icipe
African Insect Science for Food and Health

2011 *icipe* CORE ANNUAL REPORT

BASED ON

RESULTS BASED MANAGEMENT REPORTING

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

May 2012

TABLE OF CONTENTS

2011 BRIEF OF *icipe* ACHIEVEMENTS IN SELECTED PROJECTS

BRIEF BACKGROUND:

The primary mandate of *icipe* is 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 developing African countries in insect science and its application through training and collaborative work. *icipe*'s work is organized through its *4-H* 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. Cutting across the *4-Hs* are *icipe's Capacity Building and Institutional Development* activities that work to develop well-trained and highly motivated human resource capacity.

icipe Centre-wide programmes:

Overall objective for Human Health: 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.

Overall objective for Animal Health: Contribute to the improvement of livestock health and productivity through the development of integrated strategies and tools for livestock disease vectors' control and adoption by development partners, thus leading to greater availability of meat and milk, hides and draught power and thereby assisting livestock owners to get out of the poverty trap.

Overall objective for Plant Health: Contribute to stabilizing 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 developing economically viable and ecologically sound production systems with low pesticide input.

Overall objective for Environmental Health: Conservation and sustainable utilization of the agricultural production base and important natural ecosystems, by encouraging and utilizing arthropod diversity, cataloguing and sharing biodiversity data, and discovering endemic wealth by bio-prospecting for useful natural products.

Overall objective for Capacity building: To develop well-trained and highly motivated human capacity, and strengthen institutional and policy making capacity and capability required to respond to the arthropod-related development challenges in Africa.

In 2011, some key achievements, among others, of *icipe* are:

THEMATIC HIGHLIGHTS

1. Human Health:

***Nature* Publishes *icipe*–UC Riverside Research Breakthrough on Mosquitoes:** A study by a team of scientists from *icipe* and the University of California, Riverside, USA, has found three classes of carbon dioxide (CO_2) response modifying odours, which offer powerful instruments for developing new generations of mosquito repellents and lures. In a paper published in the 2nd June issue of the journal *Nature*, the scientists show that, even in small quantities, these odours

can interfere with the ability of mosquitoes to seek humans. The research, which was featured on the cover of *Nature*, was based on the understanding that CO_2 in exhaled air is the most important smell used by female mosquitoes to locate a host. Therefore, targeting the detection machinery of CO_2 by mosquitoes could be an ideal way of disrupting the insects' host-seeking process. Female mosquitoes depend primarily on olfactory cues to find hosts, i.e. the ability to sense smells that are emitted from human breath, skin and sweat. Therefore, the disruption of the behaviour of the mosquitoes in seeking hosts could reduce the transmission of the diseases. Currently, there are few strategies that target the mosquito sensory system, and those that are available, for instance DEET, are relatively costly for developing countries. They also require frequent and high dosage applications, are environmentally unfriendly and are prone to developing resistance in the insects. Hence the great prospects for alternatives, as highlighted in this landmark study. http://www.icipe.org/news/460-nature-publishes-icipe-uc-riverside-research-breakthrough-on-mosquitos.html

2. Animal Health:

Large scale and long term validation trials of *icipe*'s tsetse repellent technology have been launched at the Kenya Coast with over 200 farmers and >1,200 cattle involved. Results so far are very encouraging with significant reduction in disease and fly levels. Farmers perceptions are also very positive and they are already reporting that (i) their animals are now more settled when grazing; (ii) animals are grazing much closer to the park fence than before without being disturbed by flies; (iii) they have stopped lighting fires in the evening to smoke away flies; (iv) general body condition of the animals is improving; and (v) bulls with repellent collars have more traction power and trypanocide drug use has declined. Another positive feature is that many farmers who have not been included in the trials are demanding now to be included. The field trials were facilitated by our project partner, the Kenya Industrial Research and Development Institute (KIRDI), which produced over 600 new prototype repellent dispensers (model KIRDI/*icipe* II) and sufficient quantities of the synthetic repellent for the field trials. Moreover, *icipe* is exploring potential synergies with Novartis' Animal Health Care Division in Switzerland for evaluating the repellents against other economically important biting flies.

3. Plant Health:

icipe's plant health research agenda covers three domains: Staple Food Crop Pests, via the Centre's Habitat Management and Biological Control of Cereal Pests Programs; Horticultural Crops Pests, through *icipe*'s Vegetable and Fruit Flies Programs; and Locust and Migratory Pests.

Push-pull: In 2011 *icipe* scientists have published a landmark publication in *Ecology Letters* on *smart* plants. It revealed that natural enemies respond to herbivore-induced plant volatiles (HIPVs), but an often overlooked aspect is that there may be genotypic variation in these "indirect" plant defence traits within plant species. The scientists found that egg deposition by stemborer moths on maize landraces caused emission of HIPVs that attracted both egg and larval parasitoids, yet they were completely absent in commercial hybrid varieties. This implies a sophisticated defence strategy whereby parasitoids are recruited in anticipation of egg hatching. The effect was systemic and caused by a yet to be identified elicitor from the egg materials. The findings suggest that indirect plant defence traits may have become lost during crop breeding and could be valuable in new resistance breeding programs for sustainable agriculture.

Leaf miners: Releases of the leafminer parasitoid *Phaedrotoma scabriventris* were carried out in the Central, Rift Valley and Eastern Provinces of Kenya in 2011. More than 45,000 parasitoids were released and > 325 farmers trained in environmentally friendly practices for enhancing the performance of the natural enemies. This resulted in an increase in total parasitism rate in farmer fields and subsequent reduction in pesticide use and according to the farmers as well as a reduction of leafminer damage in areas where the releases were carried out.

***Fruit flies*:** Locally grown fruits such as mango are particularly gaining recognition in Africa as an important source of income and foreign exchange, in addition to providing the much needed vitamins and minerals for the impoverished African rural communities. Several factors, however, constrain fruit production, among which tephritid fruit flies like *Bactrocera invadens* and *Ceratitis cosyra* and the mango seed weevil (MSW) *Sternochetus mangiferae* cause direct damage to fruits leading to 40-80% losses depending on locality, variety and season. Apart from the direct fruit losses caused by these pests, quarantine restrictions on fruit fly- and MSW-infested fruits limit export to lucrative export markets in Europe, the Middle East, Japan and the US, where these insects are quarantine pests. In 2011, the fruit fly program made significant advancements in:

- Improved understanding of the dynamics and host utilization patterns of the target pests;
- Establishment of an inventory of indigenous parasitoid fauna;
- Introduction (from Hawaii) of and mass releases of 2 exotic parasitoids (*Fopius arisanus* and *Diachasmimorpha longicaudata*) of fruit flies, in the target countries - Kenya, Tanzania, Benin and Cameroon;
- Entomopathogenic fungi that are highly virulent to *B. invadens* and MSW identified; field tested and validated;
- New food-based fruit fly attractants based on local waste brewer's yeast developed;
- Development of Simple Sequence Repeat (SSR)-based *B. invadens* microsatellite markers and tracing the origin and invasion pathways of the this pest established; and
- Use of the augmentorium, which serve dual purpose of field's sanitation and parasitoid augmentation and conservation, adopted by mango growers.

***Thrips management**:* The horticulture sub-sector in East Africa contributes around US$ 1 billion annually to the regional economy. Smallholders produce more than 80% of the vegetables grown. Invasive thrips species seriously constrain production of vegetables. Apart from the direct damage they cause, they also vector tospovirus diseases such as *Iris yellow spot virus* (IYSV) and *Tomato spotted wilt virus* (TSWV). *icipe* scientists have recently reported the first occurrence of onion thrips-transmitted IYSV in East Africa in *Plant Disease* (http://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-01-11-0057). IYSV was found to inflict up to 75% leaf drying in onion and was prevalent in all onion growing regions of Kenya, Uganda and Tanzania. *icipe*'s Thrips IPM programme has built capacity to identify thrips and monitor tospoviruses for over 20 plant quarantine inspectors.

Coffee Integrated Pest Management: A visiting scientist from the University of Hannover, and coordinator of *icipe*'s Coffee Research Programme, gave a keynote speech on the impact of climate change on the coffee berry borer, worldwide the most important pest of coffee, at the 2011 Speciality Coffee Association of America's (SCAA) 23rd Annual Exposition & Symposium (http://www.scaasymposium.org/?p=current&s=speakers). The annual meeting of SCAA is considered the most important coffee event, bringing together key players of the coffee industry, growers associations, NGOs, certification organisations and scientists

4. Environmental Health:

The joint *icipe* and African Union's Inter-African Bureau for Animal Resources (AU-IBAR) proposal "***To enhance the contribution of bees and other pollinators to food security and improved livelihoods in Africa***" was approved by the European Union (EU) for funding. The regional initiative aims at establishing an African reference laboratory (with 4 satellite stations) for the management of pollinator bee diseases and pests for food security. It involves strategic partnership and networking in bee health and pollination services in Africa, establishment of satellite stations in Senegal, Burkina Faso, Cameroon and Ethiopia and a reference laboratory in Kenya (*icipe*). Strong partnerships have been established with farmers' federations, RECs and SROs; institutional capacity of target institutions and organisations reinforced; and research linked to honey value chain/pollination services. The purpose of the program is to improve bee

products and pollination services through reduced incidence of bee diseases and pests, enhanced markets access, and bee health institutional environment. In recent years, the serious decline of honeybee populations, commonly referred to as the colony collapse disorder (CCD), has alarmed governments, conservationists and the private sector for the serious impact that CCD could have on biodiversity and forest cover, nutritional aspects, agricultural practices and incomes especially for the poorest population. The impact and effects of the CCD in Africa is not yet well known. Proper conservation of honeybees must be ensured so that colony losses might not seriously harm the livelihoods of millions of rural resource-poor farmers on the continent.

5. Capacity Building:

The main goal of the programme is to build human resource capacity in insect science through award of full fellowships based on a competitive system. As a result, the major accomplishments in 2011 can be summed as provision of fourteen (14) PhD regional fellowships (11 ARPPIS + 3 DRIP scholars joined *icipe*'s postgraduates training program) to highly qualified and deserving young scientists. During 2011, five (5) PhD scholars successfully defended their research thesis at respective universities and graduated, while twelve (12) MSc scholars submitted their thesis and were successfully examined and graduated. In addition, about 50 interns were trained for a period of 3 to 6 months.

CENTRE-WIDE HIGHLIGHTS

1. icipe Results Based Management Framework:

icipe has placed increased emphasis on result-based management (RBM) in programme planning, monitoring and outcome evaluation since 2010. For this a workshop on RBM-based strategic planning was organized at *icipe*'s HQ from 27-30 September 2010.

To take this initiative further, *icipe* organized a follow-up workshop in February 2012, to conduct:

(a) a self-evaluation exercise for assessing the progress made so far in achieving the results set up in the strategic plan,
(b) propose an action plan to make RBM process an integral part of *icipe*'s project and program planning & evaluation across various organizational units and
(c) prepare 2012 activity framework and develop a reporting guide on the achievements for 2011 against the proposed outcomes listed in the RBM.

In line with the decision by *icipe* core donors to develop and implement a RBM approach, *icipe* organized a two-day workshop to facilitate self-evaluation of results envisaged under the results-based strategic planning framework of 2010. The workshop was also intended to help *icipe* in establishing systems for making the RBM process an integral part of programme planning & evaluation across all organizational units.

