

# ***Darwin Initiative Annual Report***

## **Darwin Project Information**

Project Ref Number	15/003
Project Title	Conservation of Biodiversity in Traditional West African Species
Country(ies)	Benin, Mali
UK Contract Holder Institution	CAZS Natural Resources, Bangor University
Host country Partner Institution(s)	Institut d'Economie Rurale (Mali) Institut National des Recherches Agricoles du Benin (Benin)
Other Partner Institution(s)	-
Darwin Grant Value	£245,454
Start/End dates of Project	May 2006 – October 2009
Reporting period (1 Apr 200x to 31 Mar 200y) and annual report number (1,2,3..)	1 <sup>st</sup> April 2008 – 31 <sup>st</sup> March 2009 Annual Report 3
Project Leader Name	Dr. Margaret Pasquini
Project website	<a href="http://www.cazs.bangor.ac.uk/ccstudio/Research/cazsproject_Darwin1.php">http://www.cazs.bangor.ac.uk/ccstudio/Research/cazsproject_Darwin1.php</a>
Author(s) and main contributors, date	Dr. Margaret Pasquini, Dr. Francoise Assogba-Komlan, Dr. E.M. Young, Dr. Ambrose-Oji, Dr. Enoch Achigan Dako, Mr Sognigbe N'Danikou, 30 April 2009

## **1. Project Background**

This Darwin Initiative (DI) project addresses the urgent need for research & awareness-raising on the conservation of 'traditional' vegetable biodiversity in two West African countries – Benin & Mali (see Figure 1).

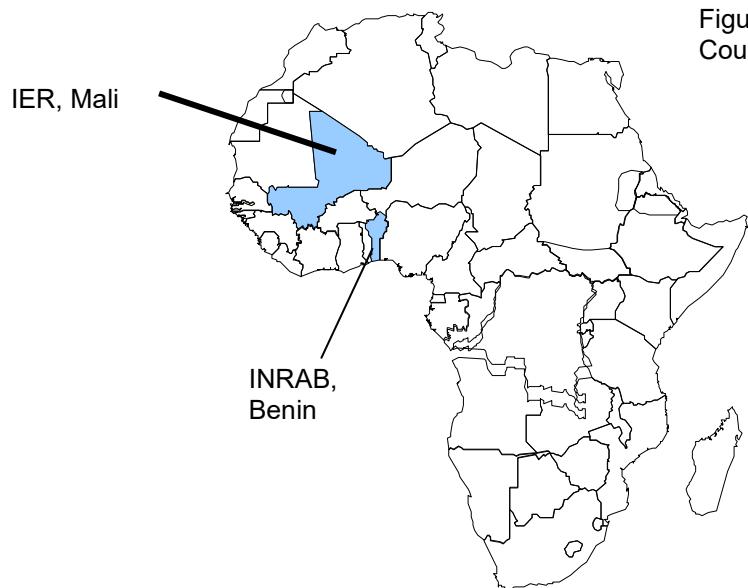


Figure 1: The Project Countries & Partners

Traditional vegetables have played an important historical role in the food systems of West Africa, but their contributions to food security and nutrition have long been neglected by the research community. Conservation of biodiversity research has tended to focus on wild species and natural/semi-natural habitats, overlooking the great diversity of plant resources used for vegetable purposes. Moreover, the vast majority of agricultural funding has been directed towards research and development of a few staple (and to a lesser extent vegetable) food crops that are usually non-native to the countries where they are consumed.

West Africa holds considerable reserves of vegetable species diversity, including species of *Amaranthus*, *Corchorus*, *Hibiscus*, *Solanum*, *Cleome*, *Curcubita*, etc., but as reported by the Consultative Group on International Research Institutions the recent years have witnessed "drastic reductions in genetic diversity" of local ecotypes and semi-wild species. The local project partners in Benin and Mali have noticed that a number of traditional vegetables once abundantly found in the wild are dwindling, through a combination of reasons e.g. over-collection or destructive harvesting practices prior to flowering, shifting cultivation, climate change and desertification, increasing population pressure leading to land clearance.

There has been little formal study of these species and their potential in Benin and Mali, and thus this DI project proposes to help remedy this situation by carrying out research (survey and inventory) of the vegetable crops and their traditional knowledge (e.g. cultivation practices, culinary practices and/or medicinal uses) in the two countries, analysis of their quantitative and qualitative potential for horticulture, and awareness-raising of their value and significance among stakeholders in the region.

## 2. Project Partnerships

**Project partnerships:** This project originally brought together three partners, CAZS Natural Resources (CAZS-NR) at Bangor University, the Institut des Recherches Agricoles du Bénin (INRAB) and the Institut d'Economie Rurale (IER) in Mali. However, in this third year no further activities have been undertaken by the latter institution owing to an on-going problem of staff availability (as mentioned in previous reports). Following discussions with the Darwin Secretariat it was agreed that the project would be extended by six months in Benin so as to repeat the on-farm domestication trials for an additional season, which would consolidate this particular aspect of the project. The project extension will also permit the partners to increase the scope of the in-country dissemination activities beyond the original project plan.

In previous years, the project management structure was such that the broad outline of the work to be carried out in the two countries was jointly developed and reviewed on various occasions by all partners. However, each partner then took responsibility, in accordance with their expertise, for fine-tuning the methodology, and implementing the activities for specific areas of work. Thus the work programme for the first two years of the project was set out in a joint meeting in May 2006, attended by representatives from CAZS-NR, IER, INRAB and the University of Abomey-Calavi (UAC) in Benin. Progress reports were exchanged by email and during the UK partner visits to the host countries, and adjustments to the programme were discussed and agreed at these times, to respond to local developments and needs. Where these adjustments led to a change in the logframe and the budget, the UK partner then applied to the Secretariat for permission to modify these. In July 2007 all partners met again to compare the outcomes of the project activities in the two countries, and in the light of these, discuss a programme for the remaining 18 months of the project, and agree who would take responsibility for each task.

In the first six months of this third year, the UK and INRAB partners continued to implement and manage the tasks for which they took responsibility at the July 2007 workshop. For example, the INRAB partner has been responsible for designing and implementing the activities relating to the on-station and on-farm domestication trials, whereas the UK partner worked with the socio-economic data for the catalogue and developed a training programme for young researchers in Benin. With the shift of the project focus in the last six months towards the dissemination and awareness-raising phase of the project, there has been a much stronger tendency towards joint planning and implementation of activities, which has required more frequent visits by the UK partner to Benin (four visits since September 2008).

Lecturers and researchers from the UAC continue to contribute strongly in various aspects of the project. Dr Achigan Dako, for example, took the lead in the write-up of the catalogue; he has contributed to the preparation of various pamphlets aimed at a farmer and consumer audience; he has been interviewed on the biodiversity of traditional vegetables for radio and TV programmes; and he has led the missions to return the project results to the villages. Ms Arlette Adjatin was one of the people who manned an INRAB stand on traditional vegetables at a Cultural Food Fair organised by the Ministry of Culture, Artisanery and Tourism on 9-11 October 2008, and also helped in the organisation of the stakeholder awareness-raising workshop held on 11-12 December 2008. Ms Ines Deleke Koko participated in the missions to return the project results to the villages. Mr Paul Yedomohan from the National Herbarium at the UAC has continued to provide his expertise to resolve problems of species identification.

The UK project leader has continued to build her capacity in project management, but has also been acquiring new skills and knowledge in developing dissemination materials for a non-technical audience.

Staff turnover has not been a problem in this last year for the INRAB partner. Through the successful proposals for the “competitive funds” the partner has been able to raise matching funds to retain various young researchers on full-time salaries.

Over the last couple of years research interest on traditional vegetables has intensified significantly and this has brought about a challenge in terms of research competition from certain sectors in the UAC. Though the DI project activities are widely known, and have included many researchers and students from the UAC, some duplication between the DI activities and some of the most recent UAC research efforts was noted. Thus, in order to foster greater collaboration and try to minimise competition and duplication, the stakeholder awareness-raising workshop (see Activity 4.2) was set up to showcase not only the DI project activities, but also the research at the UAC, and the accent was placed on identifying research priorities to be developed as joint research projects.

**Other Collaborations:** The project continues to maintain links with the CBD team. The link to the catalogue of traditional vegetables produced by the project has been posted on the website which publishes information relating to Benin’s progress towards the CBD (<http://www.biodiv.be>) by Mr Hugues Akpona (a forester working at the *Ministere de l’Environnement et de la Protection de la Nature* who manages this internet database). Mr Bienvenu Bossou, the new CBD focal point was invited to the stakeholder awareness-raising workshop held in December, though unfortunately, he could not attend.

As mentioned in previous reports, the partnership is supporting INRAB to build its capacity to meet the Convention on Biological Diversity (CBD) commitments as it concerns agricultural biodiversity, a research angle that is fairly novel for it. The project has built the capacity of existing INRAB staff, but also young graduates who started under the Darwin project with fixed-term contracts, some of whom the partner hopes to retain through INRAB’s research assistant recruitment which will take place in 2010.

### 3. Project progress

#### 3.1 Progress in carrying out project activities

*Activity 1: Surveys contributing towards the Output 1 Catalogue of IV biodiversity richness, uses and threats*

No survey activities were planned for this reporting period.

*Activity 2: Seed and sample collection contributing towards the Output 2 Seed banks established*

Seed and sample collection missions this year have been focused on finding seed and seedlings for the species selected from the domestication trials. However, the partner continues to tend the on-station garden so that the stock in the seed bank can be maintained.

