ADAPTATION FUND

DATE OF RECEIPT:
ADAPTATION FUND PROJECT ID:
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PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT/PROGRAMME INFORMATION

PROJECT/PROGRAMME CATEGORY:	FULL PROJECT
COUNTRY/IES:	MADAGASCAR
TITLE OF PROJECT/PROGRAMME:	**PROMOTING CLIMATE RESILIENCE IN THE RICE SECTOR THROUGH PILOT INVESTMENTS IN ALAOTRA-MANGORO REGION**
	TYPE OF IMPLEMENTING ENTITY: **MIE**
IMPLEMENTING ENTITY:	**UNEP**
EXECUTING ENTITY/IES:	**MINISTRY OF ENVIRONMENT AND FORESTS IN PARTNERSHIP WITH MINISTRY OF AGRICULTURE AND FARMING**
AMOUNT OF FINANCING REQUESTED:	**5,104,925** (IN U.S DOLLARS EQUIVALENT)

1. PROJECT / PROGRAMME BACKGROUND AND CONTEXT:

1. Background and Context

1.1. Geography

Madagascar is a large mountainous island located in the South West Indian Ocean, off the South-Eastern coast of Africa. It extends over 1600 km from north to south and 580 km from east to west. Madagascar is renowned for its highly endemic biological diversity, rich forests and a wealth of natural resources. However, the country is also plagued by environmental degradation, low agricultural productivity and poverty, ranking it 145th out of 177 countries according to the Human Development Index. Recent political instability has further undermined economic development, amid a global financial crisis that has accentuated impacts on the poor, leading to increasing food insecurity. Already vulnerable to climate variability and extreme weather events (e.g. cyclones), the country is at risk of increased vulnerability and degradation from anticipated climate change.

The densely populated central highlands are characterized by terraced, rice-growing valleys lying between grassy, deforested hills. Along the eastern side of the island, a steep and mountainous escarpment drops abruptly from the Central Highlands to the Indian Ocean. This eastern terrain hosts most of the last remaining pockets of tropical rainforest. The western and southern sides, lying in the rain shadow of the central highlands, are home to tropical dry forests, thorn forests, and deserts and xeric shrublands. The descent from the central highlands toward the west is gradual. The western coast features many protected harbours, but silting is a major problem caused by sediment from the high levels of inland erosion carried by rivers crossing the vast western plains. The island's highest peak, Maromokotro, at 2,876 m, is found in the Tsaratanana Massif, located in the far north of the country. The Ankaratra Massif is in the central area south of Antananarivo and hosts the third highest mountain on the island, Tsiafajavona, with an altitude of 2,642 m. Further south is the Andringitra Massif with several peaks over 2,400 m including the second and fourth highest peaks, Pic Imarivolanitra at 2,658 m

and the 2,630 m Pic Bory. The massif contains the Andringitra Reserve and includes both Pic Soaindra (2,620 m) and Pic Ivangomena (2,556 m). On very rare occasions, this region experiences snow in winter at its high altitudes.

Madagascar is divided in 22 regions, further subdivided into 116 districts, 1,548 communes, and 16,969 *fokontany*.

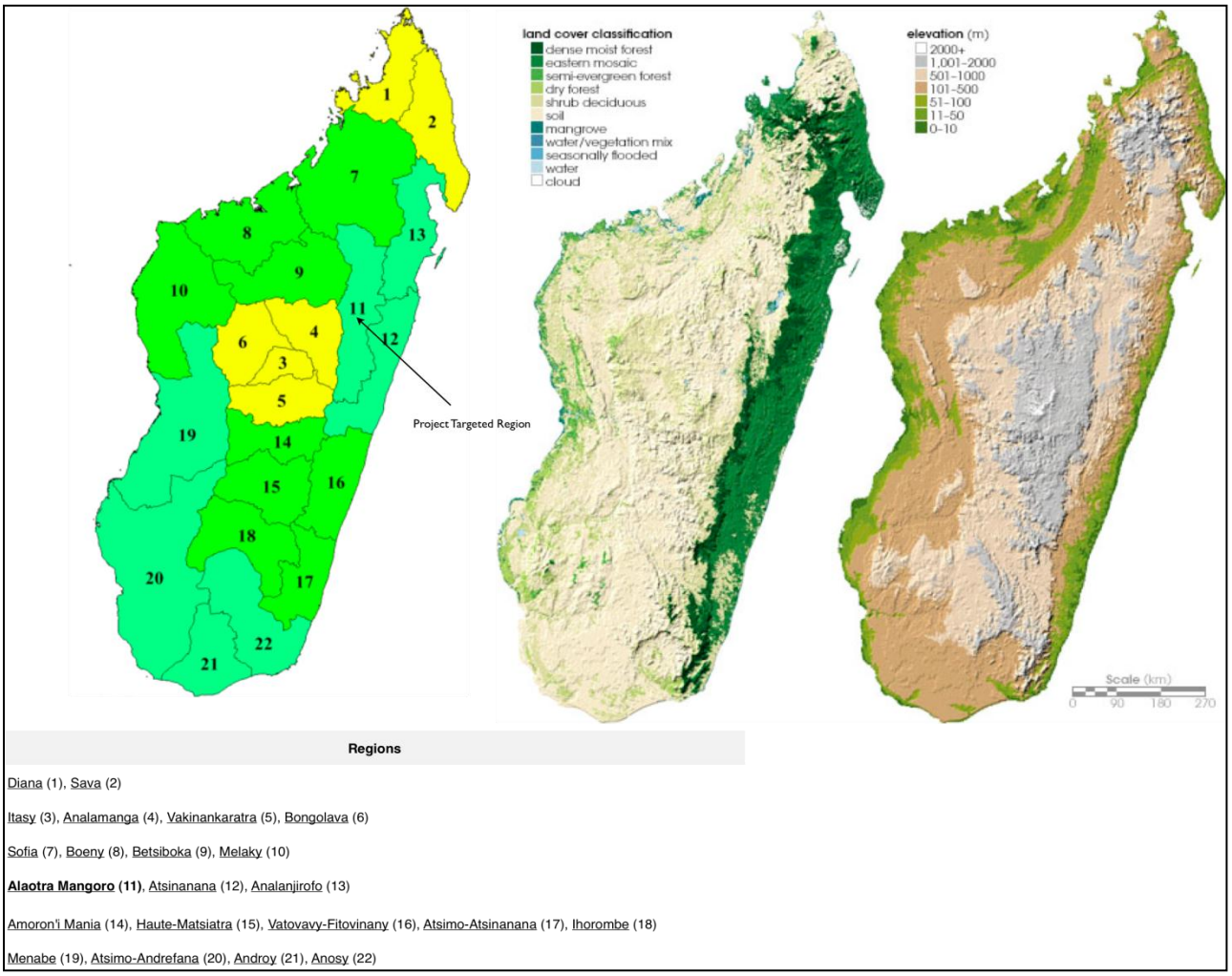

Figure 1: Administrative regions, land cover and elevation of Madagascar

1.2. Population, economy and development

The island of Madagascar is home to nearly 20 million people (2006), 80% of which live in rural areas. Incomes are generally low, with the UN estimating in 2000 that 75% of Malagasy population is living below the poverty line, most of them in rural areas. Performance against the MDGs remains low, with only 26% of population having access to potable water (2000) and only 18% having access to electricity, compounded by rural-urban inequalities. Poverty rates also differ by region, with the highest rates in the coastal regions of the east and south, where over 80 percent of the population is poor, and the lowest rates around the capital Antananarivo. Living conditions in rural areas have been steadily

declining, particularly in terms of transport, health, education and market access. Malagasy farmers practice subsistence agriculture in small plots (average size 1.3 ha). With the growth in the island's population, this situation has only worsened, so that half of Malagasy children now show signs of chronic malnutrition. The isolation of rural inhabitants also helps to make living conditions particularly hard. Roads are generally in a poor state and are unevenly distributed over the country.

The primary sector (agriculture, livestock and fisheries) remains the principal engine of the national economy, providing 95% of food intake nationally and 75% of foreign exchange thanks to the export of coffee, vanilla, clove, pepper, cocoa and various marine products. The rural sector represents a significant share of the Malagasy economy, estimated at about 43%[2] of GDP in 2000 when including agriculture, livestock, fishing, forest and downstream agro-industries. Agriculture alone provides around 27 % of GDP, 40 % of exports and provides a living to about 75 % of the population.

The recent political crisis has had a negative impact on the economy, but with marked variations across sectors. Most export-oriented activities, as well as those linked to public sector funding (such as construction) have been in disarray, as reflected by the fall in exports (down by 50 percent between 2008 and 2010). Concurrently, the primary sector has shown stronger performance, with an exceptional rice harvest in 2009 (up by 40 percent from 2008 levels). (see below section 1.3 for additional information on the rice sub-sector).

As far as health is concerned, the major diseases afflicting the country are respiratory infections, tuberculosis, malaria, diarrheal diseases and sexually transmitted infections. In terms of infrastructure, there are basic health centers in all communes, health centers in all county towns and university hospitals in most major towns.

The country's main electricity sources are hydro-electric and thermal plants. The hydraulic potential of the country is around 7800MW, but only about 250 MW are exploited, representing approximately 3%. The country has to import oil products to meet its needs in energy and the national coverage of electricity is only about 21% (Ministry of Energy Policy Letter). Madagascar is among the solar-rich countries in terms of energy potentials and solar energy is currently used for water heating, drying agricultural products and generating power for telecommunications, lighting, drugs storage and pumping. Despite these potentials, fuelwood and wood charcoal remains the main energy source for a large part of Malagasy households, leading to high levels of deforestation (2.5% annually).

Madagascar basic indicators				
	2000	**2005**	**2008**	**2009**
Population, total (millions)	15.28	17.61	19.11	19.63
Population growth (annual %)	3.0	2.8	2.7	2.7
Surface area (sq. km) (thousands)	587.0	587.0	587.0	587.0
Poverty headcount ratio at national poverty line (% of population)	..	68.7	..	..
GNI, Atlas method (current US$) (billions)	3.87	5.38	7.91	8.53
GNI per capita, Atlas method (current US$)	250	310	410	430
People				
Life expectancy at birth, total (years)	57	59	60	61
Fertility rate, total (births per woman)	5.6	5.0	4.7	4.6
Adolescent fertility rate (births per 1,000 women ages	152	141	131	127

15-19)				
Mortality rate, under-5 (per 1,000)	100	74	61	58
Primary completion rate, total (% of relevant age group)	38	60	71	79
Ratio of girls to boys in primary and secondary education (%)	..	96	97	97
Prevalence of HIV, total (% of population ages 15-49)	0.2	0.2	0.2	0.2
Environment				
Forest area (sq. km) (thousands)	131.2	128.4	..	..
Agricultural land (% of land area)	69.6	70.2	70.2	..
Improved water source (% of population with access)	37	40	41	..
Improved sanitation facilities (% of population with access)	10	11	11	..
Economy				
GDP (current US$) (billions)	3.88	5.04	9.42	8.59
GDP growth (annual %)	4.8	4.6	7.1	-3.7
Agriculture, value added (% of GDP)	29	28	25	29
Industry, value added (% of GDP)	14	16	16	16
Services, etc., value added (% of GDP)	57	56	59	55
Exports of goods and services (% of GDP)	31	28	27	28
Imports of goods and services (% of GDP)	38	46	57	52

Data source: World Development Indicators Database, 2010.

1.3. Overview of agriculture and rice sub-sector

Given the overwhelming importance of home-consumption as well as the practice of bartering rice in exchange for paddy processing services, the importance of rice production in Madagascar cannot be measured in strictly monetary terms based on reported market transactions.

With a Monetary Gross Product of 49 million USD and an economic weight of 67 million USD (including non-monetary exchanges), the entire rice supply chain represents the single most important economic activity in Madagascar. Given the importance of rice production and trade to the GDP, the performance of the rice sub sector determines to a large extent the overall performance of the agricultural sector in Madagascar. National demand amounts to 2.2 million tons per year, and domestic production of about 2 million tons is insufficient even in years with normal rainfall regime. About 200,000 tons is annually imported, and more than 47 % of the national territory arable lands are allocated for rice production.

A total of 1,7 million farmers are involved in the production of rice in Madagascar. In addition, there are about 30,000 downstream operators, who perform multiple functions (collection, processing, wholesale, importers, retailers). Since the vast majority of them represent family businesses, there exist approximately 1.750.000 households that are involved in the production, processing and handling of rice. Based on the average family size of 5.7 persons per rural household, it could be calculated that there are about 10 million people in Madagascar, or almost 70% of its population, who derive at least part of their economic income from the rice sub-sector[1]. In terms of employment, the production of rice (excluding transport, post harvest handling, processing and trading etc.) is estimated to generate around 242 millions working days per year. This number is equivalent to about 0,97 - 1,21 millions full time jobs (ratio of 200 - 250 working days per year). Salaries of agricultural workers account for about 20% of the

[1] From Bockel, L. Review of Madagascar Rice Sub Sector, 2002, for World Bank.

value-added in the rice sub-sector. Downstream activities generate around 70 000 salaried jobs. In addition, the rice sub-sector also generates jobs and incomes upstream in the value chain (agricultural inputs and services). As a consequence of the economic importance of rice, as well as the large number of people involved in its cultivation and trade, it is possible to affirm that benefits of any rice productivity increase would be widely distributed and would directly enhance the well being of rural households.

Rice production in Madagascar occurs in all types of cropping systems, from the rainfed central highlands, to the irrigated and terraced lowlands, and semi flooded coastal zones[2] (see Annex 1 for a description of rice cropping systems in Madagascar). However, most of Madagascar's rice is grown in the central highlands, under rainfed conditions, and is already vulnerable to land degradation and climate hazards, mainly droughts. Rice grown in the lowlands is also subject to climate hazards and events, including from flash floods and extreme temperatures. (See section 2.1 for a description of climate variability and change in Madagascar).