The primary purpose of the workshop was to encourage its scientists to apply RBM concepts, and to become RBM thinkers and doers. RBM thinkers are not just involved in producing research, publishing it and disseminating it. RBM requires getting the results used by sharing them with a target audience. The need is to address specific problem(s) where *icipe* research can make a difference in helping resolving the problem and benefit the target group.

The *objective* of the workshop was to assist *icipe* in (1) evaluating the results determined under the previous strategic planning framework, and (2) supporting self-sustainability in designing and implementing RBM in future plans and programs. This entailed facilitating the workshop participants in evaluation, proposing a plan of action for future similar frameworks, and

included guidelines on developing RBM-based logical framework for future programmes as well as preparing RBM reports.

***2. icipe selected as regional centre under the Stockholm Convention on Persistent Organic Pollutants*:**

In 2005, an assessment report by UNEP to identify potential institutions for regional or sub-regional centres, identified *icipe* as one of the potential institutions. The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty to protect human health and the environment from highly dangerous, long-lasting chemicals by restricting and ultimately eliminating their production, use, trade, release and storage. In a letter dated 14 September 2011, from the Executive Secretary of the Stockholm Convention, *icipe* was officially notified that the Conference of the Parties to the Stockholm Convention, by its decision SC-5/21, endorsed *icipe* as a Stockholm Convention regional or sub-regional centre for capacity-building and the transfer of technology for a period of four years (http://www.icipe.org/news/488-icipe-stockholm-convention-regional-centre.html).

Notable progress is that, *icipe*, acting upon the request of the UNEP Secretariat of the Stockholm Convention on PoPs, conducted a workshop whose sole aim was to strengthen countries' capacities, in line with the Global Alliance mission, of developing alternatives to DDT for vector control and to provide technical skills on integrated vector management (IVM) as an alternative approach to use of harmful chemicals for indoor residual spraying. Through the UNEP focal points in the countries, the Ministries of Health and Environment from nine African countries were requested to nominate two officers to attend the workshop in Nairobi. The WHO office in Geneva provided the curriculum for the training which was adapted from previous modules used for the regions. By the end of the workshop, the participants appreciated the process of evidence based decision making towards sustainable solutions to disease control.

The activities planned for the *icipe* Regional Centre focus on adding a global environmental benefit to currently funded activities at the Centre. The funded activities include IVM for malaria control in Kenya (Malindi at the Coastal Region & Nyabondo in Western part of Kenya) and Ethiopia (Tolay) in addition to a new malaria elimination project on Rusinga Island (in L. Victoria) in Western Kenya.

3. icipe selected for establishment of a Centre/Community of Research Excellence (CoRe) by CNHR:

icipe is a lead agency in a Consortium of Research (CoRe) entitled: ***Community of Excellence for Research in Neglected Vector Borne Zoonotic Diseases* (CERN*Vec*)**. This CoRe aims at linking research, response and training for neglected vector-borne zoonotic disease management.

CERN*Vec* website (http://cernvec.icipe.org) has been established and is progressing well in terms of content development with management by the Secretariat at *icipe*. The website will facilitate and improve communication and networking between institutions in the network and external collaborators, as well as data and knowledge sharing.

Under the auspices of CERN*Vec*, Jomo Kenyatta University of Agriculture and Technology (JKUAT) as well as Kenyatta University has also approved the creation of adjunct positions. Further, The Ministry of Public Health and Sanitation (MoPHS) database (with the front end of this knowledge sharing platform at http://www.ddsr.or.ke) is in progress. Advances have been made in the use of smart phones for communicating disease occurrence data, linked to the database, in real time. One of the key activities being undertaken is the sensitization of field officers for data submission. There has been close collaboration between MoPHS and JKUAT to develop course content in infectious diseases

4. Training Health Researchers into Vocational Excellence in East Africa (THRiVE):

icipe is part of a Consortium led by Uganda's Makerere University and funded by the Welcome Trust that started in the last quarter of 2009 focusing on Training Health Researchers into Vocational Excellence in East Africa (THRiVE). The implementation of the consortium activities are now up and running. THRiVE is a consortium that builds on already existing partnerships between health institutions in Uganda, Tanzania, Rwanda, Kenya and the UK.

Key developments under the auspices of THRiVE have been the award of a Postdoctoral fellowship to a fellow based at *icipe* to undertake research on "*Exploiting Mosquito Phytoceuticals for Malaria Control*". This award has also a subsequent equipment grant for the purchase of an Insect Growth Chamber.

In addition, *icipe* has benefitted in the award of two (2) Pump-Priming Grants to *icipe* postdoctoral scientists to undertake:

- *Developing molecular tools for studying the population biology of genus* Mansonia*, a vector of arboviruses; and*
- *Identification and development of new attractants that can improve the performance of bait technology to control* Glossina fuscipes fuscipes *the main vector of African Human Trypanosomosis*

5. Construction & Equipping of GMP-compliant enhanced Biosafety level 2, 2+ and 3 EID laboratory:

icipe inaugurates its GMP-compliant enhanced Biosafety levels 2, 2+ and 3 Martin Lüscher Emerging Infectious Diseases Laboratory: On 16 September 2011 *icipe* inaugurated its GMP-compliant enhanced biosafety level 2, 2+ and 3 laboratory complex for emerging infectious diseases (EID), joining the few existing laboratories on the continent to provide such a resource (http://www.icipe.org/news/489-launch-of-east-africas-first-laboratory-of-emerging-infectious-diseases.html). This is a landmark achievement for the Centre as the specialised unit will contribute to EID preparedness and response in the region and beyond. *icipe* plans to use this laboratory complex to conduct research and surveillance on emerging arboviral diseases in East Africa including Rift Valley fever (RVF), West Nile, dengue and Chikungunya among others.

Ongoing *icipe* surveillance for arbovirus infection, distribution and diversity under a Google.org supported project (http://avid.icipe.org/) is a platform that could lead to the detection of new strains of known and unknown arboviruses. The ultimate goal of these research activities is to improve risk detection, early warning and the response capacity of the national programmes in Kenya and the region to these arbovirus disease outbreaks. Projects planned for implementation in the new laboratory will incorporate training of MSc and PhD students and public health specialists from Ministries of Health of East African countries and beyond to improve/build on the existing network of surveillance, diagnostic and research capacity in arbovirus diseases in Africa.

6. New Climate Change Focused Research:

CHIESA moves into its main operational phase: On 21 January 2011, *icipe* initiated the Inception Phase activities for its flagship climate change programme CHIESA (**C**limate C**h**ange **I**mpacts on **E**cosystem Services and Food **S**ecurity in Eastern **A**frica - http://chiesa.icipe.org/). A formal meeting of the CHIESA Project Supervisory Board (SVB) was organised in Nairobi on the 24th of August 2011, to discuss the six-months inception phase report and make a decision on its approval, to enable the four-year research and development project to commence the actual implementation phase. Ms Anu Penttinen, the representative of the Ministry for Foreign Affairs (MoFA) of Finland summed up the inception report as well written and of high quality. *icipe* received approval from MoFA on the inception phase report, and hence CHIESA has commenced its main project activities for a four-year period. Additionally, the other members of the SVB were also very pleased with the inception phase report and approved it unanimously. On behalf of the Kenyan Government and the CHIESA consortium Dr Wilson Songa, the Agriculture

Secretary of Kenya's Ministry of Agriculture, thanked the Government of Finland for its long-term support for development in Africa and expressed his appreciation that the support continues in many ways, especially through the CHIESA project.

CHIESA ongoing activities recognize that Climate Change and Climatic Variability are important emerging environmental forces, which have implications for all sectors of society including those in the government, the private sector and academia. This has brought about the need to develop adaptation measures to lessen the impact of climate change and build resilience of the communities that are most affected.

As such, the CHIESA project is fundamental in bringing to light the problems that farmers at the community level are experiencing and it will also provide recommendations to counter the negative impacts of climate change on the communities through adaptation and capacity building. Furthermore, the interdisciplinary nature of the project will enhance a holistic understanding of climate change impacts on agriculture and as a result, the developed adaptation strategies will foster community growth and food security in Eastern Africa.

7. Private Sector-icipe Involvement:

icipe hosts the inaugural GIZ Public–Private Partnerships (PPP) Workshop: Following discussions between the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and scientists from *icipe*, the World Agroforestry Centre (ICRAF), and the International Livestock Research Institute (ILRI) on the possibility of sharing some of GIZ's Public–Private Partnership (PPP) experiences with partners in Africa, a two-day PPP-Unit Assessment Workshop was organised, coordinated and hosted by GIZ and *icipe,* and co-hosted by ILRI and ICRAF. Participants were drawn from more than 20 research and private agribusiness institutions from Kenya, Ethiopia and Tanzania. At the end of the meeting participants agreed on the need to create a PPP-Africa facility that would enable agricultural research centres to cooperate with local companies, and build up and support science and technology based public–private partnerships in eastern and southern Africa. The programme should bring research centres' outreach activities together in a PPP hub and synthesise existing forms of knowledge into applicable business ventures. The private sector would benefit through improved and early access to scientific knowledge and expertise, efficiency gains, and better public image and staff motivation. The initiative would also help build capacity for business development and identify new opportunities for science and technology applications. (More information at http://www.icipe.org/pppunit/).

Commercialisation & Registration of icipe 69 isolate: On 17 March 2011, Dr Henry Wainwright, CEO of Real IPM (http://www.realipm.com/), a Kenya based bio-pesticide company, and *icipe*'s DG Prof. Christian Borgemeister signed a commercialisation agreement which allowed Real IPM to market a strain of the entomopathogenic fungus *Metarhizium anisopliae* (ICIPE 69) for pest control in Africa. The ICIPE 69 isolate has been registered for control of mealybugs in papaya in Ghana, and is additionally in the registration process for microbiological control of other pests in Ethiopia, Kenya, Mozambique and the Republic of South Africa.

8. Scientific infrastructure:

icipe's second campus in Kenya, the Thomas Risley Odhiambo (TRO) campus at Mbita Point on the shores of Lake Victoria, underwent major renovations in 2011. All laboratories were completely refurbished and nine state-of-the-art screen houses were constructed, thereby greatly improving the R&D capacity of the TRO campus.

9. Commemorative event: The 40 years celebration:

icipe celebrates its 40th birthday as the African Academy of Sciences (AAS) marks its 25th

birthday. Both organisations were founded/co-founded by the late Prof. Thomas Risley Odhiambo, respectively: In November 2011 marked a very special month for *icipe* as we commemorated the 40th anniversary of the founding of *icipe* by the late Prof. Thomas Risley Odhiambo, not only the Centre's 1st Director but also one of Africa's leading scientists in the 20th century (http://www.icipe.org/news/443-40-years-of-icipe.html). TRO, as he was often referred to, steered *icipe* for more than two decades and left a lasting imprint on the Centre, among others, by establishing the African Regional Postgraduate Programme in Insect Science (ARPPIS), an invisible college at *icipe* that trains PhD and MSc scholars from all over Africa (http://arppis.icipe.org/). The main event of the 40th anniversary celebrations was the *icipe* Science Day on the 16th of November, which was attended by more than 400 guests from Kenya and beyond (slide show http://www.icipe.org/news/505-40-years-of-icipe-photo-gallery.html). On this day the Centre's staff showcased *icipe*'s ongoing R&D programmes, ranging from the various IPM projects, to commercial insects, climate change research, integrated vector management of important disease vectors, etc. In addition, *icipe,* in partnership with Postal Corporation of Kenya, unveiled stamps in commemoration of the 40th anniversary. Similarly, AAS, on its 25th Anniversary paid homage to TRO, one of its founding fathers. Among the hallmarks of the celebrations was the jointly convened AAS–*icipe*–TWAS-ROSSA Conference on "***Climate Change and Food Security: The Road for Africa***" (http://www.aasciences.org/new/index.php). To conclude, *icipe* also hosted the 19th biennial conference of the African Association of Insect Scientists (AAIS) at its HQs in Nairobi (http://aaisconference.icipe.org/).