*Activity 3: Domestication trials contributing to Output 3 Selected highly used and threatened species domesticated*

In Benin, the domestication trials are on-going with *Launaea taraxacifolia*, *Crassocephalum rubens* and *C. crepidioides*, *Ceratotheca sesamoides*, and *Justicia tenella* both on-station and on-farm.

Each village has a resident technician who guides the farmers through the protocols. In the village of Ayetedjou the trials involve four men and four women and have focused on *L. taraxacifolia* and *C. crepidioides*; in Bognongon the trials involved seven men and one woman and started on *C. rubens* and *C. crepidioides* (however, activities were closed down in this village); and in Ganro they involve seven women, and are focusing on *C. sesamoides* and *J. tenella*. The on-farm trials in Ayetedjou and Bognongon commenced with the onset of the rainy season, in May 2008, whereas in Ganro they started in January, during the dry season, with irrigation.

Details on the on-station and on-farm work are presented in Section 1 and Table I, II, III and IV, under Annex 3.

As reported previously, the partner has also been carrying out germination tests on *Bombax costatum* to underpin future research on this species. The work started in early April 2008 at the INRAB laboratory in Niaouli, which is located 70 km north of Cotonou. Ms Ronaldine Ahouanmagnagahou who has been recruited from UAC has developed a protocol with Dr Achigan-Dako to determine the conditions for conservation of these two species in cold chamber and at ambient temperature. The tests are carried out every two months, and are currently on-going.

**Activity 4.1: Development of peer-reviewed publications, best practice pamphlets and radio programmes and Activity 4.2 Awareness-raising at grassroots and policy levels contributing to Output 4 Dissemination material and training for different stakeholders delivered**

As part of Activity 4.1 the following have been undertaken (see Progress towards Project Outputs section for further details):

- Preparation of a catalogue on traditional vegetables in Benin.
- Development of four pamphlets in French.
- Development of radio programmes series to be broadcast on local and national radio.
- Development of two TV programmes. This latter activity had not been envisaged in the original proposal, but came about through a contact provided by Dr Djego, a researcher from the UAC who attended the awareness-raising events.

As part of Activity 4.2 the following events took place:

- A stakeholder consultation meeting was held on the 19 September 2008 to obtain feedback and suggestions on the dissemination strategies. The list of attendees is presented in Table V. The obligatory dissemination activities for the project were presented, as well as the different dissemination options for different stakeholder groups. After a discussion in plenary, three groups were organised around three target groups, the policy makers, the consumers/traders, and the producers to define the required dissemination approaches, the human resources needed, and the timeframe for the work. After this event, the partners reviewed the project budget to determine which additional activities could be feasible within the project timeframe and funding.
- The DI project was presented during the cultural food fair organised by the Ministry of Culture, Artisanery and Tourism on 9-11 October 2008. Through the intervention of the Cabinet Deputy Director of the Ministry for Agriculture, Livestock and Fishing, Dr Gnaho, INRAB was offered a free stand to publicise the project activities with regards to traditional vegetables. A display was organised with various project posters; the photo catalogue; pots with living specimens; and seed samples. Dr Assogba-Komlan, Ms Honfonga and Ms Adjatin staffed the stand to answer participants' questions.
- An awareness-raising workshop on the theme of "Promotion of traditional vegetables: Strategies for conservation and sustainable use of these resources in Benin" was held on 11 and 12 December 2008. It was attended by approximately 45 participants, including representatives from the Ministry of Agriculture, Livestock and Fishing, the Ministry of Environment and Protection of Nature; Ministry of Secondary Teaching and Scientific research; Cotonou city council; extension services; farmer organisations; journalists; and researchers from INRAB, the UAC, Bioversity International, WARDA, CIRAD.
- Training visits to some of the villages which had been surveyed in the first two years of the project, to inform the villages of the outcomes of the surveys, the on-going domestication trials and to share the technical pamphlets.
- A visit by the farmers from Ayetedjou to the INRAB partner research station, so that they could see the on-station domestication work with *Crassocephalum crepidioides* and *Launaea taraxacifolia*, and also visit the station's traditional vegetable garden. The farmers were also taken to the largest urban production site in Cotonou, Houeyaho, where they were able to see large-scale vegetable production, and visit the DI demonstration gardens (see point below).
- Eight demonstration gardens have been set up in various urban production sites in and around Cotonou with *Telfairia occidentalis*, *Basella alba*, *Vernonia colorata*, *Crassocephalum rubens* and *C. crepidioides*, *Cleome gynandra*, *Launaea taraxacifolia* and *Solanum scabrum*. These particular species have not been produced in Cotonou up until now. The purpose of setting up the gardens is to see whether the farmers are able to sell the produce on local markets, particularly after the airing of the radio and TV programmes. To date participating farmers have reported good sales of *Launaea taraxacifolia*, *Solanum scabrum* and *Cleome gynandra*.

## *Activity 5: Capacity-building activities for partners contributing towards the Output 5 Training and country-to-country expertise exchange delivered*

In September 2008 the UK partner organised three training days for young scientists. Dr. Margaret Pasquini delivered two sessions on project proposal writing and Dr. Bianca Ambrose-Oji delivered two training sessions on social science research and analysis methods. The list of attendees and their affiliation is given in Table VI.

A highlight of the collaboration this year in terms of capacity-building has been the fact that Mr Sognigbé N'Danikou (a young graduate from UAC who has been involved in the project activities since 2006) secured a place on, and sponsorship for, the MSc in International Natural Resource Development at Bangor University. This achievement is opening up various opportunities for him to strengthen his knowledge and skills in various areas related to biodiversity conservation.

Mr N'Danikou started his course in October 2008, however, he travelled to Bangor in mid-August to work on the catalogue of traditional vegetables in Benin. This period of six weeks was spent on compiling information on the uses of 86 of the species recorded during the Benin surveys. In September, Dr Ambrose-Oji organised a visit for him to Wakehurst Place to visit the Millennium Seed Bank project and Kew Herbarium. As well as benefiting by attending pertinent modules in his course, he has also decided to carry out the research for his MSc dissertation on a topic that is directly inspired from the DI project on the “Diversity, management and conservation challenges of indigenous vegetable and fruit species in the Fon communities of Benin”. His thesis has four aims:

- to evaluate the diversity of fruit and vegetable species in two communities of the Fon sociolinguistic group of Benin, living in different environments;
- to measure impacts of harvesting on heavily exploited species, in major vegetation types (agricultural land, fallow and secondary forest), in order to understand the conservation challenges surrounding these selected species;
- to determine communities' preference criteria for the selection of candidate species for conservation;
- to understand the implications of local resource management systems for sustainable use and conservation.

Finally, he has secured a place on the Darwin Scholarship Programme “Monitoring and Communicating Biodiversity” which takes place in August. He is currently applying to various bodies to obtain the required matched funding.

A closing UK-Mali-Benin exchange workshop had been envisaged for the final months of the third year. However, as there were no further activities undertaken in Mali, and because of staff unavailability, this workshop did not go ahead as planned.

### **3.2 Progress towards Project Outputs**

#### *Progress towards Output 1: Catalogue of IV biodiversity richness, uses & threats produced*

The surveys have recorded an impressive diversity of species used as vegetables in Benin: 245 plant species, belonging to 62 families. The outcomes of this survey work have been presented in a two-part catalogue, which covers the whole country. The first part provides an overview of the diversity of traditional vegetables in the country, the consumption and potential nutritional contributions, the medicinal properties and cultural values, the production and commercialisation, and the needs and approaches to conserve the diversity. The second part provides a detailed description of each plant species (though only species recorded in at least two villages were included), which compiles available information on the description of the species, its status and habitat, its reproductive biology, where it was recorded during the surveys, the local names, its uses, and the threats to the genetic resources.

A first version of the catalogue is available on the project website and the link was circulated inviting comment and feedback, to researchers and non-academic stakeholders in Benin, to the IndigenoVeg network (which comprises researchers working on traditional vegetables in Cote d'Ivoire, Senegal, Cameroon, Nigeria, Uganda, Tanzania, Kenya and South Africa) and a number of key researchers from AVRDC- The World Vegetable Center, CIRAD and Bioversity. The current version does not include any pictures as it would otherwise be too difficult for it to be downloaded from Benin. Once all comments have been integrated, the complete revised version will be made available on CD, and hardcopies will be distributed in the libraries of Cotonou.

See:<http://www.cazs.bangor.ac.uk/ccstudio/Library/publications/Reports/catalogue%20of%20traditional%20vegetables%20in%20Benin.pdf>

The link to the catalogue has been published also on the website that reports activities and progress towards the CBD commitments in Benin (see <http://www.biodiv.be/benin/biodiversity/agrobiodiversite>).

In Mali, 110 species belonging to 45 families have been identified. Work on the catalogue has fallen behind schedule because of the problems of staff availability and the project leader's frequent absences from the country, partly because of other work commitments and partly because of family problems. However, with the recent return of Dr. Gamby to Mali, there has been a renewed commitment and interest in finalising the catalogue. Dr Haby Sanou has engaged to coordinate part of the write-up on the IER side, and this output will be achieved by the end of the project in October.

#### *Progress towards Output 2: Seed bank established*

In Benin the partner continues to maintain its collection of seed samples. However, as reported in the previous year, the assumption that it would be possible to find seed of significant numbers of the wild species did not hold true. Thus, Output 2 has been achieved mostly with regards to cultivated species.

Because of the problems of viability of the seeds of wild species noted in the previous year, the partner continues to maintain an on-station garden comprising 24 species. This garden will be maintained beyond the project's lifetime so that the partner can develop new research work.