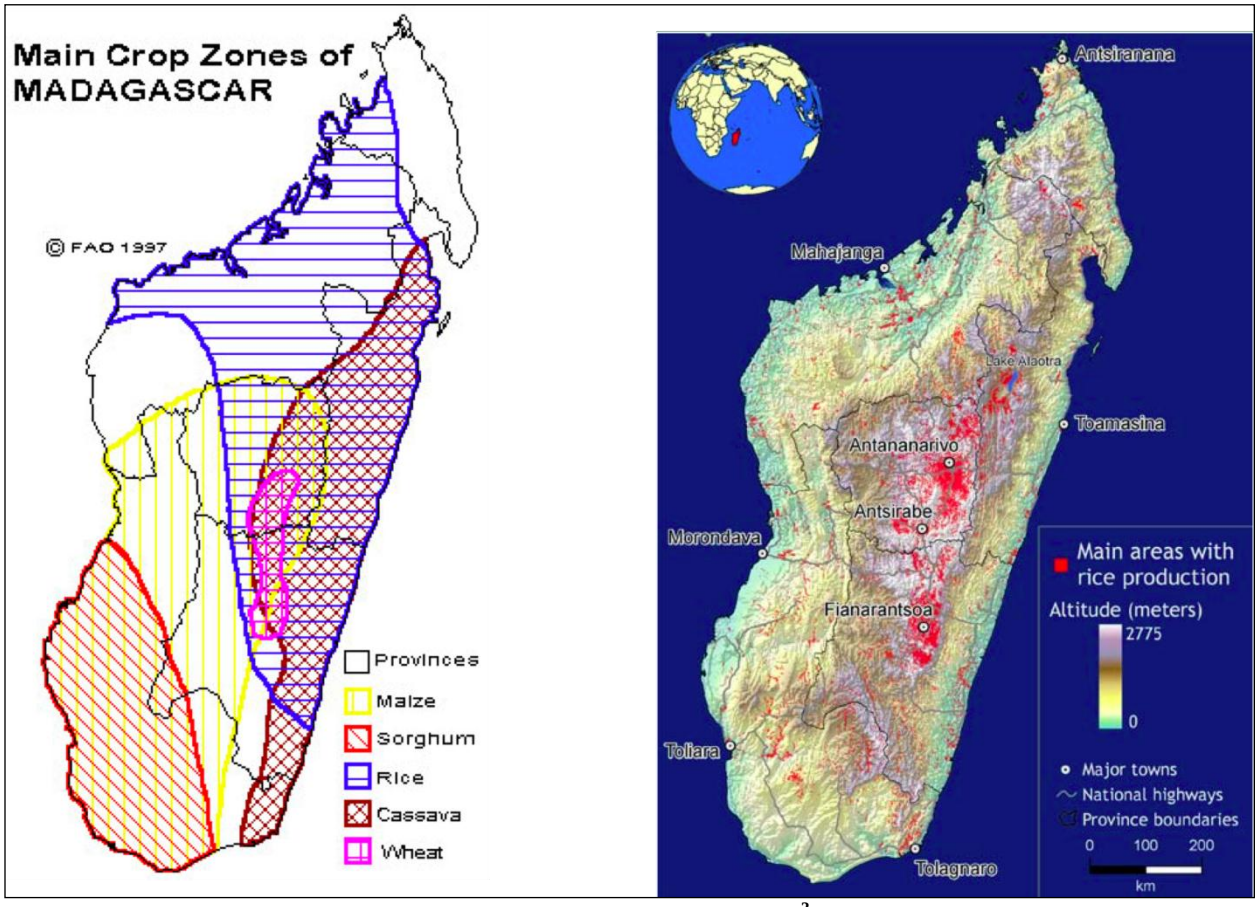

Figure 2: Main crop growing areas and rice production in Madagascar[3]

In terms of cultivated area, irrigated rice is most important, covering 82% of all areas under rice. Tavy and rainfed rice cover respectively 10% and 8% of the total rice cultivated area. Irrigated rice

[2] According to the recognized rice production systems: rainfed upland, rainfed lowland, irrigated lowland, mangrove swamp (semi-flooded) and deepwater (flooded).

[3] Reproduced from Hijmans, R. and Laborte, I, The Price of Rice in Madagascar (IRRI, 2008) and FAO, Global Information and Early Warning System.

can be subdivided into four sub cropping systems, including: (i) direct seeding cropping systems; (ii) transplanting "en foule" irrigated rice; (iii) improved rice cropping systems, SRA; and (iv) intensive rice cropping systems, SRI. Of these, transplanted rice is by far the most important subsystem, covering over 60% of the total cultivated area of rice under irrigated conditions. (see Annex 1 for more detailed characterization of cropping systems.)

In Madagascar, 70% of rice harvests occur between the months of April and June. For aquatic, flooded and lowland rice, the seasons vary according to regions. For example, mid-western lands lend themselves well to a double annual harvest, meaning the successive planting of two crops per year on the same plot. In coastal zones, dry season rice culture occurs between April and October, but subject to water availability. In the highlands and Alaotra region, colder climates make a dry season crop nearly impossible. Three types of crop calendars can be found there:

- The "vary aloha", or first season crop, planted in April-May in greenhouses and transplanted in August-September, for a December-January harvest;
- The rainy season crop "vary vakiambaty", which represents the main type of culture, and which is planted in greenhouses in September-October, transplanted in November-December, for an April-May harvest.
- A more rare inter-seasonal crop "vary siha", which results from early onset planting, and which is harvested in March.

Rice production in Madagascar suffers from a number of climatic and environmental, technical and technological constraints, that are currently limiting productivity and therefore adaptive capacity. Climate constraints include variability in the onset of rains, delays in rainy seasons, as well as disruptions in the amount of rainfall during the rice-growing season. Droughts and floods are common occurrences in rice producing districts. Cyclones are also known to destroy crops, property and infrastructure. These climate variability constraints are compounded by erosion, leading to a widespread siltation of paddies and irrigation infrastructure, further limiting water and soil quality and availability. (See section 2.2 for a description of the impacts of climate variability and change in rice sector Madagascar)

Among technical and technological constraints, access to inputs is unequal and limited in some cases. For example, at the national level, 69% of the area under irrigated rice is cropped without any mineral or organic fertilizer application. With an average level of fertilizer application amounting to 33 kg/ha in the Central Highlands region, compared to 15 kg/ha in Lake Alaotra, one observes a yield difference of 22% between the two regions. Another limitation is the low level of technical knowledge among small producers and relatively low application of best available technologies, such as Système Rizicole Amélioré (SRA, improved rice system) or the System of Rice Intensification (SRI, Système Rizicole Intensifié), that are known to produce significantly higher yields (see Annex 1 for a description of cropping systems). Significant increases in yields have also been noted between paddies under improved water management.

2. Climate

2.1. Current climate hazards and variability and their impacts

Overall, Madagascar enjoys a tropical climate, with regional variations. The average annual temperature are between 23 and 27 ° C with an annual temperature range of about 3 ° C in the North and 7 ° 5 in the

dry Southwest. The 3 700mm to 400mm rainfall varies across the island: it is hot and humid in the East and semi-arid and hot in the West and South West. The Highlands, the Western Region and the South have two distinct seasons: rainy season extending from November to April and a dry season from May to October. Whereas in the eastern region, it rains almost all year round and dry season is almost non-existent.

Madagascar is subject to extreme weather events related to current climate variability, chief among them cyclones, flooding and droughts. The island is subject to around 11 tropical disturbances, 3 of which usually reach the stage of tropical cyclone. These disturbances have become more and more frequent, and have gained in intensity over the past decades, occurring almost on a yearly basis, and leading to important infrastructure damages, losses of life, decreases in agricultural productivity, degradation of natural resources, and coastal erosion, with negative and prolonged effects on food security, access to clean water, irrigation, public health. These impacts place the Malagasy population and their development in a constant and increasing situation of vulnerability and precariousness.

Southeastern trade winds dominate the climate and weather of Madagascar, producing a hot rainy season (November-April) with frequently destructive cyclones, and a relatively cooler dry season (May-October). Broadly speaking, the climate is tropical along the coast, temperate inland, and arid in the south but factors such as regional elevation produce significant regional variation. Rain clouds originating over the Indian Ocean discharge much of their moisture over the island's eastern coast where an average 3,500 mm (137.8 in) of annual precipitation supports the area's rain forest ecosystem. The central highlands are both drier and cooler, with frost commonly occurring overnight in the dry season. Snow, however, is limited to rare occurrences at the high-elevation Ankaratra massif. The west coast is drier still, with high aridity in the southwest and southern part of the island where a semidesert climate prevails. Annual cyclones cause regular damage to infrastructure and local economies as well as loss of life. The most destructive since 1927 was Cyclone Geralda (February 2–4, 1994) which caused over 70 fatalities and left over 500,000 people homeless with the damage estimated at US$45 million.

In the Alaotra region, the rainy season generally runs from end of November to Mid-April. Even though 92% of cultivated areas are said to be “irrigated”, they are in fact totally dependent on rainfall (to fill reservoirs and water bodies). The entire area has known increasingly late onset of rains and shorter rainy seasons.

The tables below illustrate basic climate data (temperature, precipitation) for the region for 2005, 2006 and 2007 against mean and/or normal values.

2005

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
T°M	-	-	-	-	20,6	18,8	17,3	17,7	18,9		22,9	24,6
T°M/N	23,5	23,6	23,1	22,1	20,1	18,2	17,4	17,6	18,8	20,9	22,6	23,5
RR	-	-	-	-	7,1	5,2	33,5	8,5	6,7	0,1	57,4	221,4
RR/N	259	244,7	160	53,1	13,2	9,2	13,4	11,8	6	35,4	110,4	222,7
J	-	-	-	-								
J/N	17	17	17	9	7	8	11	10	5	6	10	17

2006

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
T°M							18,0	18,4	19,1			

T°M/N	23,5	23,6	23,1	22,1	20,1	18,2	17,4	17,6	18,8	20,9	22,6	23,5
RR							6,8	15,2	1,4			
RR/N	259	244,7	160	53,1	13,2	9,2	13,4	11,8	6	35,4	110,4	222,7
J							17	15	8			
J/N	17	17	17	9	7	8	11	10	5	6	10	17

2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
T°M	24,4	23,9	23,1	21,6	21,1	17,9	18,3	18,3				
T°M/N	23,5	23,6	23,1	22,1	20,1	18,2	17,4	17,6	18,8	20,9	22,6	23,5
RR	513,9	446,0	156,1	50,5	8,0	3,3	14,0	2,4				
RR/N	259	244,7	160	53,1	13,2	9,2	13,4	11,8	6	35,4	110,4	222,7
J	26	22	10	13	10	11	14	11				
J/N	17	17	17	9	7	8	11	10	5	6	10	17

Source : National Meteorological Services

T°M = Mean Monthly Temperature
T°M/N = Normal mean temperature (30 previous years)
RR = Monthly rainfall (mm)
RR/N = Mean monthly rainfall
J = Number of rain days monthly
J/N = Normal number of rain days monthly

Climate variability has already had observable impacts on rice production and agriculture in general, and many farmers have had to resort to ad hoc shifts in planting calendars, with sometimes dire results in terms of crop losses. According to the National Meteorology Service, (DGM), mean air temperatures in the southern half of the island have increased from 21,5 to 22,4°C, and from 23,3 to 23,5 C in the northern half, over the past 30 years. Since the past two decades, this increase in temperature manifests itself mostly by an increase in extreme minimal temperatures, which has a significant impact on crops and growing cycles.

Dry periods have had a tendency to become longer in the Central highlands and the eastern coast, whereas on the western coast, rains have become more intense. Annual rains have a tendency to increase since the 80s in the Southern half of the country, but to decrease in the north. Total rainfalls have stayed stable, due to seasonal variability. Tropical cyclones have also increased in frequency.

Climate change has also had visible impacts in other sectors, for example in terms of health, with the recent expansion of malaria zones to the highlands and the spread of water borne diseases (diarrhea, cholera), decreases in agricultural productivity, and in water quality.

2.2. Anticipated climate change and its impacts

Climate model projections developed during the First and Second National Communication and NAPA development processes indicate that climate change effects in 2100 could lead to a mean annual increase of 2.5°C to 3°C for the whole country, a reduction of mean annual precipitation with sharper decreases during the dry seasons and intensification of precipitation events during rainy seasons, except for the southern part of the island where precipitations would remain lowest. Rainfed crops in the

highlands and lowlands are likely to suffer most from this increased variability, unless careful water management practices are put into place, as water supply is expected to decrease at country level. In addition, severe precipitation events, coupled with deforestation, are likely to increase soil erosion.

Projections and models developed for the second national communication show the following expected climate change effects and impacts:

Mean temperatures for December- January- February (DJF) in 2025: North and North west regions of the country would show an increase of 0,8 à 1°C; South and the southernmost tip of the island an increase of up to 0,2°C. In 2050, these increases would vary between 0.2°C in the West and 2°C in the South-west and south. In 2100, they would reach 3°C in most parts of the island. These predicions are similar for June-July and August temperatures, which would increase between 4 and °C in the South and South West in 2100.

Projections for precipitations in December, January and February are as follows: In 2025, the Easter, Northern and a portion of North West and Central West regions would register decreases in precipitation between 5 and 30% compared to the reference period of 1961-1990, the rest of the country showing decreases of up to 20%. The mean rainfall intensity would decrease in the South Western, South, North and Northwest areas. In 2050, these projections would remain unchanged, except that more intense rains would be registered in the West and North. In 2100, Highlands would register increases in rainfall between 10 and 30%, and in the South West and South, rainfall would increase by 30 to 50%, with an increase in intensity. For June-August precipitations, projections show a decrease of up to 25% over the total country area; in 2050 a part of the northwest regions could register an increase of up to 20%, whereas the rest of the country would experience decreases of 10 to 60%. In 2100, North-East, North, North West, South West and Highlands would see increases in rainfall of between 10 and 60% and the rest of the country would see decreases.

As a result of these changes, it is anticipated that – while summer water demand will be covered ((November to April) – risks to water from pollution, flooding and erosion will remain important. However, during the dry season, water needs will not be satisfied and the agricultural yields will diminish, particularly in the central highlands. Water conflicts could arise. Studies undertaken during the Second National Communication on rice vulnerability indicate that in the Alaotra region, rice yields will be negatively affected by climate changes, namely because of a decrease in water availability and an increase in erosion from sudden rainfall and flooding. The increase in temperature and a delayed onset of rains will also affect the growing cycle of most rice varieties as well as other crops.

2.3 Main problem addressed by the project, root causes, barriers and preferred solutions

The project seeks to address the vulnerability of the rice sector to climate variability and anticipated climate change in order to ensure continued agricultural growth and poverty reduction. The project responds to the multiple and combined impacts of climate change, specifically the anticipated modification in rainfall patterns and decreased water availability and increases in temperatures.

