

**National Climate Change and Environment Fund (FONERWA)**  
**Full Project Document (PD)**  
**COVER SHEET**

(Attach this sheet to the front of your submission. *Please do not exceed one A4 side of paper.*)

<b>Project Title</b>	Developing local mushroom strains to improve smallholder out grower livelihoods and defend against National Park encroachment.
<b>Project Summary</b> <i>(In 75 words or less please summarise what your project intends to achieve and how)</i>	In collaboration with experts from the Botanic Garden Meise (Belgium), we will, for the first time in Rwanda, inventory edible mushroom populations of forest ecosystems to identify species a) suitable for export; and b) with potential for cultivation and marketing by Kigali Farms. Recent studies in neighbouring countries identified vast mycological potential. Mushrooms can be sustainably harvested or domesticated, helping local populations gain income from natural ecosystems and raising awareness on the value of biodiversity.
<b>Anticipated Start Date</b> <i>(DD/MM/YYYY)</i>	OCTOBER 2014
<b>Project Duration</b> <i>(in months)</i>	9
<b>Funding Requested</b> <i>(RWF)</i>	40,822,000 RWF
<b>Name of Lead Organisation</b>	Kigali Farms Ltd
<b>Type of Organisation, which best describes the Lead Organisation</b> <i>(please select only one box)</i>	<input type="checkbox"/> Government Institution
	<input type="checkbox"/> Non-Governmental Organisation (NGO)
	<input checked="" type="checkbox"/> Private Sector Enterprise
	<input type="checkbox"/> Academic Institution
	<input type="checkbox"/> Other <i>(please specify)</i>
<b>Partner Institutions</b>	Botanic Garden Meise (Belgium) Tourism and Conservation Department of RDB
<b>Full Office Address</b>	Mundi Center, @Rwandex, Kicukiro, Kigali PO Box 1796
<b>Website Address</b> <i>(if applicable)</i>	<a href="http://www.kigalifarms.com">www.kigalifarms.com</a>
<b>Contact Person</b> <i>(the person who will have ultimate responsibility and be accountable for delivering this project)</i>	<b>Name:</b> Laurent Demuynck <b>Position:</b> CEO <b>Email:</b> laurent@kigalifarms.com <b>Tel:</b> 0785 273 443 or 0782 172 433

**For Internal Purposes Only: To be Completed by the Fund Manager**

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## National Climate Change and Environment Fund (FONERWA) Full Project Document (PD)

(Please provide a complete answer to each question, even if the answer is duplicated elsewhere. This PD should not exceed 35 sides of A4 size paper.)

### SECTION 1: INFORMATION ABOUT THE APPLICANT

**Q 1.1** **What** is the Lead organisation's total number of full-time employees?

- 17 full-time salaried
- 30 daily workers

**Q 1.2** **What** is your organisation's experience of managing similar projects or activities (*please explain why you think your organisation and partners are capable of managing the project*)?

Partner Botanic Garden Meise has performed similar studies in various sub-Saharan Africa. In particular, they have designed the methodology for and conducted similar studies in Burundi, in environments very similar to the ones we are proposing to explore in Rwanda. For all practical purposes, the team is going to be repeating methodologies fine-tuned in very similar geographic environments. One could not wish for a more relevant experience.

For more background, Botanic Garden Meise (formerly National Botanic Garden of Belgium) has a very long-lasting tradition in the study of African edible fungi managing research and applied projects in this field in West- (Benin, Togo) and Central Africa (Gabon, DR Congo) for more than a decade. Mr Jérôme Degreef is the head of the department of cryptogamy. He will be leading the scientific part of the project, supported by two local experts with a strong capacity and experience in field mycology, Mr. Benoît Nzigidahera and Ms. Assoumpta Mukandera (see publications referenced sub.1.3). Evidence of the scientific expertise of the permanent staff is given by the numerous peer-reviewed papers and reference books they recently published on African mycology and particularly on edible mushrooms (Degreef et al., 1997, 2007; De Kesel et al., 2002; Dibaluka et al., 2010; Eyi & Degreef, 2010; Eyi et al., 2011; Muluwa et al., 2013). Botanic Garden Meise has also been contracted by international organizations (CIFOR, EU, GTI-UN) for supervising in-the-field mycological training sessions for local scientists, technicians and park rangers in West- and Central Africa (Benin, Togo, Cameroon, Gabon, DR Congo, and Burundi).

Kigali Farms is Rwanda's largest mushroom marketer and substrate producer. It was established in 2010 and has been producing oyster mushroom substrate and mushrooms since that time, as well as spawn. It has a staff of nearly 50 people, mostly production. The production team is led by an Engineer in Food Production and Safety, Ms. Ariane Mukeshimana, with two years of focus on mushroom cultivation. The spawn production is led by a locally trained specialist with 20+ years' experience in the field, Ms. Pélégie Nyirandikumana. Both will lead the project on Kigali Farms' side, with the support of commercial spawn specialists from the firm Gurelan SC, from Huarte, Spain, our partners in spawn production. Laurent Demuynck, Founder and CEO of Kigali Farms, MBA Stanford '95, will also be personally involved in the project.

These two teams combine unique experience in field and lab fungal research in Sub-Saharan Africa and Rwanda. All the technical expertise and country knowledge required for this project is present in the combined team.