Though AVRDC continues to house the available seed collections in Mali, the problems of viability have meant that long-term storage at their headquarters is not feasible.

#### *Progress towards Output 3: Selected highly used & threatened IV species domesticated*

In Benin, the partner is progressing with the domestication of *Launaea taraxacifolia* and *Crassocephalum* spp., both on station and in the village of Ayetedjou. However, only one rainy season of data have been collected at the village level, and the fact that the village lacks a source of irrigation water (other than well water, which is very expensive) has severely constrained progress in the dry season. The project has requested a six month extension until October 2009 to collect a second season of data in the village. This request has been approved by the Secretariat.

*Launaea taraxacifolia* can be successfully propagated through root cuttings, and this is the technique that is being recommended by the partners.

*Crassocephalum* spp. can also be propagated by stem cuttings, however, it appears that when it is propagated this way, plants flower earlier compared to seedlings. Because of this, production from seed would be preferable, however, as partners have experienced the germination is very erratic. In November trials were set up to evaluate the effect of sowing time on germination. The analysis of the data is underway.

Domestication of *Ceratotheca sesamoides* is proving very difficult. None of the techniques employed on-station have helped to break seed dormancy, and where germination does occur, the rates are exceedingly low. This has been the case both on-station and on-farm in Ganro, and Mr Eteka who is working on this species at the UAC has also reported dormancy and poor germination rates. On-station attempts to propagate the species with cuttings have also been unsuccessful.

#### *Progress towards Output 4: Dissemination material & training for different stakeholders delivered*

The DI activities have resulted in four technical pamphlets in French. One pamphlet presents the biodiversity of traditional vegetables in Benin and explains the causes of the decline of these species, particularly wild harvested resources. The other three give recommendations on the cultivation practices of *Launaea taraxacifolia*, *Crassocephalum rubens* and *C. crepidioides* and *Solanum macrocarpon*, and also suggest recipes to prepare these vegetables. The pamphlet on *Crassocephalum* spp. is not yet ready for distribution and will need to be reviewed after the forthcoming season of data.

The INRAB partner has also translated into French and adapted a set of six pamphlets on *Abelmoschus esculentus*, *Solanum scabrum*, *Corchorus olitorius*, *Solanum aetiopicum*, *Cleome gynandra* and *Vigna unguiculata*. These pamphlets were originally produced in course of a project known as IndigenoVeg (in which both the UK and the INRAB partner were participating). Neither the pamphlets nor the graphical design of these pamphlets was copyrighted, as the IndigenoVeg project sought to encourage other projects promoting traditional vegetables to freely translate, adapt or even develop new pamphlets using the template.

Contracts for the development of a series of radio programmes have been signed with Radio Ocean FM (a radio which is very popular with younger listeners in Cotonou) and Radio Immaculee.

With Radio Ocean FM, four emissions of one hour each have been agreed. To date the first two with presenter Mr David Amaglo have been developed and broadcast. The radio has also been broadcasting a 5-minute synthesis of each emission, using key excerpts from the studio and off-site interviews, in its news reels. The emissions cover: 1) biodiversity of traditional vegetables in Benin (by ethnic group and by phytogeographical region), and the threats to their conservation; 2) domestication as a strategy to conserve widely used but threatened resources; 3) a presentation of select cultivated vegetables which are no longer well-known in urban areas; 4) a presentation of tree vegetable species (particularly *Vitex doniana* and *Bombax costatum*) and the particular threats to their conservation.

With Radio Immaculee, which covers the whole of Benin, 12 30-minute sessions are being developed to be broadcast weekly with Mr Felix Houinsou as a presenter. The sessions will comprise a range of formats: technical interviews, group discussions, and interactive sessions with the listeners. The sessions will cover the same topics as in the case of Radio Ocean FM and additionally provide advice on cultivation techniques and setting up home gardens. Each session will be aired twice. Select sessions will be translated into Bariba, Yoruba and Fon and distributed to local radio stations across the country.

The project has been presented in the course of two sessions for a TV programme Arc-en-Ciel (on Canal 3), which discusses environment and health-related topics. The interview with Dr Assogba-Komlan was a general one which focused on the uses of traditional vegetables, and their importance for nutrition. This session was broadcast at 21.00 on Sunday 22 February. Dr Achigan-Dako was interviewed on the biodiversity of traditional vegetables in Benin and conservation needs. This session was broadcast at 21.00 on 15 March 2009.

The awareness-raising workshop resulted in a draft document reflecting on the strategies for integration of traditional vegetables in relevant national policies, and research proposal outlines, focusing on four priority areas: 1) conservation of traditional vegetables; 2) continuation of domestication activities of important vegetables in Benin; 3) Nutritional, toxicological and medicinal properties of widely used traditional vegetables in Benin; 4) Strategies to promote traditional vegetables in Benin. These proposals are currently being refined by the respective working groups, and the intention is to submit them for national funding.

It has been possible to arrange visits to return the project results to 19 out of the 51 survey villages. As well as presenting information on the diversity of vegetables recorded in the country, and the domestication work, copies of the pamphlets were provided and discussed. The pamphlets will be distributed more widely, through local extension offices.

A visit was organised for the trial farmers from Ayetedjou to Cotonou to: 1) visit the INRAB research station traditional vegetable garden and the trial plots, to demonstrate also how with sufficient irrigation the species under domestication can be produced year-round; 2) visit one of the demonstration gardens to witness wide-scale vegetable production in urban areas.

This output has been achieved, and beyond the envisaged indicators. In relation to the radio programmes, it should be noted that the target was achieved on track, but as the project generated a lot of material, and there is a lot of local interest in the topic, the development and broadcasting of additional radio programmes through Radio Immaculee and various local stations, will continue in the coming 3-4 months of the project.

All the assumptions held true, though fewer than envisaged policy makers attended the December workshop. Unfortunately, a short while before this event took place, there was significant reshuffling of staff within relevant Ministries. A number of influential policy makers, who were very supportive of the project, were removed from their positions, and there was not enough time for the project to build new contacts.

#### *Progress towards Output 5: Training & country-to-country expertise exchange delivered*

For reasons already described, the Benin-Mali-UK expertise exchange and training workshop did not take place in this year.

However, exchange of expertise between the UK and Benin partner has continued through different mechanisms. The fact that Mr N'Danikou has secured a funded place on one of Bangor's MSc programmes will be a significant achievement of the collaboration, once he finishes in September 2009.

The training on proposal writing and social science methods is showing some first results. Two of the young researchers attending the workshop have been successful in securing new projects from the "Competitive Funds scheme" (the funding for the scheme is derived from several sources and is managed by INRAB; however, anybody in the research sector can apply). Ms Honfonga secured a second tranche of funding for her project on "Integrating *Launaea taraxacifolia* in the management of nematodes in urban and peri-urban zones of southern Benin" and Mr Marcel Guidi with the "Analysis of offer and demand for two traditional vegetables in Cotonou: the case of *Launaea taraxacifolia* and *Ocimum gratissimum* and the implication for domestication strategies of resources harvested from the wild".

### 3.3 Standard Measures

**Table 1 Project Standard Output Measures**

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned from application
2	Number of people to attain Masters qualification (MSc, MPhil etc) *	-	-	1 Mr S. N'Danikou (Benin)	-	Had not been envisaged in original application
6A	Number of people to receive other forms of education/training	8 Mali 3 Benin	-	9 Benin (young researchers)	20	Enumerators trained on surveying and seed collection techniques (6 Mali, 3 Benin)
6B	Number of training weeks to be provided	3 wks Mali 1 wk Benin	1 week Mali	½ week	5 ½	5 weeks Mali 4 weeks Benin
7	Number of (ie. different types - not volume - of material produced) training materials to be produced for use by host country	-	-	1	1	1 training materials: 5 pamphlets
8	Number of weeks to be spent by UK project staff on project work in the host country	5 wks Mali 1 wk Benin	4 wks Mali 3 wks Benin	7 wks Benin	20	17 weeks Mali; 15 weeks Benin
13A	Number of species reference collections to be established and handed over to the host country(ies)	1 IER 1 AVRDC-Mali	-	-	2	One species reference collection established at IER; one joint collection at AVRDC-Mali; one duplicate collection at AVRDC-HQ for long-term conservation
13B	Number of species reference collections to be enhanced and handed over to the host country(ies)	1 INRAB	1 INRAB 1 IER	-	2	One species reference collection enhanced at INRAB (Benin)
14A	Number of	-	-	1 workshop	20	2 workshops to

	conferences/seminars/ workshops to be organised to present/disseminate findings			19 village-level training workshops Benin		be organised for policy makers (1 Mali; 1 Benin); 30 village-level training workshops in Mali and Benin
14B	Number of conferences/seminars/ workshops to be organised to present/disseminate findings	-	1	-	1	1 conference attended to disseminate findings
15B	Number of local press releases in host country(ies)	-	-	3 Benin	3	1 local-level press releases in the host countries
17B	Number of dissemination networks to be enhanced/extended	1 IER staff attended workshop	-	-	1	1 dissemination network ( <i>IndigenoVeg</i> ) to be enhanced by IER, Mali inclusion
18 A	Number of national TV programmes/features in host country(ies)	-	-	1 Benin (news coverage of workshop by ORTB)	1	Had not been envisaged in original application
18 B	Number of local TV programmes/features in host country(ies)	-	-	2 Benin (interviews on Arc-en-Ciel)	2	Had not been envisaged in original application
19A	Number of national radio interviews/features in host country(ies)		1 Benin	2	3	2 radio interviews (1 Mali; 1 Benin)
19C	Number of local radio interviews/features in host country(ies)	-	-	4	4	6 radio features (3 Mali; 3 Benin)
20	Estimated value (£'s) of physical assets to be handed over to host country(ies)	£6215	£700 Benin (internet access)	-	£6915	£7415 for seed bank equipment and computing resources
22	Number of permanent field plots to be established during the project and continued after Darwin funding has ceased	-	-	1 Benin (on-station garden)	1	Had not been envisaged in original application
23	Value of resources raised from other sources (ie. in addition to Darwin funding) for project work	£69,000 vehicle costs	£20,000 * 2 for vehicles £400 land resources	-	Ca. £110,000	£55,661 plus £69,000 estimated vehicle costs value plus £400 land resources

