the programme has conducted useful research and implemented the results in farmers' fields, built capacity of students and trainers, and published the data in various peer-reviewed journals. EHD has three major programme areas, supported by two units, to accomplish the goals of the Division. The RBM function of each programme and unit is given below.

Biodiversity and Conservation Programme

- Linking climate change and biodiversity agendas—as recent agreements on Reducing Emissions from Deforestation and Forest Degradation (REDD+) at the COP-15 of the UNFCCC in Copenhagen say. This potentially provides a mechanism for protecting both biodiversity and carbon stocks in tropical forests.
- Linking human development goals and biodiversity conservation—The New Partnership for Africa's Development (NEPAD) and its Environmental Action Plan (NEPAD-EAP) and the West African Plan for Combating Desertification have developed regional development strategies that explicitly acknowledge the strong, but complex links between improving human well-being and environmental protection.
- Study the interaction between pollinators and pest species in various ecosystems and the interface among them.
- Develop methods to measure the carbon stocks in the various tree species to provide environmental services to farmers as carbon credits.

Commercial Insects Programme

- Study the disease defensive behaviour in African feral bees and stingless bees (population level analysis).
- Artificial insemination of honeybees to develop selective colonies for various traits.
- Study the pollination intensity and relative efficiency of several crops using honeybees and stingless bees.
- Measurement of variable selective forces in honeybee and stingless bees colonies, and wild and mulberry silkworms rearing.
- Diversity of the chemical and mechanical properties of mulberry and wild silk.
- Neuroendocrine control of the oviposition behaviour in stingless bee species in Africa.
- DNA fingerprinting of the potential stingless bees and wild silkmoth populations in Africa.
- Scaling up beekeeping and sericulture-based products, and pollination services in several eastern African and NENA region countries, and obtain certification and develop market linkages through private entrepreneurs.

Applied Bioprospecting Programme

- Develop new low-cost nature-based mosquito repellent products with potential for use and commercial production by rural communities.
- Identify new insecticidal products from plants and microorganisms.
- Identify and optimise insect-derived microorganisms with potential for community-based production of bio-ethanol gel for local energy use from agricultural waste.

GIS Support Unit

- Provide GIS services and support to *icipe*'s four Divisions and Research Departments. This comprises data analysis and database development as well as technical services like mapping and data management.
- Offer student and staff training courses in GIS and GPS (global positioning system) to increase awareness and knowledge for the spatial dimension and GIS-based approaches, to help implement GIS as a strategic tool into the *icipe* research portfolio.
- Make available spatial data and tools via the *icipe* intranet.
- Develop research proposals to gain funding for GIS-based research at *icipe*.

Biosystematics Support Unit

- Provide support in all activities related to insect taxonomy.
- Collection, preservation and preparation, and curation of insect and arthropod specimens. In the age of computer technology, this goes far beyond the storage of pinned insects, but includes digitisation of related data, GPS coordinates, digital photography and DNA-barcoding.
- These activities contain training elements for staff and students (e.g. Basic Entomology course), and are embedded into an international environment, by sharing the data with global initiatives such as GBIF and iBOL.
- A webpage on taxonomy, the African Insect Taxonomy Toolkit, is a part of the BSU's activities.

2. Goal and broader objectives

Goal: Conservation and sustainable utilisation of the agricultural production base and important natural ecosystems, by encouraging and utilising arthropod diversity, cataloguing and sharing biodiversity data, and discovering endemic wealth by bioprospecting for useful natural products.

Objectives:

- Understand how arthropod agro-biodiversity and wild habitats support agricultural production and human health through ecosystem services (pollination, pest and vector control, and maintenance of soil fertility).
- Help to conserve forests in Africa's Global Biodiversity Hotspots.
- Use *icipe*'s technologies to alleviate poverty in forest-adjacent communities.
- Establish modern apiculture and sericulture as significant contributors to rural livelihoods in Africa.
- Participate in global efforts to catalogue arthropod biodiversity.
- Develop new natural products from plants and insects for the benefit of rural communities and beyond.
- Increase public awareness and appreciation of beneficial arthropods.