<b>Q 1.3</b>	<b>List</b> the name, position, and email of key personnel involved in the project, such as the project executive, project manager, and core technical staff. (Provide a CV for each of the key personnel as an attachment to this PD)
	<ul style="list-style-type: none"> <li>▪ Laurent Demuynck, CEO, Kigali Farms</li> <li>▪ Ariane Mukeshimana, Director, Production &amp; Quality, Kigali Farms</li> <li>▪ Pélagie Nyirandikumana, Substrate Production and Lab manager, Kigali Farms</li> <li>▪ Jérôme Degreef , Head of Department of Cryptogamy, Botanic Garden Meise (Belgium) (Chief Research Manager)</li> <li>▪ Benoît Nzigidahera , Researcher at Institut National pour l’Environnement et la Conservation de la Nature, Bujumbura (Field Research Project Manager)</li> <li>▪ Assumpta Mukandera , Researcher and Trained Mycologist (Field research manager)</li> </ul>
<b>Q 1.4</b>	<b>Lead Organisational Finances. Provide a copy of these</b> from the most recent audited annual accounts (income and expenditure statement & balance sheet in RWF, as well as the main sources of funding) as an attachment to this PD.
	<p>Last annual audited statements are for F-2012. (F-2013 will be available in May 2014).          6 month audited statements are available for Jan-Jun 2013.          See attachments</p>
<b>SECTION 2: INFORMATION ABOUT THE PROJECT</b>	
<b>Q 2.1</b>	<b>Why</b> is the project needed ( <i>clearly state the problem this project will address and the evidence base for its justification. Where possible, refer to international, national and/or sectoral strategies.</i> ) ?
	<p>Harvesting of wild mushrooms is environmentally sustainable, zero carbon and climate resilient and contributes to wealth creation and poverty reduction, and therefore meets many of Fonerwa’s objectives.</p> <p>Kigali Farms is keen to leverage its expertise in mushroom growing in Rwanda to the cultivation of new species or varieties discovered in Rwandan forests. Kigali Farms also has access to export channels to commercialize any mushrooms with market potential abroad.</p> <p>Such a fundamental study of Rwanda’s mycological resources has never before been conducted, even though we know anecdotally and from studies in neighbouring countries that Rwanda’s forest ecosystems contain valuable edible species. Their proper management will contribute to increasing the value of these ecosystems for local populations, and will also strengthen and sustain conservation and management of natural resources.</p> <p>Rwanda’s population is growing and there are mounting concerns regarding malnutrition and food security. This growing population exercises pressure on the environment. The value of the environment is not always evident for rural dwellers beset by poverty. Mushrooms are an abundant natural resource that has been overlooked. They can be harvested sustainably from the wild without damaging the existing stock. What we call “mushrooms” are the visible part, the “fruitbodies” of much larger organisms, called fungal mycelium. The mushrooms can be picked without damaging the fungal mycelium (much like harvesting fruit from a tree), hence ensuring sustainable management of the resource.</p> <p>Rural populations living in harvesting areas can benefit from this crop, either from the food mushrooms provide or from income generated from selling their harvest. In so benefiting from the natural</p>

environment, local populations will recognize the value of protecting forests and natural ecosystems. The Government stands to benefit because this crop, which exists today but is left to decay, will generate taxable business and export business, yielding foreign exchange. The same is true if wild mushrooms can be domesticated for cultivation.

**Q 2.2** **What** change is this project intended to achieve (*state specific objectives, expected results/impact and long-term legacy. To address the core environment and climate change objectives of the project, it would be helpful to refer to national and sectoral climate change and environment objectives. Provide measurable indicators, within a log-frame matrix. In addition, make a note of the expected impacts on employment and poverty reduction, as well knowledge and technological transfer.*)?

See attached log-frame matrix.

The Outcome of this project will be to create a public knowledge base about saprotrophic and mycorrhizal fungi in Rwanda's forest ecosystems (with implications on national income, for example through cultivation of mushroom species; as well as on policy, such as measuring the impact of climate change on Rwanda's forest ecosystems).

More specifically, the project will achieve the following change: We will map, for the first time in history, the mycological resource of Rwandan forest ecosystems. This resource exists, but has never been studied nor even described scientifically (other than in a preliminary, unpublished report, by one of our team members).

As a direct result of this, we will also:

1. determine whether any existing species have immediate export potential, and quantify both volumes and potential economic benefits;
2. isolate a number of species that are candidates for cultivation and perform initial screening on these species in a laboratory;
3. discover and record species putatively new for science;
4. publish results in peer-reviewed journal(s).

MINAGRI and the private sector, particularly Kigali Farms, have made great strides in developing the production and market of oyster mushrooms (*Pleurotus*). Native strains of this genus are known to exist in Rwandan forests and might be better adapted to local environmental conditions, providing better yields.

Research in tropical Africa has revealed plentiful edible mushroom species and showed the importance of the mushrooms for the diet of local populations (Eyi et al. 2011; Rammeloo & Walley, 1993). In Burundi, 43 edible species were inventoried, mostly in the woodland areas near Lake Tanganyika and along the Tanzanian border (Nzigidahera, 2007). This inventory was recently added 8 more species collected in the montane forests of Kibira National Park, bordering Rwanda (Degreeef, unpublished data). We expect similar results in Rwanda.

A preliminary inventory has also been performed in Rwanda by the staff of the Botanic Garden Meise and recorded 10 edible mushroom species in secondary forests and savannas, half of them being saprotrophic (Mukandera, 2011). As can be seen from the inventory sheet shared in a separate documents, the more in-depth studies conducted in Burundi have yielded many more mushroom species. Several species identified in Rwanda were also found in Burundi, but some are unique to

Rwanda. Based on these results, we have every reason to expect to find several species in Rwanda that have not yet been identified in the country, some uniquely present here, and some present regionally. For example, the presence of different unidentified species of *Pleurotus* in both Burundi and Rwanda should be further investigated and has good potential to yield a culturable species for production in Rwanda.

