Sustainable Weed Management Technologies for Cassava Systems in Nigeria

A proposal submitted to

The Bill and Melinda Gates Foundation

15 August 2013

Technical contact
Dr Ken Dashiell
Deputy Director General
IITA HQ, Ibadan, Nigeria
+234 2 751 74 72
K.Dashiell@cgiar.org

Administrative contact
Mrs Hilde Koper-Limbourg
Head, Project Administration Office
IITA HQ, Ibadan, Nigeria
+234 2 751 74 72
H.Koper@cgiar.org

International institute of Tropical Agriculture
HQ, PMB 5320, Oyo Road, Ibadan, Nigeria

International mailing address:
IITA, Carolyn House, 26 Dingwall Road, Croydon CR9 3EE, UK
**Date** 14 August 2013  
**Project Title** Sustainable Weed Management Technologies for Cassava Systems in Nigeria  
**Organization Name** International Institute of Tropical Agriculture

Institutional official authorized to submit and accept grants on behalf of the organization:  
**Prefix** Mrs  
**First Name** Hilde  
**Surname** Koper-Limbourg

**Title** Head – Project Administration Office  
**Address** PMB 5320, Ibadan, Nigeria  
**Telephone** +234-2 751 7472  
**Fax** + 44 208 711 3786  
**Email** H.Koper@cgiar.org  
**Web Site** www.iita.org

Project Director/Primary Contact:  
**Prefix** Dr  
**First Name** Ken  
**Surname** Dashiel  
**Title** Deputy Director General, Partnerships and Capacity Development  
**Address** PMB 5320, Ibadan, Nigeria  
**Telephone** +234-2 751 7472  
**Fax** + 44 208 711 3786  
**Email** K.Dashiell@cgiar.org  
**Web Site** www.iita.org

**U.S. Tax Status** (Refer to Tax Status Definitions)  
International Organization exempt from US income tax

**Geographic Location(s) of Project**  
Nigeria

**Amount Requested from Foundation in Dollars (U.S.)** $7,656,324  
**Project Duration (months)** 60 months

**Organization’s Fiscal Year-End Date** December 31

**Estimated Total Cost of Project in Dollars (U.S.)** $7,656,324 USD

**Organization’s Total Revenue for Most Recent Audited Financial Year in Dollars (U.S.)** more than 50 million USD
Contents
Abbreviations and acronyms
I. Charitable purpose
II. Executive summary
III. Project description
A. Background and Justification
B. Direct and ultimate beneficiaries
C. Geographic areas served
D. Key partner organizations, sub-contractors and sub-grantees
E. Nontion to previous or on-going funding
IV. Alignment with Foundation strategy
V. Sustainability and scalability
VI. Implementation, Intended Results and Results Management
A. Results framework
B. Project Plan
C. Analysis
D. Assumptions and Risks Concerning implementation and Results
E. Measurement
VII. Organizational capacity
A. Applicant: the International Institute of Tropical Agriculture (IITA)
B. Partners and sub-grantees
C. Organizational Assumptions and Risks
VIII. Budget template and Narrative
General Questions
Specific questions ................................................................................................................................. 53

A. Personnel ........................................................................................................................................ 53
B. Travel .............................................................................................................................................. 56
C. Sub-Grants to Other Organizations ............................................................................................... 58
D. Capital Equipment ............................................................................................................................. 59
E. Consultants ....................................................................................................................................... 59
F. Other Direct Costs ............................................................................................................................. 59
G. Funding ........................................................................................................................................... 61
H. Currency and Inflation Assumptions ............................................................................................... 61
I. Indirect Cost allowance ...................................................................................................................... 61

IX. Additional Benefits and Risks .......................................................................................................... 62
X. General Questions ............................................................................................................................ 62
XII. References ................................................................................................................................... 63
# Abbreviations and acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCP</td>
<td>Africa Wide Biological Control Project</td>
</tr>
<tr>
<td>ADP’s</td>
<td>Agriculture Development Programs (State-led, Nigeria)</td>
</tr>
<tr>
<td>AfDB</td>
<td>African Development Bank</td>
</tr>
<tr>
<td>AGP</td>
<td>Plant Production and Protection Division of FAO of the United Nations</td>
</tr>
<tr>
<td>AIARC</td>
<td>Association of International Agricultural Research Centers</td>
</tr>
<tr>
<td>AT</td>
<td>Agronomy Team</td>
</tr>
<tr>
<td>BASF</td>
<td>BASF Corporation (German-based chemical company)</td>
</tr>
<tr>
<td>Bio-plus</td>
<td>Biofortification of Cassava</td>
</tr>
<tr>
<td>BMGF</td>
<td>The Bill and Melinda Gates Foundation</td>
</tr>
<tr>
<td>BSV</td>
<td>(Cassava) Brown Streak Virus</td>
</tr>
<tr>
<td>CA</td>
<td>Conservation Agriculture</td>
</tr>
<tr>
<td>CBO</td>
<td>Community Based Organization</td>
</tr>
<tr>
<td>CEDP</td>
<td>Cassava Enterprises Development Project</td>
</tr>
<tr>
<td>CIAT</td>
<td>International for Tropical Agriculture</td>
</tr>
<tr>
<td>CMD</td>
<td>Cassava Mosaic Disease</td>
</tr>
<tr>
<td>CODEX</td>
<td>Codex Alimentarius Commission of FAO and WHO, UN</td>
</tr>
<tr>
<td>COMPRO II</td>
<td>The Bill and Melinda Gates Foundation funded project, implemented by IITA, Institutionalization of quality assurance mechanism and dissemination of top quality commercial products to increase crop yields and improve food security of smallholder farmers in sub-Saharan Africa</td>
</tr>
<tr>
<td>CRP</td>
<td>CGIAR Research Program</td>
</tr>
<tr>
<td>DAP</td>
<td>Days after planting</td>
</tr>
<tr>
<td>DDG</td>
<td>Deputy Director General</td>
</tr>
<tr>
<td>DG</td>
<td>Director General</td>
</tr>
<tr>
<td>DIFD</td>
<td>Department for International Development (British)</td>
</tr>
<tr>
<td>EPA</td>
<td>Environment Protection Agency</td>
</tr>
<tr>
<td>ESCAPP</td>
<td>Ecologically Sustainable Cassava Plant Protection Project</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agricultural Organization of the United Nations</td>
</tr>
<tr>
<td>FAOSTAT</td>
<td>FAO’s statistical database on food and agriculture</td>
</tr>
<tr>
<td>FBO</td>
<td>Faith Based Organizations</td>
</tr>
<tr>
<td>FFS</td>
<td>Farmer Field Schools</td>
</tr>
<tr>
<td>FFSF</td>
<td>Farmer Field School Facilitator</td>
</tr>
<tr>
<td>FMARD</td>
<td>Federal Ministry of Agriculture and Rural Development, Nigeria</td>
</tr>
<tr>
<td>FUNAAB</td>
<td>Federal University of Agriculture, Abeokuta</td>
</tr>
<tr>
<td>GoN</td>
<td>Government of Nigeria</td>
</tr>
<tr>
<td>HR</td>
<td>Human Resources</td>
</tr>
<tr>
<td>HW</td>
<td>Hoe or hand weeding</td>
</tr>
<tr>
<td>IAR&amp;T</td>
<td>Institute of Agriculture Research and Training (Ibadan, Nigeria)</td>
</tr>
<tr>
<td>ICT</td>
<td>Information communication technology</td>
</tr>
<tr>
<td>IFAD</td>
<td>International Fund for Agricultural Development</td>
</tr>
<tr>
<td>IITA</td>
<td>International Institute of Tropical Agriculture</td>
</tr>
<tr>
<td>IP</td>
<td>Innovation Platform</td>
</tr>
<tr>
<td>IPR</td>
<td>Intellectual Property Rights</td>
</tr>
<tr>
<td>KAP</td>
<td>Knowledge, attitudes and practices</td>
</tr>
<tr>
<td>MAP</td>
<td>Months after planting</td>
</tr>
</tbody>
</table>
M&E  Monitoring and Evaluation
MOUA  Michael Okpara Federal University of Agriculture, Abia State
MSMA  Monosodium acid methanearsonate (herbicide)
MT  Metric tons
NACWC  National Advisory Committee on Weed Control (Nigeria)
NAFDAC  National Agency for Food and Drug Administration and Control
NARS  National Agriculture Research Institutions
NGO  Non-governmental Organization
NRCRI  National Root Crops Research Institute (Nigeria)
NRS  Nationally Recruited Staff
PAN  Pesticide Action Network
PAO  Project Administration Office of IITA
PC  Project Coordinator
PE  Pre-emergence
PG  Pay Grade
PM  Project Manager
PR  Public Relations
PREA  Participatory Research and Extension Approach
ProMIS  Project management information system
R4D  Research for Development
RUSEP  Rural Sector Enhancement Programme
SC  Steering Committee
SON  Standards Organization of Nigeria
SSA  Sub-Saharan Africa
SSPs  Spray Service Providers (Nigeria)
TBC  To be contracted
TCI  FAO’s Investment Center
TL II  Tropical Legumes II (BMGF funded project in Nigeria jointly implemented by CGIAR Centers and others)
TOR  Terms of Reference
ToT  Training of Trainers
UAM  University of Agriculture, Makurdi
UN  United Nations
UNEP  United Nations Environment Programme
UNIPORT  University of Port Harcourts
USD  United States Dollar
WAP  Weeks after planting
WASCO  West African Seasoning Company Ltd.
WB  World Bank
WHO  World Health Organization
YIIFSWA  Yam Improvement for Income and Food Security in West Africa
2,4-D  Dichlorophenoxyacetic acid (herbicide)
I. Charitable purpose

To develop improved and integrated approaches to weed management that reduces labour requirements and enhance the productivity of small holders’ cassava farms in Nigeria.

II. Executive summary

Vision of Success and the most important results (expanded version)

This project will have, by year 5, developed and assessed with smallholder farmer participation modern, relevant and appropriate cassava weed management technologies suitable for sustainable intensification in major agro-ecological and socio-economic conditions of Nigeria. A key result will be the formulation and negotiation of a full-scale ‘investment project’ for scaling-up enhanced cassava agronomy, including judicious, safe use of herbicides, toward improved weed management, across at least 20 states in Nigeria where cassava is central to food security and livelihoods of 4.5 million farm families. The investment project, formulated by this project, will reduce the drudgery for millions of women and children who currently have responsibility for weeding the crop multiple times, now done almost entirely by hand labor. The Federal Government of Nigeria will lead the formulation, with strong technical support from this project. The investment project’s strategies and tactics will be based on outputs and outcomes of this project that focuses in benchmark areas in three principal agricultural biomes, identifying appropriate, farmer-tested (especially by women) agronomic and herbicide technologies. In addition, the project will provide the government and its follow-up investment project with a ‘community of practice’ model and framework, in which stakeholders from state governments, global and local agro-industries (including distributors and spray service providers) and NGOs are engaged in a shared vision and partnership to optimize sustainable intensification of cassava-based production systems. Finally, this project will strengthen project management capacity of the Nigerian National Root Crop Research Institute, which will fully take over management responsibilities in Year 4.

Cassava production in Nigeria is already a central element of food security, and cassava is considered by many to be of increasing importance in mitigating effects of climate change in sub-Saharan Africa, due to its relative tolerance of droughts and even of short-term flooding. At the same time cassava’s potential role, beyond food and feed, will likely expand to include being a substrate for bio-ethanol on an increasing scale. Better management of the crop thus merits major attention and investment.

Though Nigeria is still the global leader in overall production of cassava with about 50 million tons on 3.8 million hectares, average yields in Nigeria are only about half of those in leading countries in Asia, and less than half of those typical from researcher-run trials in Nigeria. Diverse factors are responsible for low productivity on the about 4.5 million cassava farms, but poor weed management is generally among the principle factors. Weed control in the humid tropics is always a challenge, but compared to most other field crops, weed control in cassava systems is much more demanding. The crop is in the field for a long time (12 to 18 months), and is sown at wide spacing, resulting in ample opportunity for weeds to occupy space under the cassava canopy and reduce productivity. Although weeds are one of the most important constraints to improving cassava productivity, for high yields, good weed control needs to be coupled with improved varieties sown in the right densities at the right time. Adequate plant nutrition and pest control are also important; however, such inputs will not result in better yields if weeds are not controlled.

Hand weeding is the predominant weed control practice on smallholder cassava farms. Conventionally, farmers weed cassava three times, but in cassava farms where perennial weeds, such as Imperata, are
predominant, extra hoe weeding may be required. Weeding takes 50 to 80% of the total labor budget. Up to 200-500 hours of labour for mostly women and children per ha are required to prevent economic cassava root losses in Nigeria. Women contribute more than 90% of the hand-weeding labor while 69% of farm children between the ages of 5-14 are forced to leave school and are used in weeding (Nweke, 2004). This burden compromises their responsibilities and education. Until weed control is improved, Nigerian farmers will not produce optimal cassava yields, since farm families cannot plant more area than they can weed. Even if land were available, without innovations in weed control, they are doomed to stay “very small-scale farmers” and will be unable to improve their livelihoods through farming.

In response to the knowledge that innovations in weed management are needed in 2012 The Bill and Melinda Gates Foundation (BMGF) conducted a study to appraise what was known and what opportunities exist to address this gap through applied research and extension of new technologies, including the judicious use of low-risk herbicides. The desk study, coupled to a convening of experts on the margin of the Global Cassava Research Conference in Uganda, was followed by a two-day workshop held in February, 2013, at the International Institute of Tropical Agriculture (IITA) campus (Ibadan, Nigeria) involving about 30 Nigerian research and development experts and another 10 international resource persons. Outputs of the study and the two short workshops pointed compellingly to the opportunity to gain better weed management by smallholder farmers through research for development provision of innovative training and input-access of selected herbicides.

IITA and its partners are therefore proposing through this project to conduct research that will develop new best bet innovative weed management practices, combining improved varieties, proper planting dates, plant populations, and plant nutrition, all coupled to intercropping and tillage options, through well-focused trials in the three agro-ecologies where cassava dominates in Nigeria. Herbicides, meeting globally accepted conventions and safety thresholds appropriate for smallholders will be tested for efficacy and economic merit to help make weed control in cassava more efficient and effective. Any herbicide activities will be integrated with good agronomic practices, i.e. integrated weed management, that is effective and sustainable.

Multi-locational on-station/off-station trials will be followed with farmer participatory evaluations. Extension manuals and other tools for farmer and applicator learning will be developed. Promising new herbicides, in this context, will be presented for consideration of the Nigerian pesticide registration instruments under guidelines of WHO, FAO, UNEP and the protocols of the Nigerian Government. An effective communication capacity will be developed to enable stakeholders to stay abreast and contribute to developments. This capacity will also facilitate effective linkages to other relevant initiatives and projects, especially those supporting efforts for farmer involvement and scaling-up application. Accordingly, the Project Components are: Agronomy; Herbicide screening; Integrated Weed Management; Extension (on a pilot basis); and Project Management, including communications and scaling up, monitoring and evaluation, and project management capacity building.

The work of this project will, over a five-year period, provide knowledge to about 125,000 Nigerian cassava farm families with better crop and weed management know-how. The project’s goal is to generate relevant information and share it with farmers to allow them to make their own decisions about which weed management options are best for their families. The project envisions in year 5 working with the Ministry of Agriculture and its partners (e.g. FAO, IFAD, WB, AfDB) to develop an investment project to scale-up across all of Nigeria the extension component using modalities and lessons learned from the project. The private sector, through CropLife and its constituents, will contribute to the goals of the project, providing products for testing, manuals for training, and advice and assistance, especially on testing environmental safety, applicator safety and food safety factors. The project will focus on
participatory research, defining best practices, and sharing knowledge with farmers and those who support them. The private sector will remain fully responsible for the production, distribution and marketing of any herbicides determined to be appropriate for Nigerian cassava farmers.¹

This project builds on existing and new partnerships that will include The Federal Ministry of Agriculture and Rural Development (FMARD), cassava producer associations, agro-dealers, chemical companies, the Federal University of Agriculture at Makurdi, Federal University of Agriculture Abeokuta (FUNAAB), National Root Crops Research Institute (NRCRI), National Agency for Food and Drug Administration and Control (NAFDAC), Standards Organization of Nigeria (SON), Agricultural Development Programs (ADPs) and other extension service providers [i.e., contract sprayers, also referred to as Spray Service Providers (SSPs)]. The project will establish synergistic links with the IITA-lead COMPRO II Project that is developing similar partnerships for successful commercialization of agricultural products to increase crop yields.

The project will be led by IITA in years 1-3, providing targeted training on project management to NRCRI. In year 4, IITA and NRCRI will jointly manage the project. In year 5 of the project NRCRI will be the lead institution.

The project will have a Steering Committee (SC), which will consist of representatives from IITA, BMGF, CropLife, FAO, producer associations, the Nigerian Federal Government, including the national ADPs (state led), and relevant universities. The SC will guide the implementation and management of the project.

The project will be organized around three hubs, i.e. Forest Zone, Derived Savanna Zone, and the Southern Guinea Savannah Zone. Each hub, facilitated by a local AEZ scientist, will increasingly be directly responsible for facilitating the planning, coordination, and extension of weed control options, linking with appropriate partners for successful implementation of the project in each agro-ecological zone.