10. PRIZES: - *icipe* Staff and Projects

- ***Prof. Borgmeister's International Plant Protection Award of Distinction by the International Association for the Plant Protection Sciences (IAPPS)***

In March 2011, *icipe*'s Director General Prof. Christian Borgemeister, won the International Plant Protection Award of Distinction (IPPAD) from the International Association for the Plant Protection Sciences (IAPPS) for his distinguished record of contributions to the development and promotion of integrated pest management (IPM) in the tropics. The award was presented during the XVII International Plant Protection Conference in August 2011 in Hawaii, USA.

- ***Prof. Zeyaur R. Khan, icipe principal scientist, announced co-winner of the 2011 TWAS Prize for Agriculture***

Prof. Zeyaur Khan was announced co-winner of the 2011 TWAS Prize for Agriculture, for his leadership of the Push-Pull Programme: Prof. Zeyaur Khan, the leader of *icipe*'s widely reputed push-pull Programme, was named co-winner of the 2011 TWAS Prize for Agriculture (http://twas.ictp.it/news-in-home-page/news/twas-announces-2011-prize-winners?searchterm=Khan). With this prize TWAS, The Academy of Sciences for the Developing World (http://twas.ictp.it/), honours individual scientists in developing countries for their outstanding contribution to the advancement of science. The TWAS Prize adds to Prof. Khan's growing list of accolades for his work as the leader of *icipe*'s push-pull Programme (http://www.push-pull.net). TWAS recognises Prof. Khan for his discovery and wide-scale implementation of the push-pull technology, a pro-poor scientific innovation for enhancing food security and environmental sustainability in Africa. Push-pull is now practised by more than 50,000 farmers in eastern Africa and was developed by Prof. Khan at *icipe* in collaboration with Rothamsted Research (UK), the Kenya Agricultural Research Institute (KARI) and various national partners in Africa.

11. NEW Strategic Alliances:

African Union: On 22 February 2011, Her Excellency Mrs Rhoda Peace Tumusiime, the African Union's Commissioner for Rural Economy and Agriculture, and *icipe* DG Prof. Christian Borgemeister signed a Memorandum of Understanding (MoU) at *icipe*'s HQs in Nairobi, to

reinforce the partnership between the two organisations. Key areas of the MoU that impinge on member countries of the AU, are food security as affected by insect pests and disease vectors, adaptation to climate change, and poverty reduction in the rural areas. Further, manpower development in various fields and at various levels will be reinforced through this partnership. Both institutions commit themselves to the implementation of this MoU to strengthen agriculture and the rural economies on the continent. http://www.icipe.org/news/415-african-union-and-icipe-sign-mou.html

INERA DR Congo: *icipe*'s renewed partnership with DR Congo: On 14 September 2011, Prof. Paul Mafuka Mbe-Mpie, the DG of Institut National pour l'Etude et la Recherche Agronomiques (INERA), the National Agricultural Research Institute, of DRC and *icipe* DG Prof. Christian Borgemeister signed a MoU at *icipe*'s HQs in Nairobi, paving way to a strengthened partnership towards an enhanced development agenda between the two institutions. The collaboration will promote joint scientific research and development, and capacity and institutional building in all agro-ecological zones of DRC. Accordingly, the two parties agree to conserve and contribute to sustainable use of the agricultural production base, and develop appropriate mitigation and adaptation strategies for the current and potential effects of climate change. The cooperation will include exchange of scientific information through publication of documents, joint conferences, seminars and workshops and other knowledge sharing initiatives.

IITA: icipe and IITA sign MoC with a particular emphasis on soil health: *icipe* and the International Institute of Tropical Agriculture (IITA) signed a memorandum of collaboration (MoC) late last year at *icipe*'s Duduville Campus in Nairobi. In an event attended by the new Director General of IITA Dr Nteranya Sanginga, *icipe* and IITA agreed to work together in the areas of IPM, biological control, and natural resource management with a particular emphasis on soil health. This research partnership paves way for a considerably strengthened research and development agenda between these two leading R&D centres in Africa (http://www.icipe.org/news/556-important-new-partnership.html).

12. ASARECA General Assembly icipe Exhibition & Keynote speech

icipe was among 450 delegates from a diverse background in Research and Development who attended the 1st General Assembly of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) in December 2011 in Entebbe, Uganda. The delegates included Ministers from some of the ASARECA member states, national representatives from each member country representing farmers, the private sector, civil society, agricultural extension, universities, national agricultural research institutions and ministries of agriculture, and other strategic partners such as development partners and international agricultural research institutions. The delegates convened to deliberate on the timely theme "**Feeding our Region in the 21st Century**," The theme was chosen because more than ever before, feeding an increasing population and attaining food security at the national, regional and global levels is one of the most important and pressing challenges of the 21st century.

icipe participated in both the presentations as well as the exhibitions. Under Sub-Theme III: Partner Institutions Perspective, *icipe*'s DG gave a plenary presentation on the Centre's R&D activities in agriculture, highlighting some of its flagship programmes like push–pull and the tsetse repellent technology.

13. icipe Ethics Review accreditation

icipe now has an **Institutional Ethics Review Committee** (IERC) which is accredited by the Kenya National Bioethics Committee (NBC) to conduct ethics review of research protocols in biological and environmental sciences**.** The IERC is an administrative body established to protect the rights and welfare of human research subjects recruited to participate in research activities conducted under the auspices of the institution with which it is affiliated. The IERC has the authority to approve, require modifications in, or disapprove all research activities that fall

within its jurisdiction as specified by both the national regulations and local institutional policy. The IERC also functions independently of but in coordination with other committees and is accredited by overseeing body.

14. icipe Pest Control Products Board accreditation

icipe has been accredited by the Kenyan Pest Control Products Board (PCPB) to carry out biological efficacy and field residue trails on pest control products for registration purposes. The accreditation requires all trials on products for the purpose of registration have to be carried out in accordance with the principals of Good Experimental Practices (GEP) and have to be authorized by the Board through an experimental permit. *icipe* is expected to make references to international guidelines such as FAO Guidelines, EPPO Guidelines, GLP Principles in the conduct of the field residual trials.

15. SGI Newsletter Introduction

In 2011, *icipe* under the leadership of its Sponsoring Group of *icipe* (SGI) Chair Dr Wolfgang Kasten of GIZ, launched a Quarterly Newsletter that intends to inform our donors and collaborators, in one or two pages, about current activities of the Centre. Key attributes of information captured are: **Major Funding Event, Recognition, Important New Partnerships, major Institutional Event, Important Research Finding, and Private Sector-*icipe* Involvement.** The Newsletter is circulated widely and also posted on the *icipe* website (www.icipe.org).

RESULTS BASED MANAGEMENT REPORTING

Background to development of icipe's Results Based Management Framework

In early 2010, *icipe*'s Governing Council (GC) and Management in consultation with its 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. Initially, *icipe* used the Medium Term Plan Framework but like many other international organisations, *icipe* introduced RBM in early 2011 as its new strategic planning and management tool. Many development co-operation agencies including UN and CGIAR organisations are now in the process of introducing or reforming their performance management systems and measurement approaches and *icipe* is no exception.

The operational guidelines specifically state that the RBM framework will take into consideration existing good practice and lay out an approach that:

(i) incorporates measuring results with widely recognized tools;
(ii) assesses risk on an ongoing basis; and
(iii) incorporates learning into strategies, projects and programmes.

The RBM already in is an operational framework that explicitly links 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 and objectives of *icipe.*

The RBM helps *icipe* 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 weakness in implementation plans. Periodic and targeted information will help the GC and *icipe* Management recognize 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 is then able to track and measure progress towards objectives, and make targeted decisions to improve performance on an ongoing basis. Process monitoring takes 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 developed their RBM Framework. All projects entail knowledge management and learning, which are the main components for any organization dealing with adaptation to climate change like *icipe.* The R&D Thematic Clusters (*i.e. 4-H paradigm*) and Capacity Building frameworks encompass a cycle of planning, periodic performance assessment and organizational learning – all of which are supportive of knowledge creation and sharing. Learning from the R&D activities influences strategy development and programme/project design, and the lessons are 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 involves increasing knowledge by learning, knowledge dissemination and feedback into decision making, project design and strategy development.

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* tracks specific performance measures at an institutional level on an annual basis. Projects implemented by *icipe* are the basis of its RBM framework. As such, tracking results begin from a project vantage point. At a project level, results are tracked during implementation and evaluated upon project completion. While the tracking tools are utilised during implementation it is important that the three major phases in a project's evolution are linked: (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 ensures *icipe*'s R&D activities are implemented in collaboration with our partners in order to contribute to a logical chain of results that are millennium development goals related priorities and provide knowledge-based solutions aimed at equipping the communities in Africa to survive and live within a rapidly changing global environment.

icipe's Results Based Management Framework Thematic Clusters

As earlier mentioned, each of *icipe's* core activity areas developed their RBM Framework and the reporting that follows is specific to the R&D Thematic Clusters (i.e. 4-H paradigm) and Capacity Building frameworks. We are pleased to inform that, in line with *icipe's* Vision and Strategy focus, *icipe's* operative 4-H paradigm - addressing Human, Animal, Plant and Environmental Health - and the many integrated pest and vector management (IPVM) and insect-based income generating technologies developed by the Centre over the years, including the Capacity Building and Institutional Development Programme are of immediate relevance to future strategies for contributing to solutions for food insecurity and malnutrition, disease, poverty and environmental degradation. *icipe* is about much more than insects. To strategically address the problems associated with arthropod pests and disease vectors on one hand, and the opportunities for their conservation and utilisation on the other, we have now thematically aligned the 4-H as follows:

1. Integrated Pest Management (IPM) – with a focus on plant health
2. Integrated Vector and Disease Management (IVDM) – with a joint focus on animal and human health; and
3. Adaptation to Climate Change & Ecosystem Services (ACCESS) – with a focus on environmental health.

A. INTEGRATED PEST MANAGEMENT OUTCOMES

Plant Health Results Based Management Framework

Overall objective for Plant Health: Contribute to stabilizing 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 developing economically viable and ecologically sound production systems with low pesticide input.