The aim of the present project is to complement this preliminary inventory by the species present in primary forest ecosystems. Roughly speaking, there are three types of edible mushrooms with commercial interest: 1) mycorrhizal, who live in close association with trees and cannot be cultivated unless by preliminary growing the host trees in the field. Among the mycorrhizal species, many *Cantharellus* (chanterelles) are present in Burundi, with definite export potential; 2) saprotrophic, who derive their feed from dead or decaying matter, and which can sometimes be cultivated. Among them, several species of *Pleurotus*, *Lentinus*, *Auricularia*, and *Agaricus* are known or assumed to be present in Rwanda, waiting to be identified; 3) symbiotic *Termitomyces* species, associated with termites and only growing on termite mounds.

*Pleurotus* was discussed above. *Lentinus sensu lato* includes the famed shiitake; *Auricularia* includes the wood ear mushroom, famous in Chinese cuisine; *Agaricus* includes the ubiquitous button mushrooms. In all cases, local species may yield new cultivars that should grow well here and have export potential. *Termitomyces* is widely present in Rwanda, but due to its close relationship with termites, has never been successfully cultivated. A species of special interest is *T. microcarpus*, called “imegeri” locally, well appreciated by local populations. *T. microcarpus* actually grows outside termite mounds, and might technically lend itself to cultivation. If successful, the market would be large for this delicacy.

This project builds upon Rwanda’s foundational strategies including the Economic Development and Poverty Reduction Strategy (EDPRS) II and the Green Growth and Climate Change Strategy (GGCCS), seamlessly integrating many of their cross-sectoral goals and several programmatic activities.

The EDPRS II hails the private sector as the engine of growth. As such, the private sector is expected to drive efforts in developing the green economy; modernizing agriculture; building greener, more sustainable cities; and promoting exports; all in an effort to reduce poverty and improve other outcomes such as food security and nutrition. Greener “city-building” and tourism promotion are ingrained in those foundational strategies.

On an individual level, the Rwanda Green Growth and Climate Change Strategy elaborates on the necessity of capacity building and knowledge transfer in efforts to improve Rwanda’s human capital and move employment off the farm. On the aggregate level, the green growth strategy focusses on the need for Rwanda to build capacity in research and development, which is at the heart of this proposal.

Programme 2 of the Green Growth Strategy calls for improved agricultural diversity in local and export markets, calling on agribusinesses to diversify crop and target “organic” and “fair-trade” niche markets abroad.

The knowledge and technologies transferred through this project, and the knowledge gained from this project, will make it possible to turn the natural resource of mushrooms into a sustainable source of income and nutrition, which will have favorable impacts on employment and poverty reduction.

The information obtained through this study will be made available publicly, to public institutions such as Minagri and also through scientific publications. We have started working with the National University of Rwanda (Pr. Cyprien Munyanshongore at the School of Public Health and Dr. Martin Ntawubizi at College of Agriculture, Animal Sciences and Veterinary Medicine) and will involve them. Also we plan on involving the National Biological Research Center at RDB. This will ensure that anyone with access to the internet will be able to access the information. The results of the study will be in the public domain.

**Q 2.3** **How** will the project objectives be achieved (*include a detailed Work Plan as an appendix highlighting key deliverables and activities and responsibilities. Clearly describe the approach and methodology to be followed and the sequence of activities planned.*)?

See attached Work Plan for details.

#### Activity 1 : Field collecting of edible fungal species

Two field trips (2-weeks each) will be conducted in Rwanda's forests.

- Mission 1 (October/November 2014) in Volcanoes National Park (Northern Province);
  - Mission 2 (March/April 2015) in Gishwati Forest and Nyungwe National Park (Western Province).
- Available vegetation and geographic maps will be preliminarily studied to locate the areas of interest for the inventory (riverine forests, montane forests, ...) and to establish a collection itinerary.

We would be happy to add studies in other parts of the country, provided budget can be increased accordingly. The East of the country will likely have less species diversity and the species will be different from the west and north due to different habitat. Would the commenter suggest adding budget and scope to this study or reserving this for a follow-on project?

The field work consists in systematically inventory every fungal specimen potentially edible (belonging to the target genera mentioned hereabove). When discovered, the specimen is given an identification number, then photographed and carefully collected. The specimen is described using standard methodology defined by Eyi et al. (2011). It will be later dried and conserved as a herbarium reference for further microscopic study and identification.

#### Activity 2: In-the-field training of local park rangers and local community support staff

Park rangers will join the field collecting trips and benefit the expertise of mycologists in describing and identifying the mushrooms collected in their working environment.

#### Activity 3: Isolation of fungal strains

Handling of mushroom fructifications (or sporophores) for isolation of strains should be done carefully in a as sterile as possible environment. Fresh sporophores are cut with sterile instruments and a ~30mm<sup>3</sup> piece of fungal tissue is removed then immediately put on the appropriate culture medium in a Petri dish. Mycelia are regularly transplanted to avoid mold contamination and obtain pure strains.

#### Activity 4: Identification of herbarium specimens

An in-depth study of every herbarium specimen collected during the field trips will be conducted by the mycologists of the Botanic Garden Meise. Macro- and microscopic characters will be listed and compared with the scientific literature for identification. In case the specimen characters do not match with the descriptions of registered species ([www.indexfungorum.org](http://www.indexfungorum.org)), it is supposed to be new for science and will be published as a new species.

#### Activity 5: Cultivation tests

In the central lab, strain specimens are multiplied on grain through three successive generations, as

would commercial strains. G3 mycelium is then inoculated into a variety of substrates to test strains' responsiveness. The scope of this project will only allow for identification of growing potential, not full-blown development of cultivation protocol.

Activity 6 : Publication in peer reviewed journal(s)

Results of this R&D project will be submitted to international journals for publication; namely new species are expected to be discovered in the framework of this study and will be published in high-ranking taxonomic journals.

Activity 7 : Production of educational material for local communities' benefit.