The project is based on the existence of a number of adaptation and coping mechanisms already under implementation in the country, such as traditional soil and water conservation practices (for example mulching, composting, inter-cropping, agro-forestry), and more elaborate systems derived from research such as the System for Rice Intensification or Integrated Pest Management which prescribe a set of cultivation methods applicable to the entire rice production chain in order to increase yields. Low

access to adequate agricultural inputs and technologies, such as fertilizers, management practices and calendars, as well as the degradation of irrigation infrastructure and, in some areas, the total absence of water conservation structures or practices, are further constraints on resilience in the rice sector in Madagascar. As a result of these factors, and despite adaptations such as the introduction of the System for Rice Intensification (a set of adaptive rice cultivation practices designed to increase yields), rice yields remain stagnant, and about 1.5 million inhabitants face seasonal food insecurity during the rainy season. In addition, there is a lack of climate related guidance for the rice sector, and existing norms, standards and practices, including the deployment of extension and research services, are not taking climate change into account.

The project intends to adapt these existing technologies and approaches - which have yet to become widespread and are not applied in an optimal manner in Madagascar - to develop integrated rice cultivation models that are resilient to anticipated climate change.

The project also intends to address a number of underlying constraints that further exacerbate the projected climate change impacts and that represent major barriers to adaptation and resilience in the rice sector, chief among them erosion (due to topographical conditions as well as unsustainable land use), unsustainable or inadequate agricultural practices (e.g. traditional slash-and-burn land preparation, tavy (hillside) rice cultivation, ad hoc or excessive planting and flooding, and mis-informed use of fertilizers), water pollution, and the destruction of buffer ecosystems such as mangroves and wetlands for agricultural or touristic expansion. These root causes of vulnerability are results of widespread poverty in Madagascar and in the targeted region in particular, leading small farmers to resort to land expansion to achieve higher yields (rather than intensification, because of lack of technical means).

Deforestation and land clearing, a particular problem in Madagascar, is also the result of growing energy needs, with fuelwood (and charcoal) still providing a significant part of energy in rural areas. It is estimated that Madagascar loses 400 tons of top soil annually due to deforestation in sloped and mountainous areas, leading to heavy siltation in lowlands and water bodies. Studies and observations using satellite imagery have shown that the Alaotra Lake had shrunk to 20% of its former size in 2000. In addition, crop productivity in the basin is reputed to have also dropped to about 40% of its former level as a consequence of the silting of the rivers and irrigation canals, yet clear-cutting and slash and burn clearing continue in the basin[4]. Sediment transport from denuded slopes occurs through weathering promoted by strong rains. It can be expected that, in a business as usual scenario, continued land clearing combined with the occurrence of stronger rainfall events due to climate change will lead to increased siltation and lower productivity in the lower lying areas. It is broadly recognized that clear cutting and land clearing are used to expand areas under cultivation, because yields are low, creating a self-reinforcing cycle between declining yields and continued deforestation. Achieving higher yields without land expansion will require addressing uphill erosion issues that function as a barrier to productivity.

Other barriers are preventing the country from achieving optimal yields and rice resilience. For example, knowledge and technical information does not reach local producers and many still resort to traditional, inadapted and sometimes unsustainable cultivation methods (e.g. tavy or slash-and-burn), that provide short-term gains but deplete soil fertility and degrade the environment. Low yields also

[4] Bakoariniaina, L.N. et.al, Disappearing Lake Alaotra: Monitoring catastrophic erosion, waterway silting, and land degradation hazards in Madagascar using Landsat imagery, Journal of African Earth Sciences 44 (2006) 241–252.

undermine producers' purchasing power and therefore their ability to acquire appropriate inputs such as enhanced genetic material or well-calibrated fertilizers. Agricultural extension services are sometimes over-stretched, and their knowledge of climate risks and climate risk management is generally low – although it has been proven that well targeted support to farmers leads to significant yield increases (see Annex 2 for data). This is compounded by the fact that, although all recognize the climate-sensitivity of rice, no significant effort has been made (for lack of means) to ensure that producers and small farmers have access to timely and relevant agro-meteorological information, allowing them to better calibrate cultivation practices and calendars. Despite severe impacts of floods and trends towards stronger rain events in the country, there is no early warning system in place. This, combined with accelerated erosion and siltation of drainage and irrigation canals, could lead to a very dire situation in rice-producing areas where flooding is already a periodical problem. At the national level, no concerted effort to address the impending impacts of climate change on rice production – the cornerstone of Madagascar agricultural sector and the most basic food supply in the country – has yet taken place.

2.4 Project approach

Climate change is expected to affect rainfall patterns and to decrease overall water availability. Adaptation in Madagascar must respond to challenges posed by climate change to agriculture, and more specifically to rice. This project posits that resilience in the rice sector can only be achieved by implementing a comprehensive set of practices designed to increase yields, decrease environmental degradation, and restore and maintain ecological services in all areas of the rice production chain.

The project will therefore attempt to provide integrated solutions to the issues mentioned above in the sub-region of Alaotra-Mangoro, by piloting a strengthened rice cultivation model that will help achieve sustainable yield increases under all climate scenarios. Project activities are designed to achieve resilience both directly and indirectly. First, by introducing additional elements of resilience, including in tree species selection, livestock management, and land management, these will become resistant to climate shocks in and of themselves (drought and flood resistance, disease resistance); second, by providing additional ecosystem services to rice production, they will contribute to the resilience of communities by providing added economic development through increased productivity, even in times of climate hardship. This pilot application will be deployed initially in three sites in the Alaotra Lake Region (see section 3), with a view to future upscaling and replicating: first, to the broader region, and second, to the rest of the country's rice production areas.

The project will strengthen scientific and technical capacity to develop a model for Integrated Resilient Rice (or Modèle Intégré de Riziculture Résiliente – MIRR), working with experienced national partners in this field (FOFIFA), regional and international centers of rice expertise (IRRI and World Vegetable Center), on the basis of existing knowledge, scientific advice and practical evidence. This improved model will be based on existing available technologies (varieties and cropping systems), but will integrate new dimensions of climate change resilience.

The model will be implemented with the support of producers and communities in the pilot region of Alaotra-Mangoro, currently considered as most vulnerable to variability but also the highest productive region in the country, using a participatory and integrated approach that involves both paddy cultivators (low land) and other land users such as livestock herders and tanety cultivators (uphill) whose practices have an impact on the health of the rice ecosystem. The model will also integrate aspects of environmental management, including watershed management, integrated pest management and

water management, so as to ensure the resilience of the ecosystem that forms the basis of all rice productivity. This will also allow the project to address barriers to adaptation and resilience, namely erosion and siltation, both factors that are leading to decreased yields and losses in arable surface, decreased soil fertility, and increased flooding. This will be achieved by working with local groups, such as producers cooperatives, forest management associations, and NGOs, as well as other ongoing projects (see section F for details) to restore the natural environment and its ecological services.

Finally, the project will engage regional partners and national policy-makers in a dialogue and reflection on potential maladaptations and policy gaps in the rice sub-sector, with a view to achieving a policy on rice resilience that will help multiply and replicate project achievements throughout the country. This will form the basis of a two-tiered replication strategy, that will first seek to apply the project outcomes in the broader Alaotra region, and secondly to integrate the results into broader rice policy-making for the country.

The approach selected for this project is inspired by the ecosystem approach to adaptation (EBA) in that it seeks to create opportunities for generating co-benefits for vulnerable communities and ecosystems, thereby creating a mutually reinforcing dynamic of resilience. EBA is a distinctive service from UNEP to support countries with innovative and low-cost solutions for adaptation. It is an approach to work with nature to build resilience of vulnerable ecosystems and use ecosystem services for adaptation and disaster risk reduction. This approach can generate multiple benefits such as carbon sequestration and other significant social, economic and cultural benefits. Healthy ecosystems and their services provide opportunities for sustainable economic prosperity while providing defense against the negative effects of climate change.

3. Overview of targeted region: Lake Alaotra Region

The project will be implemented in the Lake Alaotra-Mangoro region, which is considered among highest rice producing region in the country, but also the most vulnerable to climate variability and climate change[5]. It is anticipated that changes to rice practices adopted here would be more easily replicated in other conditions. Furthermore, the typical climate of the highlands provides an opportunity for variety testing and selection, as well as resilience testing which is unequaled in the rest of the country.

The Alaotra region is located in the Center-East of Madagscar and covers 20,984 km^2. It is comprised of 3 districts : Andilamena (8 communes), Amparafaravola (20 communes), and Ambatondrazaka (20 communes). The total population of the region is 380,291 persons, not taking into account the important migratory movements during planting harvesting seasons.

The Alaotra region is composed of lake depressions (Alaotra, Andilamena and Didy) alternating with vast

[5] The region's vulnerability to climate variability and climate change is a result of its exposure to climate change effects on rainfall patterns and extreme weather events (such as droughts and floods) as well as of the underlying vulnerability of large populations who depend almost exclusively on rice cultivation (and therefore climate-dependent natural resources), and who live in poverty. The priority of the region is due to its overall large proportion of the national rice production. The criteria that were used to select the region combine demographic data (number of people, density), social considerations (levels of poverty and reliance on natural resources), climatic vulnerability (climate variability and risks, occurence of extremes), and economic criteria (importance to national economy). A recent study supported by the ACCA project (IDRC) provided detailed vulnerability index calculations for a sample site within the region, showing medium to severe vulnerability depending on varieties used, level of technology, and access to inputs more specifically water.

plateaux (700m mean altitude). Low lying areas and comprised of marshes (a.k.a "zetra") and lakes. The hillsides have been degraded by fires and are prone to excessive erosion, characterized by deep gullies (lavakas) that form on mountain sides[6].

The region is Madagascar's principal rice growing region, with approximately 120,000 ha of paddies. It is home to the country's most productive farms, with average yield per ha standing at 25% over the national average, or an average of 250,000 and 300,000 tons annually – an average 3.5 to 4tons per hectare. Other crops include cassava (175,000 tons), potatoes (49,000 tons), corn (50,000 tons) and sugar cane (50,000 tons). Rice cultivated area per farm also significantly exceeds (2.3 times) the national average, which stands at 0.84 ha. Consequently, average total farm production is threefold the overall average figure of 1.600 kg of paddy. Livestock also occupies a part of agricultural activity, with approximately 265,000 cattle heads and a budding aquaculture activity. (see Annex 2 for annual data on rice production in the region).

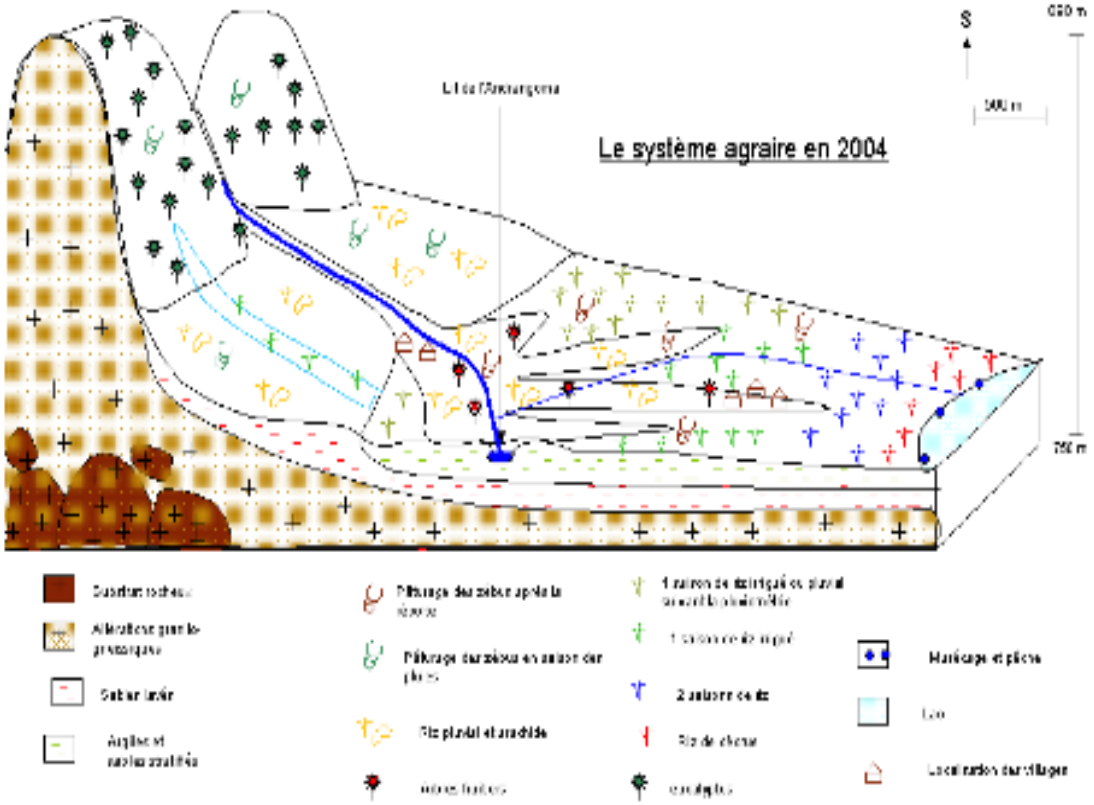

Figure 3: illustration of the rice cultivation ecosystem in Eastern Alaotra region, with interactions between paddy and various rice cultivation systems, livestock, trees and other crops[7]

[6] Recent research (e.g. Cox, 2009, or Randriamanga et.al, 2006) has shown that lavakas may have pre-dated human settlement in the area, and therefore that the once assumed link between human behaviour and lavakisation is no longer tenable. Lavakas occur as a result of subsidence, encouraged by high seismicity. Lavakas also evolve with time, from the stage 1 gullies that yield high rates of sediments during weathering, to final stage lavakas that are re-colonized by vegetation and can be used by farmers and livestock, but no longer contribute to siltation downstream.

[7] Ministry of Agriculture, Fisheries and Livestock, 2009. Document de travail BV lac n°27 Des savoirs aux savoirs faire : l'innovation alimente un front pionner : le lac Alaotra de 1897 à nos jours.

The region is the basis for a relatively large number of downstream operators, who are located in urban centers such as Ambatondrazaka and Amparafavola. The bad road situation, particularly RN44 (under rehabilitation), represents a real bottleneck to link Lake Alaotra with other regions.