¹ The project will share the findings of its weed management research but will not be involved in marketing or promoting any specific herbicide products. Companies that sell such products will remain solely responsible for their registration, distribution, and marketing.
III. Project description

3.1. Background and Justification

Both population growth and urbanization in Africa are still increasing at very concerning rates in most countries. Smallholder farmers in Africa need to be able to intensify production of food crops in a sustainable way, not only in order to feed their families, but also to provide food, fiber, feed, and bio-energy for the wider population, including the needs of rapidly expanding urban centers. Cassava has become a central crop in Africa for food security, and it has potential for industrial uses (feeds and starch markets), and even for a source of substrate for bio-energy. Approximately 118 million MT of cassava are produced across the continent, making it the major staple for more than 50 million people (FAOSTAT, 2012). The climate in Africa is changing, marked by reduced rainfall and changes in rainfall patterns (Boko et al., 2007). Africa is generally considered one of the most vulnerable continents to climate change and climate variability. Because cassava is among the most resilient crops to abiotic stresses, it is often considered a key crop for mitigation of climate change and variability (Jarvis et al., 2012).

Nigeria, Africa’s most populated country, is the global leader in total cassava production with over 50 million tons grown primarily by about 4.5 million smallholder family cassava farmers (FAOSTAT, 2012). Production in Nigeria has increased 54% from about 24 million MT in 1995 to about 37 million MT in 2010, due to increased land area planted to cassava. Yield, however, has been static at only about 12 T/ha (Table 3.1). Cassava production in Nigeria is important in most states of the three agro-ecologies: Humid Forest, Derived Savanna, and Southern Guinea Savanna.

Table 3.1. Cassava production in Nigeria.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (million metric tons)</th>
<th>Area harvested (million ha)</th>
<th>Yield (tons ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>23.831</td>
<td>2.142</td>
<td>11.1</td>
</tr>
<tr>
<td>1996</td>
<td>25.285</td>
<td>2.334</td>
<td>11.3</td>
</tr>
<tr>
<td>1997</td>
<td>27.548</td>
<td>2.349</td>
<td>11.7</td>
</tr>
<tr>
<td>1998</td>
<td>29.648</td>
<td>2.474</td>
<td>12.0</td>
</tr>
<tr>
<td>1999</td>
<td>29.924</td>
<td>2.550</td>
<td>11.7</td>
</tr>
<tr>
<td>2000</td>
<td>29.634</td>
<td>2.446</td>
<td>12.1</td>
</tr>
<tr>
<td>2001</td>
<td>27.703</td>
<td>2.328</td>
<td>11.9</td>
</tr>
<tr>
<td>2002</td>
<td>28.804</td>
<td>2.337</td>
<td>12.3</td>
</tr>
<tr>
<td>2003</td>
<td>30.393</td>
<td>2.492</td>
<td>12.2</td>
</tr>
<tr>
<td>2004</td>
<td>30.668</td>
<td>2.500</td>
<td>12.3</td>
</tr>
<tr>
<td>2005</td>
<td>32.015</td>
<td>2.570</td>
<td>12.5</td>
</tr>
<tr>
<td>2006</td>
<td>35.614</td>
<td>2.790</td>
<td>12.8</td>
</tr>
<tr>
<td>2007</td>
<td>38.032</td>
<td>2.655</td>
<td>14.3</td>
</tr>
<tr>
<td>2008</td>
<td>39.132</td>
<td>2.854</td>
<td>13.2</td>
</tr>
<tr>
<td>2009</td>
<td>33.223</td>
<td>2.984</td>
<td>11.1</td>
</tr>
<tr>
<td>2010</td>
<td>36.807</td>
<td>3.129</td>
<td>11.8</td>
</tr>
</tbody>
</table>

Millions of women and their children are spending very large parts of their time weeding this important food security crop. This, in addition to low average cassava yields in Nigeria, is the key driver of this proposal. The children should be in school, and though not yet documented, hand weeding not only keeps women from improving their livelihoods by consuming many hours of time, but excessive hand weeding
contributes to health (lower back) issues, which compromises them and results in negative effects on the entire farm family.

Figure 3.1. Cassava production in Nigeria at state level, with isolines for Ago-ecological zones.

Low Cassava Productivity in Nigeria:
Nigeria has benefited from having access to improved varieties of cassava from both The International Institute of Tropical Agriculture (IITA) and from the breeding work of national programs, such as that of the National Root Crop Research Institute (NRCRI). Varieties with resistance to Cassava Mosaic Virus have enabled productivity increases. Nigeria also benefited in the last three decades from a very successful biological control program implemented through IITA to bring the cassava mealy bug and green spider mites under control, which were inadvertently introduced into Africa from Latin America in the late 1970s. Such applied research and extension has been pivotal for the stable productivity of this vital food security crop. Even though meaningful gains have been realized in the genetic yield potential of recent cassava varieties, because management of the crop by smallholders has not improved at the farm level, the genetic potentials of old and new varieties simply are not realized. Yields at smallholder farm level are static and low. There are diverse reasons for farmers’ not applying good agronomic practices, such as: lack of understanding of the importance of and inability to plant on time and at the right plant populations; poor access to and high costs of inputs, especially of fertilizers, but also agro-chemicals, along with lack of assurance of fair prices making investment in inputs too risky; and last, but certainly not least, difficulties with weed control.

Weed control in the humid tropics is always a challenge, but compared to most other field crops, weed control in cassava systems is much more demanding. The crop is in the field for a long time (12 to 18 months), and is sown at wide spacing, resulting in ample opportunity for weeds to occupy space between

---

2 The genetic gain per year for ‘fresh root yield’ over 30 years has been estimated for IITA’s breeding program to be 1.3% (Okechukwu and Dixon, 2008, Journal of Crop Improvement Vol 2. pp 181-208.)
cassava plants and under the cassava canopy, and thereby reduce productivity of cassava. Weeds are one of the most important constraints to improving cassava productivity; but for high yields, good weed control needs to be coupled with improved varieties sown in the right densities at the right time. Adequate plant nutrition and pest control are also important; however, such inputs will not result in better yields if weeds are not controlled. A literature review of “The Need to Weed” was prepared as part of the ‘Desk Study’ leading to this proposal. Excerpts are included in Appendix 1.

There is a very wide array of weeds in cassava fields in Nigeria (see Appendix 2). In the drier Southern Guinea Savanna, perennial grasses such as Panicum maximum, Imperata cylindrica, Chromolaena odorata Andropogon gayanes, Pennisetum purpureum, Cynodon dactylon, etc., are dominant. While in higher rainfall zones, these and other perennial grasses are joined by a number of dicot and monocot seeds, such as: diverse Commelinaceae spp., Cyperus rotundus, Cyperus esculentus, Mimosa invisa, Sida rhombifolia, Calopogonium mucunoides, etc.

Hand weeding is the predominant weed control practice on smallholder cassava farms. Conventionally, farmers weed cassava three times, but in cassava farms where perennial weeds, such as Imperata, are predominant, extra hoe weeding may be required. Weeding takes 50 to 80% of the total labor budget. Up to 200-500 person-hours per ha are required to prevent economic cassava root losses in Nigeria. The key operation that needs improvement is the timely removal of weeds, as much of the cassava crop is still hand-weeded, mostly by women and children, and this work is drudgery. Women contribute more than 90% of the hand-weeding labor, while 69% of farm children between the ages of 5-14 are forced to leave school and are used in weeding (Nweke, 2004). This burden compromises their responsibilities and education. Until weed control is improved, Nigerian farmers will not produce optimal cassava yields, and the onerous task of hand weeding will fall on the shoulders of women and children. A farm family cannot plant more area than they can weed; therefore, even if land were available, without innovations in weed control, they are doomed to remain “very small-scale farmers” and will be unable to improve their livelihoods through farming.

**Current Practices of Herbicide use in Nigeria:**

Chemical control, when properly implemented, is an excellent alternative to manual weeding because it is less expensive, faster and gives better weed control. Characteristics of some common herbicides are given in Appendix 3. Research on chemical weed control in cassava has demonstrated higher cassava root yields and lower net costs. Research has also shown a decrease of 54 to 96% in labour use, as farmers switched from hoe weeding to chemical control, in southeastern Nigeria (Chikoye et al., 2007). Another study (Chikoye et al., 2006) found chemical weeding to be 30 to 50% less expensive than the cost of hand weeding three times (Table 3.2).

<table>
<thead>
<tr>
<th>Weed control method</th>
<th>Tuber Yield (t/ha)</th>
<th>Crop Value ($/ha)</th>
<th>Weeding Cost</th>
<th>Margin Over Weeding Cost</th>
<th>Margin Over HW3</th>
<th>Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate</td>
<td>24.8</td>
<td>629</td>
<td>74</td>
<td>556</td>
<td>251</td>
<td>83</td>
</tr>
<tr>
<td>HW3 (farmer practice)</td>
<td>20.8</td>
<td>507</td>
<td>203</td>
<td>304</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3.2 Partial budget analysis to determine margins over weed management treatment in cassava in Imperata dominated field in Nigeria. Source: Chikoye et al., 2006.

---

3 A desk study to appraise needs and opportunities of addressing weed management in cassava-based systems in Africa was organized and sponsored by the BMGF.
Constraints to agronomic and chemical weed management methods

There is a clear lack of agronomic studies on cassava in Nigeria with information on practices that produce high yields and reduce weed competition. This project intends to address this need and opportunity. And although past studies have demonstrated that herbicide technologies are cost-effective and give higher net returns than manual methods, there is low adoption (5 to 10%) of herbicide technologies for weed control by small-scale farmers on their cassava fields. Some obstacles for adoption of better agronomy and of herbicide-use include:

- lack of research on agronomic practices to reduce need for hand weeding and increase yields of cassava
- lack of awareness and training for women, especially on herbicide application technology (sprayer calibration and herbicide choice for predominant weed species);
- lack of involving women in the development of weed control technologies;
- high cost of spraying equipment;
- liquidity problems at the beginning of the cropping season;
- environmental and human safety concerns;
- lack of appropriate herbicides especially for cassava intercropping situations;
- inadequate technical support in areas of matching herbicides to the dominant weed communities and crops;
- lack of appropriate herbicide packages for smallholder acreage;
- lack of user friendly herbicide labels written in local languages
- inability of extension to demonstrate the benefits of herbicides sufficiently to drive adoption
- wrong perception that herbicides damage soil and crops, in fact it is considered to be a poison by some farmers
- lack of confidence in herbicide efficacy due to adulteration

The most popular herbicides for cassava-systems among farmers in Nigeria today are glyphosate, Primextra® [atrazine + metolachlor] and paraquat; and also, farmers use different variations [Sarosate®, TouchDown Forte®, Roundup®, Bushfire®, WeedOff®, Gramoxone®] of these herbicides. Some farmers apply Primextra® immediately after planting cassava, before the crop and weeds emerge, while glyphosate and paraquat are used for land preparation to kill the initial vegetation, and in some cases used as directed spray under cassava canopy to kill weeds. A major problem with Primextra® [atrazine + metolachlor] is lack of compatibility with leguminous crop intercropped with cassava, because of the atrazine component. The use of paraquat has been discontinued in many countries due to high risks to applicators, and it will not be used in this project. Extra care and training is required to use glyphosate under cassava canopy to avoid killing the cassava. Similar herbicides are used in all regions of cassava production including Africa, Latin America and Asia. A thorough review of experimentation and use of herbicides in cassava was prepared in the Desk Study (excerpts are in Appendix 1) as a baseline and guide to future steps, including those outlined in this project.

The way forward:

A two-day consultation of experts held at IITA (Ibadan, Nigeria, February 26 & 27, 2013), sponsored by the BMGF, provided insights on what is needed to be done in a model project for Nigeria that would provide the framework for a national program for Nigeria, and a ‘roadmap’ for similar developments in the many countries in Africa where cassava plays an important role in food security and livelihoods. The guidance from the convening recommended that IITA and its partners propose this project to clarify best bet innovative weed management practices, combined with: improved varieties, proper planting dates, plant populations, and plant nutrition, all coupled to intercropping and tillage options, through well-focused
trials in the three agro-ecologies where cassava dominates in Nigeria. Herbicides, meeting global conventions and safety thresholds appropriate for smallholders, will be tested for efficacy and economic merit. Multi-locational on-station trials that have all stakeholders involved in the planning will be followed with on-farm farmer-participatory evaluations. Extension manuals and other tools for farmer and applicator learning will be developed. A strong and efficient communication capacity will be developed to enable stakeholders across and within innovation platforms to stay abreast of and contribute to developments. This capacity will also facilitate effective linkages to other relevant initiatives and projects, especially those supporting efforts for farmer involvement and scaling-up application. Accordingly, the Project has 5 components: 1) Agronomy; 2) Herbicide screening; 3) Integrated Weed Management; 4) Extension (including training on safe use of herbicides); and 5) Project Management, including communications and scaling up, monitoring and evaluation, and project management capacity building.

The activities in this project will, over a five-year period, provide knowledge to 125,000 Nigerian cassava farm families with better crop and weed management know-how. The project envisions working with the Federal Ministry of Agriculture and Rural Development (FMARD) and its partners (e.g., FAO, IFAD, WB, AfDB) in year 5 to develop an investment project to scale-up across all major cassava-growing states of Nigeria the extension component using modalities and lessons learned from the project. The private sector, through CropLife and its constituents, will contribute to the goals of the project, providing products for testing, manuals for training, and advice and assistance (especially on testing environmental safety), applicator safety and food safety factors. The project will share the findings of its weed management research but will not be involved in marketing or promoting any specific herbicide products. Companies that sell such products will remain solely responsible for their registration, distribution, and marketing.

This project builds on existing and new partnerships that will include cassava producer associations, agro-dealers, chemical companies, the University of Agriculture at Makurdi, NRCRI, the Federal University of Agriculture, Abeokuta (FUNAAB), The Federal Ministry of Agriculture and Rural Development, NAFDAC, Standards Organization of Nigeria, Agricultural Development Programs and other extension service providers (i.e., contract sprayers). The project will establish synergistic links with the IITA-lead COMPRO II project that is developing similar partnerships for successful commercialization of agricultural products to increase crop yields. Contacts with other advanced research institutes (ARI’s) will be facilitated through IITA’s and the CGIAR’s vast networks and other project linkages.

Without this project’s providing the catalyst for convergence of diverse partnerships, it is most unlikely that this important work would evolve and lead to solutions to a critical constraint that has huge social and food security implications. The project will harness pivotal elements required for sustainable development, based on innovations both in research and development, tied to regulation facilitation and to other policy dimensions. The private sector and government (with its diverse partners, including UN agencies) will work together, based on a shared vision of sustainable intensification involving smallholder cassava producers, who are central to food security in Nigeria. While better weed management in cassava systems is at the center of the project’s focus, the objectives and activities will capture the synergies from identification and promotion of better agriculture practices (agronomy) and the beneficial interactions between good agricultural practices and herbicide application.

The project will be organized around three hubs, i.e. Forest Zone, Derived Savanna Zone, and the Southern Guinea Savannah Zone. Each hub, led by a local scientist, will be responsible for facilitating the planning, coordination, and knowledge-sharing of weed control options in the context of better agronomy.
to optimize productivity, linking with appropriate partners for successful implementation of the project in each agro-ecological zone.

A conceptual framework, depicting how the activities inter-relate in content and over time, as well as transition of project focus (from research managed to participatory farmer approaches) and the project leadership, is schematized in Figure 3.3.

Figure 3.2. Conceptual framework of interlinkages between project activities and agro-ecological zones and implementing responsibility, in relation to project lifetime. The project will have activities on-station (researcher managed on a research station), off-station (researcher-managed in farmer’s fields) and on-farm (farmer managed, participatory). Leadership will transition from IITA to NRCRI.

3.2 Direct and ultimate beneficiaries

The ultimate aim of the project is to minimize the drudgery of hand weeding by women and children and increase cassava productivity. In the medium term, and in the context of this project, the ultimate beneficiaries are the Nigerian farm families who are using the labor saving and yield-increasing technologies. Also, policy makers will have better information on modern, relevant and appropriate cassava weed management technologies that could be used to create and implement a strategic plan for better cassava weed management to extend the benefits to another 3-5 million farm families in Nigeria. This will also help to meet the government’s goals for sustainable intensification of agriculture while
avoiding food insecurity, in the face of population growth, urbanization, climate change and climate variability.

### 3.3 Geographic areas served

This project will focus activities primarily in the benchmark study areas (specific field sites are still to be finalized) in three states: Abia (Umudike), Oyo (Ibadan), and Benue (Makurdi), representing the Humid Forest, Derived Savanna, and Southern Guinea Savanna biomes inside Nigeria, respectively. The geographic implications of these focal areas can be seen in Figure 3.2, showing general zone/biome locations and the amount of cassava produced in each state. This strategy to conduct research and farmer discovery in the biome-based benchmark sites will ensure that differences in weed stress associated with agro-ecologies be taken into consideration, permitting different strategies of control when required.

These agro-ecological zones also are relevant to most coastal West African countries, such as Ghana. The Dry Savanna and Guinea Savanna agro-ecologies are important in cassava production in Tanzania and Uganda as well.