**Q 2.4** **How** does the project address cross-cutting issues such as gender and youth?

Wild mushroom harvesting is an activity typically undertaken by women and/or younger members of a social group. To the extent that the knowledge gained from this project translates into more extensive mushroom gathering by local populations, it is women and youth who stand to benefit first from this new source of income.

In commercial mushroom growing, where picking is very labor intensive, these jobs are primarily given to women because they do not require physical force so much as a willingness to pay attention to detail and work with care. Women tend to fill this role better than men.

The research team we will put together will be made up of younger people due to the physical demands of exploring the forest. The scientific training that will be part and parcel of the project will also be more profitable to younger people.

**Q 2.5** **Who** are the stakeholders affected by the problem, and who are the stakeholders influential in solving the problem? How have they been incorporated and involved in project design and delivery?

Our main stakeholders are the Tourism and Conservation Department of RDB, and . Mr Telesphore Ngoga, Conservation Division Manager, RDB, Tourism and Conservation Department has been consulted and is supportive of the project. They have great interest in developing economic activity near the park boundaries so local communities see the benefits of the parks for themselves. The Office of the Governor of the Northern Province and of the Western Province have likewise been consulted, as have the Districts of Musanze, Rutsiro and Rusizi. RDB need to provide their authorization to conduct research within the boundaries of the National Parks.

We are also keeping MINAGRI abreast of our research project, as they have actively supported and help develop the mushroom industry in Rwanda. While there is no need for any involvement on their part in terms of the exploration and strain study part of the project, when it comes to dissemination we will share results with RAB, the relevant department for horticulture and mushroom growing, and we will work together with them in getting the new knowledge into their teachings. Mr Tony Nsanganira, PS Minagri, is well informed of this project and very supportive of it, as he has been of Kigali Farms since inception (when he was Head of Ag at RDB).

Local communities are very important. They will be consulted once the project is approved, and they will be involved when we need to select local staff for support and when we educate them about our findings. There are different stakeholders who will benefit. In terms of training, first we will train the staff who will participate in this study. In terms of communities that will benefit, it will primarily be communities in or near the areas that we will study. Most training will be directed at those individuals

who chose to become mushroom growers, and to those communities in the North, near our own operational base, where we will want to promote awareness of income potential and nutritional benefits of mushrooms. Our methodology to identify suitable trainees is to talk first to local authorities (District agronomist, Secteur and cell leaders, leaders of relevant cooperatives) and explain our objectives. Together we can get to know farmers and individuals with relevant skills or interest or land, and approach them about mushroom cultivation and training. In the case of the present project, we also would approach local schools and educate both school officials and pupils about mushrooms and nutrition. The actual training content will be about importance of nutrition, role the mushrooms can play in a family's nutrition, ways of cooking mushrooms, ways of growing mushrooms and ways of commercializing mushrooms, as well as about wild mushrooms and the importance of never eating wild mushrooms unless one is 100% sure that it is a safe mushroom. We are attaching to this application one example of a training manual we currently use, but we will develop specific content for and from this project.

More generally, Kigali Farms is already involved in training various groups interested in the potential of mushrooms to improve health and wealth. For example we worked recently with World Vision and Partners in Health, and are planning training with One Acre Fund, an organisation working with 73,000 farmers in the south/west of the country. As the nutritional & commercial benefits of mushrooms become more widely known, we are able to distill our knowledge to tens of thousands of beneficiaries through other organizations whose mission it is to work with small holder farmers. The new knowledge obtained through this study will be integrated in these outreach missions. We are a social enterprise and it is our mission to make more Rwandans aware of the benefits they can obtain from mushroom cultivation and consumption.

**Q 2.6** **How** will the benefits of the project be sustained after FONERWA funding comes to an end?

This is not an abstract academic project. Rather, the project is really applied research with immediate and lasting economic implications. We are combining sound science with a commercial approach to ensure the sustainability of the benefits of the project. Kigali Farms is social enterprise, i.e. a private sector company with a social mandate. Our interest in this project stems from the knowledge that wild mushrooms can yield food and income for Rwandan households living in environmentally rich areas, with hardly any carbon footprint, and that we, as a private company, are in the best position to provide access to market for this resource.

The knowledge about the mycological resources of Rwanda discovered in the course of this project will be published and become part of the public domain, accessible worldwide to anyone with an interest in Rwanda's natural ecosystems.

Kigali Farms will be first to leverage this intellectual property into sustainable economic activities. After the study, we will determine whether any of the domesticated species can be cultivated with profitable yields and whether they satisfy market and consumer needs. If so, more research will likely be needed to study methods to improve yields, yet commercialization can start right away. For example, we are sure to identify local taxa of *Pleurotus*, the mushroom we already cultivate, and we predict using local strains should improve yields.

It is important that a link be made from research to commercialization.

As a commercial, for-profit enterprise Kigali Farms has a built-in incentive to leverage the results from this project into commercial products, otherwise it is useless to us. We are already the largest marketers of mushrooms and mushroom products in the country, and will therefore direct any commercially



valuable species through our existing distribution channels. We would be happy to formally add market studies to this project, and add to the budget accordingly. We had chosen to keep the Fonerwa-funded component to R&D, but if Fonerwa has budget for market studies and market development, we welcome the opportunity to increase the scope of the project.

As a matter of fact, we recently decided to move into value-added processed mushroom products, in particular mushroom soups packaged in doypacks. This packaged product would be exportable to regional, European and US markets, and we feel the market appeal would be much higher if the soup recipes included local and uniquely African mushroom species. We assumed that a marketing budget would be beyond the scope of Fonerwa, and were going to fund this externally, but would welcome Fonerwa funding for this as well.

Please note that in the case of local strains of oyster mushrooms, these will be integrated into the current production chain and do not need any particular market study.