The Lake Alaotra basin is a fragile area that hosts unique flora and fauna. This biodiversity is facing combined threats from expanding agriculture and pressure on resources, in particular erosion of mountainous areas. Slash and burn practices are continuing, despite their negative impact on the natural resources and low productivity. Rice cultivation in Alaotra region faces similar constraints as the rest of the country, with catchment deforestation leading to gradual siltation, and declining soil fertility. If the majority of catchments in the area are equipped with hydro-agricultural water infrastructure (retention dams), most have become outdated and are lacking maintenance. Irrigation and drainage infrastructures are often degraded due to lack of means for maintenance, canals and reservoirs have been silted and potable water supply has declined. For example, the concrete dam of Sahamaloto, that could once contain 30 million cubic meters of water when it was first created, is now reduced to half its capacity due to siltation. Local producers estimate that they lose 10% of their arable land annually due to siltation. Finally, the productivity of rice systems is slowing down due to low mechanization, low access to inputs such as fertilizers and tools, and outdated production technologies.

Local producers are regrouped in a federation of water users (group of water user associations - WUE), through which they contribute to a fund destined for the maintenance and rehabilitation of water infrastructure. The contribution, made in rice, is 190Kg of paddy per hectare, and the federation is charged with taking on all the regular maintenance works, using small materials. As for rehabilitation activities, they only account for 20% of financing from WUE, while the rest is solicited from outside partners and donors. Furthermore, since the subsidy programs were stopped, most local producers are now lacking the means to procure enhanced seeds, fertilizers and phytosanitary products at market prices – this being compounded by a decrease in purchasing power due to the declines in paddy prices.

Livestock management in conjunction with agricultural activities in the Alaotra region presents some challenges, as herding sometimes compete with other land uses. Management of feed, manure, reproduction and animal health also present challenges independently from crop management. Of particular relevance, overgrazing and the maintenance of ecologically appropriate herd numbers and pastoral zones represent specific challenges for rice cultivation in that in can contribute to erosion when not carefully managed. On the other hand, livestock management can also contribute positively to rice productivity through the production of manure, the effective use and disposal of rice by products as cattle feed, as well as labour.

Rice production in the region is also subject to diseases, pests and post harvest losses. For example, there has been an increase in Pyriculariosis (a disease caused by a fungus that can lead to total crop destruction depending on conditions), a disease that seems linked to the type of soils present in Alaotra region, and depending on the type of vegetable used during rotation crops. It has been shown that using resistant varieties (currently available for highlands from the FOFIFA, such as FOFIFA 160) could help increase yields to up to 5 to 7.5Tons/ha with complete absence of the disease. Other diseases include Helminthosporiosis (a nutrient deficiency), Sarocladium (plant rot in sensitive plants), and

Pseudomonas or brown rot (a bacteria that develops in colder climates and higher altitudes). In all cases, resistant varieties exist that can significantly or radically eliminate the presence of diseases. Pests include insects and rats, and can be controlled using integrated pest management techniques.

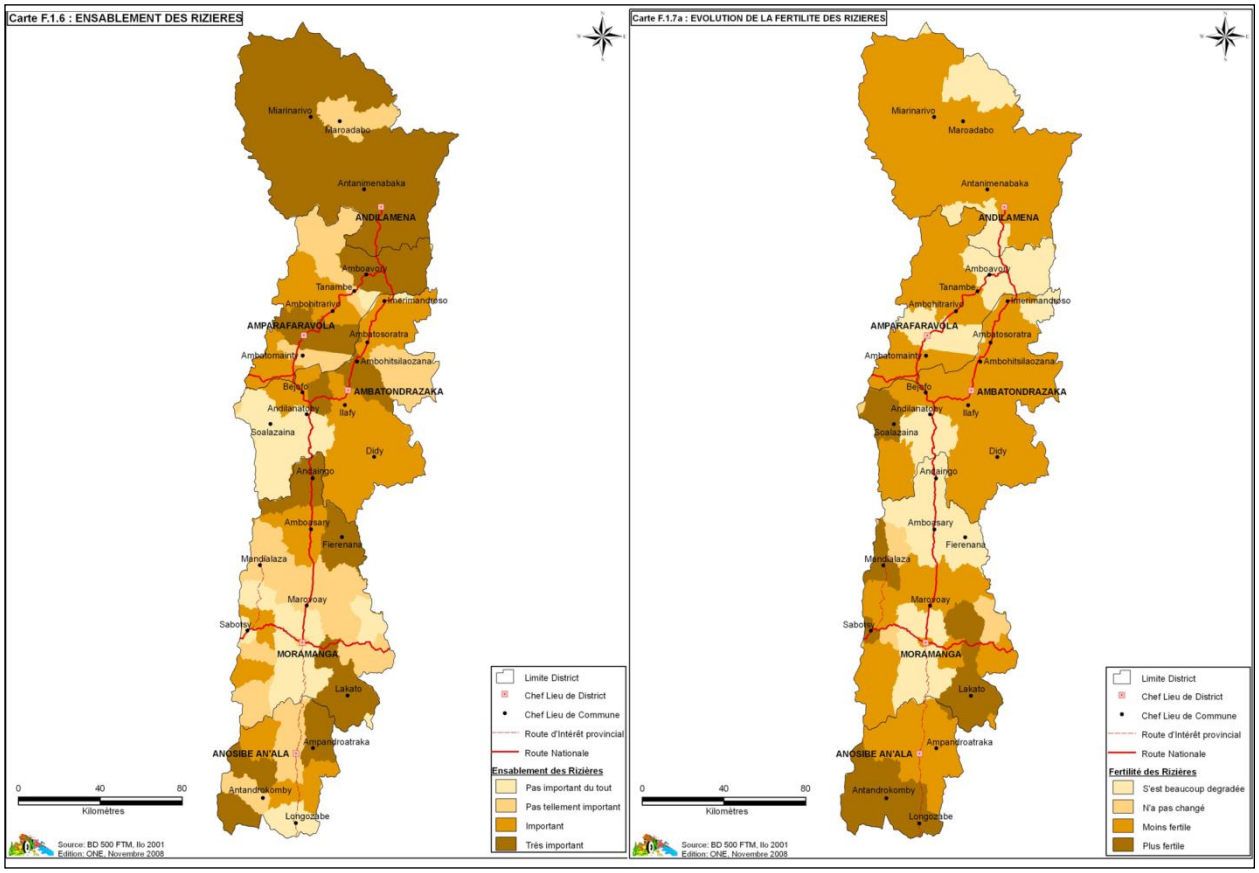

Figure 4: Siltation (left) and soil fertility change (right) in Alaotra paddies

The post harvest system is oriented towards the prevention of losses in foodstuff as well as on the transformation of crops into added value products. Quantitative post-harvest losses occur due to attack from pests (such as birds or rats) and due to inappropriate harvest practices (shelling, threshing). Qualitative losses can also occur due to presence of stones or mycotoxins, late harvesting, and inappropriate manipulations (piling, drying, packing). Strengthening of post-harvest practices, including the modification of phytosanitary standards, is an important aspect of increasing productivity. Losses have been estimated at 10 to 15% of total production. Post harvest infrastructures are insufficient in the region, both in quantitative and in qualitative terms (tools, machinery, silos, technical capacity, control mechanisms).

The majority of storage facilities are held by private operators (trader or paddy transformers). They are mostly used to stock paddy towards local resale in-between seasons (6 months in the Alaotra region). Important public facilities had been built for the Société Malgache d'Aménagement du Lac Alaotra (SOMALAC), but the large majority of these facilities are in some state of disrepair (11 out of the 21).

Regarding the use of rice by-products, producers in the region have traditionally used mulching and composting, for nutrient cycling, of leftover straws in the fields. However, rice straws are also sometimes used to provide feed and bedding for cattle and pork; since livestock cannot graze during the

rice cultivation cycle, straws are also used to provide feed when animals are stabled and during the dry season, also helping with the manure production. Rice bundles are sometimes used as combustible, and the ashes used as fertilizers. In the Alaotra region, local production of feed and combustible using rice by-products can provide additional revenue. However, there are too few small scale transformation units (other than large industrial producers) that would enable to respond to local demand and generate sufficient income.

The region also has some health infrastructure challenges, although there is at least one basic health center per commune. There is on average 1 doctor for each 8450 inhabitants; most common pathologies include malaria, acute respiratory infections, diarrheas, all of which can be related to water management and to the use of pesticides.

Project sites were selected among the region's districts and communes according to a set of social, economic, environmental, and institutional criteria (see Annex 3 for further detail). Project activities will therefore be focused in the following sites, that share the same basic characteristics and conditions:

- ***Ambatondrazaka*** district, *Ilakana* and *Sub-urban* communes: Total district population is 321 517, for a total area of 6492 km^2. Main cropping systems consist in rainfed irrigated rice, using a water retention system (dam), but without any major water conservation practices. The dam is silted. According to the latest data8, productivity in the district is 3.1Tons per hectare, using hybrid varieties (X-365); farmers have low access to inputs and irrigation infrastructures are in a state of disrepair. In Ilakana there is very low degree of mechanization, though it is higher in the sub-urban communes. There are insufficient storage facilities to satisfy local needs. Paddies suffer from siltation, with a reported 10% decrease in sub-urban communes. Local communities have also reported a trend towards hydrological deficit, and in February 2011 (latest available data), the highest reported rainfall was 111,4mm. The district is home to the FOFIFA regional center, and nearly 75 community based organizations, as well as some important NGOs working towards development and environmental conservation. There are 4 major water courses, used for irrigation (Sahabe, Lohafasika Sahasomanga that irrigates some 4000ha, Maningory and the Lovoka). These 4 rivers are suffering from high levels of sediment transport due to intense upland erosion.

- ***Andilamena*** district, *Bemaintso* commune: Total district population is 68,352 people, 80% of whom are concentrated in Bemaintso (an area of 510 Km^2). Cropping systems consist in irrigated rice, with a mean yield of 2.7 T/ha, using outdated genetic material (local communities report that access to enhanced seeds is too expensive), with severely degraded irrigation infrastructures, and low levels of mechanization. The degree of food security in the area is considered mediocre, and farmers also report a trend towards water deficit, including insufficiencies in potable water supply. Paddies are also suffering from siltation due to upland erosion, with reported spikes in sand influx during strong precipitation events. The commune has a Communal Development Plan that is not entirely funded, and its water user association is not entirely functional for lack of means. The district is home to a large number of rivers that flow into the Bemarivo, which leads to the Mozambique canal. At least 6 rivers cross the plateaux and irrigate the plains of Andilamena, feeding some lakes and retention ponds.

[8] Agricultural Statistics Division, Ministry of Agriculture, unpublished data for 2009-2010 season.

- ***Amparafaravola,*** *Ambohijanahary* commune: The district counts 206 400 people, in a total area of 6966 Km2, with 46 470 ha under rice, of which 5460 ha in the area of Ambohijanahary. The district reports a late onset of rains as well as growing water deficits. Yields are approximately 3.3 Tons/ha, using hybrid rice (X-365), but with an insufficient access to inputs such as fertilizers and phytosanitary controls; mechanization levels are medium, while the irrigation infrastructure needs to be rehabilitated to be fully functional. Half of the Alaotra lake is located in this district, with three affluents: the Sahamaloto irrigates 6000ha of rice, the Anony irrigates 4,476 ha, and the Imamba Ivakaka irrigates 2,671 ha.

All three sites report a trend towards higher mean temperatures (23.6 ^{o}C) and water deficits or a late onset of rains. On average, the number of female-headed households is 20% (17% in Amparafaravola). Average incomes are less than 100$ per year for all three districts. All three sites also benefit from an easy or relatively easy access to FOFIFA infrastructures and research stations, and intra-regional roads are for the most part practicable, except during severe or prolonged rains. Water user associations are existent in all districts, but not fully operational due to a lack of means. There are private operators throuhought the region, namely the Société Industrielle du Lac Alaotra (SILAC). In sites located on the Eastern bank of the Lake, such as Ilakana and Bemaintso communes, the slopes are rather more remote from the paddy cultivation area, and are exploited by a different community; whereas in Amparafaravola district and other areas on the western bank, the same community is responsible for using and managing both the low lying and sloped areas. The project will therefore engage with both low-land and highland communities inasmuch as the highland communities have an impact on low-land productivity through unsustainable land use, leading to erosion.

Water management is relatively weak in the region, particularly in areas where rehabilitation of the network has not yet taken place. Water resources decrease from year to year due to a drying up of the sources that lead into the dams and reservoirs; dam retention capacity decrease due to siltation and sedimentation and the filling up of canals from sediments and sand due to erosion diminishes their capacity for irrigation and water transport. The predominant type of irrigation is gravitational, with perimeters irrigated using small dams or diversions, and distribution is ensured using a network of canals with control gates. Each perimeter is surrounded by small dikes to protect against floods and the evacuation of river waters during floods is ensured using a central canal directed towards the Lake. However, these works are also all suffering from siltation and sedimentation, leading to increasing flooding. For example, the Sahamaoto dam is 40% filled (250,000 m^3 per year); for other reservoirs, such as PC23 and Anony, it was estimated that annual dredging of up to 100,000m^3 of sand would be necessary to ensure efficient irrigation (under current erosion trends).

All project activities are expected to be implemented in all three districts, with the collaboration and active participation of producers. Participating producers were selected based on local consultations, and in accordance with current practice, among those who are working as community relays in collaboration with the Agricultural Research Institutions.

Annex 3 provides compiled data and criteria for all three sites, where available.

2. PROJECT / PROGRAMME OBJECTIVES:

List the main objectives of the project.

This project seeks to demonstrate an integrated approach that addresses the vulnerability of the rice sector to climate variability and projected climate change in Alaotra-Mangoro region, as the potential basis for upscaling resilient agricultural and rural growth. This will be achieved through an increase in rice productivity, using resilient inputs, maximizing the efficiency of resource use, and ensuring an appropriate management of natural resources so that ecosystem services and productivity can resist climate changes and shocks.

This will require strengthening the scientific and technical capacities for determining further adaptive options in the rice sector, and the implementation of a set of concrete and targeted changes in the rice cultivation chain, starting with the definition and application of an Integrated Resilient Rice cultivation system (MIRR) that is based on best available technologies and practices. Project results and outcomes will then be subject of a replication and upscaling strategy that will target first the Alatroa-Mangoro broader region, and then the rest of the country through mainstreaming aspects of resilience in future rice policy.

This approach will be piloted in the Alaotra-Mangoro region located on the Central Hihglands of Madagascar. It is among the most important river basins of the Central-eastern part of the island, and is identified by the NAPA as one of the most vulnerable regions and a priority area for adaptation investment due to its relative importance in the country's economy. In this region, fluctuating increases of rice productions have been observed during the last four decades. The region is home to some of the country's remarkable and fragile ecosystems and biodiversity, including the Lake Alaotra, wetlands (which are classified as a Ramsar site), and various species of waterbirds and lemurs.