**Table 2 Publications**

Type *	Detail (title, author, year)	Publishers	Available from
Catalogue	Traditional vegetables in Benin: diversity, distribution, ecology, agronomy and utilisation. (2009). Achigan-Dako, Pasquini, Assogba-Komlan, N'Danikou, Dansi, Ambrose-Oji.	N.A.	Project website

**3.4 Progress towards the project purpose and outcomes**

In Benin the project is undoubtedly making a significant contribution towards improving the conservation and sustainable use of agro-biodiversity. The catalogue fills a significant gap in the literature for Benin, demonstrating the surprisingly wide array of species used by communities in the country, their ecological occurrence, and the significant variations in the knowledge and utilization by sociolinguistic and ecological zones. This information will be very valuable for researchers developing projects in this new area of research. The importance of the catalogue is clearly acknowledged by the research community in Benin, as is demonstrated for example, by the fact that the link to the document has been posted on Benin's CBD website.

The impacts of the domestication activities evidently will require a few years before they can be assessed. However, preliminary results are encouraging. The farmers in Ayetedjou have given enthusiastic feedback on the trials, as they have been able to diversify the vegetables used in the household, and earn income by selling the surplus. Initially, the farmers were sceptical about the possibility of producing these particular species in the dry season. After their visit to Cotonou they have been convinced that these species will indeed grow under irrigation, and are very positive about a test drip irrigation system that has been installed (see Section 1 in Annex 3) as they report that it uses 1/3 of the water used by irrigating with a watering can.

In Cotonou, the urban farmers who are testing the new vegetables have reported interest from buyers. The situation will be monitored in the coming months, to see if this interest is sustained, particularly following the promotional activities over the radio and TV, and to see whether the crops are taken up by other farmers in the area.

The support to the research proposals presented by Ms Honfonga and Mr Guidi (mentioned previously), demonstrates the wider interest of INRAB in these species. The data on the germination trials for *Crassocephalum rubens*, *C. crepidioides* and *Launaea taraxacifolia* from the DI project, as well as Ms Honfonga's trials intercropping *L. taraxacifolia* and *Solanum macrocarpon* will be presented at INRAB's Atelier Scientifique 2009. The recommendations emerging from the trials will then be presented to INRAB's Comité Regional de Recherche Développement, a committee of farmers and scientists, which recommends which areas should be a priority for research on an annual basis.

In Mali, the production of a catalogue will make an important contribution as it will provide important baseline information to underpin future research efforts.

**3.5 Progress towards impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits**

The effects of the project activities will not be fully evident for some years to come, so at the moment limited comments can be made on progress towards the overall programme goal. However, it is expected that the combination of the domestication work and the promotional activities will contribute towards the conservation and sustainable use of traditional vegetables. The domestication work of select widely used, threatened species will help to reduce the pressure on wild stocks, provided that their cultivation is taken up by farming communities on a wide enough scale. The promotional activities (the pamphlets and radio programmes particularly) have been developed to stimulate interest in these specific species, but also on traditional vegetables in general. One problem that has been observed is that the knowledge on the diversity and uses of different vegetables is no longer being transmitted systematically to the younger generations, particularly those born in urban areas. The promotional activities are aimed at revitalising the interest of consumers for these species, as communities will be most motivated to conserve their resources if these are valued and used.

## **4. Monitoring, evaluation and lessons**

Monitoring of progress in the first half of the year was done through emails and partner's interim reports and datasets. Since September, the UK partner has visited Benin four times to participate in the dissemination activities. The visits were of course used to review progress and discuss any necessary changes in the work plan.

The indicator for output 1 is a catalogue of traditional vegetable species and disappearing species for Mali and Benin, to be verified through regional and country species lists and a list of reported threatened species. This task has been finalised for Benin. Output 2 was finalised last year. The 3.1 indicator for output 3 was relevant to this year, and consisted of having results from the domestication trials. These have been verified through the partner progress reports and the recommendations for cultivation published in the pamphlets. The indicators for output 4 were: 1) At least one major awareness-raising workshop – this can be verified through the workshop minutes and the articles in three newspapers; 2) pamphlets on conservation needs, cultivation techniques, and recipes – this can be verified through the existence of the pamphlets; 3) training visits to the survey villages – this can be verified through the partner field mission reports; 4) three ½ hour radio programmes – these can be verified by the copies on CD. In relation to output 5, the UK-Mali-Benin workshop did not take place this year.

Two CDs are attached to this report: one contains the first emission on Radio Ocean FM and the excerpts broadcast during the news (in French and local languages). The other has files with the catalogue for Benin (in English); the four DI pamphlets (in French); the awareness-raising workshop minutes (in French); scanned copies of the newspaper press releases covering the awareness-raising workshop (in French).

Other reports, such as interim progress reports on the domestication trials, field mission reports and reports of the visits by the UK partners to Benin are available on request (most of the partner reports are in French).

## **5. Actions taken in response to previous reviews (if applicable)**

The responses and actions taken in response to previous reviews were addressed at the time of the half-year report.

## **6. Other comments on progress not covered elsewhere**

All comments on progress have been covered elsewhere in this and other reports.

## **7. Sustainability**

The efforts to promote the project activities and results have already been described in section 3.1 under Activity 4.1 and 4.2. The project has raised a lot of interest in the topic, within INRAB, the UAC, Bioversity, and CIRAD research environments, but also amongst a wider audience. The latter has been noted, for example, from the offer of a stand to showcase traditional vegetables and the project activities at the Cultural Food Fair (alongside the stands showcasing the typical dishes of the 12 departments), and the invitation to take part in the TV programme Arc-en-Ciel.

Thanks to the participatory approach to the development and management of project activities and the capacity building activities (two key elements of the project exit strategy), the partners have been empowered to develop a wide range of research proposals to build on the project results.

The successful projects written by Ms Honfonga and Mr Guidi, and Mr N'Danikou's MSc dissertation plans, have already been mentioned.

Another two successful proposals for the competitive funds were developed. Dr Assogba-Komlan helped Mr Eteka and Prof Ahohuendo from the UAC to prepare a project on "Investigating the possibility of domesticating two neglected traditional vegetables in Benin: *Sesamum radiatum* (Pedaliaceae) and *Justicia tenella* (Acanthaceae)", which would complement the existing UAC-funded project on four species *Sesamum radiatum*, *Justicia tenella*, *Ceratotrichia sesamoidea* and *Acmella uliginosa*. Mr Achigan-Dako developed a project on the "Establishment of the genetic and phytosanitary basis to improve the production of *Citrullus lanatus* in Benin".

Dr Komlan is also involved on a proposal submitted to a recent GlobalHort call. The project is called Recipes for Success and the goal of this project is to increase the nutritional status of underprivileged groups through better use of traditional food, mainly fruits and vegetables. This will be done through Health Clubs where producers can obtain information on the production of vegetable and fruit crops, their nutritional values, and gain access to good quality seed. If this application is successful, it will be one means of disseminating the results from the DI project more widely. Dr Achigan-Dako and Mr Vodohoue (a young PhD student who attended the DI project training) have also been involved in a bid to the GlobalHort call. The project, entitled "Reducing micronutrient deficiencies among rural and urban poor in West Africa: sustainable use of traditional vegetables through better horticultural practices" has one component on the domestication of three important wild species *Vitex doniana*, *Daniellia oliverii* and *Sterculia tragacantha*.

Dr Achigan-Dako also developed a proposal on "Conservation of wild populations of black plum (*Vitex doniana*, Verbenaceae) in Benin: investigating alternative strategies for breaking seed dormancy and developing community nurseries", which was submitted to the Rufford Small Grant (this proposal unfortunately was not successful).

Finally, work is continuing on the four proposal ideas developed in the course of the awareness-raising workshop. Two of these should be at a stage for submission to national funding sources in the next few months (the proposal on conservation of biodiversity, which is being coordinated by Mr Hermene Avohou from Bioversity, and the proposal on nutrition which is being coordinated by Dr Nadia Fanou from the UAC).

The seed bank, which was another element of the exit strategy, is already proving its utility. It has been used in the following ways:

- Seed samples of *Acmella uliginosa* and *Justicia tenella* have been supplied to Mr Eteka, a PhD student from the UAC, working on the germination of these two species and also on *Ceratotheca sesamoides* and *Justicia tenella*.
- Seed samples of *Telfairia occidentalis*, *Basella alba*, *Vernonia colorata*, *Crassocephalum rubens* (or *crepidioides*), *Cleome gynandra*, *Launaea taraxacifolia* and *Solanum scabrum* have been given to farmers in urban farms to set up demonstration plots. Cuttings of *Moringa oleifera* were supplied on request to one producer.