Specific 2011 RBM Framework Outcomes:

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
Objective 1: To increase horticultural, cash crops 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 utilized by scientists, policy makers and other stakeholders by 2013.	Pest status of at least five more key pests determined by 2013.	No *ex ante* information available for Stemborer, DBM, RSM, Cashew pests. Farmer's perception on cotton pests in Western Kenya lacking.	• 2 *ex ante* study completed in the leaf miner IPM program in Nyeri and Arusha, Tanzania. • 1 *ex ante* study on key pest of cashew in southern Tanzania. • 2 *ex ante* study on impact of fruit flies on mango and technological uptake carried out in Cameroon and Kenya. • 1 *ex ante* study on thrips infesting French bean in Naivasha, Nakuru Embu and Thika completed. • Results of 6 *ex ante* studies shared with scientists as publications/thesis and shared with other	• 2 ongoing on *ex ante* studies on leaf miners in Western Uganda and Loitokitok, Kenya. • 1 on-going *ex ante* study on *Iris Yellow Spot virus* in Kenya. • 1 on-going *ex ante* study on aphids in Kenya.

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
				stakeholders through training of agricultural extension officers and plant quarantine officers. • Farmers perception study on cotton completed • Baseline information on farmer perceptions on cotton pest undertaken in western Kenya. • Baseline information on key insect pests and diseases in cashew obtained in Benin and Tanzania. • Farmer perception study on cotton completed.	
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 publication.	Current *Maruca* management based on synthetic pesticide alone.	• One *Maruca* pheromone compound identified and is under wind tunnel testing. • Two isolates of *Metarhizium anisopliae* selected and is ready for field testing.	
1.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.	No IPM strategy is in place for management of *Maruca.*		• Sites for field trials identified.
1. Biopesticide for Thrip IPM developed and commercialized 2. Thrips IPM strategies based on intercropping, use of biopesticides,	Thrips and tospovirus management strategies for French bean and onions encompassing at	• At least one microbial bio pesticide commercialized for thrips control by 2013. • At least 1 intercropping strategies for thrips control in French beans	Thrips management strategies largely based on chemical pesticides.	• *Metarhizium anisopliae* strain ICIPE 69 commercialized for thrips and mealy bug control under the trade name "Campaign (R) in	• Field trials on evaluation of intercropping strategies for onion thrips management underway.

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
semiochemicals and botanical pesticide developed.	least two IPM components formulated by 2014	and onion evaluated by 2013. • At least one tospovirus resistant cultivar on onion identified by 2014. • Large scale implementation of IPM strategies for thrips and tospoviruses encompassing atleast two IPM components undertaken in atleast two key production areas by 2014. • Reduction in use of synthetic pesticides by at least 20% by 2014. • No. of Peer reviewed publication. • Number of thesis.		partnership with private biopesticide producer Real IPM Kenya. • Intercropping strategies for French bean with baby corn/Sunflower/Irish Potato standardized through research station trials and is ready for large scale field-testing. • Onion cultivars Bombay Red and Texas Grano found to be resistant to *Thrips tabaci* and tospovirus *Irish Yellow Spot Virus*. • Three Peer-reviewed publications published, 2 publications "In Press" • One Master's Student and two PhD students graduated.	• Screening of Onion cultivars for thrips and tospovirus resistance ongoing. • Project planning for Large scale implementation of IPM strategies undertaken with project partners.
1. Training of trainer's program organised for agricultural extension officers/plant quarantine inspectors in East Africa 2. Training materials and curricula developed 3. Field demonstration of Thrips IPM strategies based on intercropping, use of biopesticides, semiochemicals and botanical pesticides undertaken	Awareness on thrips and 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 enhanced for adoption of the thrips and tospovirus management strategies by 2014.	Minimal awareness on IPM strategies for thrips management	• Project website has had over 15,000 hits in year 2011. • Two posters on Thrips and tospovirus management developed in both English and Kiswahili and distributed to Plant Health inspectors and Agricultural extension officers. • Awareness among 109 Plant quarantine officers /Agricultural extension officers of East Africa	• Field demonstration of Thrips IPM strategies planned. • LuCID key based thrips and their natural enemy identification tools under development. • Training activities for Agricultural Extension officers and plant quarantine officers continuing. • *Ex-ante* assessment of

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
4. IPM technology adapted and validated with French bean, tomato, onion and grain legume farmers. 5. *Ex-ante* and *ex-post* assessment of the introduced Thrips and tospovirus management strategies.		• No of training reports. • French bean, onions, tomatoes and grain legume yield increased by at least 15% • Rejections of French beans reduced by at least 10% in local, urban and export market by 2013. • Popular articles, mass media reports • No. of publications, thesis		enhanced on thrips and tospovirus monitoring and management in year 2011. • Training report on in-country training programs developed and shared with BMZ/GIZ.	thrips and tospovirus management strategies planned
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.	Agromizid 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 characterized 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.	Current Agromizid leafminer management relies solely on routine use of synthetic pesticides.	• Release of *Phaedrotoma scabriventris* was done in high, mid and low altitudes in Kenya. • Survey activities were carried out in Tanzania and Kenya to assess the role of indigenous natural enemies in leafminer incidence and management. • *Diglyphus websteri* was studied and found very efficient against LMF. • 8 endophytic fungi isolates were identified for the preferred LMF host plants. • 6 peer reviewed papers were published. • 4 MSc theses finalized and 3 graduated. • 4 posters presented in scientific events.	• *P. scabriventris* recovery studies ongoing. • Performance of *Halticoptera arduine* against *Liriomyza huidobrensis, L. sativae* and *L. trifolii* carried out. • Dossier for release permit in preparation for KEPHIS. • Pathogenicity and virulence as well as side effect studies of 8 endophytic fungi isolates ongoing.

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
		• No. Peer reviewed publication.			
1. Training of trainers conducted. 2. Training of French bean, faba bean, rose coco bean, cowpea, tomato, snow peas, sugar snaps and Chrysanthemum farmer's conducted. 3. Training materials and curricula developed. 4. Field demonstration of leafminer management strategies conducted. 5. IPM technology adapted and validated with farmers. 6. *Ex-ante* and *ex-post* impact assessment of the introduced technologies undertaken.	Awareness on Agromizid leafminers IPM strategies created among agricultural extension officers, plant quarantine inspectors and French bean, faba bean, rose coco bean, snow peas, sugar snaps, 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 snaps, 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, peas, sugar snaps and tomato by 2014. • At least 10% reduction in rejection of French bean, faba bean, snow peas, sugar snaps and Chrysanthemum by 2014.	Minimal awareness on IPM strategies for leafminer management.	• A total of 169 farmers trained in High, mid and low altitudes in Kenya. • A total of 117 and 200 household were interviewed and trained on leafminer flies in Tanzania and mid altitude in Kenya. • Two posters on leafminer management developed in both English and Kiswahili and distributed to Plant Health inspectors, Agricultural extension officers and farmers. • Awareness among 105 Plant quarantine officers /Agricultural extension officers of East Africa enhanced on Agromizid leafminers monitoring and management. • Training report on in-country training programs developed.	• Farmer trainings continuing. • Ex-ante studies on leafminer flies ongoing in Uganda.
1. Community-based participatory dissemination of fruit fly and MSW IPM technologies based on baiting and male annihilation technique,	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	Currently, growers in the proposed project target countries practice cover sprays of broad spectrum pesticides for the management of fruit	• On-farm validation, adaptation and promotion of fruit flies and MSW IPM technologies conducted in the benchmark sites of the target countries. • Links established by the	• More farmers in the target countries are expected to be enrolled in the technology demonstration during the 2012/2013 mango

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
application of entomopathogens, *soft* pesticides and orchard sanitation implemented		least 70%. • Mango yield increase 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. • Rejections of mango reduced by at least 10% in local, urban and export markets by 2013.	flies and MSW.	project with NGOs and growers associations to facilitate technology dissemination to the mango growers.	season.
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 release 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.	*Fopius arisanus* and *D. longicaudata* have never been released in the target countries.	• Large-scale augmentative releases of *F. arisanus* and *D. longicaudata* carried in the benchmark sites in the target countries. • Sampling of cultivated and wild fruit collections carried out and yielded at least 20% recoveries of *F. arisanus* and *D. longicaudata.*	• More releases of the two parasitoids in other benchmark sites of the target countries will be carried out. • Installation of augmentoria in the release sites in the target countries to serve the dual purpose of parasitoid augmentation and orchard sanitation. • Fruit sampling and processing continues for parasitoid recovery and impact of fruit flies population assessment.
3. The role of the weaver ant (*Oecophylla longinoda*) in the management of fruit flies and MSW adapted,	The weaver ant technology adopted as a component of fruit flies and MSW management by	• At least 30% of growers become aware of ant importance in fruit flies and MSW management by 2013.	Knowledge on the role of the weaver ant in management of fruit flies and MSW in the target	• Field experiments were conducted in northern and central Benin in 5 orchards to validate the efficacy of *O. longinoda*. Results	• Parallel experiments are on-going in Kenya and Tanzania to validate the efficacy of the weaver ant in

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
validated and disseminated and their conservation promoted.	mango growers by 2013.	• At least 10% of growers become knowledgeable on weaver ant conservation practices. • Weaver ant reduces fruit fly and MSW infestation by at least 30% and increase mango yield by at least 30% by 2013.	countries currently lacking.	indicated that the weaver ant abundance had little effect on fruit fly infestations of mango fruits. • Studies on the interaction of weaver ant and parasitoid have been completed for *F. arisanus*, and was demonstrated that weaver ant, *O. longinoda* can directly predate on *F. arisanus* and also disrupt oviposition by the parasitoid.	suppression of fruit flies and MSW. • Similar studies are on-going for other parasitoid species namely; *D. longicaudata*.
4. Parameters for post harvest treatment based on hot water treatment of mango against *B. invadens* developed and disseminated.	Heat treatment parameters required to achieve Probit 99.99% for *B. invadens* on at least one mango cultivar developed by 2013.	• Parameters established. • Opportunity for access to export markets by the mango growers.	No such parameters have been established for *B. invadens* in mango.	• *B. invadens* colonies of have been significantly boosted for sufficient supplies of the required developmental stage for heat tolerance testing. • Developmental duration of the insects in four mango cultivars established with the results indicating that the developmental times for eggs were consistent across the mango cultivars tested.	• Experiments to establish the most heat tolerant stage in the four mango cultivars is underway. • Heat treatment parameters required to achieve Probit 99.99% for *B. invadens* on the four cultivars is scheduled for the second half of 2012.
5. Socio-economic impact of introduced control technologies determined.	Numbers of adopter 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.	No data on socio-economic impact of introduced technologies available.	• A questionnaire covering household characteristics, mango production and marketing, farmers' perception on fruit fly control package and accessibility to agricultural information, extension	• Similar studies are planned for the other project target countries.