The Initial and Second National Communications, as well as the NAPA for Madagascar, both stress the urgent need of promoting adaptation in the rice sector, while achieving progress in productivity.

The overall objective of the project is to demonstrate pathways towards the transformation of the rice sub-sector to make it more resilient to current climate variability as well as expected climate change and associated hazard, through implementation of pilot investments in the Alaotra-Mangoro region that have the potential for being upscaled at national level. This overall objective will be achieved namely by pursuing the following secondary objectives:

- Strengthening the scientific and technical capacities of Malagasy authorities to understand, analyse and manage climate risks to the rice sub-sector, as well as to determine further adaptation options for the sector. This will be achieved at regional level, working with central and decentralized government and technical services.
- Implementing and disseminating a series of concrete changes to the rice production practices, from input to harvest management, including measures designed to restore and maintain ecological services around rice ecosystems. This will be achieved through the demonstration of adaptation activities at local level in the Alaotra-Mangoro region.
- Identifying and addressing the key policy barriers, gaps or maladaptations in order to create the conditions for upscaling adaptation in the rice subsector. This objective is targeted towards the identification of upscaling mechanisms at regional and national level and activities will be deployed with regional and national partners.

This will involve implementing concrete changes at all steps of the production cycle, from the selection of cultivation inputs, to the dissemination of proven successful production techniques (including land and water management), to early warning and storage, using an integrated approach that encompasses all primary and seconday elements of the rice ecological system, including livestock, trees and forests and other crops, in the extent to which they contribute to or hinder rice productivity.

3. PROJECT / PROGRAMME COMPONENTS AND FINANCING:

PROJECT COMPONENTS	EXPECTED CONCRETE OUTPUTS/TARGETS	EXPECTED OUTCOMES	AMOUNT (US$)
1. Scientific and Technical Capacity	1.1.1 Best Available Technologies and Integrated Resilient Rice Model (Modèle Intégré de Riziculture Résiliente - MIRR) selected and publicized (165,000 US$) 1.2.1 Four crop models and one hydrological model available for rice vulnerability mapping (108,000 US$) 1.2.2 Updated, dynamic agricultural calendars and climate early warnings taking into account current and projected variability disseminated to local population (415,000 US$) 1.2.3 Agricultural extension staff trained on climate risk management in an agro-ecosystem context (90,000 US$)	1.1 Knowledge base on best practices for climate resilience in rice, based on existing local knowledge and international research 1.2 Malagasy government, research institutions and local communities have the tools and methods to assess, monitor, and understand climate change impacts on rice.	803,000
2. Adapted and resilient rice production cycle 2.a - input management 2.b – production management 2.c – harvest management	2.1.1 Climate resilient rice varieties selected through participatory field testing (190,000 US$) 2.1.2 An operational multiplication and dissemination scheme for adapted seed varieties (350,000 US$) 2.1.3 Updated fertilisation guidelines according to best available standards and taking climate conditions into consideration (535,000 US$) 2.1.4 Integrated pest management is implemented through training and extension (75,000 US$) 2.1.5 Water efficiency, management and conservation technologies and infrastructures are implemented through training and extension and infrastructure rehabilitation and construction (575,000 US$) 2.2.1 Best available land preparation, production and harvesting techniques disseminated to reduce deforestation, maintain soil fertility and integrity, and to provide adequate growing conditions (375,000 US$) 2.2.2 Watershed rehabilitation in productive landscapes introduced, including through reforestation and adaptation of agroforestry practices (460,000 US$) 2.2.3 Soil conservation and livestock management techniques adapted to topography and landscape in light of future climate conditions (330,000 US$) 2.2.4 Revitalization of producer's cooperatives and water user associations for collaborative natural resources allocations (e.g. land and water) and management (100,000 US$) 2.3.1 Water quality assessments (80,000 US$)	2.1 Sustainable increase in rice yields (using MIRR) 2.2 Ecosystem services maintained 2.3 Health improved and new disease spread prevented	3,310,000

	2.4.1 Increased utilization of rice by-product especially rice straw (110,000 US$) 2.4.2 Post-harvest storage facilities with phytosanitary control, serving as trading points and markets (130,000 US$)	2.4 Post Harvest losses reduced	
3. Leveraging policy change	3.1.1 Gaps and possible maladaptations in the current rice policy are identified and recommendations on rice policy reform are made (170,000 US$) 3.2.1 A report on best practices and lessons learned for rice adaptation in Madagascar (30,000 US$)	3.1 Technical norms and standards in rice cultivation reviewed and where necessary modified to take climate change into account 3.2 Conditions in place for a full adaptation of the rice sub-sector	200,000
4. Monitoring and Evaluation (see the M&E table under part III.C)			132,000
5. Project/Programme Execution cost (see Execution costs under Part III.A)			260,000
6. Total Project/Programme Cost (Total of 1 to 5)			4,705,000
8. Project Cycle Management Fee charged by the Implementing Entity (8.5% of Project total, see Annex 7)			399,925
Amount of Financing Requested			5,104,925

4. PROJECTED CALENDAR:

Indicate the dates of the following milestones for the proposed project/programme

MILESTONES[9]	EXPECTED DATES
Start of Project/Programme Implementation	February 2012
Mid-term Review	July 2015
Project/Programme Closing	February 2017
Terminal Evaluation	February 2017

PART II: PROJECT / PROGRAMME JUSTIFICATION

A. Describe the project / programme components, particularly focusing on the concrete adaptation activities of the project, and how these activities contribute to climate resilience. For the case of a programme, show how the combination of individual projects will contribute to the overall increase in resilience.

This project proposes the implementation of a set of concrete adaptation options in a targeted agricultural sub-sector, supported by a set of enabling measures designed to strengthen Madagascar's science, technology and policy capacity. The concrete measures in this project are direct applications of best avaialable knowledge, technology and approaches and aim at effecting an immediate change in behaviour in the rice cultivation cycle. The measures proposed in this project depart from the baseline management of the rice sector in Madagascar in that they are either additional activities (for example, water conservation) or different approaches (for example, the application of different fertilizers at

[9] Disbursement milestones are indicated in Annex 7.

different times) that are expected to make rice production more productive and resilient in the face of climate change. The desired outcome of this project is to achieve resilience in the rice sector by achiving ii) increased rice production that will withstand projected climate conditions and ii) increased environmental sustainability and ecological services in the rice sector. The project will be implemented in three pilot districts of the Alaotra sub-region (see section 3) , and will work at local level with local producers and partners, with the support of decentralized ministries and regional technical partners.

Component 1: Scientific and Technical Capacity. Although this project is based on current knowledge and scientific research, some targeted additional elements of investigations are necessary for a well calibrated transformation of the rice sector towards resilience. For example, although common knowledge indicates that rice yields would overall suffer a decrease under climate change, some reseach points to potential opportunities for rice under specific management conditions. As a first step, the project will support the selection of a limited number of optimal integrated rice cultivation models, or systems, in relation to emerging climate conditions (outcome 1.1) and appropriate to the targeted region.

Research into the various available systems will be based on a participatory comparative analysis of the existing best practices for climate resilience in rice, using indigenous and local knowledge as well as expertise from international research centers, such as the International Rice Research Institute (IRRI)[10]. This research will be conducted using established agricultural research farms and antennas in the Alaotra region, that operate in close cooperation with farmers (including through the use of farm-schools and demonstration plots). The exercise will be coordinated by the FOFIFA (agricultural research institute) in collaboration with producers cooperatives and farmer associations on the ground, as per current practice and using existing extension networks. The result of this research will be the selection of climate-adapted rice-specific best practices, or an Integrated Resilient Rice Model (Modèle Integré de Riziculture Résiliente – MIRR). The MIRR will include guidelines and prescriptions for resilient rice production along the full cycle of rice production, from species selection to input management (specifically water and fertilisation), land preparation/management and harvesting methods. Elements of resilience that should be comprised in the MIRR include:

- Variety characterization in function of emerging climate conditions and resilience analysis as a function of temperature, rainfall and other combined effects, including resistance to emerging pests and extreme events;
- Soil preparation techniques compendium in relation to temperature, weathering, rainfall and water availability and appropriate according to variety; seeding method.
- Best combination for non-rice crop alternance and adequate land management techniques (fruit trees, vegetable crops)
- Applications of water (quantity, timing, quality) under emerging climate conditions

[10] See for example, IRRI, 2010 : Advanced Technologies of Rice Production for Coping with Climate Change: 'No Regret' Options for Adaptation and Mitigation and their Potential Uptake.

- Applications of fertilizer (organic, inorganic, content, timing) appropriate for various varieties under specific conditions.

- Erosion control methods for tavy and tanety cultures and expected yields under various climate conditions and soil fertility enhancing measures in rice paddies using organic content and rice by products.

- Harvesting and preparation methods taking into consideration variety, yield, harvesting time, climate conditions and pest management.

This model (or models) will be validated through expert consultations and advice at national and local level, and will then be tested in an integrated approach at farm level under Component 2, in the shape of a package of technologies and methods that will be transferred to local producers through training and demonstration.

In addition, in order to support future decision making (outcome 2.2), government and other agricultural institutions need to develop the capacity to understand and analyse climate change impacts and their effects on the productive sectors of Malagasy economy. Hence, the project will provide the tools for crop modeling and vulnerability analysis focused on the rice sector. Current crop modeling capacity in the country is severely limited (two trained staff, using DSSAT[11] and CROPWAT modeling tools, that apply to all crops) and no models have been produced that take future climate conditions into account, for lack of data. Therefore the project will support the production of two alternate sets of models, using DSSAT as well as Oryza 2000, a crop modeling tool that is specialized for rice. These two models will be used to provide an analysis of current and future crop vulnerability for the region of Alaotra and country-wide and will serve as a basis for activities in Component 3, focused on determining adaptation gaps and policy orientations for rice resilience. The project will also support the development of a climate-based hydrological model for the region, in order to gain a sound grasp of future water availability.

As a means of providing stronger technical support to local producers, the project will also provide enhanced agro-climatic services, including updated crop and cultivation calendars that take new climate trends into account. Agricultural extension personnel will be trained on climate risk management in the context of rice agro-ecosystem, integrating all aspects of the rice production ecology, such as alternate vegetable crops, agro-forestry uses and livestock management in a context of climate change. This will ensure that technical support is provided to farmers and communities in an integrated manner, and that climate considerations are also part of advice provided regarded of the sub-component of the rice system. This is also relevant considering that a large part of dealing with climate change will involve more delicate decisions and trade-offs on the part of farmers; their need for information and careful consideration of the impacts of their farm-based decision-making on rice yields will be greater in a climate change context.

[11] Decision Support System for Agrotechnology Transfer, currently available in version 4. It allows for simulations of any crop growth, yield, as well as water and nitrogen requirements according to the type of soil and climate. It is applicable to peanuts, sunflower, sugar cane, wheat, soy, rice, tomato, sorghum,millet, barley, potato, corn, niebe, beans and more recently cotton. Oryza 2000 is an ecophysiological model. It simulates rice growth for aquatic, flooded and lowlying rice in potential growth situation, including water and nitrogen limitations. It is available for free in its version 2.13 (2009). CROPWAT modeling software is an irrigation assistance tool developed by the FAO. It allows for the calculation of water needed by crops; it allows for the development of irrigation calendars adapted to the various cultivation methods. It is currently available in version 8.0.

Finally, the project will extend climate and weather information to local producers, which is currently not practiced in the region, for early warning purposes, specifically for floods and droughts as well as for transmission of technological knowledge regarding rice cultivation. This will be ensured through the acquisition, installation and operation of a set of synoptic weather stations (under the responsibility of the National Meteorological Institute, but jointly operated by the Ministry of Agriculture). Regular weather information and early warnings will be transmitted to local producers using radio, through an agreement with the Malagasy Rural Radio Network partners.

Component 1 activities: **Scientific and Technical Capacity**

Activities	EXPECTED CONCRETE OUTPUTS	Output indicator	Baseline	Target
Outcome 1.1 Knowledge base on best practices for climate resilience in rice, based on existing local knowledge and international research				
Undertake a participatory comparative analysis of rice production techniques and technologies available in relation to their resilience and cost-effectiveness Organization of a seminar on resilient rice model (MIRR) Publish technical guidelines for MIRR	1.1.1 Best Available Technologies and Integrated Resilient Rice Model (Modèle Intégré de Riziculture Résiliente - MIRR) selected and publicized	# of resilient rice model developed	there are currently various methods for rice cultivation (SRI, SCV, Direct-Seeding, etc) that are site specific, but none integrate climate change and no specific integrated model for the region.	1 recommended resilient rice model for the region
Outcome 1.2 Malagasy government, research institutions and local communities have the tools and methods to assess, monitor, and understand climate change impacts on rice.				
Acquire software and deliver training sessions on Oryza 2000 (10 staff at central level) Perform data collection for DSSAT and Oryza model population Develop and publish to alternative models, using DSSAT and Oryza for 2050 and 2100 for the region	1.2.1 Crop models are available for rice vulnerability mapping	# of vulnerability maps of future rice production	there is currently no rice model for madagascar due to lack of data, although there are 2 staff members trained for DSSAT	4 rice models/maps by end of project
Develop a climate based hydrological model for the Alaotra region for 2050 and 2100		# of hydrological models	no information available	1 hydrological model available at mid-term
Adapt and disseminate agricultural calendars in relation to new climate trends and data, as per agreed methodology Acquire, install and operate climate and hydrological monitoring equipment for early warnings Disseminate climate and weather bulletins through radio	1.2.2 Updated, dynamic agricultural calendars and climate early warnings taking into account current and projected variability disseminated to local population	timely availability of climate information, including flood early warnings	no updated calendars and early warnings in the Alaotra region	updated agricultural information is available at the start of the season and reaches 80% of agricultural producers
Climate Risk Management and agro-ecosystem approach training for decentralized personnel (including application of agro-forestry principles and livestock management in a rice context)	1.2.3 Agricultural extension staff trained on climate risk management in an agro-ecosystem context	number of people trained (gender disaggregated)	10 persons trained	100 staff persons trained (50% women)

Component 1 activities respond to climate variability and climate change by integrating climate information into agricultural decision-making tools and by enabling the selection of a Model for Integrated climate-Resilient Riziculture (MIRR), a set of best practices that will be implemented at local level through the other project components. The activities in Component 1 also respond to climate

variability and climate change through the implementation of early warning and hydro-climatic information dissemination, as well as by helping to develop a solid understanding of future rice vulnerability through modeling.