The partner will therefore be maintaining the seed bank and the on-station garden to facilitate future research.

The impressive number and diversity of proposals developed autonomously by the INRAB and UAC researchers affiliated to the DI project, clearly shows their increased interest, commitment and capacity to continue working on the promotion and conservation of biodiversity of traditional vegetables. Thus, the outcomes and impacts of this DI project will be sustained beyond the lifetime of the project itself.

## **8. Dissemination**

The approaches used to disseminating the project results have already been covered in the sections reporting on Output 4. Here it is only necessary to add that the December awareness-raising workshop was widely publicised through various media. ORTB, Benin's national television broadcast the opening ceremony of the workshop during its evening news on the 11<sup>th</sup> December. Three newspapers (Matinal, L'Informateur, Fraternite') reported on the objectives of the workshop and the project on the 12<sup>th</sup>. Four radio stations also reported about the workshop during and for a number of days following the event: Ocean FM (local Cotonou and environs), Radio Tokpa (local Cotonou and environs), Radio ORTB (national throughout Benin), and Radio Immaculee.

## 9. Project Expenditure

**Table 3 Project expenditure during the reporting period (Defra Financial Year 01 April to 31 March)**

Item	Budget (please indicate which document you refer to if other than your project application)†	Expenditure	Balance
Rent, rates, heating, overheads etc			
Office costs (eg postage, telephone, stationery)			
Travel and subsistence			
Printing			
Conferences, seminars, etc			
Capital items/equipment			
Others			
SALARIES (specify)			
<b>TOTAL</b>			

†This budget refers to a revised budget, submitted in December 2008, and approved by the Darwin Secretariat.

## 10. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for ECTF and the Darwin Secretariat to publish the content of this section.

The project has resulted in the publication of a catalogue on traditional vegetables used in Benin. The catalogue, which draws on data gathered in 51 villages and 3 urban areas covering the whole country, is in two parts. The first part provides an overview of the diversity of traditional vegetables in the country, the consumption and potential nutritional contributions, the medicinal properties and cultural values, the production and commercialisation, and the needs and approaches to conserve the diversity. The second part provides a detailed description of plant species recorded in at least two villages, and compiles available information on the description of the species, its status and habitat, its reproductive biology, where it was recorded during the surveys, the local names, its uses, and the threats to the genetic resources.

The catalogue fills a significant gap in the literature for Benin, demonstrating the surprisingly wide array of species used by communities in the country, their ecological occurrence, and the significant variations in the knowledge and utilization by sociolinguistic and ecological zones. This information will be very valuable for researchers developing projects in this new area of research.

The link to the catalogue has been published on the website that publishes information relative to Benin's progress towards the CBD (<http://www.biodev.be>). The full version is available on the project website:

<http://www.cazs.bangor.ac.uk/ccstudio/Library/publications/Reports/catalogue%20of%20traditional%20vegetables%20in%20Benin.pdf>

## Annex 1 Report of progress and achievements against Logical Framework for Financial Year: 2008/09

Project summary	Measurable Indicators	Progress and Achievements April 2008 - March 2009	Actions required/planned for next period
<p><b>Goal:</b> To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve</p> <p><i>The conservation of biological diversity,</i></p> <p><i>The sustainable use of its components, and</i></p> <p><i>The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources</i></p>		<p><i>The impacts of the project will not be seen for several years to come. However, by spreading information on the domestication work, in combination with the promotional activities, the project aims to revitalise the interest of consumers in these species, thereby motivating communities to conserve their resources.</i></p>	<p>(do not fill not applicable)</p>
<p><b>Purpose</b> Improved conservation &amp; sustainable use of biodiversity in Mali &amp; Benin by cataloguing indigenous vegetable (IV) species, domesticating selected species &amp; promoting their value to producers &amp; consumers</p>	<p>Comprehensive list of indigenous species used as vegetables in Mali &amp; Benin produced</p> <p>Domestication trials of threatened species initiated</p> <p>IV research included as a priority topic by the end of yr 3 by IER &amp; INRAB boards</p>	<p>The project has made good progress towards its purpose of improving the conservation and sustainable use of biodiversity in Benin by collecting country-wide information to produce a catalogue of indigenous species used as vegetables, and setting up a short-term seed bank and an on-station garden. The on-station domestication work has continued with <i>L. taraxacifolia</i>, <i>Crassocephalum rubens</i>, <i>C. crepidioides</i> and <i>Ceratotheca sesamoides</i>. Production advice is available for all except <i>C. sesamoides</i>. The on-farm work ran over the rainy season in Ayetedjou, and started during the dry season in Ganro. Activities to promote the value of traditional vegetables to producers and consumers have consisted of a high-level awareness-raising workshop, a stand in the cultural food fair, training visits to the farms, urban demonstration gardens, radio and TV programmes, and pamphlets.</p>	<p>The project has been extended by six months to October 2009. This extension will allow the Benin partners to:</p> <ul style="list-style-type: none"> <li>○ Collect an additional season of data both on-farm and on-station with regards to the domestication trials.</li> <li>○ Finalise the germination tests for <i>Bombax costatum</i>.</li> <li>○ Develop 12 ½ hour radio programmes with Radio Immaculee (national coverage), to be translated into local languages for local dissemination.</li> <li>○ Broadcast the last 2 1-hour programmes with Radio Ocean FM.</li> </ul> <p>In Mali, the return of the project leader to the country after frequent and extended absences motivated by work and family reasons has stimulated a renewed interest in finalising a catalogue. The coming 6 months will allow the production of a catalogue which goes beyond a simple species list for this country as well.</p>

Project summary	Measurable Indicators	Progress and Achievements April 2008 - March 2009	Actions required/planned for next period
<b>Output 1.</b> Catalogue of IV biodiversity richness, uses & threats produced.	Catalogue of IV biodiversity & disappearing species available for 6 regions in Mali & northern Benin by end yr 2	The indicator for this output is appropriate, although the catalogue has been expanded to comprise the whole of Benin. The species list for Benin was published on the project website in January 2009 and the full catalogue was published in March 2009. Work on the catalogue in Mali is on-going and will be delivered by October 2009.	
<b>Activity 1.</b> Surveys		No survey activities were planned for this reporting period.	
<b>Output 2.</b> Seed banks established.		Seed samples collected country-wide in Mali and Benin documented & stored in fridges in IER & INRAB & backup at AVRDC by Feb 07	This indicator was achieved (as far as it could be achieved) in March 2008.
<b>Activity 2.</b> Seed & sample collection		Seed and sample collection missions this year have been focused on finding seed and seedlings for the species selected from the domestication trials. However, the partner continues to tend the on-station garden so that the stock in the seed bank can be maintained.	
<b>Output 3.</b> Selected highly used and threatened species domesticated	3.1 At least one species for domestication trials per region in Benin and Mali selected by Jan 07 3.2 Results from domestication trials with different field techniques available by Jan 09	Detailed production advice for <i>L. taraxacifolia</i> and <i>Crassocephalum</i> spp. is available, though for the latter species, an additional season of data is required. Efforts to domesticate <i>C. sesamoides</i> are unsuccessful so far. The species gives very poor and unreliable germination rates, and propagation by cuttings is not successful. With the agreement of the Darwin Secretariat the project activities for Mali did not continue in this year. Thus, the 3.2 indicator is only appropriate for Benin. The results were presented in the pamphlets by March 2009. Indicator 3.1 was achieved last year.	
<b>Activity 3.</b> Domestication trials		<p>On-station domestication work has continued with <i>Launaea taraxacifolia</i>, <i>Crassocephalum</i> spp and <i>Ceratotheca sesamoides</i>.</p> <p>On-farm work started in Ayetedjou and Bognongon in May 2008 with the onset of the rainy season. In Ganro they started in January 2009, during the dry season with irrigation. The trials had to be suspended in Bognongon because of lack of interest by the farmers. The results in Ayetedjou are promising, particularly with <i>L. taraxacifolia</i>. <i>Crassocephalum</i> spp. flower too quickly when produced by cuttings, but germination is reliable only in the wet season. The plants did not develop very well in the dry season because the village does not have access to irrigation water, and they could not afford to irrigate with the necessary amounts of water using well water. One locally-produced drip irrigation system was established to see whether this could be an economically viable solution.</p> <p>In Ganro, <i>C. sesamoides</i> has given poor germination rates. As the trials may not yield positive results with this species, the partners have suggested introducing <i>J. tenella</i> (another increasingly rare species in the area) to maintain the motivation and</p>	