3. Strategic future plans

EHD will continue with its focus on the conservation of hotspot forests, rural livelihoods, bio-prospecting and commercial insect programmes with an increased emphasis on the utilisation of wild arthropods. There will be a special emphasis on increasing and making explicit the economic benefits provided by insects to rural African populations. Through *icipe*'s BSU, efforts to secure support for taxonomy in the region have been intensified with a view to providing end-users with new IT and molecular tools (DNA barcoding) for identification.

The major new areas for EHD expansion will be in functional agro-biodiversity and the links between environmental degradation and human health. This will involve closer collaboration with the Human and Plant Health Divisions at *icipe* and with external partners. Functional agro-biodiversity research will concentrate on the ecosystem services provided by arthropods, starting with pollination and natural/ biological pest control, and emphasizing the landscape context in which smallholder farms are embedded in a mosaic of natural and semi-natural habitats. Particular attention will be given to services provided by forest fragments. Links between environmental degradation and human health will be explored for mosquito-borne diseases, emphasising the negative roles of deforestation and industrial developments in the creation and expansion of man-made habitats for mosquito breeding.

Environmental Health Results Based Management (RBM) Framework

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 1: Control of the aquatic plant pest, *Hydrilla verticillata*, in East Africa by wild *Polypedilum* (Chironomidae) species by 2012.					
1. Dissemination of information among weed-control professionals in *Hydrilla*-infested areas by 2012	*Hydrilla* control, national, and Florida, USA pest-management agencies incorporate project conclusions into work and research plans by 2013	• Reports and publications of weed-control specialists include references to use of *Polypedilum* in *Hydrilla* control	• Examination of unpublished reports, journals index	• Internet and library search • Request of reports from pest management agencies	• Work demonstrates that *Polypedilum* is a herbivore of *Hydrilla*
Objective 2: Taxonomic information of major African pests and vectors used by scientists, students and public by 2020.					
1. 5,000 DNA barcodes generated for the iBol database	Scientists use the DNA-barcode library for the African pest and vector insects to identify pest species with DNA techniques DNA Barcoding becomes a routine part of the taxonomic enterprise A taxonomic evaluation of poorly understood taxa, like stingless bees and African silk moth species	• Number of barcodes generated • Number of trainees passing examination	• www.ibol.org provides public interface to access the barcodes	• Inspection of database	• Guelph University continues to offer the sequencing of DNA barcoding free of charge

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
2.1 Three trainings per year for 10– 15 students and staff 2.2. Number of teaching modules available on intranet	Students and staff know and apply modern taxonomic techniques, including morphological identification, preparation and DNA techniques to identify insects	• Number of students and staff members trained	• Counting participants and modules	• Test analysis	• Students and colleagues have time and interest to participate in the courses
3. African Insect Taxonomy Toolkit (http://taxonomy.icipe.org)	Scientists and others make periodic use of taxonomic literature and tools	• External access rates are monitored	• IT statistics		
4. At least four projects with relevant taxonomic perspective developed and submitted by 2012	At least two projects with taxonomic component are funded.	• Number of projects funded	• *icipe* administration		• Sufficient calls and project partner available requesting taxonomic qualifications
5. By 2012, aquatic insects of streams in Kakamega forest are identified and local groups are trained in their identification	Local groups of KEEP and Muliru Farmers are capable of identifying these insects, and can monitor the quality of streams	• Number of community members trained.	• Project reports to donor		• Locals are incapable of identifying insects to the necessary taxonomic rank

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 3: **At least 6 new eco-friendly nature-based products for pest control adopted for improvement of livelihoods of rural and wider community members by the year 2020.**					
1.1 Candidate repellent plants and constituents identified based on efficacy, safety and ease of cultivation 2.1 Two repellent plant-derived products formulated and packaged 3.1 One repellent product submitted for registration with relevant bodies 4.1 Community-based domestication and cultivation of a repellent plant initiated 5.1 A community-based facility established for processing repellent plants 6.1 Production of mosquito repellent products initiated through private sector	One new nature-based mosquito repellent product adopted for commercial production and in use by 2014 At least 3 papers published in international journals	• Number of products produced and used • Number of participating community members • Number of reports and publications	• Records • Reports • Journals index	• Reviews • Inspection	• Products are acceptable • Community members will accept the project • Favourable weather conditions