Since Kigali Farms is the premier marketer of mushrooms in Rwanda, we can give a good indication of the size of the domestic market. We commercialize about 2 ton of oyster mushrooms per month, in Rwanda alone. Based on our data of substrate production and on production by others, we estimate the total market at the moment to be about 7 to 8 ton per month. We have also conducted market surveys on button mushrooms, and estimate the market to be another 2 ton/month. In addition, there is a seasonal market for wild mushroom (*Termitomyces*), of unknown size. Generally Rwandan consumers can be described as mycophiles – they like mushrooms – but supply can be an issue and at the moment demand is probably higher than supply. For example, at Kigali Farms we have a 7-week waiting line for substrate orders.

Note also that the results of the studies will be made publicly available and that other commercial operators may wish to capitalize on them as well.

The issue of educational materials for local communities is addressed to some extent in Output Indicator 1.2. In addition, the Kigali Farms business model obliges us to produce the type of materials required for local communities to understand all about mushroom production. At the moment, Kigali Farms works with outgrowers. The cycle is as follows: Kigali Farms produces the substrate (mushroom feed) on which the mushrooms grow, sells it to growers and offers to buy back their production at pre-defined prices, to assure them of a market. Kigali Farms has produced growers' manuals in which we explain how to design and build mushroom houses, how to grow mushrooms, etc. We train, assist and support all our growers free of charge. So the information package for local community growers is actually an integral part of how we already operate.

In the case of cultivated mushrooms, the issue of poisonous mushrooms does not arise, as Kigali Farms will be selecting and multiplying the relevant strains in our laboratory. Only commercial and safe strains will be provided for growing. In the case where we would encourage farmers to harvest wild mushrooms for resale to us, we would indeed train the farmers thoroughly in which species are sought after, and then at our collection points we would screen the mushrooms to avoid any confusions with undesirable specimens. We will have to set up strict controls in order to make sure we only put edible mushrooms on the market, and the lab will be used to help in the identification of poisonous mushrooms.

In addition the research results will enrich the Government's knowledge about the environment. These baseline data can be referred to in later studies and can be useful in helping to understand the effects of climate change.

**Q 2.7** **What** is the scope for income generation from the project?

As stated elsewhere in this PD, the knowledge gained from this R&D project can and should result in income generation activities for local communities and commercial operators alike. As is the nature of an R&D project, more research will likely be required as well as time, but the potential for income generation is clear and one important motivation behind this project. This is not a pure knowledge project, rather a public-private collaboration that aims to result in positive commercial effects.

Beyond the scope of this R&D project, we will be conducting market studies and implementing market development strategies to leverage the knowledge acquired in the project. This applies to the domestic and export market. For example, we intend to develop proprietary packaged soups (in doypacks), including both cultivated and wild mushrooms, with potential for distribution to US and European markets. We think unique products can be developed that will interest chains such as Whole Foods in the USA (with whom the CEO of Kigali Farms has done business before). Our vision is to turn the North of Rwanda into a center of excellence for mushroom growing in the entire region. Identifying the potential of local mushrooms is an important step in realizing that vision.

As further detailed below, mushrooms and mushroom cultivation contribute to the achievement of several National Priorities. Their nutritional potential is second-to-none, and Kigali Farms's mission is to find business means to make that nutrition available to poorer households; various fungi species can be utilized to improve composting and enhance soil management, a critical issue for smallholder farmers living off poor soils; mushrooms have definite export potential, both for South-South trade and towards Western markets, and we think that Rwanda can gain first-mover advantage over potential competitors such as Kenya and Uganda; mushrooms can be an added draw to the tourism market around Musanze by adding an interpretation center which highlights the beauty, usefulness and development potential of fungi in Rwandan society – and tourists will also be able to taste the mushrooms in the various Musanze restaurants; their cultivation by farmers near the National Park will provide them with income and will help protect the Park against encroachment; mushrooms lend themselves well to processing and therefore to the creation of off-farm jobs, and mushroom growing itself, although a biological process, is actually akin to an off-farm activity (because the grower is independent of soil content and weather patterns), that can be exercised in parallel with a farming activity (for example, a farmer would devote 100 sqm of his plot to mushroom farming, while keeping the rest for traditional farming), and hence it is a very good transition towards less dependence on pure farming income.

As noted elsewhere in the report, we may identify species with sustainable harvesting potential. Local communities would be able to collect the mushrooms and sell them to Kigali Farms. The latter would either export or sell into the domestic market. We may also identify strains of mushrooms that could be domesticated and lead to commercial cultivation. That would result in a new value chain with income and employment opportunities at many levels. That is of great interest to Kigali Farms.

Most income would flow to women, who are the largest group of employees in mushroom growing operations, and are also typically the ones harvesting wild mushrooms.

There are many ways in which fungi can help improve the livelihoods of smallholder farmers. First, as discussed already, there is the potential for cultivation. Mushrooms are an exceptionally fitting crop for

Rwanda as a country, and for its smallholder farmers in particular. In a nutshell, this is for the following reasons: mushrooms offer extremely high yields (500+ ton per hectare) and can be cultivated on plots as small as 50 or 100 sqm, making them very suitable as a cash crop for smallholders (who can still cultivate subsistence crops on the remainder of their land); mushrooms offer high value per unit weight; mushrooms are very rich in nutrition (protein, essential amino acids, iron, zinc, selenium, vitamin B and D); mushrooms require fresh temperatures and high humidity, which are naturally prevalent in many parts of Rwanda; mushrooms can easily be dried and milled, for preservation and inclusion in other value chains; mushrooms grow on agricultural waste, such as wheat straw and therefore provide a way to monetize this waste for wheat growing communities; the by-product of mushroom growing is rich compost, which can be used to improve the soils of the farmers, enriching them in Carbon and NPK.