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
				support and credit for *ex-post* data collection has been developed. • Baseline data collection from the six sub-locations (Nthagaiya, Kasafari, Karurumo, Kariru, Kathunguri, Kiringa, Mukuria and Kigumo) totaling to 375 farmers is underway.	
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.	Currently NARS personnel from partner national institutions in the target countries have never received training on fruit flies and MSW IPM technologies.	• Two PhD and three MSc. students enrolled in various projects activities. • Fourteen NARS personnel trained on fruit flies and MSW IPM technologies. • Learning materials on fruit fly IPM printed and distributed to the mango growers and NARS.	•At least 10 additional NARS personnel from each target countries are envisaged to be trained on fruit flies and MSW IPM technologies. •Additional learning materials on fruit fly and mango IPM to be printed and distributed to the growers and NARS personnel in the target countries.
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	IPM strategy based on at least two 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 publication	Management of the key insect pests of cashew (mirid and coreid bugs) largely based on the use synthetic chemical insecticides.	• 1 A male-produced two-component sex pheromone of coreid bug identified. • Candidate semiochemicals contributing to sex/aggregation attraction in males identified from cashew volatiles.	•Evaluation and optimisation of pheromone dispensers ongoing. • Bioassays on dose-response mortality and virulence of selected fungal isolates against

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
Oecophylla longinoda in the management of mirid and coreid pests evaluated, fine-tuned and disseminated.				• Two isolates each of *Metarhizium anisopliae* and of *Beauveria bassiana* selected against both mirid and coreid bugs. • Efficacy of weaver ant against mirid and coreid bugs confirmed in field experiments.	different developmental stages of mirid bug in progress. • Fish base-bait strategy for conservation of waver ant during off-season under evaluation in the field.
1. Alternatives to management strategies for powdery mildew and leaf and nut blight 2. The impact of new strategies on beneficials (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 and 1 environmentally friendly fungicide evaluated by 2012. •Resistant varieties identified. •No. of Peer reviewed publication.	Management of powdery mildew and leaf and nut blight in cashew based on the use of synthetic chemical fungicides.	• Epidemiology of leaf and nut blight in Tanzania established. • Field evaluation of potential alternatives to powdery mildew completed. • An isolate of *Ampelomyces, a* hyperparasite of powdery mildew naturally-occurring, obtained from CABI.	•Evaluation of varietal resistance to blight disease in progress. •Bioassays on the efficacy of *Ampelomyces* against powdery mildew are underway.
1. Training of trainer's program organised for cowpea farmers 2. *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.	Farmers have minimal knowledge of cashew IPM strategies.	• Weaknesses of the current agricultural extension service in Tanzania identified. • Pilot testing of viable dissemination tools identified in Tanzania. • Farmers' knowledge and perception of insect species associated with cashew and beneficials in Northern Benin established.	•
1. Circardian behaviour of red spider mites and its	Understanding on the circardian behaviour	•No. of Publications •No. of Thesis	The circardian behaviour of	•Master's student enrolled for undertaking research	•Laboratory bioassays in progress

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
predator elucidated in the laboratory. 2. Greenhouse and field evaluation of treated and non-treated net placement based on the circardian movement of red spider mite and its predator undertaken. 3. PhD student and MSc student training on behavioural research with red spider mite and its predators.	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.	• At least 1 PhD and 1 MSc student trained by 2014.	*Tetranychus urticae* has been well documented while it is absent for *T. evansi* and its predator *Phytoseiulus longipes.*	on circardian behaviour of *T. evansi* and *P. longipes* on African nightshade.	
1. A 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.	• Cotton farmers in Western Kenya are not aware of the potential benefits of Push-pull technology in controlling cotton pests. • Low productivity of cotton (about 20% of the potential).	• Key pests of cotton in smallholder farms in Western Kenya and North East Brazil identified. • A manuscript on farmer perceptions on cotton pests and their management in Western Kenya prepared. • Colonies of the key pests (bollworms) of cotton established at *icipe* Thomas Odhiambo Campus, Mbita and used for screening and bioassay studies. • Partnerships formed: community based groups, farmer groups, national and international agricultural/research institutions.	• Study the effects of the selected pests on cotton and natural enemy behaviour and activity. • Collect and identify the physiologically active volatile organic compounds emitted by the identified host and non-host plants that mediate pest control. • Conduct on-station and on farm trials on the effectiveness of trap and intercrop plants on managing the target pests • Conduct participatory evaluation/ validation and assess stakeholder perceptions on the technology.

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
1. Wide scale implementation of push-pull technology, reaching 50,000 farm households, and benefiting 0.5 million people in *icipe* project areas by 2013. 2. Improved soils for at least 30,000 hectares of land and reclaimed degraded farmland.	Food sufficiency and household incomes of 50,000 Push-pull farmers enhanced by at least 50% by 2013 through at least100% increase in grain yields from the current 1 t/ha and sustained fodder and milk productivity.	• Acreage of farmland under Push-pull in target areas • Household income levels attributable to Push-pull. • No. of households having cereal food sufficiency. • Cereal and fodder yields and milk production levels among target farmers. • Number of Push-pull female and male farmers in the target areas utilizing fodder from push-pull in their dairy production. • Number of dissemination channels optimized and employed. • Number of partnerships formed and stakeholders trained.	• About 40,000 farmers utilising Push-pull technology by end of 2010. • Grain yields of non-Push-pull farmers is < 1t/ha. • At least 3,000 farmers having dairy goats and adopting Push-pull technology.	• Over 45,000 farmers are utilising Push-pull technology on about 500 ha of land in East Africa • Push-pull technology farmers are food secure with an average harvest of 3.0 and 2.7 t/ha of maize and sorghum respectively per cropping season. • Over 4,000 smallholder farmers dairy farmers feeding their livestock on fodder from Push-pull farms. • At least 0.3 million people benefiting from higher sustained crop, fodder and milk yields • *New research published:* Crop Protection 30: 531-538 (2011), International Journal of Pest Management 57: 133–145 (2011)	• Implement and disseminate the climate smart push pull technology widely.
An integrated management approach developed and implemented for striga control in maize in Western Kenya and Nigeria by 2014.	Food sufficiency and livelihoods of at least 15,000 smallholder farmers improved by at least 50% by 2014 through efficient control of striga and stemborer resulting in increases in maize, millets and rice 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	• Components of integrated striga management approach are available and tested.	• National stakeholders identified and awareness created about the striga control technologies among smallholder farmers. • Farmers' perceptions collected on striga control technologies. • Partnership platforms established to identify the	

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
		striga control. • Number of peer-reviewed publications • Number of partnerships formed.		technology best bets. • *New research published:* International Journal of Agricultural sustainability 9: 162-170 (2011)	
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.	• Farmers not aware of the potential of video technology to disseminate Push-pull. • Farmer to farmer communication, print material and radio are used as channels for dissemination.	• Participatory video methodology introduced to 6 farmer groups in four districts in Western Kenya and used to document Push-pull activities. • Partnerships strengthened: Existing FFS farmer groups, non- governmental organizations and national agricultural research institutes.	•
An integrated management approach for Napier stunt disease developed and implemented in Western Kenya by 2013.	• Improved incomes and livelihoods of at least 2,000 Napier farmers in Western Kenya by at least 50% through adoption of an integrated disease management strategy, characterised by increased fodder and milk	• 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	At least 70% of Napier grass in Western Kenya is infected by stunt disease • Stunt disease-resistant Napier varieties available • A management approach for Napier stunt disease available	• NSD vector, *Maiestas banda*, identified and colony established. • Rapid molecular disease diagnostic tools (PCR and LAMP) optimised for germplasm screening. • Up to 70 Napier grass varieties and alternative fodder grasses assembled. • NSD phytoplasm strains identified. • Farmers' perception of NSD conducted. • Partnerships strengthened with national agricultural	

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
	production			research institutes, national extension systems, non-governmental organizations, international agricultural research centres and community-based organizations. **New research published**: • Journal of Microbiological Methods 84: 312–316 (2011); • New Disease Reports 24: 17 (2011)	
Stem borer management approach developed by exploiting early herbivory traits and plant signalling by 2015.	•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 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 .	•Cereal yield losses ranging from 20 – 80% resulting from stemborer damage •Early herbivory traits exist in some maize landraces from South America and Africa •Plant signalling is reported in some plant species but has not been exploited to protect staple crops	**New research published:** • Ecology Letters 14: 1057-1083 (2011)	
Environmental risk due to genetically modified	Results of at least 2 *ex-ante* information	• Number of publications biodiversity and pest			

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
organisms (GMOs) in cotton and maize assessed by 2015.	on the diversity of lepidopteran pests and their associated natural enemies on GMO cotton and maize made available by 2013. 20% increase in stakeholders' awareness about negative externalities of use of GMOs and mitigation measures by 2015.	resistance on GM cotton and maize. • Number of policy briefs on cotton and maize (GMOs) published. • Mitigation measures endorsed and adopted by stakeholders. • Number of stakeholders reached in awareness campaigns undertaken by 2013.			
Objective 2: Minimize the vulnerabilities of horticulture and staple crops to climate change-induced pest problems by at least 10% by 2020					
1. Baseline information on ecosystem services (pollination and pest management, biodiversity, habitats and water resources) established.	Study outcomes utilized by scientists, policy makers, extension workers and other stakeholders by 2015.	• Effects of climate change on biodiversity and habitats explored through modelling by 2015.	Little Information on ecosystem services (pollination and pest management, biodiversity, habitats and water resources). While information on effects of climate change on ecosystem services lacking.	• Selection of study transects across the gradient in Taita taveta, Kenya; Kilimanjaro, Tanzania and Jimma, Ethiopia undertaken.	
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 utilized by stakeholders by	• 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.	Geospatial datasets for Taita Taveta available but lacking for Kilimanjaro and Jimma lacking.	• Geospatial datasets for the target transects developed and shared with partners organisations and other stakeholders. • Aerial remote sensing campaign undertaken in Taita Taveta along the study transect.	• Validation of remote sensing data sets with field observation on-going. • Training of MSc and PhD students and staffs of stakeholder organizations organised.

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
	2015.	• MSc and PhD training on GIS organized for at least 25 staff members of the stakeholder organisations.		• MSc and PhD students to carry out research on GIS along the study transects selected.	
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.	Economic valuation of the benefits of ecosystem services in Afromontane regions of East Africa Biodiversity Hotspot lacking.		• Students undertaking research on valuation of ecosystem services selected. • Training of MSc and PhD students and member of stakeholder organisation on valuation of ecosystem services organised.
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.	Minimal Information on effects of climate change and land cover change on biodiversity in The Afro-montane regions of EABH.	• Selection of students to undertake research on evaluation of impacts of climate change on biodiversity and habitat undertaken.	• Selection of study sites, field surveys and observations on-going.
5. Baseline data and monitoring protocols for functional	Baseline data available and widely used by trained staff	• Historical data on pollinators, pests and natural enemies of target	Baseline information on the dynamics of DBM, maize	• Identification of study transects across the altitudinal gradient in the	• Field surveys ongoing • Finalization of MOU with partner

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
ecosystem pest management and pollination established along altitudinal gradients in three research areas	members in the 25 stakeholder organisations by 2015.	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.	Stemborer available in Taita Taveta, but lacking for other pests and from other study transects.	Taita Taveta, Kilimanjaro and Jimma undertaken • Field sites for monitoring pest and natural enemy dynamics identified • Selection of 6 PhD Students and 1 Master's 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. • Selection of sites for placement of Automatic weather stations, finalization of MOU with National meteorological department and procurement of weather stations undertaken. • Weather stations placed in four locations of Taita Taveta.	organisation on-going • Procurement and placement of data loggers of temperature and humidity observations in study sites on-going • Laboratory bioassays to establish temperature dependent life tables for the target pest species to be initiated. • 11 Weather stations installed and operational on the Taita Hills, Mt. Kilimanjaro and Jimma Highland.
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.	Baseline information on hydrological datasets for Pangani river basin available from the Valuing the Arc project but further detailed information for Kilimanjaro, Taita Taveta and Jimma	•	• Water basin boundaries defined and maps available for the study areas. • Hydrometric data collected from the study areas, on-going. • Hydrological models developed for three