### 3.4 Key partner organizations, sub-contractors and sub-grantees

This project builds on existing and new partnerships. A listing of examples of different partnerships is detailed below:

**Sub-grantees:**
- NRCRI, Federal University of Agriculture at Makurdi, Federal University of Agriculture at Abeokuta

**Government partners:**
- FMARD, NRCRI, NAFDAC, SON, ADPs

**NGO collaborators:**
- Crop Life, WCBGs

### 3.5 Relation to previous or on-going funding

The project will establish synergistic links with the IITA-lead COMPRO II project that is developing similar partnerships for successful commercialization of agricultural products to increase crop yields. In addition, this project will be part of the CIP-led CGIAR Research Program (CRP) on Roots, Tubers and Bananas and the IITA-led CRP on Humidtropics. The goals of this project strongly correlate with the Agricultural Transformation Agenda developed by the Federal Ministry of Agriculture and Rural Development (FMARD) of Nigeria. This project also complements several on-going activities on cassava within BMGF (Farm Radio, Cassava ISFM etc).

### IV. Alignment with Foundation strategy

**a) Describe the foundation strategies with which this project will align etc**

**The project aligns with the Agricultural Development Strategy by:**
- Putting smallholder farmers at the center of our approach with specific activities to ensure that women and children and the small holder farmers benefit from the intervention;
- Focusing on a priority African staple crop that is key for food security and income generation in West Africa;

---

4 Policy makers and cassava experts will visit the project (probably year 3 or 4) from three other cassava producing countries, Ghana, Tanzania, and Uganda of priority for BMGF’s cassava focus.
• Fostering agricultural sustainability through judicious use of resources.
• Targeted country (i.e. Nigeria) has been identified for focussed investments by the Foundation;
• Building partnerships with and capacities of local institutions to ensure delivery of research outcomes.

b) Discuss the existing relevant research and efforts in this field, with focus on how the proposed project fits in this broader context.

In the early 1980s, a solid initial body of research commenced on weed management constraints in cassava-based production systems at both IITA and CIAT, including the screening of herbicides available at that time. Unfortunately there was a misconception in the late 80s across the CGIAR that agronomic research (crop and soil management, including weed management) was so site-specific that it should be addressed by NARS. It was argued that little would be gained by inputs from the CGIAR, and consequently, funding for agronomy was minimized. A few disperse and diffuse studies on cassava weed control emerged at IITA, and by several weed scientists in Nigeria in the last 20 years, but very few of the currently available safer herbicides were appraised.

A better understanding of how agronomic research contributes to sustainable intensification of crop production has, fortunately, gained momentum during the last decade. The enthusiasm comes in part from the major breakthroughs in crop and soil management in Brazil, and a realization that there are a number of principles of good agronomic practices relevant to large land areas within biomes. This is coupled to the broader appreciation that weed management remains a huge constraint in nearly all tropical cropping systems where rainfall is adequate for reliable crop growth, and that weeds are particularly difficult and onerous in cassava-based systems because the crop is sown at wide spacings to accommodate the growth of this large shrubby plant, and because it is kept in the field longer than most food crops giving need to multiple weedings.

Also during the last two decades a wide variety of herbicides have been developed. Some of these are considered low risk to the environment, the food system and to applicators. There is a huge opportunity to identify which new herbicides can be safely harnessed to be appropriate for cassava-based systems in Africa. This project is a timely catalytic investment in applied research on weed management agronomy along with judicious use of safe herbicides for smallholder cassava production. The project is designed to have outputs that will be farmer-tested and ready for scaling-up through an investment project, also created as a project output, to help the Nigerian government to help cassava farmers (mostly women) in more than 20 states.

V. Sustainability and scalability

Equity, self-reliance, sustainability and scalability issues:
Cassava is unequivocally a major crop in terms of meeting food security needs in Africa, and especially in Nigeria, where about 4.5 million smallholder farmers struggle to produce cassava. Women and children are generally responsible for the difficult hand weeding of cassava. Weed control in cassava is particularly challenging, due to wide spacing between plants and the very long period of time the crop is in the field, allowing weeds to re-emerge after a dry season or a pest attack, such as a locust attack that decimates the leaf canopy, letting light penetrate to the weeds in the lower canopy. By addressing directly the weed control, as a point of emphasis in better agriculture practices, including other agronomics, the solution to better weed control will reduce the time spent by women and children (who should be in school) and enabling them to be more productive and happy.

In agriculture, and especially regarding cassava weeding, there are few, if any, domains where gender inequity is more pronounced. New innovations that reduce the drudgery and time-waste of weeding for
women and children, while increasing the productivity of cassava, are desperately needed. Fortunately, there is a resurgence of interest in applied agricultural research in Africa, and especially in Nigeria, including harnessing better agricultural practices in agronomy and weed management. This project, being focused on a huge opportunity where innovations can be relatively quickly identified, will take advantage of policy support from government and goodwill and interest of the private sector agro-industries to participate in future projects on good practices that enhance food security.

Assumptions and risks associated with sustainability and scale:
The risk that could undermine the major scaling and the impact of this pilot project is: that by the time this project is ready (2018) to help the Ministry of Agriculture formulate an investment project for country-wide extension, a new priority could shift the agenda of a new minister, who would not be eager to allocate both human and financial capital into a formulation exercise, or would not earmark this investment project as a priority for donor support. While the current Ministry has stated clear support and engagement, this could always change. To address this risk, which is unlikely due to cassava’s increasing relevance to food security in the face of climate change and urbanization, IITA and diverse development partners will keep current and future policy makers well aware of the project and its implications, especially through personal interactions at the highest levels, but also through effective communication tools, such as newsletters, a shared web site, blogs, etc. And, as the state and federal governments will be directly involved in major aspects of the project, from research to extension to regulatory support, and then in preparing for jointly implementing the formulation of an investment project, we feel the risk of the project’s being demoted, as a government priority, very unlikely.

Were cassava brown streak virus to move into Nigeria (currently in East and Southern Africa), devastating cassava productivity, less emphasis could be placed on the agronomy of weed management. This risk is real, but its potential losses are likely to be mitigated by IITA and the NRCRI multiplying and distributing BSV-resistant germplasm. The improved weed management agronomy could be coupled with distribution of new varieties.

Given the challenging business environment in Nigeria, many international companies in the agriculture sector are reluctant to operate in this country. To many, the idea of selling weed control products to low income farmers in Nigeria is unappealing, with problems more likely than profits. The companies may be hesitant, therefore, to bring their newest and best chemical products to Nigeria for testing under the proposed project. To address this challenge, the project will reach out to these companies, directly and through their trade association, to share information about this opportunity, the number of Nigerian cassava farmers, and the advantages of participation. During the formulation process, a close working relationship with CropLife International has developed, and a seasoned consultant of CropLife, who attended the Ibadan Convening, has proactively created awareness of the project concept with major relevant agro-chemical companies, many of which have indicated interest in the project and willingness to provide product for preliminary testing. It is probable that more than 40 new chemistries will be available for initial screening.

There is a risk that the availability of safe, new herbicides could be delayed or blocked by problems in Nigeria’s registration process for such products. We believe this risk to be small, because the agro-chemical companies participating in the February convening informed us that NAFDAC’s procedures promote safety while remaining reasonable. IITA and its partners have developed good working relationships with NAFDAC in recent years through cooperation on COMPRO and other projects. The Ministry of Agriculture strongly supports this project and will help strengthen the relationship with NAFDAC. The integrity of NAFDAC’s regulatory role and processes will be respected with full compliance.
Ultimately, the companies will be responsible for supplying the required information and securing registration for any products they choose to offer as options for Nigerian farmers.

There is a risk that the NRCRI will be unable to take over the management of the project in Year 4. This risk is very low, as the capacity building role for IITA to empower NRCRI will be prioritized as a major outcome of the project. During year 4, a careful, yet effective sharing of management processes is planned. IITA will backstop NRCRI as needed.

VI. Implementation, Intended Results and Results Management

A. Results framework

The Results framework for the project can be found in Appendix 5.

B. Project Plan

The project aims to develop new innovations in agronomy and herbicides to meet the needs of smallholder farmers. The summaries below describe the key activities that will be undertaken in each objective to achieve the project outputs.

Objective 1: Develop appropriate agronomic practices that increase cassava productivity, and reduce losses from weed competition and drudgery for women and children.

Context:
Very little agronomic research in the last 20 years has focused primarily on weed control in cassava and most innovations from research have been imposed rather than developed in a participatory manner. Further and probably more important is the fact that the entire set of popular and high yielding varieties has been changed over the same time, while soil fertility has been declining. Thus there is no basic information on the agronomic responses of today’s varieties under today’s soil and climate conditions. With the generally increased cropping intensity (frequency of land use for crops) it has to be assumed that the weed seed bank and the weed species composition have undergone changes that need consideration in future weed control efforts. Agronomic research in this objective will innovate and pull together best practices for cassava management, focusing on plant density, varietal canopy structure, intercropping fertilizer use and tillage, with a particular focus on measures suppressing weeds.

Approach and Methodology:
Good agronomic practices are an integral part of weed management. The approach considers the basic weed control regime of a total of four weedings, conducted at 4, 8, 12 and 24 weeks after planting where rainfall is monomodal and weeding at 4, 8, 12 weeks after planting in the first rainy season and 1 weeding after the on-set of the second rainy season where rainfall is bimodal. This weeding regime is currently the best option for producing high cassava root yields. However it is labour intensive as 4 weedings are required.

Density trials will be conducted in each of the three agroecological zones (see Figure 3.2). This experiment will evaluate the effect of variety (an erect non-branching versus a low and profusely branching type) and a range of planting densities from 10,000 to 25,000 plants per ha on weed growth. Figure 6.1 shows a split block arrangement for the factors to be tested with two cassava varieties both sole and intercropped, both with and without fertilizer application. The tillage regime is largely determined by the agroecological zone. The density trials will comprise the usual or most common tillage system in each agroecological zone (minimum tillage in DS, mounding in SGS and small mounds in FZ) plus one alternative
which will contrast in intensity to the current system. Fertilizer applications will cover the required nutrient amounts in a crop attaining at least twice the national average yield as well as mimic those of cassava farmers, where relevant, to ensure that results are applicable to farmers conditions. In year 2, the same experiment will be repeated to confirm or modify year 1 results.

Figure 6.1 Example of a complete replicate of a density trial, including all factors (Density [not shown as it is inside a single plot], variety, intercrop, fertilizer and tillage all at two levels. Note: this layout is not randomized – randomization will be done when implemented in the field.

In year two a second set of trials will be implemented, based on the year 1 results of the density trials. This second set of trials will address the potential to reduce weeding without herbicide use yet without compromising cassava yields. Based on the recommendation of four weedings the year 2 ‘weeding frequency trials’ will evaluate how many and which weedings can be skipped under optimized agronomic practices. The weeding frequency trials will use the best agronomic practice identified in the density trial in year 1, i.e. they will be conducted with one set of factor combinations within an agro-ecological zone. They require strict adherence to the time schedule thus will be researcher managed but will be conducted in farmers’ fields (off-station) to permit farmer participatory appraisal. Details of the structure of the weeding frequency trials are displayed in Figure 6.2. Plot size in these trials is proposed at 216m² (12 x 18 m) to allow the valid recording of the labour time required for each weeding. The IITA Agronomist and local partners will select farmers who usually weed cassava fields and allocate teams of two persons randomly to the plots. The local supervisor will observe that the weeding is conducted with sufficient care and effort, to obtain relevant labour time data. A farmer practice treatment in which the farmer can choose frequency and timing of weeding will be included to obtain information on the yield differences based purely on weeding regime (all other factors are constant). The weeding frequency trials will be conducted in both seasons over two years and be conducted as in the first season.
Figure 6.2 Example of a complete replicate of a weeding frequency trial, including the elimination (skip) of either none one or two weedicings and a farmer weeding practice. Note: this layout is not randomized – randomization will be done when implemented in the field. It is not mandatory to have all plots in the same farmer field, they can be spread over two to four farms.

In all trials, variables and parameters to be measured are listed in Table 6.1.
Table 6.1 Variables and parameters to be observed/determined in the agronomy section

**General - soil and environment**  
Rainfall, temperature, solar radiation (photosynthetically active), soil moisture in top soil (2 or 3 layers)  
Soil chemical and physical properties

**Weeds**  
Cropping history (Previous vegetation - fallow – crops)  
Weed density, biomass and partial species composition before crop establishment  
Weed density, biomass and partial species composition before every scheduled weeding  
Weed density, biomass and partial species composition at crop harvest  
Gender dis-aggregated labour time for weeding

**Cassava**  
Cassava growth parameters, such as plant height, number of shoots, level of branching, canopy cover at defined stages (1, 2, 3, 6, 9, 12 MAP) and at every scheduled weeding  
Cassava root yield and root yield distribution (by plant and root mass distribution)  
Root mass losses (root rot, undersized, deformed, lignified, damaged roots not useful)  
Cassava above ground yield separated by leaves and stems (planting material)  
Cassava nutrient uptake (assessment of competitive effects of weeds)

**Intercrops**  
Growth parameters such as height, canopy cover, duration  
Grain yield  
Stover yield and nutrient content (nutrient recycling / competitive effects of weeds)

Three main outcomes will be the results of the component 1 implementation.

| I. Best agronomic practices with maximum weed suppressive effect attain twice the current national average cassava yield |
| II. Cassava yields are maintained under reduced weeding when best agronomic practices are applied |
| III. Stakeholders adjust timing and frequency of weeding to reduce labour without yield losses. |

Output 1. An agronomic research team focusing on weed control in cassava-production systems is constituted with a shared vision on the scope of work and on responsibilities.

**Context:** Trials are to be planted in each of the three agroecological zones: the southwest (Ogun State), the southern portion of the central middle belt (Benue state), and the southeast (Abia state) of Nigeria.

**Output 1 Key Activities will include:**  
Prior to the onset of the first rainy season, national programs (e.g. NRCRI, FUNNAB & UAM) will attach one agronomist to the project to strengthen human resources to meet increased demands for applied agronomic research on weed control in cassava systems. A senior IITA agronomy scientist will back stop (20-25%) activities in Objective 1.

The agronomy team, including national partners, will during the first 2 months of the project develop the detailed protocols for a set of researcher-managed trials (off-station) to evaluate the impact of cassava
variety and plant population with or without intercrops with or without recommended fertilizer rates and common tillage practices on weed competitiveness. The agronomy team will conduct site selection (on and off-station in three agro-ecologies) to ensure the dominant and the problematic weeds are present in the trial area.

**Output 2. Training of national partners on statistical and technical aspects of the agronomy trials**

**Context:** Capacity building is a major component of the project and will be required to ensure the across the agro-ecological zones trial implementation is done correctly and timely. Modern agronomy approaches such as the density trial need to be communicated and their statistical and technical implications need to be understood by the conducting agronomists on–site.

**Output 2 Key Activities will include:**
The training will be held at IITA HQ Ibadan where similar trials are already established and where participants will be exposed to the new structures. The training will be a combination of class room activities to explain the theory but will largely be hands-on in the field exercises for the agronomists to obtain the skills required in establishing and conducting these trials.

**Output 3: Agronomic trials to optimize productivity, while minimizing weed stress, are conducted in three agro-ecologies.**

**Context:** The agronomy team will provide general guidance on the density trials. The trials will be conducted in year 1 and 2 and in each year in the first and second rainy season (southern Nigeria has a bi-modal rainfall distribution). In year 2, the results of the first set of density trials will be used to choose the best agronomic practice to be used in the weeding frequency trials and the complementary herbicide use trials). With the results of two seasons of density trials, the local partners, in collaboration with the IITA backstopping scientist (agronomist), and a gender expert (from IITA), will introduce the improved agronomic practices to selected farming communities, as demonstration trials in year 3 (part of Objective 3). These demonstration trials will primarily serve the purpose of generating farmer feedback on the technologies, through farmer participatory appraisals. The entire project team will review the results of farmers’ evaluations and identify ‘bottle necks’ and suitable ‘entry points’ for on-farm testing of best technology combinations.

**Output 3 Key Activities will include:**

A. The agronomist will do the regular monitoring of the trials, with responsibility for the timely collection of data, the timely application of fertilizer and weeding. In the course of each density trial the agronomist and partners will:
   - sample soil at trial sites and facilitate analysis at the IITA laboratory;
   - record germination and emergence rates of cassava and intercrops;
   - take at least 4 weed samples in areas of selected cassava plant densities;
   - determine weed species, numbers and biomass at each sampling;
   - conduct 4 full plot weedings; and record at each weeding the labour time by gender
   - record at each weeding the growth parameters of the cassava and the intercrops;
   - take the final harvest of the intercrops and the cassava;
   - analyze the data and report.

B. The agronomy team will repeat trials and use data in weeding frequency trials. Anticipated work includes:
   - In the first and second season of year 2, the density trial will be repeated to confirm first year results. The same set of data as in year one will be obtained.
Output 4: Weeding frequency trials to determine labour reduction options under optimal agronomic practices in three agro-ecologies.

Context: Labour reduction for weeding can only be attained if entire weedicings are skipped. Although there is a possibility that optimal agronomic practices will suppress weeds to an extent that a single weeding may require less time, the real benefit would come from a complete elimination of weeding requirements at any time of the weeding schedule. So far no weeding frequency trials have been conducted under optimal agronomic practices and there is no information which weeding could be skipped without negative effects on cassava yields. These trials will evaluate how many and which weedicings are no longer required when optimal agronomic practices are used. The agronomy team will provide general guidance on the weeding frequency trials.