Component 2: "seed to store" rice sector transformation. This Component, which comprises the bulk of the project, is comprised of 3 sub-components targeted to each step of the production cycle. Based on the outputs of Component 1 (MIRR), and on existing scientific and technical knowledge, this component aims to put in practice a set of changes to the rice cultivation cycle. Each of the three steps represents a delineation of the MIRR model defined in Component 1 above.

Sub-Component 2a concerns primarly "*Input Management*" and is concerned with providing farmers with the appropriate working material, starting with adapted and resilient seeds and varieties, appropriate fertilizers and adequate quantities and quality of water. To initiate production, seeds will be taken from existing varieties recognized as resistant by the competent authorities and available in Madagascar, while the project works to identify more resilient materials using a participatory field testing and variety selection process[12]. Some attention will also be dedicated to the selection of appropriate and resilient non-rice genetic material, including fruit trees and vegetable crops that can help enhance the rice cultivation system and provide additional nutritional benefit.

Resistant and resilient materials will be certified by the Ministry of Agriculture's Seed Certification Service, and disseminated to the targeted communities using existing multiplication and distribution networks (seed producers' cooperatives, under supervision from the Ministry of Agriculture), and in accordance with current practices regarding sale and distribution of genetic material by government authorities in Madagascar, in order to not create perverse incentives and inequities. Materials will therefore be distributed at a low subsidized price.

As part of the MIRR, the project will also support the modification of fertilization practices to take into account revised climate and growing conditions, in accordance with specific varieties. Specifically, the project will provide upgraded fertilization guidelines for the application of traditional organic and chemical fertilizers and will also introduce innovative and more affordable sources of organic fertilizers, such as locally produced manure, guano, and the use of agricultural wastes (through partnerships with private sector companies). The modification of fertilization practices has a triple role in promoting resilience: first by sustainably increasing soil fertility and therefore rice productivity; second by reducing water pollution from chemicals and organic residues; and third by increasing resource efficiency. Appropriate and timely management and application of fertilisers can also help reduce parasites, pests and various diseases that appear in rice crops. The use of chemical fertilizers will be limited, calibrated to the type of soil and rice variety used. Current Ministry of Agriculture policy is to promote the use of organic fertilizers[13] as these are more readily available and affordable to local producers.

In addition, in order to reduce the use of pesticides, the project will also implement Integrated Pest Management techniques. This includes seed selection and the selection of pest resistant varieties, as

[12] FOFIFA and the Ministry of Agriculture hold a variety of rice varieties and strains that have, under research conditions, exhibited a set of resistance traits. Initial selection wil be undertaken from nationally available varieties. Should the project identify other varieties not available in the country, import of seeds will be subject to the application of the Cartagena Protocol on Biosafety and national phytosanitary rules and regulations.

[13] Technical guidance received from the Ministry of Agriculture indicates the following fertilization requirements: Organic fertilizers, 5T/ha; Mineral fertilizers (60N, 60P) combined with manure, ranging from 5 to 15T/ha depending on soil organic matter; Urea 50Kg/ha. These guidelines are based on current knowledge and will be updated during the project to take climate change impacts on soil and improved varieties into account.

well as cultural practices (distance between plants, irrigation management, and weeding), which will be addressed as part of this project. It also includes methods for biocontrol (through the introduction of predators[14], such as birds). Particular attention will also be paid to the appearance of new parasites or to the spread of diseases not currently present in the highlands, as these can be related to climate changes (humidity, rainfall, temperature).

Activities under this sub-component will also pay particular attention to water as an agricultural input. This will include rehabilitating damaged irrigation infrastructure (cleaning up of silted channels, repairing gravitational infrastructures and reservoirs) and dredging the water reservoirs and small dams that have been silted due to uphill erosion (further erosion will be prevented through reforestation and revegetation under sub-component 2.2). The project will ensure that installations are rehabilitated up to norms that take climate change into account (future precipitation regimes, drainage and run-off). Installation of irrigation infrastructure in previously rain-fed areas, based on rainwater harvesting and water conservation technologies (cisterns, small dams), as a means to supplement water supply during droughts will also be created. Efforts to monitor the rates of siltation within dams and irrigation canals will be scaled up with the participation of communities, so as to ensure proper maintenance and early warning, and to maximize the life-span of irrigation infrastructure. This will be ensured though water users' participation in water monitoring which will also measure the types and quantities of sediments in paddy waters (see component 2.2).

It has been demonstrated that a sustainable and well-managed water supply can increase rice yields per hectare up to 50%. These activities will be supplemented by targeted training and support towards the revitalization of water user associations (under sub-Component 2.2).

Activities under this component are to be delivered through existing channels that prevail for communication and transfer of new knowledge to local farmers, using research and extension services, and farmer associations as relays. Participating producers have already regrouped into cooperatives and user associations, which will serve as a focal point for the transmission of information. On-farm training and demonstration plots will also be used for the dissemination of knowledge on best practices.

Sub-Component 2a activities**: input management**

Activities	**EXPECTED CONCRETE OUTPUTS**	**Output indicator**	**Baseline**	**Target**
Outcome 2.1 Sustainable increase in rice yields (using MIRR)				
Pre-select adapted varieties among existing strains (rice and non-rice)	2.1.1 climate resilient rice varieties selected through participatory field testing	availability of information on climate resilient rice varieties	there are currently 10 potential rice varieties showing various degrees of adaptability	at least 5 rice varieties tested and proven resilient in laboratory and field testing conditions
Procure inputs and materials (seeds, tools)				
Perform participatory field test of the adapted varieties in relation to identified climate stresses				
Monitor the participatory variety selection programme over 2 seasons				
Participatory variety selection validation (from a shortlist of resistant varieties)	2.1.2 An operational multiplication and dissemination scheme for adapted	availability of seeds from resistant varieties	no certified resilient seeds available	100 Kgs of resilient certified seeds produced and disseminated
Production of pre-base and				

[14] This will be undertaken using local endogenous species, in order to avoid the introduction of Invasive Alien Species.

foundation seeds Multiplication and distribution of certified seeds	seed varieties			to 10 multipliers
Update fertilisation formulas, guidelines and packets using climate change and MIRR models, considering socio-economic aspects Use locally available fertilizer resources (eg compost, manure, agricultural residues, including rice straws and by products)	2.1.3 Updated fertilisation guidelines according to best available standards and taking climate conditions into consideration	change in use of organic fertilisers and sustainable bio-organic fertilisers	straws are commonly used, but provide insufficient input. bio-organic fertilisers are not commonly used	50% increase in sustainable fertilisers
Implementation of Integrated Pest Management Best Practices through training and dissemination of technological packets	2.1.4 Integrated pest management is implemented	# of people trained in IPM (gender disaggregated)	no training in IPM available	400 farmers trained in IPM (gender disaggregated)
Rehabilitation of damaged gravitational irrigation infrastructure and canals and continued monitoring	2.1.5 Water efficiency, management and conservation technologies and infrastructures are implemented	Km of rehabilitated irrigation canals	all irrigation canals are showing signs of degradation and blockage	200 Km of irrigation canals cured, dredged and maintained
Dredging of silted water reservoirs		Number of reservoirs dredged	all reservoirs are showing signs of siltation	3 main reservoirs and water retention structures drained
Installation of new irrigation, drainage and water conservation structures		% increase in water availability in all seasons	Quantity of water available for irrigation is dependent on rainfall and erosion	35% increase in water availability in all seasons
Implement enhanced irrigation methods and management and water conservation practices (including water harvesting) adapted to new climate trends and conditions through acquisition and operation of upgraded irrigation equipment and training of water users		% increase in water use efficiency	current water per ton usage approximately 30Kg per m3	20% increase in WUE

The activities in Sub-Component 2.1 respond to the direct and indirect impacts of climate change and climate variability on rice cultivation, specifically the impacts of climate change on rainfall regimes and water availability, first by introducing enhanced seeds that will resist to the anticipated impacts of climate change on rainfall patterns, vector distribution and growing season parameters (drought and pest resistance, flooding resistance and productivity traits). The project will also help adapt cultivation practices (input management) to emerging climate patterns and conditions, by promoting water conservation and efficiency increase (to respond to droughts and floods). Enhanced fertilisation (to increase yields in relation to enhanced genetic material and reduce pollution of scarce water resources) and integrated pest management (to respond to new vectors and diseases while reducing pollution of natural resources) are included in the sub-component as measures to support increased and sustained yields, as well as to reduce pollution of water resources that will be becoming increasingly scarce under climate change scenarios.

Sub-component 2.b "Production Management", concerns primarily the land and agro-biodiversity management practices involved in rice production. Techniques identified in Component 1 as part of the MIRR will be disseminated through training and extension services, to ensure that cultivators are implementing the best available sustainable land management practices. These include land preparation techniques, tillage, irrigation management and maintenance, planting and replanting schedules, fertilising schedules and ratios. Taking into consideration the entire rice production system, this component will also dedicate some attention to the resilience of non-rice components of the ecosystem, inasmuch as they have an impact on rice resilience and productivity: vegetable cropping along river and lake banks, tavy and tanety (hillside) cultures, off-season crops, trees and fruit trees, as well as livestock.

The transfer of knowledge and approaches will be undertaken by the Ministry of Agriculture, through its existing extension and agricultural services at local level, using training and demonstrations, including farm-schools. Participatory management of natural resources (land, water, biomass) as a culture is already prevalent and in the region, and decisions regarding allocations and management of natural assets are taken collectively. The project intends to facilitate this process by building the capacity of local associations to make sustainable decisions and to maintain their operations.

As a means of increasing soil fertility and productivity, in an adaptation of agro-forestry practices, a system of vegetable-rice rotation will also be implemented as part of the MIRR and as a direct contribution to reduced vulnerability of local populations. This will allow for the increased income and nutritional inputs at local level, and through nutrient cycling and fixing, will assist in increasing rice production. In some cases, it has been shown that increases in productivity can reach up to 1 ton per hectare. Vegetables to be planted will include potatoes, sorghum and a variety of leafy vegetables, as these have been deemed acceptable and usable (and profitable) by local communities, based on current practices and an analysis of resilience for these crops. Variety selection for optimal productivity and rice production co-benefit will be undertaken under Component 2a.

In order to prevent further paddy siltation from uphill erosion and to restore and maintain the ecosystem services that are key to agricultural productivity, the project will support efforts to restore and increase vegetative cover of degraded areas. This will involve participatory reforestation using native multi-purpose tree species selected for their resilience traits, including fruit trees in 8500 hectares of sloped areas around the targeted rice paddies, as well as using grasses such as vetiver to stablize eroded slopes. Direct reforestation using trees and grasses will be used preferentially in or around active lavakas[15], to further stabilize the soil, and in areas showing low soil cover, whereas agro-forestry and SLM methods will be used preferentially on slopes that are currently being used for pasture or cropping (including final stage lavakas). The restoration of soil cover will use local multi-use trees and shrub species (for example *Prunus Africana*, *Tamarind*, or *Neem*[16]) and vetiver grasses. Vetiver grasses are used around the world and in similar conditions for their stabilization properties, and have proven

[15] Lavakas have been shown to evolve over time. Active lavakas, or stage 1 to 3 lavakas contribute significantly to sediment transfer through weathering; over time, lavakas become revegetated, slopes become more rounded and grasses and trees gradually re-colonize the gullies. Final stage lavakas are considered to be stable and provide pockets of high biodiversity. Some lavakas are used for pasture and cultivated.

[16] Prunus africana possesses extrafloral nectaries that provide anti-herbivore insects with a nutrient source in return for protecting the foliage, thereby a potential contribution to Integrated pest management. It also has many traditional medicinal uses (fever, malaria,etc..). The timber can be used in the manufacture of agricultural tools and furniture. Tamarind fruit is used in cooking, medicine and its wood can be used for furniture making. Neem is used in medicine; Neem seed cake (residue of neem seeds after oil extraction) when used for soil amendment or added to soil, enriches the soil with organic matter and lowers nitrogen losses by inhibiting nitrification.

highly successful as "first generation" restorers of soil cover, preparing the land for larger scale vegetal growth[17].

Typical agroforestry combinations experienced in this region include the planting of trees in high eroded lands (under community-based management), followed by food crops in lower altitudes (in this case, rice), and vegetable gardening along the banks of water bodies. Training of communities using low-lying as well as upland areas in methods of agro-forestry in a climate change context will also be provided.

Soil conservation methods will also be implemented as part of the MIRR, including a selection of tillage, mulching, fencing and other techniques appropriate to the topography and climate conditions (both low land and slopes). In particular, where vegetable production is underway in the tanety (hillside) or in the lavakas, this will include the transfer of appropriate land use methods for controlling sediment and run-off, in consideration of emerging rainfall patterns and increased weathering. The project will also support an assessment of livestock management methods within the rice sub-system, in relation to climate change, focussing particularly on the potential co-benefits of sustainable livestock management for rice resilience, including the facilitation of participatory agro-pastoral zoning, stabling and the management of manure and feed for enhanced rice and livestock productivity.

This group of activities, although not directly concerned with rice production itself, has been retained for a number of reasons: first, restoration of soil vegetative cover is required to stabilize slopes around the rice cultivation areas, helping to prevent sediment transport during severe rainfall events (which are due to increase with climate change); second, achieving a sustainable rice yield increase per hectare without expanding the area under cultivation will require removing the barrier posed by siltation and erosion in irrigation canals and paddies; third, given the variety of land uses in the rice system, paying adequate attention to the interactions between upland and lowland management practices can provide added benefits for rice productivity and remove hidden barriers to resilience in the ecosystem as a whole.

This work will be undertaken using previously tested models for promoting sustainable land management and collaboration between upland and low-land communities[18]. In this case, the project will help set up sub-basin management committees comprised of communities active in paddy and upland land use, including livestock and vegetable cultivators. These various user groups, as well as paddy farmers, will benefit from training in sustainable land management, including on the application of agroforestry principles within the MIRR and in sloped areas. Based upon an agreement with local forestry services and local authorities, and on an agreed set of terms of reference (cahier des charges), the local communities will undertake joint management of the restored resources. Participatory reforestation activities will be undertaken by local communities and supervised by the technical services of the Ministry of Forests; tree species selection will be undertaken based on resilience analysis and using a participatory selection approach, at the same time as the rice variety selection exercise included under Component 2a. These community-based organizations will be empowered through training, logistical and technical tools, to manage and monitor re-forested or restored areas as a means of self-controlling erosion impacts[19].