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
1.2 At least 4 new potential insecticidal products identified from plants based on efficacy, safety and ease of application. 2.2 Two insecticidal plant-derived products formulated and packaged. 3.2 Community-based cultivation of selected insecticidal plants initiated. 4.2 Community-based production and use of plant-derived insecticidal products initiated in at least one project site. 5.2 One PhD and two MSc. Students trained. 6.2 At least three papers prepared and submitted to international journals.	One plant-derived insecticidal product adopted for use in pest control by a local community by 2013. Three papers on potential insecticidal products published by 2013.	• Number of products produced and used • Number of community members using the insecticidal products • Number of reports and publications • Number of students trained	• Records • Reports • Journals index	• Reviews • Inspection	• Products are acceptable • Favourable weather conditions • Funds are available

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
1.3 Two plants with bioactivity against honey bee pests/diseases identified. 2.3 One plant-derived product formulated and evaluated for control of a honeybee pest/ disease. 3.3 The bee pest/disease control product submitted for registration with relevant bodies. 4.3 Protocols for production of the bee pest/disease control product established.	One plant-derived product for honey bee pests/diseases control adopted for production and in use by 2015 Two publications /utility model/patent on potential honeybee pest control products published by 2014.	• Number of products produced and used • Number of reports and publications	• Records • Reports • Theses • Journals index	• Reviews • Inspection	• Products are acceptable • Favourable weather conditions • Funds are available
Objective 4: Geographic information systems are fully integrated as a strategic research tool for *icipe* by 2020.					
1. Geospatial data server expanded	GIS and increasingly remote sensing data variables are accessible and usable to scientists within *icipe*	• GIS data server available to all *icipe* staff • 2 new remote sensing data sets were processed and uploaded	• Number of GIS and remote sensing data variables	• Reviews • Inspection • Internet review	• Funding available