Output 4 Key Activities will include:
A. The agronomist will do the regular monitoring of the trials, with responsibility for the timely collection of data, the timely weeding and application of fertilizer. In the course of each weeding frequency trial the agronomist and partners will:
   • sample soil at trial sites and facilitate analysis at the IITA laboratory;
   • record germination and emergence rates of cassava and intercrops (if used);
   • take weed samples in selected areas of plots before every scheduled weeding;
   • determine weed species, numbers and biomass at each sampling;
   • conduct the appropriate plot weedicings (depending on number of eliminated weedicings);
   • record at each weeding the labour time by gender
   • record at each weeding the growth parameters of the cassava and the intercrops;
   • take the final harvest of the intercrops and the cassava;
   • analyze the data and report.
B. The agronomy team will repeat trials in year 3 and use data in complementary herbicide use trials.

Anticipated work includes:
   • In the first and second season of year 3, the weeding frequency trial will be repeated to confirm year 2 results. The same set of data as in year 2 will be obtained.

Output 5: Improved mechanical weeding options

Cassava as a row crop offers the opportunity to use mechanical weeding implements in the early stages of crop growth. In Nigeria the currently recommended planting density is 10000 ha⁻¹ on a square pattern at 1 m x 1 m distance. After planting, the crop does not develop a large canopy for about 4 to 6 weeks, which gives weeds the opportunity to grow practically unimpeded. However, weed infestation during early stages has severe effects on yields and therefore the evaluation of mechanical weed control options should be considered. The project, therefore, will identify and test alternative hoe and rotary mechanical weedicers as well as motorized brush cutters (“weed wackers or weed eaters”), self propelled motorized weedicers (see example below) and tractor-drawn weeder-cultivators (two-wheel, Chinese-style tractors). The approach is to compare mechanical weed control options of different intensity (cost, labor and technical requirements). Within intensity levels improvements or modifications of the standard tools will be conducted to suit the requirements of the cassava crop, specifically to treat a maximum of the row space, to avoid penetration of tools to depths where tuberizing roots could be injured and to eliminate the widest possible range of weeds. The weeding efficacy of these implements will be tested using the following parameters: number of cassava plants damaged, time of operations, power requirements, weeding depth, and the cost of the implements. The trials will be conducted in parallel to the agronomic trials in the first and second year. Weed control options found suitable and capable to significantly reduce
labor and increase weed control, the best options could be integrated in the demonstration trial phase and later in the on-farm trials.

The options to be compared are:

- Hand hoes – usual short-handled, round blade African hoe versus long handled hoes with straight or slightly concave blades.
- Hand operated rotary tools – rotary hoes with narrow (few) blades to be pushed
- Powered weeding tools - Weed wacker versus rotary hoe on single axle tractor

Hand hoes

The currently used hand hoes all have short handles and round blades. The short handles require farmers to bend down to reach the soil and force them to remain in such bend position for rather long periods plus using their arms to do the actual hoeing. Although the control over the hoe is better due to the short handle the overall strain on the body is tremendous. Furthermore the round blades permit weeds with flexible or hard stems to bend away (either down or sideways) and escape being cut off. This causes the farmer to scrape below the soil surface thereby increasing the amount of force required to pull the hoe. As an alternative long handled hoes with straight or slightly concave blades should be tested to evaluate the time required, and the efficiency of the weeding. Straight or concave blades do not allow weeds to move sideways around the blade and thus will be more likely cut off in the first attempt. Furthermore, moving the blade in the soil is not necessary thus less energy would be required to operate.

Hand operated shearing or rotary tools

Rotary hoes were used for weed control in the past, although there is no experience with these tools in cassava. The rotary hoe works well on sandy (no clumps) soils by ripping weeds (specifically those with tender stems and poor rooting) out of the soil. These tools can be hand operated between cassava rows and in the interrow space (as they are not large). It is proposed to construct from standard rotary hoe parts a hand operated unit and test it against hand hoes.

Powered weeding tools

Weed wacker

The weed wacker operates with a horizontally rotating blade or strong nylon string fed from a role. The wacker cuts weeds at the soil surface, it is not suitable to penetrate the soil. At a cost of around 200-250$
per unit (price base USA) this machine is potentially affordable. The machine can as well be used to clear bush and grassland thus would have application beyond weeding. It is proposed to test the suitability of the weed wacker in cassava and to assess the technical requirements to safely operate it as well as the costs of operation.

Brush cutter/weed eater/weed wacker (more efficient than a cutlass or slasher)

Powered rotary hoes

Standard single axle power tillers are relatively expensive yet would have a wide range of applications, thus would probably be machines for situations where other operations are to be mechanized. Roto tillers are not suitable for weeding in cassava as the standard machines would work too deep and the depth is difficult to control. However with some modifications these machines could be equipped with lead wheels to control the depth and pull rotary hoes mounted to a tool bar.

5HP Row crop weeders designed by The Federal University of Technology-Akure-

**Output 5 Key Activities will include:**
Determine the time required to weed a certain area,
Assess the strain on the weeding person caused by different weeding methods,
Determine the regrowth of weeds after different mechanical weeding,
Determine the number of cassava plants damaged,
Determine input (fuel & parts) to conduct weeding,
Determine depth of soil penetration and tuberized root injury,
Assess the profitability of different mechanical weeding options (cost of implements versus labor savings)

**Objective 2: Identify effective and safe herbicides for weed control in cassava in Nigeria.**

**Context:** Experiments that will lead to the identification of effective and safe herbicides for weed control in cassava will be conducted in the three agro-ecological zones in Nigeria to help make weed control in cassava more efficient and effective. Any herbicide activities will be integrated with good agronomist practices i.e. integrated weed management that is effective and sustainable. This would lead directly into the experiments described in Objective 3

In the first quarter of year 1, a prioritized list of major weeds of cassava, in the target zones, will be produced and classified into major weed classes. International partners at Purdue University and CropLife International will contact major herbicide companies with potential products for weed control in sole and intercropped cassava. It is expected that a minimum of 40 herbicides will be received from herbicide companies for testing. Project scientists and representatives of herbicide companies will sensitize regulatory agencies in Nigeria on project objectives and activities through visits and joint meetings to facilitate importation of herbicides.

Prior to the onset of the first rainy season the project will hire a weed scientist (PI) to strengthen human resources to meet increased demands for applied research on weed control in cassava systems. The PI will group herbicides into modes of action or family and identify those that are effective on major weed classes found in the project sites. Safety issues will also be integrated into the selection process. This will help reduce the candidate number of herbicides for testing.

In the second quarter of year 1, preliminary screening of candidate herbicides under controlled conditions will be conducted by the herbicide screening team, to determine the best candidate herbicides for extensive testing in cassava cropping systems (sole cassava, companion crops and weeds). A more extensive testing of best candidate herbicides will be carried out in three benchmark zones by IITA in year 2 from where the best-bet candidates will be picked for the next level of testing in year 3.

**Herbicide-tolerant Cassava?**

*The Gates Foundation is currently considering support for research efforts by other institutions to use mutagenic tools to create new cassava cultivars that are herbicide-tolerant. Fields planted with such new cultivars could be sprayed with herbicides that kill the weeds but do no harm to the cassava, greatly facilitating weed control (similar to technologies that are used in maize, soybean, and cotton fields in the US). These research projects will aim to create cultivars resistant to glyphosate and ALS-inhibiting herbicides, a process that is likely to take several years. Our project will generate data on the weed-killing performance of these categories of herbicides to assist these companion research projects.*

Special consideration will be given to ALS-inhibiting candidate products, given the potential development of new, tolerant cultivars. Herbicides testing in year 3 will integrate best-bet agronomic practices developed in objective 1 in year 1 and 2. Those best candidate herbicides picked by national partners in year 3 will be used for on-farm testing in year 4 and 5.
Currently existing pre-emergence herbicides are always supplemented with post-emergence herbicides applied directly to the weed. The herbicide screening team will conduct another experiment, at the target zones, to determine timing of introduction of post-emergence herbicide application following the new pre-emergence herbicides, for acceptable weed control in sole and intercropped cassava, using a weed wiper and backpack sprayer.

In year 3, root and leaf quality of cassava treated with herbicides will be analyzed by the herbicide screening team. This will provide relevant data required by regulatory agencies for registration of herbicides in Nigeria.

Four main outcomes will be the results of the component’s implementation:

<table>
<thead>
<tr>
<th>I. Project stakeholders share a common vision of applicability of herbicides in cassava weed management.</th>
</tr>
</thead>
<tbody>
<tr>
<td>II. Partners from NRCRI, UAM and FUNAAB are enabled to carry out extensive testing.</td>
</tr>
<tr>
<td>III. Herbicide companies register identified herbicides with NAFDAC.</td>
</tr>
<tr>
<td>IV. Government of Nigeria adopts, as part of its national food security strategy, farmer-tested technologies on innovations in safe herbicide use, developed by the project, which are broadly adopted by farmers in all major agro-ecological zones.</td>
</tr>
</tbody>
</table>

**Outputs:** This project objective will be organized in 8 outputs:

**Output 1.** A prioritized list of major cassava weeds is produced in the first quarter of year 1 for use in site selection.

**Output 1 Key Activities will include:**

A. The herbicide screening team will carry out a *desk-and ground-truthing* assessment of major weeds of cassava and the magnitude of damage on cassava caused by these weeds in the target ecological zones. Published literature, dissertations and theses in universities, located in the target zones, will be consulted.

**Output 2.** Candidate herbicides with potential for weed control in cassava are compiled using due diligence, in the first quarter of year 1.

**Output 2 Key Activities will include:**

A. The herbicide team, in collaboration with international partners from Purdue University and CropLife International, will contact major herbicide companies for new herbicides, with potentials for weed management in sole and intercropped cassava, with strong consideration for herbicides that would be compatible with legumes in a cassava-legume intercrop. Safety concerns will also be factored into the selection process, as described in more detail under the management component.

**Output 3.** Regulatory agencies in Nigeria are sensitized on project objectives.

**Output 3 Key Activities will include:**

A. IITA and project representatives will visit key officers of the Nigerian Federal Ministry of Agriculture and Rural Development (FMARD), as well as regulatory agencies, the Standards Organization of Nigeria (SON) and National Agency for Food and Drug Administration and Control (NAFDAC), responsible for registration and quality standards for herbicides. A meeting of IITA key scientists and officials of FMARD, SON, NAFDAC and other agencies will be organized at IITA to discuss the objectives of the project and to facilitate importation of proposed herbicides into the country for testing.
Output 4. Preliminary screening of candidate herbicides implemented by IITA at selected project sites, to determine the best candidate herbicides for extensive testing in cassava cropping situations (sole cassava, companion crops and weeds) is carried out in year 1.

Output 4 Key Activities will include:

A. Based on output 1 and 2 (above), the herbicide screening team will select suitable sites at benchmark agro-ecological zones for preliminary screening of candidate herbicides at the onset of the rainy season.

B. The herbicide screening team will screen at least 40 candidate herbicides for weed control efficacy with cassava and companion crops (egusi melon, maize, soybean, and cowpea). The screening will be conducted separately for cassava and the companion crops. The herbicides for screening will be grouped into two categories: pre- and post-emergence herbicides. All herbicides treatments will be arranged in a randomized block design in 4 replicates. One existing pre- and post-emergence herbicides used by some farmers will be included as controls. Plot size will be 4m x 4m to accommodate 4 rows of each crop at standard populations. Pre-emergence herbicides will be applied on the soil surface, after the crops are planted, using a hand-held backpack sprayer. Post-emergence herbicides will be sprayed over recently emerged weeds, cassava and companion crops. Standard (recommended or label) rates of each herbicide will be used. Crop safety and weed control will be evaluated, visually, every two weeks for 16 weeks after treatment, using a rating scale of 0-10, where 0 represents no weed control or no crop injury, and 10 represents complete weed control or complete crop kill. Uncontrolled major weeds will be identified and counted, and other weeds will be lumped together to provide information on weed density. Crop vigor will be measured on a scale of 1-5, with 1 representing stunted plants and 5 very vigorous plants. Acceptable weed control will be measured as better than 80%.

Output 5. Extensive testing of best candidate herbicides in cassava cropping situations at the three agro-ecological zones is carried out in year 2.

Output 5 Key Activities will include:

A. National partners from NRCRI, UAM and FUNAAB will visit IITA, Ibadan, to review protocol for testing candidate herbicides.

B. Based on output 1, above, the herbicide screening team will select suitable sites in the various benchmark agro-ecological zones for extensive testing of best candidate herbicides from the preliminary screening.

C. The IITA weed management team, in collaboration with the national partners, will evaluate at least eight best bet herbicides, from the preliminary screening in sole and intercropped cassava in the three agro-ecological zones. This evaluation will include at least 4 pre- and 4 post-emergence herbicides from the preliminary screening. A pre- (Primextra Gold™) and post-emergence (glyphosate), registered in Nigeria and currently used by farmers, a weedy and manually kept weed free plots will be included in the evaluation as controls. Because of the atrazine component, Primextra Gold™ will not be included as control in the intercrop involving legumes, while glyphosate will not be evaluated where egusi melon is used. Because of the existing knowledge that pre-emergence herbicides do not give long season control, post-emergence herbicides will be used as supplementary herbicides to the pre-emergence, applied by a weed wiper and backpack sprayer. Evaluation trials will be designed differently for sole cassava and for cassava intercropped with other crops. The cassava intercrop system will be dependent on agro-ecological zone (Table 6.2). The evaluation will be designed as a split plot trial in a randomized complete block design,
replicated four times. The main factor will consist of five different pre-emergence herbicides [four herbicides from the preliminary screening, plus Primextra Gold™ as control]. The sub factor will consist of different rates [normal rate (N), 0.5N and 1.5N] of four post-emergence herbicides [two non-systemic contact (PsC1 & PsC2) and 2 systemic (PsS1 (glyphosate) & PsS2) (Figure 6.3)]. Different rates of the pre-emergence herbicides, without post-emergence herbicides, will be included in the evaluation as a check. Plot size will be 5m x 6m to accommodate four rows of each crop at standard populations. Pre-emergence herbicides will be applied on the soil surface after the crops are planted, using a hand-held backpack sprayer. Post-emergence herbicides will be applied as directed spray using a shield or weed shield. The crops are plowed the crops are planted and 5 very vigorous weeds will be killed with glyphosate. An assessment of the initial weed density and biomass of experimental plots will be carried out before the trial. Crop safety and weed control will be evaluated, visually, every two weeks for 16 weeks after treatment, using a rating scale of 0-10, where 0 represent no weed control or no crop injury and 10 represents complete weed control or complete crop kill. Uncontrolled weeds will be identified and counted to provide information on weed density. Crop vigor will be measured on a scale of 1-5, with 1 representing stunted plants and 5 very vigorous plants. Acceptable weed control will be measured as better than 80%. Companion crops to cassava will be harvested at physiological maturity. Cassava roots will be harvested after 12 months. At cassava harvest, weed density and biomass of the experimental plots will be assessed.

Table 6.2. Cassava intercrop system

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cassava/maize</td>
<td>Cassava/maize</td>
<td>Cassava/maize</td>
</tr>
<tr>
<td>2</td>
<td>Cassava/egusi melon</td>
<td>Cassava/egusi melon</td>
<td>Cassava/egusi melon</td>
</tr>
<tr>
<td>3</td>
<td>Cassava/soybean</td>
<td></td>
<td>Cassava/soybean</td>
</tr>
</tbody>
</table>

Figure 6.3. Field plan for evaluation of 8 best bet herbicides. H1-H5= Pre-emergence 1 to 5; Ps=Post-emergence; PsC = Non selective contact herbicides; PsS=Non selective systemic herbicides.
D. The herbicide screening team will determine time of introduction of post-emergence herbicide, after pre-emergence herbicide application, for acceptable weed control in sole and intercropped cassava, using a weed wiper and backpack sprayer. The experiment will be conducted separately for sole and intercropped cassava in two blocks: (i) post emergence herbicide applied with a weed wiper, (ii) post emergence herbicide applied with a backpack sprayer. Each block will consist of two factors: (i) pre-emergence herbicides and (ii) post emergence herbicides applied at different time periods. The first factor will consist of four different types of pre-emergence herbicides, while the second factor will consist of nine levels of post emergence herbicides sprayed at 8, 12, 24; 12, 24 and at 24 weeks after application of pre-emergence herbicides (Figure 6.4). A non-weeded and manually weeded plot will be included as controls. Plot size will be 5m x 10m, to accommodate four rows of each crop at standard populations. Each experiment will be replicated four times. Pre-emergence herbicides will be applied on the soil surface, after the crops are planted, using a hand-held backpack sprayer. Post-emergence herbicides will be applied as directed spray using a shield at 8, 12, 24; 12, 24 and at 24 weeks after planting. Weed data, crop safety and yield will be collected for sole cassava and intercropped cassava.

Output 6. One or more ALS-targeted herbicides that can be used post-emergence in cassava-production systems to control all major weeds, regardless of cassava’s current sensitivity to the herbicide(s) is identified.
Output 6 Key Activities will include:
A. New ALS herbicides will not only be screened for cassava tolerance, they will also be screened by the herbicide team in ‘weed hotspots’ on experiment stations to determine their effectivity to kill the ten weeds most difficult to control.
B. Herbicides that control all the difficult weeds, but also damage cassava, will be provided as candidates for herbicide tolerant cassava.