Project summary	Measurable Indicators	Progress and Achievements April 2008 - March 2009	Actions required/planned for next period	
		enthusiasm of the farmers. This species has been accepted by the trial farmers.  The germination tests on <i>Bombax costatum</i> started in April 2008, and are on-going.		
<b>Output 4.</b> Dissemination material and training for different stakeholders delivered	4.1 At least one major awareness-raising workshop delivered in both countries by Nov 08 4.2 Pamphlets on conservation needs, cultivation techniques, preparation and recipes produced for both countries by Nov 08 4.3 In each survey village pamphlets distributed and training delivered by Mar 09 4.4 Three ½ hour radio programmes produced and aired by Apr 09	<ul style="list-style-type: none"> <li>○ The awareness raising workshop was delivered in December 2008.</li> <li>○ Four DI pamphlets have been produced, three on the cultivation and recipes for <i>Launaea taraxacifolia</i>, <i>Crassocephalum spp</i> and <i>Solanum macrocarpon</i>, and one on the need to conserve the biodiversity of traditional vegetables. However, the <i>Crassocephalum</i> pamphlets still need to be finalised after the second round of the domestication trials.</li> <li>○ The village training visits took place in April 2009.</li> <li>○ Two 1-hour radio programmes with Radio Ocean FM have been developed and were broadcast in April. Another 2 programmes will be broadcast in May. The partner has a contract with Radio Immaculee for 12 30-minute programmes to be developed and broadcast over the coming 3 months. Select sessions will be translated and distributed to various local radio stations.</li> </ul> <p>This outputs that were not in the original lograme comprised:</p> <ul style="list-style-type: none"> <li>○ Two TV sessions on the Arc-en-Ciel programme were developed and broadcast in February and March.</li> <li>○ Eight demonstration gardens for traditional vegetable species were set up in March 2009 in Cotonou urban production sites.</li> <li>○ A project stand was set up at the national Cultural Food Fair in October 2008.</li> </ul> <p>Thus, this output has been achieved beyond the original envisaged indicators. Furthermore, as the project was extended by six months, the partner will be able to extend the scale of the dissemination through radio.</p>		
<b>Activity 4.1.</b> Development of peer-reviewed publications, best practice pamphlets and radio programmes		In Benin the following were undertaken: <ul style="list-style-type: none"> <li>○ Production of a catalogue on traditional vegetables</li> <li>○ Development of four pamphlets on cultivation practices and recipes and on conservation needs in French</li> <li>○ Development of radio programmes with Radio Ocean FM and Radio Immaculee</li> <li>○ Development of TV programmes with Arc-en-Ciel</li> </ul>		
<b>Activity 4.2.</b> Awareness-raising at grassroots and policy levels		In Benin the following were undertaken: <ul style="list-style-type: none"> <li>○ The organisation of a stakeholder consultation workshop for advice on the project dissemination strategy on 19 September 2008.</li> <li>○ The organisation of a project stand at the Cultural Food Fair on 9-11 October 2008.</li> <li>○ The organisation of an awareness-raising workshop on the theme "Promotion of traditional vegetables: Strategies for conservation and</li> </ul>		

Project summary	Measurable Indicators	Progress and Achievements April 2008 - March 2009	Actions required/planned for next period
		<p>sustainable use of these resources in Benin" 11-12 December 2008, attended by 45 participants (policy makers, researchers, and farmer organisation representatives)</p> <ul style="list-style-type: none"> <li>○ Media coverage of this event through national TV, 4 radio stations, and 3 newspapers.</li> <li>○ Training visits at village level to disseminate the project findings and pamphlets in 19 villages (visits were on-going in April, the end of the project year).</li> <li>○ The establishment of eight demonstration gardens in urban production sites around Cotonou.</li> <li>○ A visit from the Ayetedjou trial farmers to the INRAB station and to the Houeyaho urban production site, to see the traditional vegetable gardens.</li> </ul>	
<b>Output 5.</b> Training & country-to-country expertise exchange delivered	5. Benin-Mali-UK-expertise exchange & training workshops carried out once a year	The country-to-country expertise between all three partners was delivered on target last year, but not delivered this year. However, UK-Benin expertise exchange was delivered on target.	
<b>Activity 5.</b> Capacity-building activities for partners		<p>The end of project Benin-Mali-UK expertise exchange workshop did not take place because of on-going staff availability problems in Mali.</p> <p>However, the UK partner organised training workshops for young scientists in Benin, which took place 17, 18 and 24 September 2008. Mr N'Danikou also obtained a funded MSc place at Bangor University, which started in October 2008.</p>	

## Annex 2 Project's full current logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Goal:			
To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources			
Purpose	<p>Comprehensive list of indigenous species used as vegetables in Mali &amp; Benin produced</p> <p>Domestication trials of threatened species initiated</p> <p>IV research included as a priority topic by the end of yr 3 by IER &amp; INRAB boards</p>	<p>Research programme reports</p> <p>IER &amp; INRAB board reports</p>	Mali & Benin governments maintain the same level of or increase financial support for agricultural research & allow this to be tied in to conservation measures
Outputs	<p><b>1</b> Catalogue of IV biodiversity richness, uses &amp; threats produced.</p> <p><b>2</b> Seed banks established.</p> <p><b>3</b> Selected highly used &amp; threatened IV species domesticated</p> <p><b>4</b> Dissemination material &amp; training for different stakeholders delivered</p>	<p><b>1</b> Catalogue of IV biodiversity &amp; disappearing species available for 6 regions in Mali &amp; northern Benin by end yr 2</p> <p><b>2</b> Seed samples collected country-wide in Mali and Benin documented &amp; stored in fridges in IER &amp; INRAB &amp; backup at AVRDC by Feb 07</p> <p><b>3.1</b> At least one species for domestication trials per region in Benin &amp; Mali selected by Jan 07</p> <p><b>3.2</b> Results from domestication trials with different field techniques available by Jan 09</p> <p><b>4.1</b> At least one major awareness-raising workshop delivered in both countries by Nov 08</p> <p><b>4.2</b> Pamphlets on</p>	<p>The following information will be made available on the project web-site, which will feature the DI logo:</p> <p>Regional &amp; country species lists &amp; reported threats published</p> <p>Reports on cultivation practices published</p> <p>Uses &amp; preparation manuals, recipe collections published</p> <p>List of seed samples collected &amp; stored made available through the AVRDC website</p> <p>Domestication trial reports</p> <p>Workshop minutes &amp; reports published (website)</p> <p>Radio programme material</p> <p>Farmers are willing to cooperate with the enumerators during the survey</p> <p>Plants which have gone to seed can be found for seed collection</p> <p>Electricity supply is stable</p> <p>Sufficient numbers of policy makers can attend the workshops</p> <p>Farmers find the training sessions sufficiently valuable to attend</p> <p>Radio stations are interested in broadcasting the dissemination programmes</p> <p>Aviation and other fuel prices do not rise unexpectedly (affecting travel costs)</p>

	<p>conservation needs, cultivation techniques, preparation &amp; recipes produced for both countries by Nov 08</p> <p><b>4.3</b> In each survey village pamphlets distributed &amp; training delivered by Mar 09</p> <p><b>4.4</b> Three ½ hour radio programmes produced &amp; aired by Apr 09</p>	<p>Articles published in newsletters &amp; peer-reviewed journals</p>	
<b>5</b> Training & country-to-country expertise exchange delivered	<b>5</b> Benin-Mali-UK-expertise exchange & training workshops carried out once a year		
<p>Activities</p> <p><b>1</b> Surveys</p> <p><b>2</b> Seed &amp; sample collection</p> <p><b>3</b> Domestication trials</p> <p><b>4.1</b> Development of peer-reviewed publications, best practice pamphlets &amp; radio programmes</p> <p><b>4.2</b> Awareness-raising at grassroots &amp; policy levels</p> <p><b>5</b> Capacity-building activities for partners</p>		<p>Activity Milestones</p> <p><b>1</b> Survey enumerators trained (6 in Mali, 3 in Benin) by June 06 &amp; questionnaires agreed; surveys to identify IV species found in six regions in Mali &amp; three in Benin, describe cultivation practices &amp; uses &amp; preparation of IVs completed by Mar 07; data inputting &amp; analysis by Jul 07; data write-up by May 08</p> <p><b>2</b> Seed bank facilities established Jun 06; seed &amp; sample collection largely completed by Feb 07 (but repeat visits may occur later depending on seed production periods)</p> <p><b>3</b> IVs for domestication trials selected in Jan 07; domestication trials begin May 07; trials for report write-up completed by Jan 09.</p> <p><b>4.1</b> Reports/peer-reviewed publication joint write-up commences May 08; pamphlets prepared by Nov 08; pamphlets distributed by Mar 09; radio programmes prepared by Dec 08; radio programmes aired Jan-Apr.</p> <p><b>4.2</b> Sourcing further funding commences Sep 07; awareness-raising workshop for policy makers Nov 08; training sessions on the need for IV conservation, cultivation techniques, preparation techniques, recipe exchanges, delivered in each survey village by Mar 09.</p> <p><b>5</b> Introductory Benin-Mali-UK expertise exchange workshops in May 06 to finalise Detailed Work Plan. Mid-term meeting in Aug 07; final summary workshop Feb 09. Partners to be in close e-mail contact throughout.</p>	

## Annex 3 onwards – supplementary material (optional)

### Section 1: Activity 3

#### o On-station trials

A large number of on-station germination tests with *C. crepidioides* have been carried out (Table I). Of the sun-dried seed from the collection missions only the second and third nurseries resulted in a small number of plants (the third nursery batch was unfortunately destroyed by snails). The plants from the second nursery were transplanted and resulted in seed. The fresh seed did not germinate either in lab tests or in nurseries established in June and July. In July there was germination for a couple of nurseries, and from August there was germination of both fresh and dried seed of both the red-flowering and yellow-flowering varieties.

Since November, Ms Honfonga has been looking at the effect of sowing time on germination. Sun-dried seed for five days has been sown every fifteen days from November through to March. The analysis of the data is underway.

Two studies have been carried out to evaluate the yield and flowering of *C. crepidioides* propagated by cuttings. The first study is evaluating the performance and yield of transplanted seedlings versus stem cuttings, planted at different periods. The second study is comparing the flowering behaviour of the stem cuttings of the yellow phenotype against the red phenotype. The data analysis is on-going, but preliminary observation suggest that when *C. crepidioides* is propagated by stem cuttings, plants flower earlier compared to seedlings, and that the yellow phenotype flowers much earlier than the red phenotype.