[17] See for example, case studies included in National Research Council, 1993, "Vetiver grass: A thin green line against erosion". Also, Holloway, L, 2004 "Ecosystem restoration and rehabilitation in Madagascar". Other studies recognize the link between watershed degradation and paddy siltation, with its consequences on productivity, see for example : "Successful Cases on Sustainable Rice Paddy Farming Practices and Wetland Conservation in Asia" based on "the International Workshop on Rice Paddy and Wetland Conservation: Best Practices in Asia" held in Takashima, Japan on August 6-7, 2010 (available at www.wetlands.org)

[18] Note that in Andilamena there is only one community responible for management of both the lowlying areas and slopes.

[19] This approach replicates a similar model used by the multi-partner initiative on Watershed Rehabilitation and Irrigated Perimeters, implemented with World Bank, FAO, IFAD, Japan and European support in surrounding areas. Similar approaches are being used so as to avoid creating different practices and competing models for natural resources management.

Other producer's cooperatives, natural resource user groups (specifically water user groups and livestock producers) will also be mobilized and revitalized for this project, so as to serve as a basis for the seed dissemination activities, as well as for cooperative management of land and water resources. This will include producers cooperatives, water user associations, as well as the collaborative management systems for secondary productive assets (e.g. forests, wetlands). A community based management plan will be developed that will include all aspects of the rice system ecology (other crops and livestock). It is expected that demonstrations of higher yields without land clearing will create further incentives for farmers to participate in the conservation of highland vegetative cover.

Finally, this sub-component will also include a targeted measurement of water quality, to assess the spread of waterborne diseases and the general evlution of water quality (for irrigation and drinking) in rice ecosystems. Local water quality monitoring will be undertaken by the Ministry of Water. This will include measurements of sediment content in paddy and reservoir waters to provide an indication of the rates of siltation[20]. This monitoring is scheduled to take place annually or during exceptional rainfall events, as needed. As part of its adaptive management approach, the project will integrate this information into its Monitoring and Evaluation plan as well as within its risk management framework, and if necessary, will react to unsatisfactory sediment measures by adjusting erosion control activities, including replanting, revegetation, erosion control barriers. The project aims to achieve a maximal reduction of erosion rates in order to lift the barriers to rice productivity and therefore to resilience. Bearing in mind that some measure of weathering is natural, and that paddy cultivation can tolerate sediment up to a certain measure, the project aims to reduce current erosion rates by 50 to 75%.

This sub-component responds to the effects of climate change by promoting the restoration of ecosystem services that form the basis of agricultural productivity. Application of sustainable land management (preparation and cultivation) techniques are designed to provide a barrier against soil fertility declines and to maintain productivity in the face of increased variability and climate uncertainty. The rehabilitation of vegetative cover in the more elevated areas is also designed to help resist the effects of water-induced soil erosion (which is due to accelerate as strong rainfall events increase) while also reducing siltation in the paddies and water reservoirs, which has acted as an impediment to increased productivity. Activities targeting the non-rice elements of the ecosystem also respond to climate change directly and indirectly: first, by introducing additional elements of resilience, including in tree species selection, livestock management, and land management, these will become resistant to climate shocks; second, by providing additional ecosystem services to rice production, they will contribute to the resilience of communities by providing added economic development in times of climate hardhip.

Training will be provided to support collaborative land allocation and management and to allow natural resource user associations to perform their duties, including local enforcement of no-take zones and conservation areas. It is hoped that increased yields will create a lasting incentive to cease land clearing and wood-cutting in slopes; since land clearing has been mostly due to the need for expansion of land under cultivation (slash and burn) because of low yields and declining productivity in lowland paddies. Finally, in order to ensure that continued maintenance is performed on infrastructure (such as water reservoirs) and that resources are managed sustainably after the project finishes, the capacity of local

[20] Altough a land-based erosion measurement mechanism could have been selected for this activity, the costs of this exercise would be high (mineral testing, multiple sample extraction, isotope measurements) – for cost-effectiveness purposes, it was decided to measure erosion rates downstream, where they impact rice production.

producers also has to be strengthened (for example, to collect dues and perform maintenance tasks, to resolve conflicts, and to enhance production).

Sub-Component 2b activities **Production management**

Activities	EXPECTED CONCRETE OUTPUTS	Output indicator	Baseline	Target
Outcome 2.2 Ecosystem services maintained				
Implement and disseminate Integrated Resilient Rice Model (MIRR) for production through training and extension services	2.2.1 Best available land preparation, production and harvesting techniques disseminated to reduce deforestation, maintain soil fertility and integrity, and to provide adequate growing conditions	% application of resilient rice model (gender disaggregated)	no farms currently applying resilient rice model	75% of targeted producers use resilient rice model (gender disaggregated)
Introduce rice-vegetable rotation systems using disease resistant, water efficient resilient crops (leafy vegetables, legumes)		change in rice productivity	average 1.5 T per ha	1 to 2 T/ha average increase
Develop and distribute technological packets and information documents				
Participatory revegetation of degraded slopes and forests, using multi-purpose resilient trees, grasses (vetiver) and participatory management of forest resources	2.2.2 Watershed rehabilitation in productive landscapes introduced, including through reforestation and adaptation of agroforestry practices	# of ha reforested	some reforestation underway in the broader basin but not in project sites	8500 ha reforested around project sites
Training on sustainable agroforestry and land management (including in climate change context)				
Adaptation and reintroduction of soil conservation methods for erosion control (tillage, sediment barriers, mulching) in upland and lowland uses	2.2.3 Soil conservation and livestock management techniques adapted to topography and landscape in light of future climate conditions	% change in erosion rate within paddies	Average erosion rate in the region is 12 m m.yr.$^{-1}$ (21)	50-75% reduction in erosion rates

[21] Cox, R. et.al, 2009 « Erosion Rates and Sediment Contributions in Madagascar Inferred from 10^{Be} Analysis of Lavaka, Slope, and River Sediment » ; this study includes an analysis of Alaotra region data and samples. Note that varying erosion rates exist in the literature for Madagascar and for the Alaotra region as a region in particular. Erosion rates should be treated with careful consideration of data collection and analysis methods, and validated locally. Another local study indicates effective erosion rates depending on the type of land managment and slope, ranging from 9 to 87 ton·ha^{-1}yr^{-1} of soil loss (Van Hulste, F., 2011, Soil erosion prediction using RUSLE for rain fed crops under Conservation Agriculture practices in the Lake Alaotra region in Madagascar).

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Training on the sustainable land use of inactive or stage 2 lavakas and tanety agriculture (for upland communities) Assessment of resilience in livestock management within rice cultivation systems and adaptation of practices for resilience, erosion control, and increased productivity				
Training, legal support and provision of administrative means for producers cooperatives, sub-basin management committees, water user associations and natural resources user associations	2.2.4 Revitalization of producer's cooperatives, natural resources and water user associations for collaborative natural resources allocations (e.g. land and water) and management	# of operational water user associations	out of the legally created associations, only 20% are currently operational; there are no sub-basin management committees in the project sites	75% of associations are operational
Outcome 2.3: Health improved and new disease spread prevented				
Perform local level water quality monitoring (including sediment content)	2.3.1 Water quality assessments	% change in water quality (e.g reduction in turbidity, pollutant content, microbial content, sediment content)	data not available, will be obtained during first monitoring exercise	15% increase in water quality by end of project

Sub-component 2.3 concerns primarily Harvest Management, and is designed to assist communities in coping with climate shocks such as droughts and floods, and to reduce post harvest losses. As the rehabilitation of rural infrastructure (e.g. roads) falls outside the possible scope of this project and is being undertaken as part of the development baseline, this sub-component seeks to ensure the availability of trading infrastructures at least at the communal level, to avoid sudden price fluctuations due to transport costs in times of flooding, that may lead to further unsustainable practices. Hence the main activities under this sub-component will be the revitalization of community-managed reserves in cases of floods or droughts; and the rehabilitation of post-harvest storage facilities equipped with appropriate phytosanitary controls, that could serve as trading points and markets.

Sub-Component 2c Activities: **Harvest management**

Activities	**EXPECTED CONCRETE OUTPUTS**	**Output indicator**	**Baseline**	Target
Outcome 2.4 Harvest losses reduced				
Introduction of techniques and technologies for the utilization of rice straws in animal feed and for energy production (training and extension)	2.4.1 Increased utilization of rice by-product especially rice straw	% use of rice straws in feed and for briquetting	rice straw currently not being used for feed or briquetting	50% of producers use or commercialize rice straws

Rehabilitation of storage facilities using upgraded phytosanitary and climate resilience norms on the basis of an inventory	2.4.2 Post-harvest storage facilities with phytosanitary control, serving as trading points and markets	# of operational storage facilities	20% of available facilities are operational	75% of existing facilities are operational

Activities in this sub-component are responding to climate change and climate variability by helping create and maintain, or rehabilitate and upgrade, storage facilities that can provide grain reserves during floods or droughts. In addition, in order to achieve a sustainable yield increase despite of climate shocks, post-harvest losses have to be minimized. Finally, the promotion of rice by-product re-use forms part of an integrated cultivation cycle and helps reduce vulnerability by providing means of feeding cattle in times of climate shocks or economic crises and reducing overgrazing and deforestation, two underlying causes of ecosystem vulnerability.

Component 3: Leveraging policy change. The project will support the creation of mechanisms to capture lessons learned and to ensure that technical successes achieved in promoting resilience are replicable at the regional and national level. Taking into consideration the breadth and scope of changes to be implemented to the rice cultivation cycle in this project, and the site-specific nature of potential results, the project will adopt a two-tiered replication and upscaling strategy.

First, the project will seek to identify factors of success that might be applicable and replicable in the Alaotra broader basin as a first stage replication.Second, the project will support the creation and operation of an effective interministerial and multi-partner platform on rice resilience, that will bring together government, private sector, NGOs, as well as academic and research institutions and local representatives. This mechanism will be based on the existing Rice Platform (Plateforme du Riz) in Madagascar, a national intersectoral mechanism that is not fully operational and doesn't currently have the means to address the added demands imposed by climate change. The purpose of this renewed Platform will be to examine current rice policies with a view to identifying gaps and potential maladaptations, and to make recommendations on the modification of policies, rules and norms related to rice.

In collaboration with the Rice Platform and the Rice Observatory (a parastatal rice-based think-tank focused on price monitoring), and using the scientific and technical knowledge produced in Components 1 and 2, the project will support the extraction of best practices for rice resilience and the production of a set of policy recommendations towards their generalization and dissemination to the rest of the country. A report on best practices will be produced that will also identify the conditions for replicability to other regions in the country and other types of rice cultivation.

Component 3 Activities: **Leveraging policy change**

Activities	EXPECTED CONCRETE OUTPUTS	Output indicator	Baseline	Target
Outcome 3.1 Technical norms and standards in rice cultivation reviewed and where necessary modified to take climate change into account				

Create a multi-partner and interministerial task form on rice resilience, including government, NGOs, private sector and local representatives)	3.1.1 gaps and possible maladaptations in the current rice policy are identified and recommendations on rice policy reform are made	# of operational intersectoral mechanisms for rice policy making	there is currently 1 rice platform - it is not operational	1 broad national platform exists and is functional
Identify options for upscaling and replication from MIRR application in broader Alaotra basin and in other regions		# of replication strategies	There is no replication strategy for the Alaotra region	1 replication strategy and action plan for Alaotra region
Develop recommendations on the rice sector transformation and propose a rice policy		# of recommendations on rice resilience	no such recommendation	1 white paper on rice
Outcome 3.2 Conditions in place for a full adaptation of the rice sub-sector				
Engage a dialogue on the socio-economic conditions required for project sustainability	3.2.1 a report on best practices and lessons learned for rice adaptation in Madagascar	# of lessons learned reports	0	1 report at end of project

B. Describe how the project / programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities.

As stressed above, Madagascar is particularly vulnerable to climate change because of the over-dependence on a single rainfed crop and the high incidence of poverty. Rice trade dominates food-marketing channels and rice is the staple food in Madagascar. As this project is designed to build resilience in the rice sector, with a potential side benefit of increasing rice yields, it is expected to have beneficial impacts on local food security, including through the creation of reserves in case of climate shocks. Sustainable land and water management techniques, along with water quality monitoring, are also expected to have benefits for local health, while the sustainable management of non-rice crops, trees and livestock will also have benefits on overall nutrition.

Community-based watershed management and restoration is expected to preserve the local ecosystems, including fragile biodiversity from further degradation and pollutions; reforestation will have benefits for water retention, soil fertility and drainage, along with flood control and carbon sequestration. The use of organic fertilizer and rational utilization of chemical fertilizer will prevent soil nutrient depletion, along with a careful management of rice field agro-biodiversity.

The region of Alaotra-Mangoro selected as project target area is home to some of the country's remarkable and fragile ecosystems and biodiversity, including the Lake Alaotra, wetlands (which are classified as a Ramsar site), and various species of waterbirds and lemurs. So, the project interventions in this this region will result in global environemntal benefits.

Drastic changes in rainfall patterns coupled with rising temperatures are likely to introduce unfavourable growing conditions that, unless abated by appropriate management techniques, could reduce crop productivity. Once upscaled, the transformation of the rice sector towards resilience could have lasting impacts on the country's economy, with the agricultural sector generating economic growth that could be redistributed.