Output 7. Quality analysis of cassava roots and leaves treated with herbicides is carried out by IITA in year 3.

Output 7 Key Activities will include:
A. The herbicide screening team will collect cassava roots and leaves treated with herbicides for quality analysis in an accredited laboratory.

Output 8. Relevant research data on herbicide efficacy of tested herbicides is provided to Nigerian Regulatory Agencies, to facilitate herbicide registration.

Output 8 Key Activities will include:
A. IITA scientists will prepare documentation on the efficacy of each tested herbicides.
B. IITA and project representatives will organize meetings of key officers of regulatory agencies, CropLife Nigeria, and NRCRI, UAM and FUNAAB to sensitize them on the research results.
C. While the project will share its findings with all concerned parties, the responsibility for securing registrations and paying for this will remain with the companies, and decisions on registration will remain the responsiblity of the sovereign regulatory authoritiy: NAFDAC.

A table summarising field trials and training opportunities can be found in Annex Objective 2.

**Objective 3. Evaluate new integrated approaches combining best agronomic measures with best-suited herbicides to maximize weed control in cassava systems.**

**Context:** Integration of herbicides with improved agronomic practices will start in year 3. The agronomy and herbicide screening team will conduct trials in all three agro-ecological zones to test newly identified pre- & post-emergence herbicides at recommended rates in combination with best best agronomic practices (recommended from Objective 1). The control will be farmer agronomic and weed management practices.

Two trials will be conducted. The first trial will test the weed control efficacy of pre-emergence herbicides [proposed are the 3 best from the screening trials] integrated with best tillage, variety, plant population and fertilizer regimes [improved agronomic practices] (Figure 6.5). The second trial will test the weed control efficacy of a pre-emergence herbicide supplemented with post-emergence herbicide (proposed are the 2 best from the screening trials) integrated with improved agronomic practices by skipping the second, the third and the fourth manual weeding (Figure 6.6). In both trials weedy and hand weeded plots at 4, 8 & 12 weeks after planting will be used as controls.

In all the integrated weed management [agronomic + herbicide] trials the integrated weed management team will:
- sample the soil at the trials sites and facilitate analysis (chemical and physical properties) at the IITA laboratory,
- record germination and emergence rates of cassava and intercrops.
- determine weed numbers/biomass before herbicide application/each weeding.
• conduct full plot weeding at specified dates
• record labour required to weed each plot
• record at each weeding the growth parameters of the cassava and the intercrops
• take the final harvest of the intercrops and the cassava

Measurements on companion crops will include visual photo-toxicity, plant height, days to flowering and to maturity, and crop yields.

One major outcome will be the result of the component 3 implementation.

### I. Best integrated cassava weed management technologies are available and used by stakeholders.

**Outputs:** This project objective will be organized in 2 outputs:

1. Newly identified pre-emergence herbicides integrated with improved agronomic practices are tested for weed control efficacy and optimum yield (cassava and companion crops) in year three.
2. Newly identified pre-emergence herbicide supplemented with post-emergence herbicide and integrated with improved agronomic practices is tested for weed control efficacy and optimum crop yield (cassava and companion crop yields) in years 3-5.

**Output 1. Newly identified pre-emergence herbicides integrated with improved agronomic practices are tested for weed control efficacy and optimum crop yield (cassava and companion crop yields) in year three.**

**Output 1 Key Activities will include:**

A. The integrated cassava weed management team will conduct trials in all three agro-ecological zones to test newly identified pre-emergence herbicides at recommended rates in combination with best tillage, variety, plant population and fertilizer regimes in a split plot arrangement. Weedy and hand weeded controls will be used as control (Figure 6.5).

**Output 2. Newly identified pre-emergence herbicides combined with post-emergence herbicides and integrated with improved agronomic practices are tested for weed control efficacy (including labour) in year 3-5.**

**Output 2 Key Activities will include:**

A. The integrated cassava weed management team will conduct trials in all agro-ecological zones to test the weed control efficacy of single application of pre-emergence herbicide supplemented with post-emergence herbicide under improved agronomic practices. Newly identified pre-and post-emergence herbicides at recommended rates will be used in combination with best tillage, variety, plant population and fertilizer regimes in a split plot arrangement. Appropriate timing of application of post emergence herbicides identified in the extensive herbicide testing will be used. Weedy and hand weeded controls will be used as control (Figure 6.6).
Figure 6.5. Experimental plan for testing pre-emergence herbicides integrated with best tillage, variety, plant population and fertilizer regimes in sole and intercropped cassava.

Figure 6.6. Experimental plan for testing pre- and post-emergence herbicides integrated with best tillage, variety, plant population and fertilizer regimes in sole and intercropped cassava.
Objective 4. 4.1 Involve farmers and other stakeholders in the research to develop improved weed management practices in cassava and 4.2 Empower extension services, primarily the ADPs but also NGOs, agro-dealers, and spray service providers, to provide farmers with the knowledge they need to improve weed management practices.

Approach: An extension and communication program will be developed for outreach to approximately 125,000 farmers (women and men) in 11 local governments in Nigeria on a pilot basis. Beyond local implementation this component seeks to partner with ADPs (state-based governmental extension services) in the research process with the aim of increasing the probability for rapid scaling up and replication of the extension program in new zones of the three states and on a national level. Possibilities of including innovative communication approaches (e.g. development of knowledge sharing models via the Cassava Innovation Platform, mobile phone based text message exchange with farmers) and new interactive methodologies will be explored in close collaboration with the project partners.

The Extension Team (made up of the Communication Officer, IITA scientists, focal points in the three partner organizations, ADPs, and locally identified extension services) will prepare the extension activities during year 3 with a series of qualitative studies on knowledge, attitudes and practices (KAP) and Training of Trainers (ToT) to be ready for implementation once the off-station and on-farm trials are in full swing in years 4-5.

Partnership with governmental (ADPs) and private extension actors, including weed control business groups (WCBG) and other spray-service providers, will be developed for successful project implementation, along with technology transfer to farmers and women’s associations. Particular emphasis is given to the development of messages dealing safety in the use of herbicides via ToT, farmer field days, and WCBGs.

The project will not distribute or market any specific herbicide product; instead, it will share the findings of its research and facilitate farmers’ access to information on various integrated weed management options. Farmers will choose those that best meet their individual family’s needs.

Other extension and communication materials needed will be produced in a limited quantity only, allowing the creation of a successful extension tool box which can be distributed in large scale through the commitment of governmental services and other interested partners in another phase of this project.

Component 4 will have four main extension and communication outcomes.

| I. Farmers (women and men) and other stakeholders are involved in the research program. |
| II. State-based extension services (ADPs) and locally identified partners for extension provide farmers with the knowledge they need to improve weed management. |
| III. Farmers (women and men) and other stakeholders understand the research findings. |
| IV. The Nigerian government develops plans to expand the extension effort. |

Outcome I. Farmers (women and men) are involved in the research program.

Output 1: 150 on-farm field demonstrations and farmer field days are organized in the three project areas.

(A) To organize farm demonstrations and farmer field days during years 3-5 for farmers (women and men) and extension workers
On-farm demonstrations of the project research findings, with various cassava cropping systems for farm-level adoption, will be carried out from year 3 onwards in the three agro-ecological zones. There will be a total of 150 village- and farming community-level demonstrations for women and men, local extension agents from three ADPs, weed control groups, and other spray service providers. Other participants include the public sector, private commercial sector, CBOs/ FBOs, farmers and women’s groups and existing Farmer Field Schools. Specific events will be scheduled for the visit of state-based extension services (ADP) in year 4.

The on-farm demonstrations include the best herbicide use practices from mixing to application. Safety and avoidance of contamination with the proper protective clothing will be demonstrated through the use of blue dye to track contamination among spray applicators, along with spray equipment care and maintenance that will enhance safe application. Mid-season evaluation and field days will be conducted to evaluate on-farm testing of various weed control technologies. End-season field days are organized to demonstrate increased yield and showcase the best weed management techniques.

The project aims to reach through social mobilisation 80 farmers per field demonstration or 10% of all farmers involved, who would then have the capacity to inform two to three other farmers, so 25% of all farmers involved can be reached via on-farm demonstrations.

On-farm demonstrations will be carried out as follows:

<table>
<thead>
<tr>
<th>Zone</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>1600</td>
<td>1600</td>
<td>1600</td>
</tr>
<tr>
<td></td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
</tr>
</tbody>
</table>

The on-farm demonstrations will be organized by the implementing partners in the three areas in close collaboration with the IITA communication officer, ADPs, and other local extension workers. Radio announcements will be produced to support the social mobilization activities.

**Output 2: An educational on-farm trial video documentation on integrated weed management is completed and ready for distribution in year 4**

A. To produce an educational on-farm trial video documentation in three languages by the end of year 3;

B. To elaborate a plan for best dissemination of the video in 2016;

C. To edit short clips for web upload in the beginning of year 4.

One of the most convincing ways of delivering information on how to reach increased yield in cassava fields is by letting the farmers see good examples. The on-farm trials will therefore be documented on video for educational purposes and could be disseminated via different channels, such as community video clubs, extension services (tablets), and community screenings during farmer field days. Assuming the rapidly changing media use in rural Africa will continue, further dissemination methods of audiovisual products will be evaluated in consultation with AGRA, and the Foundation, and are part of other phases of
potential scaling-up extension projects. The video documentation will be edited in short clips in English and uploaded on the project’s web portal.

The IITA Communication Office will produce the video documentation in three languages in close collaboration with the implementing partners. Depending on the audiovisual capacities of the Universities, the IITA communication office will produce the video directly or support the partners in documenting the field research themselves.

<table>
<thead>
<tr>
<th></th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video production</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Web uploads</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Farmers’ field day dissemination</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Scaled-up dissemination</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Outcome II. State-based extension services (ADPs⁵), Weed Control Business Groups, and other locally identified extension services provide farmers with the knowledge they need to improve weed management (see Figure 6.7).

Output 1: Extension capacities and training needs assessments are analyzed.

A. To convene an initial meeting with the three ADPs

The Communication officer and the Project Coordinator will visit the three state-based ADP offices in the three target areas in the beginning of year 2 and analyze options for cooperation.

B. To analyze extension capacities and training needs assessments of the three state-based ADP programs.

---

⁵ Extension services in Nigeria: Administrative Structures

Village/Field/Site Level: Extension Agents (EA), other extension service providers, and farmers groups interact at field level to exchange and experience information and get farmers’ needs.

Block/Local Government Level: Local/Site Management Committee chaired by Chairman of Local government where project is located. Other members include ward councilors from participating local; government area (LGA), site field managers, specialists, extension staff.

Zonal Level: The Zonal Manager is responsible for program implementation. He/she should facilitate zonal level interactions among stakeholders in the zone for effective extension delivery.

State Level: The Agricultural Development Project Executive Committee (ADPEC) constitutes the steering committee at the state level. The chairman is the Governor or the State Commissioner for Agriculture. Other members are Commissioners for relevant ministries to Agriculture and Finance, Directors of RBDA and Research Institutes covering the state; PCU/NFRA (NFRA (National Food Reserve Agency) Provides policy support and guidance on implementation.

Regional Level Coordination (Geopolitical): The Regional Offices of PCU/NFRA coordinates activities of states in their zones. This level has been weak over the years and needs to be strengthened.

National Coordination: PCU/NFRA has responsibility to coordinate, supervise, and implement activities in collaboration with state technical management committees and ADPEC. The facilitation of coordination of efforts of stakeholders also falls on the agency.
The Communication Officer, in close collaboration with the three focal points in the partner organisations, will conduct an institutional assessment to generate a better understanding on the extension capacities and training needs of the ADPs. Particular attention is given to training needs in ensuring the availability of the capacities below:

(i) Farmer-driven and friendly extension; (ii) The use of appropriate extension approach and methodologies; (iii) Decentralization of the extension system and activities; (iv) Extension support to all categories of farmers and women; (v) Efficient and effective extension service delivery system; (vi) Adequate training of extension personnel; and (vii) Sustained funding of agricultural extension delivery.

**Output 2: Three tripartite Memoranda of Understanding between the three state-based ADPs, partner organizations, and IITA are signed.**

A. To negotiate and conclude roles and responsibilities in the extension activities for the cassava weed management project.

B. To sign three MoUs with state-based ADPs and partner organizations.

On the basis of the institutional analysis, three MoUs are signed involving the implementing partners, the ADPs, and IITA. Within the MoU, roles and responsibilities are clarified to ensure that all capacities are met for implementing the training of farmers in cassava weed management. IITA will, in close collaboration with the implementing partners, coordinate the ToT, while the implementing partners will have a monitoring role on the actual farmer’s training of the ADPs. The MoUs will as well include clauses for the replication of successful extension activities in other local governments in the three target states.

**Output 3: One curriculum, for Training of Trainers for ADP extension workers is developed.**

A. To hire a training consultant and a gender specialist for the implementation of the ToT.

B. To develop a curriculum for the successful implementation of the ToT for ADPs.

The curriculum for the ToT of governmental extension workers is developed by a team, consisting of the Communication Officer and the training consultant. Together, the team will analyze the data from the focus group discussions (FGD) and identify constraints/issues and opportunities/options to include in the curriculum. The ToT curricula for the integrated weeds management will include aspects of land preparation, soil health, nursery management, herbicide safety, including disposal of containers, equipment calibration, mixing of chemicals, agronomic aspects on cassava crop growth and value chains, nutrient management, weed identification, aspects of non-formal education, gender, computer skills, and report writing. Each training unit will take 4-6 hours, so the ToT can be delivered during 10 consecutive days. It is preferable to split up the ToT in two sections of five days. This would allow the training participants to share their experience in training delivery to farmers during a second training. The curriculum will be designed in English and in a way that it can be replicated easily in other state-based ADPs.

**Output 4: 100 trainers and 3000 training participant guides are available in year 3.**

A. The training consultant will develop, in close collaboration with the focal points from the partner organisations, the PI, extension agents from the ADPs and other resource scientists, a trainers’ guide in English (100 copies) and a training participant guide in three languages for 3000 participants (1000 copies each).
Output 5: A 5-day ToT course for ADP extension agents is successfully implemented by year 3.

A. To conduct a five-day ToT for extension agents in three ADP from block and zonal levels of extension services (11 men and 11 women from block level and 6 zonal managers and 3 partner organization focal points) in IITA.

By April 2016, one five-day training for 28 extension agents from the three target areas is implemented and facilitated by the training expert in close consultation with IITA resource people with specialized background. The training in IITA will allow visits to field trials.

Output 6: Implementation of a first training schedule for approximately 1300 farmers (50% women) is implemented by the ADPs and monitored by the partner organizations in the beginning of year 4.

A. The extension agents of the local governments will identify training participants at the village level via farmers’ and women’s associations and other potential extension partners and conduct a series of two 3-day training sessions (one before the season, and one mid-season) for an average of 30 participants per session in year 4. The training will be field based and will reach a total of 1300 farmers.

Output 7: Three supplementary 5-day ToT field refresher training course for ADP extension agents, lead farmers, NGOs, and other locally identified extension workers is successfully implemented for 66 participants in year 4 in the respective zones.

A. The communication officer and the three focal points of the implementing partners will conduct three 5-day training courses for three ADPs, involving 22 extension managers from the zonal level ADPs at the zonal level (11 men and 11 women) including two resource persons concerned (one agronomist, one herbicide specialist) in three of the 11 target zones in the three focal states.

B. The refresher course is designed for the field and is open as well to a limited number (not more than 15 supplementary participants per training unit) of lead farmers, other extension workers (locally identified men and women, NGOs), and accompanied by the project PI. This refresher course will take place in the beginning of the season.

Output 8: Based on the expanded ToT in year 5, 2700 more farmers (50% women) receive training on weed management in the 11 local government areas of the project implementation zone.

A. The 22 extension agents from three ADPs will each train another 60 farmers in two 3-day training sessions in the field during year 5, while other 45 ToT participants are expected to each include 30 more farmers in training activities during the cassava season in year 5 in one-day training sessions.

B. The training sessions will be monitored by the ADPs and by the focal points of implementing partners.
Output 9: 11 Weed Control Business Groups (women and men) are functional to work as extension partners for 30,000 farmers in the 11 district zones of the on-farm trials by year 4.

In 2010, IITA facilitated training of commercial weed control business groups (WCBG) that could assist farmers with cost-effective weed control practices. Major input dealers provided agro-chemicals to these WCBG at subsidized prices, and loans from financial institutions were facilitated. These market linkages led to the creation of new jobs for 216 farmers and to the establishment of 22 village shops in the participating communities. Various chemical companies have established close contacts with the WCBG farmers and deliver their inputs on time. The cost of the inputs has also become competitive and farmers now have the liberty to choose between different herbicides.

A. Based on existing spray service providers (men) and new spray services (women), 11 new WCBG groups (women and men) will be identified and strengthened in the 11 zones concerned by year 3.

B. The ToT curriculum will be adapted to a version “business light” tailored for a 3-days training course, combining gender issues, business, and safety training for herbicide use suitable for the training of IITA-facilitated spray services, the “weed control business groups”.

C. An in-depth guide for WCBG on gender, business development, and weed management, including herbicide use, is developed in year 4.