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
2. GIS and remote sensing training courses set up and given to students and resource managers	The percentage of students who use GIS and remote sensing solutions in *icipe* increased by 25% in 2012, when compared to 2011.	• 5 out of 12 ARPIS students use GIS in their work in 2012. • 10 students attend PhD level remote sensing course • Peer reviewed papers on the use of GIS and remote sensing in climate change studies published	• Project reports • Student thesis • GIS course material • List of trainees	• Reviews • Inspection	
3. The GIS and Remote Sensing e-learning platform is developed	E-learning course conducted by 2013	Curriculum for the e-learning course available	• Curriculum write-up • Project Reports • E-learning platform	• Reviews • Inspection	Adequate bandwidth to support the e-learning platform
4. Conceptualizing and submitting proposals on Ecosystem Services and spatial epidemiology mapping	Remote sensing and GIS is an integral part of the MANGROVAL proposal on ESS, submitted in 2012	One proposal on ESS submitted	• Proposal document	• Proposal database	
5. Efforts undertaken to increase the use of GIS in new and existing projects	Rift Valley Fever Project uses GIS tracking data for RVF assessment CERNVEC has a GIS component to train scientist to use GIS in health sciences	One more *icipe* project, uses GIS as a working tool for RVF research	• Project Document	• Project M&E	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
Objective 5: Increasing honey and silk production by 20% in selected African farming communities by 2020.					
1. Potential and healthy silk and bee races identified for enterprise development in Africa by 2012 2. Healthy silk and bee races are distributed to 3000 trainers for the farmer groups 3. Atleast 15 PhD and 10 MSc. Students trained. 4. At least 50 peer reviewed papers and 5 books/proceedings published in international journals.	50% of the farmers use improved bee and silk races	• Number of farmers using improved races	• Morphometrics and DNA fingerprinting results	• Field surveys	• Bee and silkmoth diseases under control
5. Training material developed 5.1 Training sessions held for 2,000 trainers.	Knowledge of sericulture and apiculture is applied by at least 750 farmer groups (each 50 to 100)	• Number of farmers trained • Number of certificates (exam) • Number of farmers applying their new knowledge	• Registry data	• Records	
6. Business model developed using value chain approach	Business model and business responsibility adopted by at least 400 farmer groups	• Number of enterprises registered	• Relevant Government office and private sector	• Survey • Records	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
7. 16 to 20 marketplaces (honey and silk harvesting, processing and selling units) established	25% increase in honey and silk quantity by 2013	• DC registry • Production records	• Records • Bank statement of marketplace account	• Survey • Inspection	• Conducive weather
8. Modern beehives supplied to farmers and rearing houses (silk moth) established	500 beehives supplied to farmers by 2013	• Project records	• Registry of farmers	• Field evaluation	
9. Internal control system (ICS) training for 3,000 trainers conducted	Percentage of communities producing honey and silk to EU standards increases from 20 to 40% by 2013	• Honey and silk quality assessed and certified	• Government standards agencies (KEBS, IMO Switzerland)	• Laboratory test	
Objective 6: Improve bee products and pollination services by 30% through reduced incidence of bee diseases and pests, enhanced markets access, and bee health policy and institutional environment by 2020.					
1. Bee health facilities for innovative technologies and provision of pest risk analysis, baselines and benchmarks established	Documentation of honeybee pests, maps available and utilised by 40% of stakeholders for training beekeepers by 2020	• Number of stakeholders using maps • Peer-reviewed publications	• Publications • Theses • Training manuals	• Field surveys	• Funding is available for the programme
2. Development of validated bee disease and pest management modules with efficient field based diagnostic tools	Honeybee–pest interaction understood and applied by 30% of bee extensionists by 2013	• Number of bee extensionists applying new knowledge • Peer-reviewed publications	• Publications • Extension manuals	• Field studies • Stakeholder interviews	• Scientific community embraces the programme • Stakeholder cooperation
3. Innovative integrated honeybee pest control strategies developed	Use of honeybee integrated pest control strategies increased by 20% by 2013	• Number of beekeepers trained • Number of beekeepers applying new knowledge • Peer-reviewed publications	• Training manuals • Publications • Theses • Posters	• Laboratory experiments • Field evaluations • Impact studies	

Outputs	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and assumptions
4. Improve awareness of honeybee health and conducive environment for enhanced bee disease control, access to markets and consumer safety	Effective multi-stakeholder partnerships and mechanisms for the development of policy, institutional and market options for bee health and pollination services established and functional by 2014	• At least 75% of participating countries have formulated/ reviewed their policies on honeybee health for hive products	• Project files • Journal indices • Publications • Reports • Book chapters	• Field surveys • Farmer interviews • Field studies	• Beekeeper cooperation
5. Capacity of beekeeper/farmers' federations, RECs and NARS on bee health management systems and policy options strengthened	At least 20 beekeepers associations supported/ strengthened by the end of 2014 80% of the beekeepers' associations actively engaged in bee health policy processes at national level	• Project and policy activities report • Farmers' Federations reports	• Government and private sector records • Journal indices	• Project records • Training materials • Secondary data	• Extensionists cooperation

CAPACITY BUIDING AND INSTITUTIONAL DEVELOPMENT PROGRAMME

1. Rationale for capacity development

Capacity strengthening is crucial in equipping African communities with the necessary know-how to uplift themselves out of poverty and unlock the continent's potential for development. Training is an important element in capacity strengthening. More important is the building of strategic partnerships that will work to address the capacity gaps and linkages based on real needs of the people in the community setup they live in. Research, training and institutional building are therefore important investments for anchoring sustainable development.