Secondly, our study will not only document edible mushrooms, but also species which may be detrimental to some farmers. For example, it is likely that root rot fungus (*Armillaria mellea*) is present in Rwanda (as it is in Uganda and Kenya). This species is a pest to coffee and tea farmers, and there is no scientific description of its presence in Rwanda at the moment. Confirming or infirming its presence would be valuable knowledge to assist farmers in fighting this pest.

Please note in particular that mushrooms are no season dependent, and do not rely on natural rainfall, and as such help strengthen climate change resilience of farming communities.

In all cases, identifying fungal threats to coffee and tea farmers would help tens of thousands protect their income base. Cultivating mushrooms has the potential to put several thousand farmers to work. Since mushroom farming requires little land, no fertilizers and no pesticides and no heavy equipment, and converts carbon-based agri-waste into nutritious food, we feel promoting this crop is very much in line with Fonerwa objectives of sustainability and poverty reduction.

<b>Q 2.8</b>	<b>Preparation:</b> Has a feasibility or pre-feasibility study been conducted ( <i>If yes, then please attach a copy to this PD</i> )?
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No, there is no need for a feasibility of pre-feasibility study. This project is simple in its execution, the experts on the team are familiar with this kind of research and the one of them is familiar with the terrain.

<b>Q 2.9</b>	<b>Preparation:</b> Are there any outstanding regulatory or legal requirements that need to be met before the project can proceed ( <i>access to land, planning consent, use of new technologies</i> )?
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The main regulatory requirement is permission to conduct the research in the National Parks. The project has been presented to RDB – Tourism Department in January 2013, and was received very favorably. Until we know there is funding for the project, there is no need to seek the actual authorizations. The response from RDB was positive, as they immediately understood the potential for tourism benefits and the possibility to generate income for communities neighbouring the Parks. Having the local communities benefit sustainably from the Park is an important objective of sound Park management. There is every reason to expect swift deliverance of authorizations once funding is obtained and requests are made.

Since this is a light R&D project, which does not entail any land use change or building or any permanent physical imprint on the environment, there is no need for planning consent.

The technologies we deploy are well known and have been used by team members before.

<b>Q 2.10</b>	<b>Preparation:</b> Has an Environmental Impact Assessment been conducted for the project ( <i>If yes, then please attach a copy to this PD</i> )?
<p>There is no need for and Environmental Impact Assessment.</p>	
<b>Q 2.11</b>	<b>How</b> will the performance of the project be monitored and evaluated ( <i>both during and after the project</i> )?
<p>Reference is made to the project log-frame.</p> <p>The outcome indicators – two field missions followed by two lab projects based on results from the field studies – are short-term events – a few weeks for the field missions and a few months for the lab tests - simple to monitor and observe.</p> <p>The six output indicators are likewise easily quantifiable and tracable: internal reports (field and lab) produced for stakeholders; educational material for local communities; articles published in the scientific literature; staff report; and budget execution report.</p> <p>The task of monitoring, evaluating and reporting will be assigned to Ms. Adeline Mushikiwabo, Director of Administration and Finance at Kigali Farms, using standard MIS systems.</p> <p>Progress reports will be produced internally and filed with Fonerwa quarterly, by Oct 15, Jan 15, Apr 15 , July 15 and a final report on Sep 30, 2015. The final report will include the presentation of educational materials to local communities near where the research took place. Thereafter Tracking reports will be produced bi-yearly for 3 years (Mar 30 and Sep 30, through 2018) to report on publication of research material in the scientific press.</p> <p>In addition field reports will be produced after each field mission (Jan and May 2015, with closing report on July 30 2015), and lab test reports will be produced following completio of lab tests (April and July 2015).</p>	
<b>Q 2.12</b>	<b>How</b> will you involve the beneficiaries and other stakeholders in monitoring and evaluation?
<p>It is important that beneficiaries and stakeholders be informed of M&amp;E progress. After all, the very object of this project is knowledge acquisition and dissemination.</p> <p>Field and lab reports will be shared as they become available with Fonerwa, RDB, Minagri, Minaloc, REMA, Minirena, Minicom, Minisante and local District and Secteur authorities. We feel that mushrooms as a crop can be valuable to the country as a whole, and we want to make sure the authorities are better aware of their potential so that they can be integrated into national policy making at many levels.</p> <p>We take particular interest in pride in presenting the results, in educational format, to the communities close to the research area. RDB has been clear that it is one of their objectives to promote income generating activities and a better understanding of the benefits of the National Parks to the neughoring communities, because communities with a stake in the Parks respect them more. We share this vision and want to support that effort through our educational outreach.</p>	
<b>Q 2.13</b>	<b>Which</b> Output from the FONERWA’s overarching M&E framework will be contributed to in the project’s M&E Framework ( <i>if possible choose an indicator from FONERWA’s M&amp;E framework</i> )?

Fonerwa Output 2: Renewable energy and other environmentally sustainable, low carbon and climate resilient technologies adopted, developed and/or improved for use in Rwanda, as a result of the Fund.

Fonerwa Output Indicator 2.1: Number of monitoring and MIS systems with sufficient environmental & climate change data to inform policy decisions

The R&D nature of this project will result in the generation in environmental data which can serve as a basis for policy decisions in various areas such as food safety and nutrition; local community income generation; tourism; environmental protection; climate change mitigation.

Mushroom cultivation and harvesting are environmentally sustainable, low carbon and climate resilient activities.

**Q 2.14** **Lesson Learning:** Please explain how the learning from this project will be disseminated and shared during (and at the end) of the project, and to whom this information will target (*e.g. Project stakeholders and others outside the project*)

There are many ways in which learnings from this project will be communicated and disseminated, and to many different audiences.