D. The WCBG will be trained by the 22 agents of the three ADPs in the 11 zones with an average of 25-28 trainees.

E. The project management will facilitate the provision of 10-liter herbicide containers for easy use by women.

F. The trained WCBG will reach out to an average of 50 farmers per season in year 4/5, bringing the number of trained farmers up to 30,000, see Figure 6.8.
Outcome III. Farmers (women and men) and other stakeholders understand the research findings.

Output 1: Preliminary set-ups for effective extension and communication material development and dissemination are completed by the end of year 2.

A. Mid-way through year 1, IITA will hire a Communication Officer with significant experience in extension and training approaches. For gender mainstreaming reasons within the project management team, a woman’s candidature will be given preference.

B. Also, mid-way through year 1, a part-time social media expert will be recruited for maintaining the project’s online presentation.

C. By the end of the year, a part-time professional photographer is hired as a consultant.

D. In the beginning of year 2, three communication focal points are identified in the partner organizations to ensure smooth collaboration and exchange of research and extension approaches and results.

E. The Communication Officer will diagnose the institutional communication capacities of existing extension partners and assess communication mechanisms and channels.

F. Regular meetings, twice a year, will be conducted in the different locations of IITA and partner organizations.

Output 2: A community assessment and 22 focus group discussions are conducted in 11 local governments (1 for women and 1 for men) by year 2.

A. In year 2, the Communication Officer will implement via a consulting firm a situation analysis and communication needs assessment in each of the 11 local governments, using qualitative methods (FGDs) to better understand the level of knowledge, attitudes, and practices (KAP) of farmers. 22 FGDs are conducted with a total of 180 participants (women and men disaggregated) to generate work indicators on what the gaps in information, attitudes, and improved practices of cassava weed management are and to be able to develop appropriate materials to answer these communication needs.

B. During the implementation of the KAP study, a community assessment is conducted to identify existing extension partners at the community level.

C. The results of the KAP study and community assessment will be shared among partners and key shareholders in a report and power point presentations. They will also be uploaded on the website.
Output 3: Research findings are translated in content and language and packaged in different formats ready for dissemination to farmers and different stakeholders and uploaded on the web by year 3.

A. The Communication Officer will generate content on research interventions, best practices and lessons learned with IITA scientists and partner institutions via regular updates and reporting mechanisms on research findings (reporting frequency to be defined).

B. The Communication Team will convert these research findings into user-adapted formats, taking into consideration the languages needed and the reading capabilities of different target groups.

C. The Social Media expert will upload all content on the website and create online dialogue via appropriate online discussion groups (LinkedIn, Twitter, Facebook).

Output 4: Effective print materials are produced (photo guide, pocket guide, posters) and distributed to farmers and other stakeholders via on-farm demonstrations and training.

A. The Communication Team will design the necessary print materials for audiences, such as a photo guide on advantages of improved weed management techniques for farmers based on the research findings, posters on safety issues (use of protective gear) for agro-dealers selling herbicides, and a photographic pocket guide on do’s and don’ts in using herbicides for farmers (25,000 copies in each language).

B. Before final production the materials will be tested with the target groups with at least 4 FGDs in each of the three focus states (total of 12 FGDs).

C. The materials will be put in an extension tool kit (CD), which can be replicated in other languages for scaling up at the national level.

Output 5: The benefits of improved weed technologies are elaborated and produced via a series of 3 radio spots (increased yield, reduced labor, improved health).

A. Based on the finding in the KAP study, three sensitization radio spots will be produced for household heads in the target areas. Farmers make crop production management decisions based on issues such as yield and market potential, and often omit crop protection as a consideration. Agronomic practices are largely dictated by labor and economic realities at the time. Some of these decisions may affect the type of integrated cassava weed management options. The radio spots will elaborate on the three main benefits linked to improved weed management: increased yield, reduced labor, and improved health. The spots are translated in the three local languages and can be broadcasted via radio stations in the three target zones during the project’s extension phase.

B. Before final production the radio spot will be tested with the target groups with at least 4 FGDs in each of the three focus states (total of 12 FGDs).

C. A broadcasting and media plan is developed by 2016 as an integral part of the extension tool box.

D. An impact evaluation of extension activities is carried out in the three states in year 5.

Total number of farmers to be reached is described in table 6.3.

<table>
<thead>
<tr>
<th>Direct Extension Materials</th>
<th>Farmers field days</th>
<th>ToT with ADP agents</th>
<th>Weed Control Groups</th>
<th>Total farmers informed</th>
</tr>
</thead>
<tbody>
<tr>
<td>55,000</td>
<td>30,000</td>
<td>10,000</td>
<td>30,000</td>
<td>Approx. 125,000</td>
</tr>
</tbody>
</table>
Outcome IV. The Nigerian government has developed plans to expand the extension effort.

Output 1: Quarterly newsletters are uploaded on the website (from last quarter of year 1 onwards) and disseminated to governmental services, partners, potential donors, and media release services, providing summaries on the research process for non-scientists.

A. The Communication Officer, in collaboration with the three focal points, will generate research content via regular project reports, convert the content to a language for non-scientists, and adapt the format for press release services.
B. The photographer will collect people-centered photo materials which will be stored in an online database and used for the newsletters.
C. The Communication Officer will identify a release service for targeting the best stakeholders in Nigeria.
D. The Communication Officer will send out the newsletters and press releases on a quarterly basis via e-mail groups and release services and print them in limited quantity (100 each).

Output 3: The state-of-the-art extension toolbox and communication kit is distributed in face-to-face meetings to governmental extension service, potential donors, and the herbicide companies for further dissemination.

A. The Project Coordinator, in close collaboration with the DDG (Partnerships and Capacity Development), will develop a strategy for scaling up of extension activities in supplementary zones in the three states and on a national level.
B. Based on the strategy personal visits to governmental services, herbicide companies and potential donors are undertaken to promote scaling-up of extension.
C. During face-to-face meeting the project toolbox and communication kit is discussed for further use in extension activities.

IITA will be linking up governmental extension services with potential donors for programme replication (see component 5).

Objective 5: Ensure project impact through good governance and effective management strategies for result handover to national partners

Context, Approach, Methodology: In order to be successful and achieve impact, strategies will be put in place ensuring that the project activities and lessons learned live beyond the project timeframe. These
strategies are crosscutting the four technical components through provision of diverse management services, such as: setting up of internal procedures for proper resource use, such as HR, financial and procurement management as well as monitoring and evaluation of project activities. The strategies involve as well capacity building efforts, training of NRCRI staff on project management, so that NRCRI can take over the management of this project. IITA will continue to be fully involved as a major implementing partner. In addition, this component will manage the Steering Committee and its two sub-committees. It will provide the formal interface between the project and national Institutions, and with international stakeholders, such as the BMGF, CropLife and its affiliates, national agro-input dealers, FAO, IFAD, WHO, WB, etc. The component will also take leadership role in developing communication tools to minimize possible misunderstanding regarding judicious use of safe herbicides and other policy-level communications for the project’s web-portal and other local and international media. Lastly, the component will take the leadership in creating a shared vision, a plan of action, and functioning partnership (government, donors, facilitators (e.g. FAO) that culminates in the formulation of a follow-up investment project. This investment project will enable the Government of Nigeria to scale-up innovations from the “pilot project,” across 20 or more states, where cassava is a central food security crop. The project will also investigate possibilities of collecting all data in a single database to be made publicly available. During the first three years of the project, IITA will manage the overall coordination. The project office will be in Ibadan, at IITA HQ. IITA will utilize its agricultural scientific expertise to provide overall technical direction. It will lead the development and dissemination of new and emerging technologies and capacity building for Nigerian agricultural research organizations. IITA will also oversee all administrative functions for the project during the first three years, including grants and subcontracts management, personnel administration, financial reporting, and ensuring an open channel of communication with the donor. In year 4, project management will migrate to the NCRCI, facilitating sustainability of the project outcomes, through local ownership of project outputs.

Human resources for the project will be a combination of IITA staff, national institutions staff, hired project staff, and consultants. Potential managerial and technical backstopping include: IITA DDG for Partnerships and Capacity Building, IITA’s Director for Plant Health, NRCRI’s Representative and Scientist, agroecological zonal scientists working on the project, IITA’s Cassava Team Leader, IITA’s Root Crops Agronomist, IITA’s Head of Communication, and the IITA Principal Investigator.

A Principal Investigator (PI) (Dr Friday Ekeleme) will be responsible for day to day management of the project. The PI will be supervised by a Project Coordinator (PC) (Dr Alfred Dixon) during the first three years and 3 months. From year three and 3 months through the end of year 5 of the project NRCRI will be the lead institute and the PI will report to the designated Project Coordinator, now in NRCRI, thus ensuring continuity.

The Project Coordinator will be responsible for overall project management and leadership. He will oversee relationships with subgrantees, monitor progress to ensure goals are met on time and within budget, ensure compliance and maintain effective coordination with donor and Nigerian stakeholders.

The project will have a Steering Committee (SC), which will consist of representatives from IITA, BMGF, CropLife, FAO, producer associations, farmer organisations, the Nigerian Federal Government, NAFDAC, one representative from the three state ADPs in which the work is carried out, and one representative

---

6 Though this project has a medium-term life of five years, it can only develop the technical content and pilot test the adoption in benchmark zones in three states, representing major agro-ecologies. Scaling to 20 plus states in this project in Nigeria will be up to the Government of Nigeria at a later stage. It is also considered a pilot (proof of concept), as a model for replication in other countries.
each from the three Federal Universities pf Agriculture (UAM, MOUA, FUNAAB). The SC will guide the implementation and management of the project.

The SC will constitute two sub-committees: one on herbicides (3 to 5 experts) and one on safe usage. The herbicide sub-committee could have the remit of developing the framework for identification and selection of candidate chemistries for testing, and engaging with companies to solicit candidate herbicides and the necessary background information on their safe use. This sub-committee could establish and apply selection criteria, including: effectivity, safety and pricing implications, and will decide which candidates will go forward into further testing beyond the IITA Ibadan test site for initial appraisal. The second sub-committee (2-4 people) will develop the framework for safe use of herbicides using FAO guidelines.

Each Objective will be led by a Team, with technical representatives from IITA and AEZ partner organisations. Applying a team approach will build the technical capacity of the partner organization in design and management of activities.

A schematization of the project structure is presented in Figure 6.9.

*Figure 6.9. Schematization of project structure.* The Steering committee will have an advisory role. Overall responsibility for implementation of the project will be with the Project Coordinator. Each objective will be led by a team of scientists (from IITA and partner organisations).

The IITA HQ team in Nigeria will ensure all contract deliverables and financial systems are accurate, timely and compliant. The PC, under guidance from the steering committee, will employ and facilitate a consultant for monitoring and evaluation who will elaborate substantive reports to be presented at the end of year 2 and year 4 to help guide timely adjustments.
Selected staff at NRCRI will undergo training on financial and administrative procedures, led by IITA’s Project Administration Office (PAO). A situational analysis, undertaken by PAO, prior to the training, of the structures already in place at NRCRI, will give guidance on which areas need strengthening.

The training approach will be participatory and will stress needs of NRCRI, in order to be able to manage and implement project activities, handle reporting requirements, as required by the donor, and activities and plans beyond the life of this project.

**IITA’s Project management interventions will be guided by the following:**

**Gender Equity.** This project will ensure women have access to, and benefit equitably from, project support. This will include ensuring that female farmers’ needs and the way they use information are taken into account in the research and dissemination process; linking to the educational grants program to create opportunities for more women to participate in research; and building gender awareness and promoting women’s participation and leadership into organizational capacity building efforts for targeted public and private sector organizations. We will actively seek gender balance in personnel and include gender awareness training for all staff.

**Sensible Environmental Stewardship.** Agriculture, food security and environment are inextricably linked. Environmental degradation in Nigeria is an obstacle to agricultural development. This project’s commitment to environmental sustainability will extend beyond compliance to include sustainable management and protection of natural resources and will address the effects of climate change by introducing adaptation strategies. The project will encourage the introduction of technologies that can increase the sustainability of production activities while reducing negative environmental consequences. It will also build the understanding of climate issues through effective information dissemination.

Four main outcomes will be the results of the Objective 5 implementation.

<table>
<thead>
<tr>
<th>I. Effective project management leads to competent planning, implementation, strategic partnerships, capacity building and monitoring, that ensure successful implementation of the project, resulting in a follow-up investment project for country-wide scaling-up of project outputs that enhance cassava productivity of smallholder farmers, especially women.</th>
</tr>
</thead>
<tbody>
<tr>
<td>II. Good public image will be maintained through special communication efforts.</td>
</tr>
<tr>
<td>III. NRCRI has the capacity to manage complex projects</td>
</tr>
<tr>
<td>IV. The government of Nigeria is enabled to effectively reach about 4.5 million smallholder cassava farmers in more than 20 states.</td>
</tr>
</tbody>
</table>

Output 1: Project staff, administrative mechanisms, and capital equipment are in place, operational and coordinated by month 3 following the project launching.

**Output 1 Key Activities will include:**

A. IITA’s administration team will aim to recruit and employ project staff during the first 3 months of the project (see list in context);

B. The project team, assisted by the IITA administration team, will organize a stakeholders’ workshop at IITA for both partners’ administrators, but also for key technical staff involved in the implementation, in month 2 or 3, to ensure a shared vision and a confirmation of roles and responsibilities, along with an understanding of strategies and processes, including budget access and accountability.
C. IITA’s administration team, along with new project staff, will procure items needed for project implementation, during the first 3 months from launching, following consultation with national stakeholders.

D. IITA’s leadership will nominate a provisional Steering Committee Chairperson and then jointly constitute the steering committee and schedule the first SC-meeting to be held by month 4.

E. Project management, with guidance of the SC, 3-5 will constitute sub-committees as needed. The project team will prepare sub-contracts to enable partners to implement approved activities.

F. The project management team will provide quality service to the scientific endeavor through the life of the project.

G. The IITA HQ team in Nigeria will monitor monthly to ensure all contract deliverables and financial systems are accurate, timely and compliant up to year 4, when NRCRI will assume this task.

H. The IITA Communication team will survey mass and social media via a PR release service (African Press Organization) for early notice of any debates related to weed management, giving opportunity to the project communication staff to prepare and disseminate evidence-based material, through a pro-active PR approach (e.g., active participation in op-eds, social media, blogs, radio and TV interviews).

I. The Communication Office will develop messages for different audiences, throughout the project implementation, detailing state-of-the-art cassava weed management techniques deriving from the findings of the project research, and highlighting the non-biased nature of the approach used.

J. The project communication team will develop an interactive project web-platform, designed for stakeholders in cassava weed management, providing information, comments and feedback in an open and transparent manner.

Output 2: The project’s Information Hub will, by month 9, be functional with a web-portal.

Output 2 Key Activities include:
A. IITA’s in-house IT unit will work with project staff to design an ICT “channel strategy” for the project based on the above workshop and other experiences.

Output 3: The capacity for NRCRI to manage complex projects, such as this one, will be enhanced through direct training on project management provided by the PC, PM, Project Management Team, and IITA’s management team, beginning in year two.

Output 3 Key Activities:
A. PAO, in year 1, will conduct a situation analysis of the current capacity at NRCRI and identify the key persons in NRCRI to be trained and determine the scope of each training.

B. PAO, in year 2, will initiate ‘learning-by-doing’ models for trainees who will come to IITA for two weeks of hands-on involvement in the project’s management, coupled to training visits of project staff to NRCRI to work with the trainee in her/his own environment

C. A gender mainstreaming training will beheld with project and partner management.

Output 4: Internal monitoring of the project is conducted to ensure timely adjustments in strategies and tactics to realize the desired outputs of the project.

Output 4 Key Activities include:
The PC, under guidance from the steering committee, will employ and facilitate a consultant for monitoring and evaluation who will conduct a practical review comprising: visits to project sites, and
discussions with stakeholder and partners. She/he will elaborate substantive reports, presented at the end of year 1, 3, and 5, to help guide timely adjustments and evaluate results.

Output 5: A pro-active PR approach is applied and effective messaging on integrated weed management practices is created and shared amongst shareholders.

Output 5 key activities include:

A. The communication team will establish focal points for communication at participating stakeholder organizations, as well as other relevant institutions and establish mechanisms for better information exchange and institutional networking.

B. IITA Communication team will survey mass and social media for early notice of any debates related to weed management, giving opportunity to the project communication staff to prepare and disseminate evidence-based material, through a pro-active PR approach (e.g., op-eds, social media, blogs, radio and TV interviews).

C. The communication team will develop messages for different audiences, throughout the project implementation, detailing state-of-the-art cassava weed management techniques derived from the findings of the project research, and highlighting the non-biased nature of the approach used.

D. The project communication team will develop an interactive project web-platform, designed for stakeholders in cassava weed management, providing information, comments and feedback in an open and transparent manner.

Output 6: An investment project, designed through catalytic inputs from the project, will be elaborated for scaling up innovations from the project, to enable the government of Nigeria to effectively reach about 4.5 million smallholder cassava farmers in more than 20 states.

Output 6 Key Activities include:

A. Project management, supported by IITA management, will meet with the Federal Ministry of Agriculture and Rural Development, in year 1 of the project, to develop a shared vision on how to bring about an adequately funded strategy and policy that will enable country-wide scaling-up of better agronomic and weed management practices for cassava-based production systems.