2. Strategic programme goals and objectives

The major objective of *icipe*'s Capacity and Institutional Building Programme is to build human resource capacity in insect science and related areas of the biosciences that is well trained, highly motivated and able to respond to the arthropod-related development needs of its African constituency. Most importantly, *icipe*'s approach has been to acclimatise researchers such that they can function and perform within the African context, yet remain competitive within the global research and development arena. *icipe*'s capacity building effort has always been intricately in-built into its R&D programmes. These span the whole continuum, from basic strategic research to technology development and validation, and finally community-based adaptation. Hence, *icipe*'s training objectives at all levels are achieved as the Centre undertakes its core research work in fulfilment of its mandate.

One of the key elements of *icipe*'s training programmes is the emphasis on 'hands-on' experience and regular contact with the target communities, be it through training of farmers or training of trainers (ToT) and extension workers. *icipe* believes that this contact is pivotal in ensuring that the training remains relevant and that the trainees are aware of the pressing on-the-ground problems of technology implementation, adaptation and dissemination in Africa.

icipe's current capacity building programme is complemented by collaborative arrangements with university and research institutions in developed countries. The programme is structured along the following major thrusts:

- **Training at the postgraduate level** for leadership in scientific research and policy formulation;
- **Technology dissemination to NARES through group training courses** mainly targeted to practitioners in the national agricultural and health research and extension systems;
- **Professional development schemes**, where postdoctoral fellows, research associates and visiting scientists come to *icipe* to develop and share expertise;
- **Interactive on-site training** in participation with the beneficiary communities;
- **Institutional development** by nurturing and strengthening of African organisations and institutions; and
- **Fostering Africa-wide cooperation and networking** to ensure a continental presence of *icipe*'s work.

These training programmes are undertaken under the auspices of *icipe*'s training programmes and projects in the context of the 4-H Divisions.

3. Strategic future plans

In its current vision and strategy, *icipe* interprets its mission to be more about contributing to poverty alleviation, income generation and improved human health. Two kinds of strategic investments are required for this vision to be realised. First, investing in institutional strengthening so that developing countries can build capacity to 'do it themselves' and sustain the development process required in order to uplift communities out of poverty and unlock the potential for development. Second, investment in the support of communities that are engaged not only as beneficiaries, but also as empowered drivers of change able to keep pace in the rapidly evolving world.

Therefore, in developing a forward perspective for *icipe*'s capacity strengthening activities, there is need to focus on enhancing the dual complementarities between formal and informal training. As a future strategy, more emphasis will be made on need- and opportunity-based training, putting acquired skills and experiences before formal training. In this regard, there is need to design and develop programmes that will strengthen weak linkages from both a value chain perspective as well as from an innovation systems approach. In general, it is strategically important to see more of *icipe*'s programmes and projects emphasising assistance to other training institutions through training of trainers (ToT) and working with qualified institutions and NGOs in undertaking the training function, especially at the beneficiary level.

4. External evaluation conducted in quarter 4 of 2012

In October 2012, two independent consultants evaluated the capacity building programme and proposed a revised framework for the period 2014–2020. The evaluation concluded that not all CB&ID results are equally important and the programme should be re-designed into three result areas to improve its focus. These are:

- Result area 1: Capacity building and professional development of African scientists and professionals.
- Result area 2: Institutional development by nurturing and strengthening of African higher education institutions (including existing *icipe* sub-regional centres).
- Result area 3: Promotion of innovation on insect science in collaboration with regional and national agricultural research and advisory services and the private sector.

The consultants recommended that this new programme shall address three sets of problems as priorities: i) continuing significant lack of highly qualified African insect scientists and professionals; ii) widely existing insufficient capacity of African tertiary education to enable cutting-edge research and relevant education in insect science; and iii) widespread insufficient technology dissemination fostering the rapid application of innovation with significant consequences on the 4-H (human, animal, plant and environmental health) paradigm.

The proposed intervention logic of the 2014–2020 CB&ID programme has taken into consideration a combination of principal elements: *icipe's* goals and supporting strategy, and global and continental policies and programmes (such as the MDGs and NEPAD/CAADP). The total financing requirements for the implementation of the proposed programme will require funding to the tune of US$ 78 million.