- During the project, the project staff will be trained in the basics of mycological research.
- During the project, Fonerwa, RDB and local authorities will be kept apprised of progress through direct communication and periodic reporting (following each field trip).
- After the project, a full report of findings will be produced and shared with key stakeholders Fonerwa, RDB, Minagri, Minaloc, REMA, Minirena, Minicom, Minisante and local District and Sector authorities.
- After the project, key findings will be assembled in scientific articles and submitted for publication to peer-reviewed journals. Given the ground-breaking nature of the research and the world-class quality of the researchers, there is no doubt that these articles will be accepted and published.
- After the project, Botanic Garden of Meise will publish key findings in a monograph in the series ABC Taxa (see [www.abctaxa.be](http://www.abctaxa.be)).
- After the project, key findings will be summarized in educational material to be presented to local communities.
- After the project, Kigali Farms will incorporate key findings into its corporate communication and into its touristic information materials at Musanze substrate factory.

**Q 2.15** **Risk Management:** Please outline the main risks to the successful delivery of this project indicating whether they are high, medium or low. If the risks are outside your direct control, how will the project be designed to address them?

Reference is made to the log-frame. All risks to this project can be categorized as LOW.

The only high-impact risks would be acts of God (war, earthquake, passing of one of the key team members, etc.). They cannot be protected against, but the likelihood is so low as to not be worth considering any further.

Since the project is based on field studies, one risk is the weather. Mushrooms are seasonal and appear during the rainy season. This is why we schedule the two field missions after the onset of both rainy seasons. Given recent variability in weather patterns, we must acknowledge that rains can be late, which is why we left some flexibility into the actual dates of the missions. Low rains might also result in smaller observed mushroom populations, which would affect the quality of the study somewhat, but the montane forests we are targeting are reliably wet and it is extremely unlikely that mushroom levels

would be severely affected by the weather. So by timing our trips and allowing some flexibility in actual dates, we have addressed this particular risk sufficiently.

Another risk is that RDB would not grant us exploration permits. Our long-standing relationship with them and the interest they have shown in the project indicates that the risk of this happening is very low. As soon as Fonerwa approval is secured, our first task will be to obtain these authorizations.

The quality of the lab work will be a function of the quality of the samples retrieved during field work. Given that we picked the right season to do the field work and that the team is made up of experts on sub-saharan fungi, the risk of not retrieving satisfactory specimens is negligibly low. The lab teams will also be made up of experts from Kigali Farms, assisted by the experts from Botanic Gardens Meise, with sophisticated new equipment acquired through Fonerwa grant, so here again the operational risk is negligibly low.

The risk of not being able to identify strains that can be domesticated is actually not a risk. It is simply an outcome of the research. It would be nicer of course to find commercially valuable species, but not finding them would also be a valuable learning. So we do not categorize this as a risk.

As for scientific publications, the very nature of the peer-reviewed process means we do not control the outcome. However, the lead scientists on our team, Mr. Degreeef and Mr. Nzigidahera, are highly published authors and understand the process well. Their research is highly regarded and likely to be welcomed by the scientific press. In addition, this research will be ground-breaking – the first data on fungi from Rwanda!!! – and publishers will be very keen to publish such material. Finally, the monograph series ABC Taxa, with titles such as “Champignons comestibles des forêts denses d’Afrique centrale” (“Edible Mushrooms from high-density forests of Central Africa”), co-authored by Mr. Degreeef, is actually co-edited by Mr. Degreeef, so publication in a subsequent volume is quasi-guaranteed. In sum, we bring a terrific platform to disseminate the knowledge acquired about Rwandan fungi to the world, and the risk of not succeeding is negligible.

<b>Q 2.16</b>	<b>Risk Management:</b> What specific risks, if any, does your project pose to the environment, people or institutions affected by the project and how will these be managed and mitigated?
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This project has a very light footprint: teams of 6 to 8 people enter limited forest areas for up to two weeks and measure data. Some mushroom specimens are taken off the field for further analysis. Nothing else is removed from the environment and nothing is left in the environment (no structures nor equipment are left behind). This is not materially different from a group of tourists entering the forest to see gorillas, for example – in fact it is less intrusive.

The remainder of the work takes place inside a lab, with no environmental impact.

The only possible risk is one of an individual hurting themselves while on the field trip, but again not more or less risky than a trip in the woods.

No institutions are affected in any way.

Hence, there is no need for a risk management or mitigation strategy.

### SECTION 3: PROJECT BUDGET AND VALUE FOR MONEY

<b>Q 3.1</b>	<b>What</b> is the total cost of the project (RWF; provide total cost for each year of the project disaggregated by capital and recurrent expenditure)?
The project will be completed within one year, for a total budget of 56,838,275 RWF, all recurrent expenditure.	
<b>Q 3.2</b>	<b>What</b> is the total amount requested from FONERWA (RWF; provide financing needs for each year of the project)?
The project will be completed within one year, and Fonerwa funding is only required for that one year. The total amount requested is 40,822,000 RWF, or 72%.	
Some requested items are small assets without which the project could not be executed. The company does not currently own such assets. If this is an issue, we can discuss switching budget items around.	
<b>Q 3.3</b>	<b>List</b> all other sources of funding. Note whether the status of other funding sources ( <i>i.e. Whether the money has been approved or is awaiting authorisation</i> )
Kigali Farms and Botanic Garden Meise are the sole other sources of funding. Funding comes from their general budgets and is approved.	
<b>Q 3.4</b>	<b>Additionality:</b> Explain why the project cannot be fully financed by other sources than FONERWA?
Funding from FONERWA is necessary because this is an R&D effort with benefits for the environment and the economy of Rwanda as a whole, and because this type of early stage effort cannot be supported by the private sector alone.	
The data collected will certainly be useful to better understand Rwanda’s environment and to help design better environmental policies. It will also be useful for local communities to understand the resources they can sustainably extract from their environment and generate revenue with.	
Whether or not the data will lead to commercial returns is less certain. This is why it is not possible for a private sector company to fully fund this kind of research, and as a matter of fact such type of research is always funded by the public sector, often through academia. If commercial returns do follow, they will also have a positive social component, in terms of employment and income generation for local workers.	
In sum, the project is a public good with significant positive externalities and for this reason deserves to be funded by Fonerwa.	
<b>Q 3.5</b>	<b>What</b> non-financial support is needed to implement the project? What is the best way for FONERWA to deliver this support?
We have all the necessary skills in house to successfully implement the project. Fonerwa assistance will be necessary to help us understand the Fonerwa reporting and M&E framework and execute it correctly. Equally we will work with Fonerwa to ensure the procurement system is executed correctly.	
The Fonerwa “brand” and reputation will also make it easier for us to find support, where necessary, with stakeholders such as RDB, local authorities and local communities.	