B. Based on outcomes of discussion with FMARD, the project management will communicate with donors such as IFAD, AFDB, WB, etc., to explore possible interest in supporting the formulation exercise and the actual investment project.

C. Based on the outcome of communications with donors (see above), the project management and IITA management will hire a consultant in year 5 to approach FAO’s Investment Center (TCI) and/or IFAD to develop detailed terms of reference for a formulation mission.

C. Analysis

Pace of activities to achieve intended outputs within timeframes.

Experienced human resources required are largely available at the onset of the project through close partnerships already existing among: IITA, NRCRI, University of Agriculture Makurdi, state-organized agriculture development projects (ADPs), the Federal Ministry of Agriculture and Rural Development, the private sector (including CropLife) and key UN agencies. Through the workshop in February 2013 at IITA, principal stakeholders have become aware of the project and have helped articulate their roles in its implementation. The shared vision among principle stakeholders at the very onset will greatly enhance the flow of activities. The agronomic and herbicide trials have already been designed to enable timely implementation. Extensive pre-review of possible new herbicides to test has already been elaborated, and
discussions with sources are underway so that as soon as the project is launched, rapid acquisition to testing is assured. Timeliness is central to designing the project and its implementation.

The agronomy, herbicide and extension components are poised to engage in implementing the designed research, and the sequence of activities to realize outputs are logical. For example, the best agronomic practices and the most promising herbicides will be identified early, mostly years 1 & 2, and then combined in component III (agronomy + herbicides) where integration of technologies and farmer-learning processes are emphasized.

The extension training will begin in year 1 with focus on the basics of safe use of herbicides, and on optimizing good production practices. The extension component will, ‘mid-project,’ also appraise with farmers the new innovations from the other technical components. In addition, the project will study how best to enable farmers to understand their choices and implications of diverse weed management strategies. These technical tools - developed and farmer-‘ground-truthed’- will provide the technical base for the formulation of an investment project to enable the government to scale-up extensively the innovations from this ‘pilot project’ to cassava farmers in more than 20 states where cassava is very important.

As lessons are learned, including from things that do not work as initially hoped, the project, with its management team and steering committee, will be agile to increase emphasis in some critical areas and even eliminate un-productive work when appropriate.

D. Assumptions and Risks Concerning implementation and Results

E. Measurement

For M&E, the team will rely on the Results Framework submitted along with this proposal. Key parameters for assessing progress will be:

- Evidence of new agronomic and chemical weed approaches compared to controls, and
- Evidence of adaption by farmers of integrated cassava weed management technologies.

VII. Organizational capacity

A. Applicant: the International Institute of Tropical Agriculture (IITA)

IITA is an Africa-based international research-for-development organization and one of Africa’s leading research partners in finding solutions for hunger and poverty. IITA has over 40 years of experience with 100 international scientists across Africa and over 1,500 total staff members worldwide. IITA has world-class agricultural research expertise in crop improvement, pest management and natural resource management. IITA was founded in 1967 and in 1971 it became one of the founding centres of the CGIAR. To deliver on its mandate to reduce food insecurity and poverty, it focuses on the most important food crops (including cassava) and related cropping systems of SSA. IITA is a not-for-profit institution registered in Nigeria, and working directly or with partners in about 30 countries in SSA. IITA’s mission is to increase agricultural production, food security, and income in the tropics especially SSA through research-for-development (R4D). Our goal is to raise over 20 million people out of poverty while simultaneously freeing up over 25 million hectares of farm lands. IITA will achieve this goal by pursuing three interrelated and cascading objectives:

---

7 Estimate calculated from current yields, acreage, (national statistics and FAOSTAT) against IITA yields in the field.
• Improve food security
• Increase profitability of foods and other agricultural products
• Help national entities expand agricultural growth

Our proposed project will certainly further the mission and goals of IITA, especially in West Africa, as we aim to increase cassava productivity, reduce losses, expand market opportunities, and build capacity in ways that would lead to increased incomes and improved livelihoods of cassava producers and consumers.

IITA is governed by a board of trustees, and it has over 100 internationally and regionally recruited scientific staff based in several countries of SSA. The Institute is led by a Director General (DG). Three Deputy Directors Generals (DDGs) report to the DG, one responsible for R4D, one responsible for partnerships and capacity development and one responsible for research support (or administration). Scientists based in the four sub-regions report to the DDG-R4D through research directors- one each for Central Africa (based in Bukavu/Nairobi), Eastern Africa (based at Dar-es-Salaam, Tanzania), Southern Africa (based at Lusaka, Zambia) and Western Africa (based at Ibadan, Nigeria).

IITA has many years of experience in cassava research and in managing multi-donor and multi-partner projects, including those funded directly by the Foundation. The annual budget of IITA is about 70 million USD. The Institute has the competence and administrative experience to manage this project and it has the commitment, through its CGIAR mandate, to find the resources and partnerships required to sustain the momentum that would be generated through this project.

IITA currently administers more than $50 million in subawards driven by a comprehensive subaward management system that ensures competition, transparency, responsible due-diligence, effective monitoring, compliance with donor requirements and timely achievement of targeted results.

The IITA team’s technical approach optimizes the engagement of local partners by issuing sub-grants and contracts to address identified infrastructure and capacity building and business development needs based on their implementation and management capacity.

IITA approaches grants and subcontracts as investments and tailors milestones and deliverables to ensure maximum return, while linking them to expert technical assistance to build local capacity within and beyond the life of project. The Project Coordinator and component leads will direct technical aspects of the fund, with regular input and final approval from the donor. Financial officers in IITA’s Project Administration Office and Finance Directorate will draft competitive grant solicitation documents, oversee fund disbursement, monitor financial compliance, track deliverables and train subrecipients for compliance with donor rules and regulations.

In support of the project team our Project Administration Office (PAO) will be responsible for administrative matters from the start-up to the close-out of the project. The Finance Office financially administers all projects in accordance with international standards. The financial controls are reinforced by an Internal Audit unit, which is independent of Finance Office and other departments in IITA. The unit’s head reports to the Chair of the Audit Committee of IITA's Board of Trustees. Internal Audit reviews project expenses for legitimacy, validity and compliance with project agreement, etc.

**B. Partners and sub-grantees**

IITA has collaborated for many years with the partners chosen for implementing this project. They have been chosen for their technical and managerial competences, effectiveness in past projects, their
commitment to development of West Africa, and the mutual trust built over the years. All partners participated actively in the planning activities that formed the basis for this proposal.

RELATIONSHIP BETWEEN INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE (IITA) IBADAN AND NATIONAL ROOT CROPS RESEARCH INSTITUTE (NRCRI) UMUDIKE, UMUAHIA

National Root Crops Research Institute Umudike (NRCRI) has had good working relationship with International Institute of Tropical Agriculture (IIITA) Ibadan over the past three decades. This started in the early 1970’s during the years of Dr S.K Hahn with cassava breeding. Since then the relationship has grown from strength to strength.

Both Institutions have been collaborating in areas of human capacity development such that over ten of our scientists passed through IITA in the last ten years. In collaboration with IITA, NRCRI has released 23 high yielding, disease resistant varieties and these varieties are widely grown in Nigeria. NRCRI also leads the national component of the next generation Cassava Breeding project along with IITA with Cornell University as the co-ordinating center.

NRCRI and IITA have also collaborated in several mutually beneficial projects in the past, such as the preemptive Management of a severe form of Cassava Mosaic Disease and Cassava Enterprises Development Project.

In addition, NRCRI has had collaborative research projects with IITA in the following areas:


Other areas of collaboration include exchanges of Germ Plasm materials, Tissue Culture and Biotechnology. Also the Institute collaborated with IITA in some plant protection related projects. Some of which include the Ecologically Sustainable Cassava Plant Protection Project (ESCAPP), the Africa Wide Biological Control Project (ABCP). Currently, there are collaborative projects with IITA on the Biofortification of Cassava (Bio-plus) with aims at enriching the Vitamin A content of new cassava varieties as a means of combating Vitamin A deficiency in children.

RELATIONSHIP BETWEEN UNIVERSITY OF AGRICULTURE MAKURDI AND IITA

The University of Agriculture Makurdi is member of the Governing Council of the IITA. The membership is rotated between the three universities of Agriculture: University of Agriculture Makurdi (UAM), Michael Okpara University of Agriculture, Abia State and the University of Agriculture Abeokuta.

UAM and IITA have been collaborating in research activities. A major collaboration was the DFID sponsored project on management of *Striga* and *Imperata* in Nigeria. UAM anchored the *Imperata* component in Benue, Cross River and Kogi states.

Staff and students of UAM use facilities (Laboratory and Library) at IITA for research.

Both Institutions have also been collaborating in the area of human capacity building. Many of our scientists passed through IITA either as graduate research fellow or former employee of the Institute. Over the years our scientists have collaborated with IITA in the release of improved cowpea varieties with combined resistant to parasitic weeds and multiple pests and these varieties are widely grown in Nigeria (IT98K-573-1-1-Sampea 13 and IT98K-573-2-1-Sampea 14).
In the last three years, one of UAM scientists is collaborating with cowpea breeders at IITA on aspects of breeding resistance cowpea varieties to *Striga* and *Alectra* using molecular tools in the project ‘Integrated Striga Management in Africa ’ funded by the Bill and Melinda Gates Foundation. In addition, the University is collaborating with IITA on the implementation of the Tropical legumes II (TL II) project in Nigeria, funded by the Bill & Melinda Gates Foundation, and jointly implemented by other International Research Centers.

Other areas of collaboration include exchange of cowpea germplasm materials for breeding purpose (Tvu 16514, Tvu 2727, Tvu 4383 etc.) and molecular breeding.

**FUNAAB capability and Partnership statement**

The Federal University of Agriculture, Abeokuta (FUNAAB) was established by Decree No. 48 of 2 November, 1992 by the then Military Government of Nigeria (among the three Universities of Agriculture: others are in Makurdi and Umudike) as a centre of excellence in teaching academic, research and professional programmes leading to award of first degrees (including diplomas) and postgraduate degrees. The vision of FUNAAB is to be a centre of excellence in knowledge generation for global development and the sustenance of an environmentally friendly society. The university has mission to build great future leaders and generate knowledge through research and intellectually stimulating environment for teaching, learning and community outreach towards sustainable development. FUNAAB is well experienced in basic and applied research with national, regional and international partnerships using funds from various donors such as Bill & Melinda Gates Foundation, DFID, FAO, AAU, and European Union.

FUNAAB Scientists have executed agriculture, food and nutrition based projects in the region i.e. Food Developers Initiative sponsored by Association of African Universities in Nigeria, Benin and Sierra Leone since 2008-2010 and Food Science and Nutrition Network in West Africa, March 2010-Aug 2011 under the sponsorship of Association of African Universities/UK DFID. We are also the country office of a five-Country project-Nigeria, Ghana, Uganda, Tanzania, Malawi; Cassava: Adding Value for Africa (C: AVA). Our university has contributed to the Cassava Value Chain Development project in West Africa, covering Nigeria, Sierra Leone, Benin Republic and other food, nutrition, agriculture and health activities with other partners.

We have in partnership with various institutes developed appropriate post harvest technologies for the development of root and tuber crops. This was attested to by Calestous Juma in her book ‘The New Harvest Agricultural Innovation in Africa’ (Oxford University Press, 2011, pgs 54-59) with demonstrable evidence of universities and firms working together to build capacity for innovation. Our university is proud to be associated with the International Institute of Tropical Agriculture (IITA), Ibadan in 2 major landmarks. First was the soybean research and the second was the cassava flash dryer development. The cassava flash dryer development engaged 9 institutions and 1 private sector, Godilogo, in Cross Rivers State. That initiative backed by funds from the Federal Government of Nigeria, USAID and SPDC ably led by IITA with one of our staff as the Post-Harvest Scientist (Integrated Cassava Project) opened the floor of further innovations in the drying industry for the development of root and tuber crops. We jointly won 2008 CGIAR Regional Award for Outstanding Agricultural Technology in the Sub-Saharan Africa Region (http://www.cgiar.org/newsroom/scientific.html). This partnership assisted in design of user friendly environment waste collection for the Small and Medium Enterprises. Our Scientist also excellently served as the Project Coordinator, Cassava Value Chain Development project in West Africa, covering Nigeria, Sierra Leone, Benin Republic; a three-year project, sponsored by the Common Fund for Commodities from August 2008 - March, 2012 and implemented by the International Institute of Tropical Agriculture, Ibadan.
Nigeria ([http://www.common-fund.org/news-and-events/news/cfc-cassava-value-chain-development-in-west-africa/](http://www.common-fund.org/news-and-events/news/cfc-cassava-value-chain-development-in-west-africa/)). There was also a collaborative effort with FUNAAB Scientists and IITA in testing suitable varieties for resistant and tolerant to striga and parasitic wastes using maize and cowpea. FUNAAB has developed with other partners approaches to add value to liquid and solid wastes for food, industrial and feed applications.

The project team is aware of other on-going initiatives in Nigeria, such as RTEP, MARKETS II and CRS, and will work with them on this project. IITA has good working relationship with IAR&T and will consult with them on this project. It is important to note that RTEP has good work collaboration with one of the Sub-grantees (NRCRI). NRCRI has national mandate for root and tuber crops.

In addition, the project team is aware of commercial enterprises such as Graham Hatty and the WASCO projects and the Component 2 team will visit, learn from and incorporate their experiences into this project. The project team is also familiar with the Agricultural Transformation Agenda (ATA)’s commercial cassava production project. The project will learn from ATA’s experience. A potential link to ATA’s cassava production project already exists through one of the sub-grantees (NRCRI). NRCRI has the Nigerian national mandate for cassava breeding, multiplication, distribution and demonstration farms under ATA.

Large scale cassava production systems in north central Nigeria exist, and the project will certainly learn from these. However, it is important to note that although a substantial number of mono cropped cassava farmers exist in Nigeria, majority of smallholder cassava production is inter-cropped with manual weeding as a the predominant method of weed control. It is also important to note that the main beneficiaries of this project are to be smallholder farmers

**C. Organizational Assumptions and Risks**

Any inadequacies in the capacities of service providers that would be contracted could undermine progress towards the project’s target. This would be addressed through careful selection and capacity building of partners and the provision of technical backstopping. Regular monitoring, evaluation, and effective communication would be the bases for revealing and addressing any lapses that may arise from breakdown in effectiveness of partnerships. Restrictions in germplasm sharing within Nigeria would be forestalled through adequate material transfer agreements which are standard at IITA and these would be supported through advocacy for support from relevant policy makers. Poor access to input (seed, credit, etc) and output markets may prevent adoption and/or sustainability of use of otherwise working technologies.

**VIII. Budget template and Narrative**

A detailed budget is given in Appendix 6. Appendix 7.a, b, c provides tentative sub-grant budgets.

**General Questions**

Cost estimates are based on actual costs known to IITA and where not known, best estimates of costs necessary to conduct activities are provided. For equipment/consumables purchase, IITA has a procurement unit who helps with providing cost estimates.

We have been conducting similar studies and have built the budget for the proposed project based on those experiences and our best estimates. The timeline and budget proposed in this project is guided by experience obtained during implementation of several projects of similar scale.
Financial and internal controls, procedures and policies are in place at IITA to ensure proper accountability and accurate reporting of project activities. The internal controls and processes include proper authorization and approvals; compliance with project agreement and terms; adequacy of support documents; oracle financial/management information system that ensure complete and timely processing of financial data/information and workflows; instituted imprest system for IITA Stations outside the HQ; establishment of cost/budget center specific to each project (or sub-activity) that ensures non-comingling of funds; budget monitoring; prompt bank reconciliation; proper assets management, including tagging, disposal/transfers, insurance; etc. IITA disburses funds as advance to collaborators based on the scope of work and budget agreed between two parties. Subsequent disbursements are based on satisfactory technical and financial reporting. The control environment is reinforced by an Internal Audit unit, which is independent of Finance Office and other departments in IITA. The unit head reports to the Chair of the Audit Committee of IITA’s Board of Trustees. Internal Audit reviews project expenses for legitimacy, validity and compliance with project agreement, etc. IITA uses ORACLE financial Applications Release 11i with real time processing of transactions. There are well-defined accounting procedures and operating manuals that define responsibilities and processing/verification procedures for each major class of transactions. There is an accounts chart for various types of transactions which roll up to major headings like Staff Cost, General Administrative expenses, Material and Supplies, Travel expenses and Capital expenditures.

**Prospects for cash or in-kind support from other sources:**

Additional funding for activities in relation to this project will be sought. Synergies with existing projects will be leveraged where applicable.

**Financial risks:** Financial risks are minimal, but more than expected inflation over the project period, currency fluctuations (US$ versus local currency in the country the project is implemented), and unexpected price rises could occur. IITA uses Financial Times (of London) Guide to World Currencies for weekly conversion of all non-US$ transactions, and gains/losses on exchange transactions are managed centrally and not on project basis; exchange fluctuations are centrally-managed to balance the risks. As IITA has a policy of no pre-financing, late spending can be avoided by timely receipt of payments. IITA will not start the work before the agreement has been signed and the funds received. Coordination of this with the planting season, if relevant to the project, is essential.

**Specific questions**

A. **Personnel**

A list of tentative roles and responsibilities of international staff included in this proposal can be found in table 8.1. For Internationally Recruited Staff (IRS), rates are based on AIARC institutional average calculation.