Capacity Building and Institutional Development Results Based Management (RBM) Framework

Output	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
Objective: **Increase the number of high quality researchers and middle level practitioners required to respond to arthropod-related research and development challenges in Africa by 2020.**					
1. 200 PhD and MSc postgraduates trained in arthropod-related sciences trained in research and development and working in NARS, universities and the private sector in Africa	At least 80% of graduates trained in research and development working in NARS, RECs, SROs, CGIARs, and universities in Africa by 2013	6 PhDs and 36 MSc. trained in 2012 Number of scientists trained at *icipe* engaged (>50% of their work time) in African institutions led research Number of research activities/ projects implemented in Africa by African institutions	• *icipe* CB &ID database • Tracer study • Tailor-made questionnaires • Ad-hoc interviews • External evaluation report	• Completed PhD studies • Publications in peer reviewed journals	• Continued availability of funds
	At least 50% graduates trained involved in research dealing with food security and poverty reduction issues	• Number of graduates involved in research leading public & private organisations/enterprises in Africa		• Graduates engaged in research and training	

Output	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
2. Publication of research results (theses, book chapters, peer-reviewed journal, brochures, etc.)	At least 80% of research results disseminated in relevant formats at scientific community and policy makers levels in Africa by 2013	• 58 publications of research results done in 2012. • Number of published articles in journals, student theses, book chapters, peer-reviewed journal articles, brochures • Quality and relevance of *icipe* led-research results shared with scientific community	• *icipe* Information Resource Centre • Number of research results shared with the scientific community and policy makers	• Published in peer-reviewed journals • Theses published	• Continued availability of funds • Stakeholder cooperation
		• Number of citations in peer reviewed publications	• Endnote programme	• Not yet known	
	At least 30% of research results shared with the scientific community and policy makers by 2013	• Number of students participating in scientific symposia	• Trip reports	• Students participated in symposia	
3. 200 mid-level practitioners and extension workers from 30 national systems in Africa trained in non-degree professional development courses	At least 50% of trained middle-level practitioners applying their knowledge and expertise in NARES in Africa by 2013	• Number of training courses • Number of trainees • Number of new technologies produced and adopted • Training and information	• Training reports	• Training courses held • Trainees	
4. 150 undergraduate interns trained	At least 80% of trained undergraduate interns progressing to research and development careers by 2013	• Number of interns trained • Number of internship reports	• CB&ID database	• Interns trained • Internship reports	• Availability of continuous funding to the programmes

Output	Outcome	Performance Indicators	Data Source	Means of obtaining data	Risks and Assumptions
5. 10 new networks with national and regional research and higher education institutions established	At least 5 new projects developed with national and regional partners by 2013 At least 10 new trainees at postgraduate level and 50 mid-level trainees resulting from these networks Increased technology uptake and out-scaling in NARES in Africa by 2013	• Signed MoU's and collaborative agreements • Exchange visits to network partners • Number of network partners • Number of joint research projects funded • Number of technologies adopted by NARES	• MoU, mission reports	• Exchange visits undertaken • Network partners in collaborative agreements • Collaborative projects • Technologies adopted	• Regional cooperation • Adequate resource mobilisation
6. 10 career development opportunities for ten professional development programme (short term - visiting scientists and PDFs) implemented by 2013	At least 70% of graduates contribute to research and development in NARES and higher education institutions in Africa by 2013 At least 50% of graduates attract competitive research grants by 2015	• Number of postdoctoral fellows and visiting scientists trained • Number of grants received by 2015 • Number of research publications in peer-reviewed journals	• Project documents, reports	• Postdoctoral fellows and visiting scientists • Research grants achieved • Publications in peer reviewed journals	

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African Insect Science for Food and Health

International Centre of Insect Physiology and Ecology

P. O. Box 30772-00100 Nairobi, Kenya
Phone: +254 (20) 8632000; Fax: +254 (20) 8632001/2
Email: icipe@icipe.org Website: www.icipe.org