<p><b>Q 3.6</b></p>	<p><b><u>Value for Money (Economy):</u></b></p> <ul style="list-style-type: none"> <li>i) Briefly describe how the required inputs have been identified and how the GoR procurement procedures will be used to ensure they are obtained cost effectively</li> <li>ii) Provide identified unit cost measures or selected project outputs? (Please see VfM guidelines on how to determine these. Further guidance from the FONERWA Secretariat is available)</li> </ul>
<ul style="list-style-type: none"> <li>i. We intend to apply all GoR procurement procedures to this project, and are requesting Fonerwa assistance in this matter, to make sure we understand and respect all requirements (&gt; 100k rwf and &lt; 1m rwf, three quotes; &gt; 1m rwf advertising). For estimative purposes of this budget, we have relied on the expertise of the Botanic Garden Meise, who have executed very similar research in the region in the past. Whether in terms of staffing needs, logistical needs, small lab or field equipment or consumables, Botanic Garden Meise has produced an estimative budget based on recent previous purchases of same items or services for same purposes. We are therefore confident that the budget closely approximates actual needs.</li> <li>ii. Referring to Output Indicator 1.1, based on the production of 6 scientific publications and an overall budget of 80.8M RWF (of which 58.1M RWF for Fonerwa), the unit cost is 13.5M RWF per publication (or 9.7M RWF per publication for Fonerwa). Referring to Output Indicators 1.1, 1.2, 1.3 and 2.1, including the production of educational presentations for the local communities and the policy-enabling reports addressed to GoR and local authorities, a total of 14 reports, the cost per unit becomes 5.8M RWF per report/publication (of which 4.1M RWF per report/publication for Fonerwa).</li> </ul>	
<p><b>Q 3.7</b></p>	<p><b><u>Value for Money (Efficiency):</u></b></p> <ul style="list-style-type: none"> <li>i) Briefly explain how the provision and operation of project inputs produce the expected outputs</li> <li>ii) What is the Net Present Value (NPV) and benefit cost ratio for this project (Please see VfM guidelines on how to determine these measures. Further guidance from the FONERWA Secretariat is available)?</li> </ul>
<p>As per discussion with Fonerwa staff (March 28, 2014) since this is an R&amp;D project, there is no need for Efficiency, NPV or benefit cost ratio calculation.</p>	
<p><b>Q 3.8</b></p>	<p><b><u>Value for Money (Effectiveness):</u></b></p> <p>How does your project demonstrate effectiveness:</p> <ul style="list-style-type: none"> <li>- How will it show the outputs meet the project objectives?</li> <li>- Which indicators will you measure to demonstrate effectiveness?</li> </ul>
<p>Reference is made to the log-frame of the project.</p> <p>The project objective is to develop a knowledge base of saprotrophic and mycorrhizal fungi in Rwanda's forest ecosystems (with implications on national income, for example through cultivation of mushroom species; as well as on policy, such as measuring the impact of climate change on Rwanda's forest ecosystems).</p> <p>This is an R&amp;D project. The overall goal is to develop knowledge that can be used for policy development and for sustainable economic development. For knowledge to be useful it must be disseminated. For knowledge to be disseminated effectively, it must be "packaged" in a way that makes it easily accessible to many.</p> <p>Therefore we have selected as Output 1 the publication of our research results, in various ways that can best serve our objective: scientific publications to give our research world-wide resonance: anyone in Rwanda and indeed in the world with access to internet will be able to access the results of this project. The project results will belong to the public domain. We will also customize and present some of our findings to be relevant to the local communities which can most directly benefit from the results of this</p>	



project. Last but not least, we will produce reports to be directly communicated to all key Rwandan decision-making Ministries and agencies (Fonerwa, RDB, Minagri, Minaloc, REMA, Minirena, Minicom, Minisante and local District and Secteur authorities), giving the outcome of this project an opportunity to be integrated into national and local policy.

Output 2 is the production of scientific results directly tied-in to private sector use. By studying in the lab whether any strains identified in the Rwandan forests can be domesticated for downstream commercial use, we accelerate the pace of transition from research to the “real world” – reducing to months a step which typically would take years because science can be so disconnected from practical applications. This output guarantees that the results of this research do not sit idly in a drawer, but rather become actionable and can start adding value to the real economy. The link between science and commerce is what makes this project effective.

Finally, Output 3, Project Management, is what makes the entire project viable and effective. Sound project management is the foundation upon which the grand outcome of knowledge acquisition and dissemination becomes possible.

**ATTACH ANNEXES HERE TO THE PD APPLICATION** – *these can be accepted as separate files but clearly organise and identify the annexes so they are easy to refer to.*