On-station germination trials with *C. rubens* started in September 2008. This species gives good germination rates (Table II).

The on-station work for *L. taraxacifolia* shows that it can be propagated successfully through root cuttings. If the plant goes to seed and there is wind dispersion, the seeds also germinate quite well. However, deliberate germination tests with the phenotype/variety that is on the station have performed poorly (5-10%). The same phenotype/variety also performed poorly in the village trials, but in the village there are other phenotype varieties that are germinating much better. One variety tested on station germinated at 95% (Table III).

Work on *C. sesamoides* started in February 2008. The first nursery was dug up after a month of non-germination, and the nursery was used for other activities. However, the partners noted that many months later, the *C. sesamoides* seeds left in the nursery started germinating. Some of these plants were transplanted to obtain further seed. Of all the other attempts, germination was only obtained in two cases (after 17 and 19 days respectively), at very low levels. Ms Honfoga also started some lab test for germination, but in all cases she had no germination. She has tried various techniques to remove dormancy but none has succeeded (Table IV). Mr Eteka, a PhD student from the UAC, has tried to remove dormancy of *C. sesamoides* using various techniques and products, but these are not effective. At best he has obtained 10% germination rates. When germination occurs quite quickly it takes place 13-20 days after planting. He has also remarked that if seeds do not germinate immediately, if they are left they can start germinating up to 5 months after. This observation is in agreement with information from farmers who say *C. sesamoides* only germinates after a year.

Table I: Summary of germination tests for *Crassocephalum crepidioides*

Type	Origin	Seed treatment	Date of sowing	10.1 Location	Germination rate
Yellow and red mixed	Seed collection missions	Sun-dried, without fibres	29/03/08	Station	0 %
Yellow and red mixed	Seed collection missions	Sun-dried, without fibres (100 grains)	29/03/08	Laboratory	0 %

Yellow and red mixed	Seed collection missions	Sun-dried, with and without fibres	03/04/08	Station	Yes
Yellow and red mixed	Seed collection missions	Sun-dried, with and without fibres (100 grains)	03/04/08	Laboratory	0 %
Yellow and red mixed	Seed collection missions	Sun-dried, without fibres	17/04/08	Station	Yes
Yellow and red mixed	Seed collection missions	Sun-dried, without fibres (100 grains)	17/04/08	Laboratory	0 %
Yellow and red mixed	Seed collection missions	Sun-dried, without fibres	22/04/08	Station	No
Yellow and red mixed	Seed collection missions	Soaked in hot water (50°C) for 30 mins	03/04/08	Station	No
Yellow and red mixed	Seed collection missions	Soaked in boiling water for 10 mins	03/04/08	Station	No
Yellow and red mixed	Seed collection missions	Soaked in boiling water until it cooled	03/04/08	Station	No
Yellow and red mixed	Seed collection missions	Passed through fire for 20 mins	03/04/08	Station	No
Yellow and red mixed	Seed collection missions	Soaked in cold water for 24 hours	03/04/08	Station	No
Yellow and red mixed	Seed collection missions	Sun-dried, with and without fibres (100 grains each)	16/05/08	Station	0 %
Yellow and red mixed	Seed collection missions	Sun-dried, with and without fibres (100 grains each)	22/05/08	Station	0 %
Yellow and red mixed	Seed collection missions	Sun-dried, with and without fibres (100 grains each)	22/05/08	Laboratory	0 %
Yellow	From plants on the station	Fresh, with and without fibres (100 grains each)	23/06/08	Station	0 %
Yellow	From plants on the station	Fresh, without fibres (100 grains)	26/06/08	Station	0 %
Yellow	From plants on the station	Fresh, without fibres (100 grains)	26/06/08	Laboratory	0 %
Yellow	From plants on the station	Fresh, without fibres (100 grains)	03/07/08	Station	0 %
Red	From plants on the station	Fresh, without fibres (100 grains)	03/07/08	Station	0 %
Yellow	From plants on the station	Fresh, without fibres (100 grains)	09/07/08	Station	0 %
Red	From plants on the station	Fresh, without fibres (100 grains)	09/07/08	Station	0 %
Yellow	From plants on the station	Fresh, without fibres (100 grains)	18/07/08	Station	0 %
Red	From plants on the station	Fresh, without fibres (100 grains)	18/07/08	Station	0 %
Yellow	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	25/07/08	Station	26 %

Red	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	25/07/08	Station	0 %
Yellow	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	25/07/08	Laboratory	5 %
Red	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	25/07/08	Laboratory	0 %
Yellow	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	31/07/08	Station	0 %
Red	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	31/07/08	Station	31 %
Yellow	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	31/07/08	Laboratory	0 %
Red	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	31/07/08	Laboratory	0 %
Yellow	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	04/08/08	Station	28 %
Red	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	04/08/08	Station	23 %
Yellow	From plants on the station	Fresh, without fibres (100 grains)	04/08/08	Station	15 %
Red	From plants on the station	Fresh, without fibres (100 grains)	04/08/08	Station	21 %
Yellow	From plants on the station	Sun-dried for 10 days, without fibres (100 grains)	14/08/08	Station	25 %
Red	From plants on the station	Sun-dried for 10 days, without fibres (100 grains)	14/08/08	Station	24 %
Yellow	From plants on the station	Fresh, without fibres (100 grains)	14/08/08	Station	26 %
Red	From plants on the station	Fresh, without fibres (100 grains)	14/08/08	Station	32 %
Red	From plants on the station	Sun-dried for 5 days, without fibres (100 grains)	29/08/08	Station	51 %
Red	From plants on the station	Sun-dried for 4 days, without fibres (100 grains)	29/08/08	Station	40 %
Red	From plants on the station	Sun-dried for 3 days, without fibres (100 grains)	29/08/08	Station	25 %
Red	From plants on the station	Dried in the dessicator for 7 days, without fibres (100 grains)	03/09/08	Station	22 %
Yellow	From plants on the station	Dried in the dessicator for 7 days, without fibres (100 grains)	03/09/08	Station	0 %

Table II: Summary of germination tests for *Crassocephalum rubens*

Type	Origin	Seed treatment	Date of sowing	10.2 Location	Germination rate
Purple	Bognongon	Sun-dried for 2 days, without fibres	05/09/08	Station	67 %
Purple	Ayétédjou	Sun-dried for 5 days, without fibres	05/09/08	Station	69 %
Purple	Ayétédjou	Sun-dried for 8 days, without fibres	05/09/08	Station	78 %

Table III: Summary of germination tests for *Launaea taraxacifolia*

Type	Origin	Seed treatment	Date of sowing	10.3 Location	Germination rate
White	From plants on the station	Sun-dried for 2 months	14/03/08	Station	No
White	From plants on the station	Sun-dried for 2 weeks (100 grains)	27/03/08	Station	0%
White	From plants on the station	Sun-dried for 2 weeks (100 graines)	27/03/08	Laboratory	0%
Black	From plants on the station	Sun-dried for 2 weeks (100 grains)	03/04/08	Station	9.33%
Black	From plants on the station	Sun-dried for 2 weeks (100 grains))	03/04/08	Laboratory	0 %
Black	From plants on the station	Sun-dried for 5 days (50 grains)	14/05/08	Station	0 %
Black	From plants on the station	Fresh (50 grains)	14/05/08	Station	0 %
Black	From plants on the station	Sun-dried for 2 weeks (50 grains)	27/06/08	Station	0 %
Black	From plants on the station	Fresh (50 graines)	27/06/08	Station	0 %
Black	From plants on the station	Sun-dried for 3 days (50 grains)	15/07/08	Station	0 %
Black	From plants on the station	Sun-dried for 5 days (50 grains)	15/07/08	Station	0 %
Black	From plants on the station	Fresh (50 grains)	06/08/08	Station	6 %
Black	From Ayétédjou	Sun-dried for 2 weeks (100 grains)	05/09/08	Station	95 %

Table IV: Summary of germination tests for *Ceratotheca sesamoides*

Type	Origin	Seed treatment	Date of sowing	10.4 Location	Germination rate
Black	Seed collection missions	Sun-dried	22/02/08	Station	Yes
Black	Seed collection missions	Sun-dried (100 grains)	22/02/08	Laboratory	0%
Black	Seed collection missions	Sun-dried	03/03/08	Station	Yes
Black	Seed collection missions	Sun-dried (100 grains)	03/03/08	Laboratory	0 %
Black	Seed collection missions	Sun-dried	14/03/08	Station	No
Black	Seed collection missions	Soaked in hot water (50°C) for 30 mins (100 graines)	03/04/08	Station	No
Black	Seed collection missions	Soaked in boiling water for 10 mins (100 grains)	03/04/08	Station	No
Black	Seed collection missions	Soaked in boiling water until it cooled (100 grains)	03/04/08	Station	No
Black	Seed collection missions	Passed through fire for 20 mins (100 grains)	03/04/08	Station	No
Black	Seed collection missions	Soaked in cold water for 24 hours (100 grains)	03/04/08	Station	No
Black	Seed collection missions	Sun-dried (100 grains)	24/04/08	Station	0 %
Yellow	Seed collection	Sun-dried (100 grains)	24/04/08	Station	0 %

	missions				
Black	Seed collection missions	Sun-dried (100 grains)	24/04/08	Laboratory	0 %
Yellow	Seed collection missions	Sun-dried (100 grains)	24/04/08	Laboratory	0 %
Black	From plants on the station	Sun-dried (100 grains)	12/05/08	Station	0 %
Yellow	From plants on the station	Sun-dried (100 grains)	12/05/08	Station	0 %
Black	From plants on the station	Sun-dried (100 grains)	12/05/08	Laboratory	0 %
Yellow	From plants on the station	Sun-dried (100 grains)	12/05/08	Laboratory	0 %
Black	From plants on the station	Sun-dried (100 grains)	10/06/08	Station	0 %
Black	From plants on the station	Sun-dried (100 grains)	27/06/08	Station	0 %
Black	From plants on the station	Sun-dried (100 grains)	23/07/08	Station	0 %
Black	From plants on the station	Sun-dried (100 grains)	23/07/08	Laboratory	0 %
Yellow	From plants on the station	Sun-dried (100 grains)	23/07/08	Station	0 %
Yellow	From plants on the station	Sun-dried (100 grains)	23/07/08	Laboratory	0 %
Black	From plants on the station	Sun-dried (100 grains)	14/08/08	Station	0 %
Black	From plants on the station	Sun-dried for 5 days (100 grains)	26/08/08	Station	0 %
Black	From plants on the station	Sun-dried for 5 days (100 grains)	26/08/08	Laboratory	0 %
Black	From plants on the station	Fresh (100 grains)	26/08/08	Station	0 %
Black	From plants on the station	Fresh (100 grains)	26/08/08	Laboratory	0 %