**Table 8.1. Roles, responsibility and rationale for project positions**

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibility/Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Coordinator (PC)</td>
<td>To provide overall responsibility and institutional oversight of the project</td>
</tr>
<tr>
<td>Principal Investigator (PI)</td>
<td>To handle technical day-to-day management of the project</td>
</tr>
<tr>
<td>Communication Officer</td>
<td>To coordinate communication, extension and M&amp;E activities in consultation with other project members</td>
</tr>
<tr>
<td>Role</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IITA scientist (agronomy) (20-25%)</td>
<td>To provide technical backstopping and management for Objectives 1, 2, 3.</td>
</tr>
<tr>
<td>IITA Head of Communications (10%)</td>
<td>To backstop communication, extension and M&amp;E activities</td>
</tr>
<tr>
<td>IITA Head of Biometrics unit (10%)</td>
<td>To backstop statistical analyses.</td>
</tr>
<tr>
<td>Research associates (1 at IITA and each partner organization)</td>
<td>To facilitate technical implementation of activities in Objectives 1, 2, 3 and 4. Can be a PhD student.</td>
</tr>
</tbody>
</table>

For Nationally Recruited Staff (NRS) IITA uses Pay Grade (PG) rates depending on country laws on wages and salaries and internal set scales. Staff costs under pay grades are split into salaries and fringe benefits or allowances, including pemison, insurance and medical, with such allowances as housing allowance, transport allowance, subsistence allowance, utility allowance, entertainment allowance, leave allowance, lunch allowance and vehicle maintenance. Allowances can be higher than salaries to enable IITA to have an interesting pay packages to attract suitable candidates in the competitive local market. The following positions are intended to be filled by NRS: a project administrator, a senior project accountant, an administrative assistant, a driver, a social media expert, a research associate, a research supervisor, a laboratory/field technician, and field workers.

IITA has calculated cost based on benefits available to staff. Actuals depend on the situation of the staff hired, and can change over the duration of employment of such staff. Where we know the person suggested to be hired for this project, we have used that persons actual cost. The fringe benefits for all the internationally recruited staff that will be contributing time to the project are calculated at 125% of a basic salary of $80,000. Items included under fringe benefits include: Auto allowance/ insurance, Health insurance, AIARC Admin fees, First year Medical tests, Retirement benefits, Education tuition and travel/ school run, Housing/ Rent and utility, Initial and Repatriation travel, Settlement and repatriation allowance, Generator/ Inverter allowance, Security/ Security alarm, Home leave/ leave expenses. An annual salary increase rate considers institutional adjustments for inflation and performance.

We have anticipated that it takes time to recruit staff, and have in some cases budgeted start of employment 3 months and onwards of the duration of the project. Leadership of the project will transition to NRCRI in year 4, and the employment of the Project Coordinator and most support staff at IITA will end in month 39, anticipating an overlap of leadership between IITA and NRCRI of 3 months in year 4. To ensure continuity, the PI will as of year 4 report to the Project Coordinator at NRCRI and the previous PC will be a part-time consultant in years 4 and 5, providing backstopping to NRCRI. Technical backstopping (10-20%) will be provided by IITA senior agronomist, Head of Communications and Head of Biometrics.

Similar project staffing needs to that of IITA is anticipated in the partner organisations. Figure 8.1.a provides an overview of technical and administrative staff needed in years 3-5, and figure 8.1.b schematizes the transition of leadership.
b)

Figure 8.1 a,b. Tentative staff positions during years 1-3 (a) and 4-5 (b). Advancement of NRCRI staff could be possible if the AEZ scientist took over the role of Project Coordinator, thus enabling the AEZ Research Associate to step in as AEZ scientist while ensuring continuity within the project. Dashed lines indicate part-time participation in the project, and bold lines indicate more than one staff per positions.

B. Travel

Cost estimates for all airfares are based on quotes for economy fares, averaging peak and non-peak costs for the entire project. All fares are based on at least a one-week advanced purchase. Per diem is budgeted based on the current per diem rates and IITA policy. We have also budgeted the costs of visas, and ground transportation costs (to and from airports).

The actual costs for per diem (depending on location as specified in last updated rates at IITA) were used. Cost of international travel includes air ticket, visa (where necessary), airport transfers and airport assistance. Vehicle and fuel costs were calculated from averages of previous expenditure on similar projects. The frequency of trips was determined based on the nature of the tasks, the number of staff,
location and from previous experience. Trips were linked with major activities that support achievement of goals.

Procedure used to estimate cost of travel based on our previous experiences and IITA official rates where applicable, is given in the table below. Travel costs (airfare, per diem, visas and other travel related costs and accommodation) in relation to international, regional and local travel have been specified, in relation to activities in each objective. We have also anticipated travel in relation to recruitment (3 candidates) of the international staff position (1 Communications manager).

A similar approach is used to estimate the travel costs for meetings, workshops, field inspections, experimental trials etc, see example in Table 8.2.

Table 8.2. Examples of estimates of costings for annual steering committee/project planning meetings

<table>
<thead>
<tr>
<th>Meeting at IITA Ibadan, Nigeria</th>
<th>Unit costs</th>
<th>Days</th>
<th>Staff</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodation</td>
<td>100/day</td>
<td>5</td>
<td>10</td>
<td>5000</td>
</tr>
<tr>
<td>International flight (air tickets for international members of steering committee)</td>
<td>1,300 (to &amp; fro)</td>
<td>1</td>
<td>3</td>
<td>3900</td>
</tr>
<tr>
<td>Airport Assistance (Lagos)</td>
<td>20/person</td>
<td>2</td>
<td>5</td>
<td>200</td>
</tr>
<tr>
<td>Visa charges (3 international pax)</td>
<td>50</td>
<td>1</td>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td>Conference room</td>
<td>300/day</td>
<td>3</td>
<td>1</td>
<td>900</td>
</tr>
<tr>
<td>In country travel</td>
<td>100 (to &amp; fro)</td>
<td>2</td>
<td>2</td>
<td>400</td>
</tr>
<tr>
<td>Coffee and Tea*</td>
<td>5/person</td>
<td>3</td>
<td>15</td>
<td>225</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>10775</strong></td>
</tr>
</tbody>
</table>

Meeting-related travel will include:

**Team Planning Meetings** – Team Planning Meetings will be held once per quarter. Responsibility for hosting the meetings will rotate between IITA and the sub-grant partners. Budget has been included for the Project Lead and the AEZ Scientist to travel to the three meetings not hosted by IITA and includes local airfare for two trips, airport transfers, and accommodations and per diem for all trips.

**Progress Visits** – Progress visits will be made once per quarter to each site by the IITA Project Lead in Years 1-3. To conserve resources, one Progress Visit per quarter, per site, will be conducted during the Team Planning Meetings held on a rotating basis at each site. Starting in Year 4 project leadership will transfer to NRCRI, and travel budget has been included in the sub-grant budget for this. The managing scientist from IITA will join the NRCRI Project Lead in Years 4 and 5 on Progress Visits to ensure that IITA is aware of the status of the work at each site.

**Field Supervision Visits** – Conducted by NRS staff (Field Technician or Research Associate) by road in Years 1 and 2. IITA staff will be located at sites during this time. In Years 3-5 most visits will be managed by sub-grant staff. Trips will last three days and occur on a bi-weekly basis in Years 1-2. Site visit frequency decreases in remaining project years. Accommodations priced at $50/night. Per diem priced at $30/day

**Site Selection Visits** – Site selection will be conducted in the first year of the project to identify optimal sites for each sub-grant partner to conduct field research. These visits will be conducted by the Project Lead and the AEZ Scientist. Budget has been included for three trips and includes local airfare for two trips, airport transfers, and accommodations and per diem for all trips.
**Steering Committee Meetings** – IITA to fund these in Years 1-3. NRCRI to fund in Years 4-5. Funding included to cover international and local air travel, visas, airport transfers and per diems.

**Sub-Committee Meetings** - IITA to fund these in Years 1-3. NRCRI to fund in Years 4-5. Funding included to cover local air and road travel, visas, airport transfers and per diems, where applicable.

In general, different types of visits will be conducted per site. Trips will last 2-5 days and we assume 1 out of 3 (2 sites are far away from Oyo state) will be conducted by road. We have included accommodation and per diem for all travelers.

### C. Sub-Grants to Other Organizations

Descriptions of intended sub-grants to other organizations are given below in table 8.3.

Table 8.3. Intended sub-grants, work to be conducted and IITA’s previous experience

<table>
<thead>
<tr>
<th>Name of sub-grantee</th>
<th>Work to be conducted</th>
<th>Previous experience and assumptions for cost estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRCRI, Nigeria</td>
<td>Field trials under objectives 1, 2 and 3: implementation of trials (agronomic and herbicide testing trials), field days organization, management, herbicide risk assessment and assessment of agronomic packages and data collection for project monitoring and evaluation. Project management, including staff, in year 4-5, including responsibility for technical and financial reporting.</td>
<td>Over 15 years of collaboration in germplasm evaluation, seed propagation and agronomic trials.</td>
</tr>
<tr>
<td>U of Makurdi, Nigeria</td>
<td>Field trials under objectives 1, 2 and 3: implementation of trials (agronomic and herbicide testing trials), field days organization, management, herbicide risk assessment and assessment of agronomic packages and data collection for project monitoring and evaluation.</td>
<td>The University of Agriculture Makurdi is a member of the Governing Council of the IITA and there has been over 10 years of collaborative experience.</td>
</tr>
<tr>
<td>Federal University of Agriculture, Abeokuta (FUNAAB)</td>
<td>Field trials under objectives 1, 2 and 3: implementation of trials (agronomic and herbicide testing trials), field days organization, management, herbicide risk assessment and assessment of agronomic packages and data collection for project monitoring and evaluation.</td>
<td>Over 15 years of collaboration in germplasm evaluation, seed propagation and agronomic trials.</td>
</tr>
</tbody>
</table>

IITA operates a project management system (ProMIS) that ensures that regular follow up reminders are given regarding timely submission of technical and financial reports and grant payments. Costs are based on knowledge of applicable market rates. In addition, sub-grant budgets will/have been submitted by sub-grantees prior to project execution/Signing of an agreement.
D. Capital Equipment

According to IITA’s policies, the nonexpendable property threshold is $5,000. We have budgeted for four project vehicles (1 vehicle per sub-grant): 4 Toyota Hilux Double Cabins at an average unit cost of $36000. We also budgeted for four (4) drying ovens (FX28-2 Shel Lab Forced Air Oven 27.5 Cu ft 220 V) at an average cost of 5 500 USD each (1 per sub-grant). We have also budgeted for a fixed leaf area meter (USD 15 000) and equipment for meteorological stations in each AEZ.

E. Consultants

It is envisaged that a number of specialists will be needed over short periods. While many such needs will only be determined when the project is underway, need for consultants for the following tasks has been determined and budgeted for:

- Technical issues (e.g. Steve Waller of Purdue University) 100 days
- Training on herbicide safety and usage (1 activity per site)
- Educational video documentation of off-station trials and farmer field days
- Gender training (Objective 4, Objective 5)
- Photographer
- KAP study
- Pre-testig of extension materials
- Impact evaluation
- Monitoring (ADPs)
- Agricultural Business Development
- Administrative and financial management training (in-house by Project Administration Office)
- Leadership continuity (former PC consultant to new PC in year 4 and 5).

Payment is guided by the IITA HR policy on consultants, which is related to the level of experience and qualification.

F. Other Direct Costs

Other direct costs are summarised in Table 8.4. All items purchased with project funds will be used exclusively for use in the project. If in an unusual situation a project vehicle is used by another project, the other project will be charged mileage for use, and this project will receive funds. However, we do not anticipate this to take place.

Table 8.4. Summary of other direct costs included in the budget.

<table>
<thead>
<tr>
<th>Item</th>
<th>Business Purpose</th>
<th>Cost assumptions for estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-capital equipment</td>
<td>Motorcycles (4) Jincheng (1 per sub-grant, and IITA)</td>
<td>Based on the knowledge on prevailing market price</td>
</tr>
<tr>
<td>Computers and accessorier</td>
<td>Purchase of 7 computers and accessories for project staff.</td>
<td>Based on the knowledge on prevailing market price</td>
</tr>
<tr>
<td>Vehicle insurance and maintenance</td>
<td>Safe and reliable transportation.</td>
<td>Insurance coverage at $200/month for all months of the project once the vehicle has been purchased six months into Year 1.</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Calculated at $750/service. Service will occur twice in Year 1 and four times in all following years.</td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>Transportation</td>
<td>Calculated starting 6 months into the project following arrival of vehicle at usage of 200 litres/month.</td>
</tr>
<tr>
<td>Car rental and fuel</td>
<td>Cars will be rented for the first 6 months of the life of the project as this is the anticipated time of vehicle procurement. Two cars for activities at Ibadan in objectives 1-5. Fuel for two cars to implement field work and management.</td>
<td>Car rental for transportation until vehicle purchase is completed. Cost is $750/month. Fuel for Rental car – 6 months of use, 200 litres/month. Estimation based on a number of Km per month/year, a rate of consumption of 10 Km per litre and the price in Nigeria.</td>
</tr>
<tr>
<td>Laboratory supplies</td>
<td>Chemicals and glasswares etc needed for analyses.</td>
<td>Based on the knowledge on prevailing market price.</td>
</tr>
<tr>
<td>Field trial implementation costs</td>
<td>Field tools and equipment incl. field Supplies – mobile phone credits for field staff, field notes, pegs, markers, soap, twine, water, refreshments, etc.</td>
<td>Based on the knowledge on prevailing market price.</td>
</tr>
<tr>
<td>Sprayers and sprayer accessories</td>
<td>Herbicide testing.</td>
<td>Based on the knowledge on prevailing market price.</td>
</tr>
<tr>
<td>Fees</td>
<td>Costs for bank fees, legal fees and external audits.</td>
<td>Based on the knowledge on prevailing market price.</td>
</tr>
<tr>
<td>Casual labor</td>
<td>For ad hoc on-farm, on-station and laboratory support.</td>
<td>Current rates applicable in Nigeria.</td>
</tr>
<tr>
<td>Project meetings, workshops and training.</td>
<td>See B. Travel</td>
<td>Based on the knowledge on prevailing market prices and IITA rates.</td>
</tr>
<tr>
<td>Field trials and analytical services</td>
<td>Assess weed management options (density trials, weeding frequency trials, herbicide use trials).</td>
<td>Based on the knowledge on prevailing market price and rates at IITA.</td>
</tr>
<tr>
<td>Project launch meetings</td>
<td>Create awareness of project</td>
<td>Costs for launch include cost of venue, teas/coffees and lunches for participants, any cocktail or dinner in relation to project launch, cost of travel/accommodation for invited participants, cost of</td>
</tr>
</tbody>
</table>
producing and printing
banners and other information
materials

Other computer accessories (printers, computer software, USB modem, scanner and UPS/surge protectors) and other computer external hardware were also provided for to facilitate quick dissemination of information.

G. Funding
See “General questions”.

H. Currency and Inflation Assumptions
This project will take place in Nigeria, and thus, apart from travel on the project through or to countries with other rates, the currency used will include Nigerian Naira. The current rates (June-2013) are 1US$ = 158.4 Naira. IITA works with weekly changing currency rates and guided by inflation rates published by the Economist and Financial Times of London. The average inflation rate of 5% suffices to cover general increases in prices. Some expenditure will be incurred in local currencies and it is hoped that the inflation variations would be evened out through conversion to the reporting currency, US$.

I. Indirect Cost allowance
IITA strives to utilize every human, financial, and material resource in the most effective and prudent manner possible. In order to create and maintain a thriving work environment, IITA has established a baseline of all services, equipment and environment needed for its teams to reach their full potential. This baseline consists of resources and services included in IITA’s indirect cost rate. IITA’s indirect cost rate is adjusted every year in accordance with the results of the annual audit, which is conducted by internationally recognized auditors in line with the CGIAR Financial Guidelines. Project proposals submitted for donor funding always consider the most current rate. IITA’s indirect cost rate is currently 14.8%.
**IX. Additional Benefits and Risks**

**X. General Questions**

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Will this project involve research using human subjects and/or vertebrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>animals?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Will the project involve the use of recombinant DNA or genetically modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>organisms (including genetically modified plants)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Will the project involve the use of biohazards?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the project involve the use of pathogens or toxins identified as select agents by U.S. law?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Global Access and Intellectual Property Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Will the project involve the creation of a new technology, software, database,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>formulation, product, or medical procedure, or the further development of any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>existing technology, formulation, product, or medical procedure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Will the project involve the use of technology, a product, material, or data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>owned or to be provided by a third party?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the project involve the creation of drawings, or written material (such as an</td>
<td></td>
<td></td>
</tr>
<tr>
<td>analysis, a curriculum, guidelines, policy recommendations) other than internal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>working documents, reports to the foundation, or publications?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advocacy Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Could any potential controversies result from the content, geographic focus, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>expected outcomes of the proposed project?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the project require meetings with government officials or intergovernmental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>organization staff?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Due Diligence Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Is your organization a for-profit entity?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Will the project involve activities being conducted in countries where U.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>embargoes (Cuba, Sudan, and Iran) or significant economic restrictions (for example,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Korea, Myanmar, Syria) apply?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
XII. References


NACWC (USA) National Advisory Committee on Weed Control. (1994). *Weed control Recommendations for Nigeria* (Series No. 3).