Output	Outcome	Performance indicators	Baseline	Results Year I (2011)	Results Year II (2012)
			lacking.		target areas, on-going.
7. Adaptation strategies to changes in ecosystem services elaborated and Adaptive Management Framework (AMF) tools developed	Adaptation options and implementation strategies identified and developed for stakeholders in the three target areas by 2015.	• A set of AMF tools available by 2015. • Tools for vulnerability assessment prioritized, susceptibility index and vulnerability maps completed by 2015. • Action plans and reporting mechanisms completed by 2015.	Information on Adaptation strategies to climate change if any by the communities not documented.	• 1 Master's student to survey 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.	• Project kick-off meeting organised in Moshi, Tanzania to sensitize on project activities undertaken. • Baseline literature analysis completed and shared with project partners and stakeholders.
8. Push-pull technology adapted to dry weather conditions associated with climate change for smallholder cereal – livestock farming systems in eastern Africa through identification and utilisation of drought-tolerant companion	• Food sufficiency and household incomes of 5000 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 At least three outcomes of the technology adaptation process utilised by scientists, policy makers and other stakeholders by 2013.	• 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 • Number of stakeholders trained • Number of partnership formed	• Current Push-pull trap plants are not drought-tolerant	• Brachiaria and *Desmodium intortum* (green leaf) have been identified as drought-tolerant companion plants with potential for use on farmers' fields • Partnerships formed: Heifer International Kenya, Heifer International Tanzania, Institute of Sustainable Development and EIAR (Ethiopia), Rothamsted Research (UK), KARI (Kenya) and LZARDI (Tanzania)	• Drought tolerant desmodium species (e.g. *D. Intortum, D. Ramosissimum, D. Incanum, D. Tortuosum and D. Repandum)*are being evaluated for their effects on striga suspension, stemborer repellence, ability to improve soil health and usefulness as fodder • Dissemination of climate smart push pull ongoing

B. INTEGRATED VECTOR AND DISEASE MANAGEMENT OUTCOMES

Under this thematic area, as mentioned, *icipe* has combined the animal and human health R&D activities to enhance disciplinary inter-relationships as well as create synergies. The rationale behind this theme is that, some diseases e.g. trypanosomiasis and rift valley fever (RVF) among others, do affect both animals and human beings and addressing them jointly has a scientific advantage. We, however retain the focus of each for clarity in reporting.

(i) Animal Health Results Based Management (RBM) Framework

Overall objective for Animal Health: Contribute to the improvement of livestock health and productivity through the development of integrated strategies and tools for livestock disease vectors' control and adoption by development partners, thus leading to greater availability of meat and milk, hides and draught power and thereby assisting livestock owners to get out of the poverty trap.

Specific 2011 RBM Framework Outcomes:

Outputs	Outcomes	Performance Indicators	Baseline	Results Year I (2011)	Results Year II (2012)
Objective 1: To reduce trypanosomiasis risk by 50% in cattle of pastoralists and agro pastoralists by 2013 by development and optimization 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 by participating livestock keepers. • Publications produced. • Journal index. • Project reports.	• No repellents available.	• One new dispenser model (KIRDI/*icipe* ii) produced for field trials. • Patent application for dispensers submitted. • Preliminary application for WRB submitted. • WRB publication accepted.	
Repellents and their dispensers evaluated.	Drug use by farmers and disease incidence in cattle reduced by > 50% using tsetse	• 50% decrease in drug use and 50% decrease in disease incidence. • Favourable assessment	• More than 40% disease incidence. • Farmers	• Ongoing field trials with 1300 cattle and 258 farmers ongoing and showing promising	

Outputs	Outcomes	Performance Indicators	Baseline	Results Year I (2011)	Results Year II (2012)
	repellent technology by 2013.	by participating livestock keepers and veterinary staff. • Publications produced. • Journal index • Project reports	dependent upon drugs for treatment. • Cattle not grazed near the park. • Smoke used to repel flies.	results. • Disease incidence and drug use already reduced by >50%. • Assessment by livestock keepers very positive and demand cannot be met.	
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 MoUs 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.	• Farmers and other stakeholders unaware of repellents.	• Agreement signed with Novartis Animal Health, Switzerland for evaluation of effects on other insects. • Major stakeholder meeting to exhibit the technology planned for June 2012. • Joint EU & *icipe* press release issued. • 6 media articles published worldwide. • One interview with Channel Africa Radio from south Africa. • >400 farmers attended dissemination sessions.	
1.Training farmers in use of repellent technology. 2. 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. • Reports by NARES.		• >95% farmers willing to adopt technology.	
Technology for large scale production	No. of agreements signed with	• No. of expression of interest from		• One National institute is willing to upscale-	

Outputs	Outcomes	Performance Indicators	Baseline	Results Year I (2011)	Results Year II (2012)
of dispensers and repellent compounds passed over to local entrepreneurs	entrepreneurs for commercialization of tsetse repellent technology by 2013	commercial/local companies to explore development of dispensers and repellents. • No. of agreements signed. • No. of meetings held with entrepreneurs.		production.	
Objective 2: To reduce by 50% the disease constraint 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 enhance pig production in Ghana developed	Pig production increased by 40 % in Ghana by 2014	• Documentation on animal health package made available. • No. of on-farm trials undertaken. • Cases and technical reports produced. • Pig production Increased by 40%. • Up-scaling and replication of package in other production systems. • Publications produced. • Technical Advisory Notes produced. • Independent evaluation by NARES.	• Pig mortality very high due to trypanosomosis. • Piglets sold at very early age. • No pigs zero-grazing units.	• On farm trials in two villages' ongoing and showing promising results indicating productivity target will be met. • Project reports produced.	
2. Animal health package to protect dairy cows in zero grazing units from vectors of livestock	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.	• Mastitis infections more than 70%. • Waste pits connected to	• Trends indicate that milk production will double.	

Outputs	Outcomes	Performance Indicators	Baseline	Results Year I (2011)	Results Year II (2012)
developed		• Cases and technical reports produced • Milk production doubled. • Up-scaling and replication of package in other production systems. • Publications produced. • Technical Advisory Notes produced. • Independent evaluation by NARES.	zero-grazing un-protected. • Biting fly numbers very high in zero-grazing units.		
3. 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 in selected areas in Ghana, Burkina-Faso and Kenya	• 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. • Journal index. • Technical Advisory Notes produced. • Independent evaluation by NARES in respective countries.		• In 2 target countries (Kenya & Ghana) biting fly populations already reduced by>80% in project sites. • In B. Faso populations reduced by>50% but trials started late compared to other countries.	
4. Training of farmers and NARES in management of zero grazing units	400 farmers trained in Eastern and Western Africa in management of zero grazing units by	• No. of farmers, rural communities and NARES participating in project activities in different		• 120 farmers in Kenya and 100 farmers in West Africa trained on	

Outputs	Outcomes	Performance Indicators	Baseline	Results Year I (2011)	Results Year II (2012)
in order to minimize vector borne diseases	the end of 2013	countries. • No. of training courses/workshops held. • No. of trained farmers and community leaders. • No. of women trained.		management of the zero-grazing units.	
5. Training of farmers in production and utilization of better quality fodder.	400 farmers using better quality fodders by 2013 in targeted areas.	• 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.			
Objective 3: To reduce populations of riverine tsetse causing human sleeping sickness by 50% by 2013 by development of baits					
1. Attractants from monitor lizards identified. 2. Dispensers for olfactory attractants developed. 3. Traps/targets developed.	New artificial baits (both visual and olfactory) for vectors of human sleeping sickness used in at least three African countries by 2013	• No. of countries new baits used. • % of tsetse population reduced. • No. of new traps produced. • Publications produced.	• No attractants from monitor lizards used as artificial baits for vectors of human sleeping sickness.	• At project site, tsetse population already reduced by 90% with the new visual target. • Olfactory-based bait developed but not effective in field trials in trapping tsetse flies. Project closed.	
Objective 4: to reduce ticks and the diseases they cause by 50% in icipe project areas by 2015					

Outputs	Outcomes	Performance Indicators	Baseline	Results Year I (2011)	Results Year II (2012)
1. Potent ethno botanicals identified and their essential oils important for tick control characterized. 2. Tick specific pathogens identified and their formulation for control of ticks optimized. 3. Important semiochemicals for manipulating tick behaviour on-host and off-host identified. 4. Integrated tick control strategies / technologies for controlling ticks developed.	On-farm technology based on ethno-botanicals, entomopathogens and semiochemicals for integrated control of ticks utilized by more than 1000 small holders livestock keepers by 2020. At least two national animal health services in Eastern Africa take up icipe recommendations and technologies and integrate them in their programmes by 2015.	• New proposal funded. • Tick populations reduced by 50%. • Production of Technical Advisory Notes. • No of countries requesting for new tick control technologies. • Acarcide use reduced by 50%. • Project reports. • Publications produced. • Journal index.		• In 2011 no funding secured for this work to be undertaken.	
Objective 5: To develop molecular tools for identifying sources of blood meals in tsetse flies (Diptera: Glossinidae) by 2012					
New tools for identifying tsetse fly blood meals developed.	New tools for identifying blood meals available to stakeholders by 2012. Molecular tools integrated in decision support systems for integrated management African	• No of publications • Standard operating procedures (SOPs) for collection and storage of blood meals • SOPs for identification of blood meals • No of trained	• No simple, field applicable methods are available	• New laboratory SOPs developed • Proof of concept established using laboratory fed tsetse flies	• Blood meals from field-caught tsetse flies identified.

Outputs	Outcomes	Performance Indicators	Baseline	Results Year I (2011)	Results Year II (2012)
	trypanosomiasis by stakeholders by 2015	personnel • Laboratory experiments • Field reports			
Objective 6: To develop innovative approaches to disrupt transmission of trypanosomiasis by 2015					
Innovative tools and approaches for controlling African trypanosomes.	Novel gene targets with potential incorporation into control strategies identified by 2015. A map of protein-protein interactions developed to provide data on critical pathways associated with transmission of trypanosomes in tsetse flies by 2015	• Establish systems for analysis of gene function in tsetse flies, by 2012. • No. of genes critical to transmission of trypanosomes identified. • Protocols established for RNA interference in tsetse flies for analyzing gene function. • No of trained personnel. • Laboratory experiments.	• Whole genome of Glossina not available; a dataset for cDNA is available. • Interaction map for Glossina proteins unavailable.	• RNA interference (RNAi) protocols tested in *Glossina pallidipes*. • Two postgraduate students (one PhD; one MSc) completed their studies.	• Genome of *Glossina morsitans morsitans* complete. • International training on genome annotation, with many African participants hosted by *icipe*.

(ii) Human Health Results Based Management (RBM) Framework

Overall objective for Human Health: 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.