- Trials in Ayetedjou

In Ayetedjou the trials were focusing on *Launaea taraxacifolia* and seedlings of what was thought to be *Crassocephalum rubens*. The first attempts to set up nurseries with seeds collected during the field missions failed, as the seeds did not germinate. Thus, the first plots were set up with small plants collected from the wild. When these developed the partners noted that *L. taraxacifolia* and *C. rubens* had different phenotypes. In the latter case these were characterised by yellow, red and purple flowers, and following identification by Mr Paul Yedomonhan, from the National Herbarium of Benin it emerged that the plants with yellow and red flowers were actually *C. crepidioides* and the plants with purple flowers were *C. rubens*.

On each plot nurseries of the three species were established to verify germination rates. The germination rates of *L. taraxacifolia* are very variable. There appears to be a link to the phenotype, but further research needs to be undertaken. The germination of *Crassocephalum* spp. is very erratic. As also observed on-station, on the whole, *C. rubens* germinates better than *C. crepidioides*.

For *L. taraxacifolia* trials were set up to compare leaf size and yield of plants which had been produced from seed, from root cuttings planted vertically, and from root cuttings planted horizontally. For *Crassocephalum* spp. trials were set up to compare leaf size and yield from plants produced from seed and stem cutting.

The farmers were able to harvest from all three species, but were also retaining stands for seed production. During a visit by Dr Pasquini and Dr Ambrose-Oji to the village in September, the farmers

commented that they were managing to market both species successfully, and that the highest revenue was obtained from *L. taraxicifolia*. The germination of *C. crepidioides* appears to be very erratic, but farmers commented that plants produced from cuttings did not produce large leaves and also went to seed very quickly, and they emphasised the need to be able to produce plants reliably from seed. The women farmers requested to remove *C. rubens* explaining that they would never consume this, as they found the leaves were tough, and they believed that it gave fever and convulsions in young children. Accordingly, this species has been removed from the trials, apart from a small bed for seed production.

With the onset of the dry season the problem of affordability of irrigation water was encountered. The village does not have a source of irrigation water, apart from the well water. Using this for irrigation is very expensive, and farmers may spend 15,000 FCFA a month, which they cannot recover at the moment from what they sell. The project has been covering part of the irrigation costs (3000 FCFA a month), but it is clearly insufficient. Because the farmers could not afford to irrigate as much as they should the plants were not growing, and therefore farmers harvested very little or not at all. As the experience on-station shows, it is possible to produce these two crops under irrigation, but they require frequent irrigation, particularly *C. crepidioides*. Therefore, in March, a locally-produced, low-cost drip irrigation system was installed on one farm to evaluate to what degree water consumption could be reduced, its effects on crop productivity, and see whether it could be an economically viable solution.

- Trials in Bognongan

In Bognongan the trials only focused on *Crassocephalum* spp. As in Ayetedjou the farmers set up trials to compare the leaf size and yield from plants from seed and plants from cuttings, and nurseries to examine germination rates.

Unfortunately, the work in this village did not progress in a satisfactory manner. The village was selected because the farmers had expressed a strong interest in domesticating *Crassocephalum* spp. But when the trials commenced the farmers started requesting financial contributions to carry out the work. The INRAB partner explained that the project would benefit them in terms of research support to domesticate a species which could then be marketed. But most of the farmers lost interest and indeed, during a visit by the UK partner to the village in September, it was observed that most of the trial plots were being neglected. A short while later, the resident technician handed in his notice, explaining that the non-cooperation by the farmers and their aggressive behaviour were preventing him from fulfilling his duties.

Following this incident, and having also discovered that the village had been part of a development project run by an NGO in the past, the INRAB partners came to the conclusion the village had accepted to be involved in the trials, thinking that the project would pay them in cash or food produce. The partner therefore closed down the project in this location.

- Trials in Ganro

The work in Ganro started in December 2008. The trials were not started earlier because the women farmers were engaged in other farm duties.

Two species are being evaluated, *Ceratotheca sesamoides* and *Justicia tenella*. The latter species had not been in the original plan of work, however, in the course of a visit in January 2009 by Dr Achigan-Dako and Mr Avohou when it was apparent that *C. sesamoides* was showing problems of germination, and given that this species cannot be propagated through cuttings, it was proposed that *J. tenella* be included. The women farmers welcomed this suggestion, as this species is also increasingly difficult to find around the village.

**Section 2: Activity 4.2**

Table V: List of attendees at the training workshop, 17, 19 and 24 September 2008

Name	Qualifications	Institution
Felix HOUINSOU	Specialiste de communication	WARDA
Raymond VODOUHE	Coordonnateur	Bioversity International
Kouboura IGUE DJINADOU	Chef Service Relations Publiques et Valorisation	INRAB
David AMAGLO	Journaliste	Ocean FM
Christophe TOSSOU	Responsable filiere ananas	INRAB
Louis GNAHO	Directeur adj. cabinet	Ministere de l'Agriculture, l'Elevage et de la Peche
Edgar DEGUENON	Producteur formateur	UCP Cotonou/VIMAS
Armel MENSAH	Ingenieur Agronome	PCM/INRAB
Jocelyne ALLADAYE	Communication	Ministere de l'Agriculture, l'Elevage et de la Peche
Parfait Gohoun	Gerant	A Y N Corporation
Boris TOMAVO	Directeur Creation Publicitaire	La Machine
Gaudence DJEGO	LEA/FSA/DAC Chercheur	Faculte de Sciences Agronomiques/UAC
Richard AHLONSOU	Chef service appui aux initiatives communautaires	Mairie Cotonou
Francoise ASSOGBA KOMLAN	Responsable PCM	INRAB
Margaret PASQUINI	Doctorat en geographie	Universite de Bangor
Bianca AMBROSE OJI	Doctorat en sociologie environmental	Universite de Bangor

### Section 3: Activity 5

Table VI: List of attendees at the workshop organised to consult various stakeholders on the project dissemination strategies, 19 September 2008

Name	Qualifications	Institution	Days attended
Ines DELEKE KOKO	Doctorante en ethnobotanique	Faculte des Sciences Agronomiques /UAC	17, 18, 24 Sep
Thierry ASSOGBA	Ingénieur agronome	Programme Cultures Maraîchères /INRAB	17, 18, 24 Sep
Fifanou VODOUHE	Doctorant	Laboratoire d'Ecologie Appliquée / Faculte des Sciences Agronomiques/UAC	17, 18, 24 Sep
Ronaldine AHOUANMAGNAGAHOU	Ingénieur des travaux	Programme Cultures Maraîchères /INRAB	17, 18, 24 Sep
Servais AVOHOU	Géo-économiste	Programme Cultures Maraîchères /INRAB	17, 18, 24 Sep
Arlette ADJATIN	Diplôme d'études approfondies en légumes feuilles traditionnels	Faculté des Sciences et Techniques /UAC	17, 18, 24 Sep
Judith HONFOGA	Ingénieur des travaux	Programme Cultures Maraîchères /INRAB	17, 18, 24 Sep
Marcel GUIDI	Ingénieur agronome	Faculte des Sciences Agronomiques /UAC Programme Cultures Maraîchères /INRAB	17, 18, 24 Sep
Armel MENSAH	Ingénieur agronome	Programme Cultures Maraîchères /INRAB	17, 18, 24 Sep
Jean-Patrice AGOHOUNUMBO	Licence en sociologie	Mairie de Cotonou	17, 18, 24 Sep
Richard AHLONSOU	Administrateur	Mairie de Cotonou	17 Sep
Noel AHONONGA	Technicien développement rural	Programme Cultures Maraîchères /INRAB	17, 18, 24 Sep (logistical arrangements)
Christophe TOSSOU	Ingénieur en agro-écologie	Cultures Fruitières /INRAB	17, 18, 24 Sep
Hermane AVOHOU	Assistant de recherche	Bioversity International	18 Sep
Margaret PASQUINI	Doctorat en géographie	Universite de Bangor	17, 18, 24 Sep (trainer)
Bianca AMBROSE-OJI	Doctorat en sociologie	Universite de Bangor	17, 18 Sep (trainer)
Francoise ASSOGBA KOMLAN	Doctorat et Ingénieur Science du Sol	Programme Cultures Maraîchères /INRAB	17, 18 Sep (organiser)

### ***Checklist for submission***

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