Specific 2011 RBM Framework Outcomes:

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
Objective 1: Contribute towards malaria elimination through the development of effective vector control strategies and public health					

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
initiatives by 2020					
1. Develop understanding of the link between livelihoods, ecosystem health and malaria in 50% of target community populations by 2020.	• At least 30% of the community members are embedding safety measures in their livelihood seeking activities.	• Presence of malaria self groups. • Increased demand of education about malaria control. • Agenda for taking collective action against malaria adoption of safer livelihood practices. • Peer-reviewed publications • Books.	• Scarce knowledge on the link between livelihoods and malaria.	• Fishing and small-scale farmer social practices aggravating malaria described.	• A draft outcome mapping strategy on the interrelationship between malaria and livelihoods developed.
2. A minimum of Five communities empowered on IVM-based strategies for vector-borne disease control by 2020.	• 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 the East and Central Africa. • At least 50% decrease in mosquito densities.	• 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.	• Two 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 have been held.	• One regional training workshop held on strengthening country capacities to implement Integrated Vector Management (IVM). • Five-year strategic plan of IVM R&D activities drafted.	• Meeting held to discuss the draft on IVM utility model for decision makers available. • Impact analysis of role of brick making on malaria transmission done.

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
3. Plant-derived mosquito control strategies established by 2015.	• Plant derived products identified and formulated from at least 3 plants for utilization in field trials by scientists.	• Plant-derived lure for trapping mosquitoes available. • Peer reviewed publications	• Little knowledge on mosquito plant feeding behaviour. • Little knowledge on semiochemicals associated with mosquito host plant choices.	Four candidate compounds thought to affect mosquito host plant choices identified.	
4. 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	• One funded study. • One dedicated scientist present. • One dedicated technician present.	• Five strains of the malaria mosquito *Anopheles gambiae* colonized to support ongoing studies. • MSc. candidate recruited	• MoU between *icipe* and Institut Pasteur, France, signed. • Postdoctoral fellow from Institut Pasteur, France, hosted at *icipe* for initial two months in early 2012. • MSc. level consultant recruited.
5. Develop at least two chemical-based technologies for surveillance and/or disruption of malaria transmission 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 programs. • 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.	• Several synthetic mosquito attractants developed. • Studies largely confined within semi-field settings.	• Push-pull vector control concept developed and tested. • New attractant blend formulated and tested in the field. • Funding secured for trialling odour-baited traps for malaria control at village level.	• Alternative tools for delivery of synthetic attractants tested. • Outdoor versus indoor efficacy of synthetic attractants tested.

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
		• Project progress reports • Thesis • Posters			
6. Develop understanding of oviposition response of *An. gambiae* to aquatic habitats that differ in their chemical and bacterial profiles for vector control purposes 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 NMCPs. • Peer-reviewed publications • Books. • Thesis.	• Little knowledge of oviposition behaviour of major malaria vectors in general. • No semichemicals known to be associated with oviposition choice in *An. Gambiae.* • No oviposition trap available for collecting and controlling gravid malaria mosquitoes outdoors.	• Laboratory bioassays have been conducted. • Semi-field assessment of laboratory results in greenhouse setting. • Simulated open-field trials and field tests under natural conditions. • Systematic and desk reviews.	• Field assessment of colonisation of natural habitats is ongoing. • Chemical and bacteria profiles have been collected for sites with and without malaria.
7. Develop innovative application strategies of novel, persistent insecticides for *An.*	• Optimum concentration of insecticides for malaria control used by the	• Increased interest in larval source management by national malaria control programs	• Larval source management is targeted at all aquatic habitats in the intervention	• Laboratory bioassays. • Semi-field assessment of	Field testing of larvicides are ongoing. (1 draft manuscript has been developed.)

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
gambiae by 2020.	communities in western Kenya. • An 'Attract and kill' strategy adapted by combining oviposition attractants with long-lasting larvicides developed and used by communities.	(NMCPs). • Rationalized larval source management strategies for malaria control. • Use of novel insecticides in national programs. • No. Peer-reviewed publications. • Books. • No. Thesis produced.	areas at short (weekly) intervals • Residual larvicides have not been tested and are not used for mosquito control	laboratory results in greenhouse setting. • Simulated open-field trials and field tests under natural conditions. • Systematic and desk reviews.	
Objective 2: To 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. Establishment of an arbovirus surveillance and response system for early warning and response in East Africa by 2013.	• Field surveillance and diagnostic network for East Africa for Rift Valley Fever and other arboviruses surveillance is established and responds to outbreaks.	• Sequencing and diagnostics in place, 30 trained personnel. • Early detection and response to arbovirus outbreaks in the region. • Files of the project proposal. • Virus databases • Taxonomic keys. • Diagnostics manuals.		• 454 Sequencing and Mass Tag training for staff done. • Functionality/and operation of equipment training of staff and optimization of assays/panel for African arbovirus for screening of samples is complete. First 98 samples screened.	• Two manuscripts have been completed and submitted to journals for consideration for publication. • Another seven are in various stages of publication by consortium members and we anticipate having some of these submitted in 2012.
2. To train 20 field and	20 field and lab	• Log of trained	•	• Phase 1 of training	Phase 2-(Laboratory

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
lab officers from East African countries on lab diagnostics, field sampling and biobanking by 2012.	personnel capacity improved in arbovirus surveillance.	personnel and contacts maintained. • Files of the project proposal. • Taxonomic keys. • Training folders.		(field sampling and biobanking) successfully completed on 15th November 2010. • Phase 2 training on lab platforms delayed due to late acquisition of multiplex PCR equipment. And the time it took to optimize assays for African arboviruses. This is now done and sample screening is just starting.	training on multiplex PCR and second generation sequencing) to be done in 2012.
3. Detection of 20 known (arbo-) viruses and 5 new pathogens or their variants OR Screen 10,000 samples by multiplex PCR or ELISA by 2015.	• 20 known and 5 new viruses or variants isolates deposited in virus bank.	• Sequences in genebank. • Number of publications in peer reviewed journals. • Files of the project proposal. • Virus data bases • Taxonomic keys		• 16 nearly full genomes were sequenced. In addition, sequence reads from another 19 pathogens are available. • Laboratory testing and analysis tools.	
4. Development of a vector map associated with the transmission of different arboviruses in different East African regions by 2014.	• Improved targeted vector control initiatives that are specific regionally	• Published vector/arbovirus map that is used by other East African institutes when considering vector control initiatives		• Molecular identification tools have been developed, enabling development of vector distribution maps based on morphology and	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
				molecular tools. • A number of species with DNA barcode tags associated with them one. • Using this tool, *Aedes luridus*, previously not known to be present in Kenya was identified among pools previously identified as *Aedes mcintoshi* that were collected in association with 2007 Rift valley fever outbreak.	
Objective 3: To 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.					
Odour-bait trapping system developed for RVF vectors.	• Utilization 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. • Thesis.		Laboratory identification of potential odour-bait field trials underway.	• Continue with field trials.
Objective 4: To develop tools for xenomonitoring of Human trypanosomiasis for control programs in developing countries, by 2015					
Xenomonitoring tools available for application by stakeholders in the management of	• National and international stakeholders using tools developed to monitor control	• No. Technologies evaluated. • Identification of the most appropriate technologies, based	Xenomonitoring tools lacking in developing countries.	• Good cooperation among stakeholders and a Consortium Agreement signed.	Animal-based tools for monitoring availed for application by stakeholders in the management of

Outputs	Outcome	Perform. Indic.	Baseline	Results Year I (2011)	Results Year II (2012)
trypanosomiasis.	programs for tsetse and trypanosomiasis by 2015. • Guidelines defining criteria for identifying appropriate technologies published.	on agreed criteria. • No. of training manuals • No. of trainees • Publications • Product protocols • No. of stakeholders applying the technology.		• Two manuscripts produced and a good draft of the third paper is under review.	trypanosomiasis.
Objective 5: To contribute to the reduction in the transmission of trypanosomiasis by developing epidemiological tools.					
The process developed evaluated.	• Genetic targets identified and a process for their use in identifying blood meals developed. • No. of students trained. • Publications. • Product protocols	• Project reports • Training manuals • Assessment reports by partners • No. of students trained. • Publications • Product protocols	• The strategy/process developed will be applicable across different ecosystems, inhabited by different complexities of potential hosts. • Products will be taken up by control agencies.	• Genetic targets identified and a process for their use in identifying blood meals developed.	

C. ADAPTATION TO CLIMATE CHANGE & ECOSYSTEM SERVICES OUTCOMES

Environmental Health Results Based Management (RBM) Framework

Overall objective for Environmental Health: Conservation and sustainable utilization of the agricultural production base and important natural ecosystems, by encouraging and utilizing arthropod diversity, cataloguing and sharing biodiversity data, and discovering endemic wealth by bio-prospecting for useful natural products.

Specific 2011 RBM Framework Outcomes:

Outputs	**Outcome**	**Perform. Indic.**	**Baseline**	**Results Year 1 (2011)**	**Results Year II (2012)**
Objective 1: Control of the aquatic plant pest, *Hydrilla verticillata*, using wild *Polypedilum* (Chironomidae) species from East Africa by 2015					
1.1.1 Lakes in East African countries surveyed for *Hydrilla*, and *Hydrilla*-positive and negative locations mapped by 2011. 1.1.2 Rearing facilities for producing chironomid adults established, and suspect *Polypedilum* and associated chironomid species reared from *Hydrilla* and non-target plants identified in a least one lake in at least two countries by 2011. 1.1.3 Specificity of *Polypedilum* species to *Hydrilla* and non-target aquatic plant species evaluated in at least one lake in at least two countries by 2011. 1.1.4 Insect damage to *Hydrilla* evaluated and source of damage identified in at least one lake in at least two countries by 2012. 1.1.1 Target *Polypedilum* species colonized on naïve *Hydrilla* cultures in the laboratory by 2011.	At least three manuscripts based on research findings on utility of *Polypedilum* to control *Hydrilla* published in peer-reviewed journals by 2012.	Number of reports and publications.	No previous studies.	•*Journal Publication:* 2011. Florida Entomologist 94(3): 669-676. •*Journal Publication:* 2011. Journal of East African Natural History 100 (1&2): 113-121. •*Journal Publication:* 2011. Journal of Aquatic Plant Management 49: 19-27.	•*Journal Publication:* 2012. Annals of the Entomological Society of America 105: 206-224 •Manuscript in press. Journal of East African Natural History. - Chironomidae (Insecta: Diptera) associated with *Hydrilla verticillata*
1. 2. Dissemination of information among	*Hydrilla* control, national,	Reports and	No previous	To be accomplished by 2012.	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
weed-control professionals in *Hydrilla*-infested areas by 2012.	and Florida, USA pest-management agencies incorporate project conclusions into work and research plans by 2013.	publications of weed-control specialists include references to use of *Polypedilum* in *Hydrilla* control.	studies.		
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.	DNA-Barcode library for the African pest and vector insects is used by scientists to identify pest species with DNA techniques.	Number of DNA Barcodes.	No previous studies.	• Currently the existing Barcodes are not yet publicly available, only after release by scientists. • About 7000 insect specimens of 1200 species have been contributed through BSU, RS Copeland and NMK, resulting in about 2500 sequences.	
2.1 Three trainings per year for 10-15 students and staff. 2.2 Number of teaching modules available in intranet.	Students and staff know and apply modern taxonomic techniques, including morphological identification, preparation and DNA techniques to identify insects by 2013.	Number of trainees.	No previous training.	• 40 Students and staff trained in modern taxonomic techniques, including morphological identification, preparation and DNA techniques to identify insects. • A training given on Basic Entomology for ARPPIS and other students in 2011 and 2012 • Taxonomy training in ADOPT Project in Mbita.	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
				• Training course in DNA Barcoding. • Lecture of Taxonomic techniques.	
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.		• 6000 page views of the tool kit registered in 2011. • A detailed statistics is available and is produced by Google every month.	
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		Three projects funded in 2011.	One funded proposal scheduled to be implemented in 2012.
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 Framers are capable to identify these insect and can monitor the quality of streams	Checklist of insects and number of trained locals. Project Reports	Locals are incapable of identifying insects to the necessary taxonomic rank.		
Objective 3: At least 6 new eco-friendly, nature-based products for pest control and local energy production adopted for improvement of livelihoods of community members living adjacent to threatened biodiversity rich areas by the year 2020.					
3.1. 1. Candidate repellent plants and constituents identified based on efficacy, safety and ease of cultivation. 3.1.2. Two low-cost repellent plant-derived products formulated and packaged. 3.1.3. One repellent product submitted for registration with relevant bodies. 3.1.4. Community-based domestication and commercial cultivation of a selected	• One new low-cost nature-based mosquito repellent product adopted for commercial production and in use by 2013. • At least 3 papers published in international journals.	At least 20% of participating community households demonstrate increased income through sales of nature-	One mosquito repellent product previously developed and over 15,000 pieces used.	• One new plant-derived repellent product formulated and packaged. • Protocols for patenting and registration of the repellent product initiated. • Community-based domestication and cultivation of the repellent	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
repellent plant initiated. 3.1.5. A community-based facility established for processing repellent plants. 3.1.6. Community-based production of low-cost mosquito repellent products initiated through private sector.		based mosquito repellent. Number of reports and publications		plant undertaken by 710 households in Kenya and Tanzania. • Two community-based facilities for processing the repellent plant operational in Kenya and Tanzania. • Production of the mosquito repellent product initiated through private sector. • Two additional candidate repellent plants identified based on efficacy and safety.	
3.2.1. Microorganism strains from insects with potential for hydrolysis and fermentation of agricultural waste to sugars and ethanol isolated, identified and preserved. 3.2.2. Selected microbial strains optimized. 3.2.3. Bio-ethanol gel products formulated. 3.2.4. A community-based facility for pilot production of bio-ethanol established. 3.2.5. Over 100 community members trained in production of bio-ethanol. 3.2.6. Community-based pilot scale production of bio-ethanol initiated. 3.2.7. At least 2 papers published in international journals.	• Bio-ethanol gel for local energy use is produced from agricultural waste by community members using insect-derived microorganisms by 2013. • At least one paper published in international journals.	A total of at least one ton of bio-ethanol gel produced by over 100 households and used for cooking and lighting. Number of reports and publications	No previous studies.	• 1 MSc. student trained. • Thirty two candidate cellulose-degrading microorganisms isolated from insect intestinal tracts and preserved. • 1 MSc. thesis produced.	
3.3.1. At least 4 new potential insecticidal products identified from plants and microorganisms based on efficacy, safety and ease of application. 3.3.2. One PhD and two MSc. Students trained.	Four papers on potential insecticidal products published by 2013.	Number of reports and publications. Number of students	No insecticidal product developed.	• One peer-reviewed paper published. • One plant-derived insecticidal product with potential for rural	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
3.3.3. At least five papers prepared and submitted to international journals.		trained.		community-based application formulated. •One PhD and 2 MSc. students recruited and under training. •Two additional papers under preparation.	
Objective 4: Geographic Information Systems are fully integrated as a strategic research tool for *icipe* by 2020.					
1.1 GIS software and data server with database for *icipe* research areas is accessible. 1.2 Thirty students and/or staff member/project partner get hands-on training courses for GPS and GIS annually. 1.3 Two GIS courses are developed for an e-learning platform. 1.4 Ten students trained and supervised on e-learning platform based courses annually.	- The use of GIS by students and scientists increased by 20% by 2013.	Hits on data server, intranet web site. Number of students in training and coursework Course exams Number of publications with GIS impact. Number of courses online		•65% of the 40 trained students use GIS as a tool for their research. •Construction of a GIS software and data server with database for *icipe* research areas initiated. •Forty students trained on GPS and GIS.	
2.1 At least two key project proposals with strong focus on spatial epidemiology and/or ecosystem services are submitted annually. 2.2 At least three projects use GIS as strategic tool.	- Increased GIS impact on research outputs by 2013 (50% of staff time funded through projects, 20% more publications with GIS related research, 20	Number of Projects funded. Staff employed.	No previous grants.	• Three projects are using GIS as strategic tool.	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
	more students per year supervised in GIS).	Number of publications/ Maps / reports with GIS impact. Number of MSc. students supervised, Number of reports and publications.			
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.	50% of the farmers use improved bee and silk races.	Number of farmers using improved races	No identification of bee and silkworm races	• 70% of the 3000 farmers in 12 African countries are using improved bee races. • 30% of the 3000 farmers in 6 countries in Africa using improved silkworm races. Six bee races identified for enterprise development in Africa. • Five silkworm races identified for enterprise development in Africa. • Healthy bee races distributed to 2000 farmers in 12 countries. • Healthy silkworm races are distributed to 1000 farmers in 6 countries.	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
3. Training material developed. 4. Training sessions held for 2,000 trainers.	Knowledge of sericulture and apiculture is applied by at least 750 farmer groups (each 50 to 100).	Numbers of farmers trained, number of certificates (exam), numbers of farmers applying their new knowledge.	No training manuals	• 200 farmer groups in 12 countries in Africa apply improved skills in apiculture. • 120 farmer groups in 6 countries in Africa apply improved skills in sericulture. • Five training manuals in 7 languages developed. • 2000 farmers from 12 countries in Africa trained in apiculture. • 1000 farmers from 6 countries in Africa trained in sericulture.	
5. Business model developed using value chain approach.	Business model and business responsibility adopted by at least 400 farmer groups.	Number of enterprises registered.	No apiculture and sericulture business models	• 200 farmer groups adopt new business models in apiculture and sericulture. • Two business models in apiculture and sericulture developed using the value chain approach.	
6. Establish 16 to 20 marketplaces [honey and silk harvesting, processing and selling units].	25% Increase in honey and silk quantity by 2013.	• DC registry • Production records		• 25% increase in honey production in 12 countries in Africa. • 10% increase in silk production in 6 countries in Africa. • Ten marketplaces for harvesting, processing and selling honey established	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
				in 7 countries in Africa. • Eight marketplaces for harvesting, processing and selling silk established in 5 countries in Africa.	
7. Supplying modern beehives to farmers and establish rearing houses (silk moth).				• 15,000 beehives supplied to farmers in 8 countries in Africa.	
8. Internal Control System (ICS) training for 3,000 farmers.	Percentage of communities producing honey and silk to EU standards increases from 20% to 40% by 2013.	Honey and silk quality assessed and certified	No organic certification	• 25% increase in number of community members producing honey to EU standards. • 1,000 farmers from 2 countries in Africa trained in Internal Control System (ICS).	
Objective 6: To improve bee products and pollination services by 30% through reduced incidence of bee diseases and pests, enhanced markets access and bee health and policy and institutional environment by 2020.					
1. Bee health facilities for innovative technologies and provision of pest risk analysis, baselines and bench marks established.	Documentation of honeybee pests, maps available and utilized by 40% of stakeholders for training beekeepers by 2020.	Number of stakeholders using maps. Peer-reviewed publication	No bee health surveillance data available in Africa	Programme starts in 2012.	
2. Development of validated bee disease and pest management module s 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 publication		Programme starts in 2012.	
3. Innovative integrated honeybee pest control strategies developed.	Use of honeybee integrated pest control strategies	Number of beekeepers	No bee health record	Programme starts in 2012.	

Outputs	Outcome	Perform. Indic.	Baseline	Results Year 1 (2011)	Results Year II (2012)
	increased by 20% by 2013	trained, Number of beekeepers applying new knowledge Peer-reviewed publication	available in Africa		
4. Improve awareness of honey bee health and contusive environment for enhanced bee disease control, access to markets and consumer safety.	Effective multi-stakeholders 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 honey bee health for hive products	No bee health record available in Africa	Programme starts in 2012.	
5. Capacity of beekeeper/farmers' federation, 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.	No reports available	Programme starts in 2012.	

D. CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT OUTCOMES

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

Overall objective for Capacity building: To develop well-trained and highly motivated human capacity, and strengthen institutional and policy making capacity and capability required to respond to the arthropod-related development challenges in Africa.

Specific 2011 RBM Framework Outcomes:

Output	Outcome	Performance indicators	Baseline	Results Year 1 (2011)	Results II (2012)
Objective:	**To 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. Two hundred PhD and MSc postgraduates trained in arthropod-related sciences for research leadership and policy formulation.	• At least 80% of graduates trained in research and development working in NARS, RECs, SROs, CGIARs, and Universities in Africa by 2013.	• Number of postgraduates completing their studies. • Number of publications in peer-reviewed journals.	• *icipe* CB &ID database • Tracer study • Tailor-made questionnaires • Ad-hoc interviews	• 15 completed PhD studies. • 20 publications in peer reviewed journals. • 70% of graduates trained in research and development working in NARS, RECs, SROs, CGIARs, and Universities in Africa by 2013.	
	• At least 50% graduates trained involved in researches dealing with food security and poverty reduction issues.	• Number of graduates leading public & private organisations/enterprises in Africa • Number of research activities/projects implemented in Africa by African institutions.		• 7 graduates engaged in research and training.	
2. Publication of research results (theses, book chapters, peer-reviewed journal, brochures,...)	• At least 80% of research results disseminated in relevant formats at scientific community and policy makers level in Africa by 2013.	• Number of published articles in journals, student theses, book chapters, peer-reviewed journal articles, brochures...	• *icipe* information resource centre.	• 20 published in peer-reviewed journals. • 15 theses published.	
		• Number of citations in peer reviewed publications.	• End note programme	• Not yet known.	

Output	Outcome	Performance indicators	Baseline	Results Year 1 (2011)	Results II (2012)
	• 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	• 20 students participated in symposia.	
3. Two hundred 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	• 8 training courses held • 120 trainees. • 170 Mid-level practitioners and extension workers from over 20 national systems in Africa trained. • 4 new technologies developed. • 12 training and information manuals prepared. • 10 media reports prepared and distributed.	
4. One hundred and fifty 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	• 75 interns trained. • 50 internship reports.	
5. Ten 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 MoUs 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.	• 5 exchange visits undertaken. • 16 network partners in collaborative agreements. • 8 collaborative projects • 2 technologies adopted. • 7 collaborative agreements (ASARECA + AFAAS, IGAD, FARA, CORAF, EAFF, ROPPA, IGAD).	

Output	Outcome	Performance indicators	Baseline	Results Year 1 (2011)	Results II (2012)
6. Ten career development opportunities for ten professional development program (short term - visiting scientists and PDF) 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 post doctoral fellows and visiting scientists trained. • Number of grants received by 2015. • Number of research publications in peer-reviewed journals.	• Project documents, reports.	• 9 postdoctoral fellows and visiting scientists. • 9 research grants achieved. • 5 publications in peer reviewed journals.	