Specific expected benefits of this project include:

Component	Social benefits	Economic benefits	Environmental benefits
1. Scientific and Technical Capacity	- Increased knowledge on rice resilience and best practice through the definition of an integrated resilient rice model. - Increased data on crop vulnerability and water-related future stresses	- Decreased economic losses due to flooding through Early Warning System - Increased productivity through the timely application of agro-meteorological information (through EWS)	- Increased technical data on climate and water projections
2. Adapted and resilient Rice production	- Increase in on-farm employment through the use and transformation of rice by products. - Increase in locally available nutrition - 35% increase in water availability in all seasons. - Better health for local populations through enhanced nutrition, reduced erosion and pollution. - The project is expected to reach 30,000 rice producers.	- Resilient increase in rice yields (1 to 2 tons per hectare, for an average targeted yield of 5 Tons per hectare), leading to increases in household incomes. At a mean price of 538 Ar per Kilo, an increase of 50% in yields could mean the production of 538$ in additional annual income per hectare in the region (under normal pricing circumstances).	- Maintenance of ecosystem services (soil fertility, nutrient cycling, carbon sinks, biodiversity, water) - Increase of 20% in water use efficiency - 8500 hectares reforested and revegetated around project sites, leading to a 50 to 75% decrease in erosion and an increase in carbon sinks - Reductions of 50% in the use of pesticides and fertilisers, leading to reduced water pollution
3. Leveraging policy change	- Participatory and collaborative processes for rice policy making - Increased awareness and understanding of climate risks and policy gaps		

Participating farmers have been selected on the basis of local consultations and an inventory of agricultural producers in each of the identified districts. All participating farmers have expressed vulnerability to climate variability and climate extremes, through surveys and questionnaires. Farmers selected to participate in seed production and multiplication scheme are already organized in a network

under the aegis of the Seed Multiplication Center in Anosiboribory. Other participating farmers are also organized in water user associations, and purchasing groups. Local extension services, under the responsibility of the Ministry of Agriculture, have conducted preliminary surveys of participating farmers according to their income, productivity, and access to services and inputs. In accordance with the prevailing land tenure arrangements, farmers selected to participate in project activities will for the most part be land owners, although the project will also enlist the participation of sharecroppers (who represent a minority in the region). The project intends to reach approximately 30,000 farmers, meaning indirectly benefit 125,000 to 150,000 inhabitants of the region.

Benefits of the project will be concentrated at first among the participating stakeholders, however as productivity increases and as community mobilization strengthens, indirect benefits are also expected to accrue to the rest of the region, for example through increased purchasing power, increased economic transactions from paddy and secondary products, and increased availability of income. Benefit sharing mechanisms, among low and upland communities involved in the joint management of resources will be designed by consultative processes (in an adaptation of the payment-for-ecosystem services system). It is also expected that the training and technical support delivered to participating farmers will percolate to other producers in the region, and that demonstrations of increased yields will help convince other farmers to adopt better technologies for rice production.

Gender Considerations

Gender considerations have been taken into account from the start of the project design, with the inclusion of the number of female-headed households among the site selection criteria. Given that there are no legal constraints to the access of women to land, no special provisions have been made to ensure the participation of female producers in the project other than through their voluntary participation in the project activities Project design consultations have included equal representations of women and men to ensure appropriate integration of gender-specific concerns, and taking into consideration the different roles of men and women within the rice-production cycle in the region.

This project targets an entire food production chain and as such, is expected to equally benefit men and women as vulnerable communities. Nevertheless, taking into account that in the targeted regions, there at 20% of female-headed households, this project will pay particular attention to the strengthening of the capacities of female producers. Training will be provided in equal opportunity to women and men, and an equitable distribution of female members in community-based organizations (user associations, basin management committee, cooperatives, etc), including in positions of authority, will be pursued in this project. Equal participation of women and men will also be sought in project-specific committees, task forces, staff, procurement and consultancies.

Project indicators that lend themselves to gender-disaggregated data gathering have been indicated. The project will also attempt to measure success rates in the application of the MIRR, at the project objective level, through the use of gender-disaggregated data. This will enable the identification of gender-specific obstacles or factors of success in the application and potential upscale of the MIRR.

C. Describe or provide an analysis of the cost-effectiveness of the proposed project / programme.

The selected adaptive measures contained in this project consist mainly of a series of targeted activities designed to achieve a sustainable and resilient increase in rice production as a means to reduce vulnerability. The activities in this project form a collection of low-regret or no-regret strategies and activities that can be easily managed and that will lead to easily identifiable benefits for local communities.

The selected measures consist of a range of recognized best practice measures to avert climate-related losses in agriculture. These include (i) engineering measures (crop engineering); (ii) behavioural measures (watershed management and soil management); (iii) infrastructure measures (irrigation techniques, water harvesting). These measures were selected from an exhaustive listing of more than 400 identified in the UNEP-GEF McKinsey Report on Economics of Climate Change Adaptation[22], and had previously been evaluated from a cost-effectiveness perspective when applied in other countries such as India, Mali and China.

Expensive infrastructures to address some of the key challenges facing the sector were excluded (for example rural roads), although some infrastructure rehabilitation and development has been deemed necessary in order to address the most urgent needs for water management and conservation, such as for example the rehabilitation of water mobilization and conservation structures (cisterns, small earthen dams, pipes). Rehabilitation activities for irrigation and water retention infrastructures will be undertaken using local labour. The project will cover the one-time costs of rehabilitation while the water user associations will perform the regular maintenance works taking from their own budgets, collected from member dues. In Madagascar, local investments and membership dues are typically paid in rice. Therefore it is expected that the project will facilitate payments through increased productivity Low productivity often prevents producers from paying dues and labour. Therefore by increasing productivity this project will ensure the financial sustainability of water investments as well.

The construction of new post-harvest storage facilities was also excluded due to high costs, and to the possibility of upgrading existing facilities so as to serve as community reserves, and trading points. Similarly, the project will use existing institutions and distribution mechanisms, as well as existing and available research and extension facilities, to deliver the bulk of its activities.

Experience in other countries and global research (e.g. West Africa Rice Development Agency, International Rice Research Institute[23]) have shown that the most cost-effective approaches to adaptation in the rice sector involve a blend of relatively minor practice or behaviour shifts, such as variety improvement, changes in land and water management, and the careful management of ecological services, as embodied through the System of Rice Intensification, among other approaches. This blend of changes has been shown to generate both gains in productivity as well as environmental benefits.

Approaches to make the rice sector more productive have so far been focused on only a part of the production chain – either the technical production standards (inputs), the management cycle, or the

[22] UNEP-GEF McKinsey (2010): Economics of Climate Adaptation: Shaping Climate Resilient Development, a Framework for Decision Making.

[23] See for example: "Agriculture, pauvreté rurale et politiques économiques à Madagascar", Edited by: Bart Minten, Jean-Claude Randrianarisoa, and Lalaina Randrianarison, Cornell University, FOFIFA, INSTAT, 2000; "The Price of Rice in Madagascar", IRRI, 2008; http://www.irri.org/science/cnyinfo/madagascar.asp; System of Rice Intensification website hosted by Cornell University: http://ciifad.cornell.edu/sri/methods.html ; "Recherche variétale du Riz a Madagascar", presentation by -- R. Rakotonirainy at the Africa Rice Congress, 2006.

marketing issues that regulate prices (outputs). To date few efforts have tackled all rice production issues in an integrated manner, which could have led to the perpetuation of negative incentives in this sub-sector. However, it is increasingly recognized that a single adaptive action on a select element of the rice cultivation cycle (for example, seed enhancement alone) will be less effective than if accompanied by adaptive actions in all other elements of the cultivation cycle. Therefore maximum resilience impact can only be achieved through the implementation of adaptations in each of the aspects of the rice cycle (input management, cultivation practices, and harvest management). As an example, additional investment in extension services alone was said to have increased production by 1 to 2T/ha in some districts in the Alaotra region (Ministry of Agriculture). Other studies found that the application of the System of Rice Intensification (SRI), which will be part of the technologies to be selected for the elaboration of the Resilient Rice Model in this project, have led to up to 30% increased yields and more than 50% income increases, 90% reductions in pesticide use, leading to reductions in production costs.[24]

In the case of water management, the proposed interventions are cost effective in that large infrastructural investments are not considered (for example the project will not build new water mobilization infrastructure, such as dams or reservoirs), but also because the proposed interventions are expected to have side benefits in terms of health, environmental integrity and biodiversity conservation, and poverty reduction. The approach taken is to rehabilitate existing water infrastructure, to ensure appropriate flows and conservation, while at the same time halting the erosion that is leading to the infrastructure's degradation. A recent study supported by the Adaptation to Climate Change in Africa (ACCA) project (IDRC) in Madagascar, produced a detailed vulnerability index calculation for a district in the Alaotra region. The study showed that as a combination of exposure and adaptive capacity the region was moderately to severely vulnerable to climate change impacts on water. The study also showed potential gains to be realized from various types of water-related investments, ranging from 596 Tons to 1125 Tons of increased production annually (depending on the type of water infrastructure).

In the short to medium term, and in the absence of a readily available economic alternative, seeking the adaptation of the rice sub-sector is more cost efficient than other options in the agriculture sector, for example to re-orient agricultural production towards other crops as this would have a high opportunity costs as farmers would lose a few years in the transition (absence of systems, markets, technical inputs, etc…), and yields would remain low unless technical constraints are also addressed. Diversifying outside of agriculture, meaning to diminish agricultural production in favour of other sectors also bears a high risk that food imports would remain too expensive for ensuring food security, one that few producers would be willing to bear in the current context.

While in the longer term, a gradual diversification away from agriculture and rice may be a legitimate policy direction, particularly in the face of climate change, such a transition would involve changing longstanding historical and cultural values. Hence, in the short-to-medium term, and indeed in the foreseeable future, promoting resilience in the rice sub-sector has been deemed not only more economically efficient, but also a more politically, socially and culturally viable option, and one that helps address existing as well as emerging climate change impacts.

[24] Final Evaluation Report on Verification and Refinement of the System of Rice Intensification (SRI) Project in Selected Areas of Bangladesh, IRRI, 2004.

In terms of cost-effectiveness, therefore, interventions designed to target the rice sub-sector as a whole, combined with sustainable use of natural resources and climate resilience measures have a significant chance of generating impact on rural poverty, environmental degradation and ecosystem services, thereby potentially multiplying benefits in the long term. The piloting of this approach in the Alaotra-Mangoro region, which is the main rice producing region in the country but also one that faces most significant challenges, also maximizes the chances that this project will generate knowledge and approaches that are applicable elsewhere in the country, and, given Madagascar's long-standing rice cultivation history, extendable to other countries in Asia and Africa. The interventions introduced under component 3 will assist in this upscaling and replication effort, and will help to ensure sustainability of project outcomes in the mid- to long term. This increases the cost effectiveness of the project.

The table below summarizes the key options[25] retained in this project and the type of trade-offs involved in implementing possible alternatives that would provide similar benefits.

Options	**Project Cost (USD)**	**Benefits**	**Loss averted**	**Alternatives and trade-offs (USD)**
Crop engineering (Resilient rice varieties)	540,000	- increased yields - increased income and purchasing power - increased resource efficiency	- food insecurity - health issues associated to malnutrition	-Imported rice to meet the increased demand for the staple food with the risk of increased prices and food insecurity; -Protein and other food imports with associated economic and food security risks from price increases and crises; -Decreased rice consumption and associated social impact and transformation as rice is a staple food cultivated by 60% of population and consumed by more than 85% of population who eat rice three times a day with an average annual consumption. These options were **rejected** for mid -term because of the expected high cost and high associated social impact
Water efficiency, sustainable management, conservation and monitoring	655,000	- increased productivity and resource use efficiency - Adequate access to water for production	- losses in production from droughts or lack of access to water - disease avoidance	- construction of new irrigation infrastructure - decommission or construction of new dams and reservoirs - conversion to strictly rainfed rice - Business as usual water

[25] Key options were analyzed on the basis of the available data and information about their costs, benefits and losses averted.

		- increased health benefits		management practices <u>These options were **rejected**</u> because of high costs and because of their low contribution to achieving resilience and increased productivity.
Integrated watershed rehabilitation, management and soil conservation (participatory reforestation, SLM, agro-forestry, livestock management)	890,000	-ensure appropriate water flow and conservation -increase water infiltration - carbon sequestration -maintain ecosystem services - increased diversification of nutritional products	- erosion and soil loss - water losses due to excessive runoff - siltation of paddies and lake eutrophication	- Relocation of paddies and local populations with significant social, cultural and economic costs - regular dredging of paddies, relocation of irrigation canals, dredging of the Alaotra lake to combat siltation - installation of dams up hill to prevent siltation - Business as usual tavy and tanety cultivation (uphill) - Business as usual livestock management These <u>options were **rejected**</u> because of high costs and low potential economic and environmental benefits, and because of unsustainability.
Fertilization techniques and Integrated Pest Management (organic)	610,000	-productivity increased	-reduced food insecurity -reduced health issues associated to malnutrition -reduce water pollution	- Continued or increased use of inorganic fertilizers with impacts on long term soil fertility depletion and high costs 2-3 times higher than organic fertilizer <u>This was not retained</u> because of the higher cost and impacts to environment

D. Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

This project is consistent and supports national orientations, and takes into account the country needs stated in national planning and strategy documents. These orientations and priorities have been embodied particularly in the Millennium Development Goals (MDG), the Madagascar Action Plan (MAP), the National Environmental Action Plan (PAE), the National Action Plan for Adaptation (NAPA), the Initial

and Second National Communications, the Rural Development Management Plan (PADR), and some local development plans. The MAP is a strategy document developed by the government of Madagascar to guide development planning in the country. Among other objectives, it commits to doubling rice production over the next five years.

Underestimation of climate change risks and impacts could jeopardize some of the benefits provided by these national actions. The lack of adaptive measures in current agricultural activities stems, among other factors, from the lack of public awareness on climate change issues and associated impacts, as well as from a lack of policy and technical capacity. The present project will have beneficial impacts towards the realization of the stated objectives of these strategy documents, by including innovative approaches that contribute to the sustainable development of the country as well as to preserve environmental integrity.

The present project is consistent with the MDGs, particularly the Millennium Target 1: "Eradicate hunger and extreme poverty", MDG 7 on environmental sustainability, the MAPs sixth commitment "high-growth economy", the PAE's objective "Ensure poverty eradication". This project is consistent with the MAP's fourth commitment "rural development and green revolution", the PADR's objective "intensification and professionalization of agricultural productivities" and the NAPA's third project "emphasizing the intensification of agricultural productivities". As mentioned above, Component 3 will address these issues.

The project is consistent with MAP's seventh commitment: "Cherish the environment", PAE's objective "Preserve and valorize environmental resources", NAPA's second project "Implementation and/or strengthening of water managing associations", and the Initial National Communication and Second National Communication.

The project is also in direct application of the Regional Development Plan and Environmental profile (under National Plan of Action for Environment) for the Alaotra Region, which was developed in 2006, and which includes priority actions such as reforestation, water resources protection, more sustainable agricultural practices.

E. Describe how the project / programme meets relevant national technical standards, where applicable.

There are currently no widespread government supported standards for organic agriculture in Madagascar, let alone any standards for resilience in rice. Standards regarding rice production and commercialization are in force, as promoted by the Ministry of Agriculture, however, due to weaknesses in the extension system it is unsure if these standards are enforced in all locations. Interventions regarding the dissemination of rice varieties and other inputs will be deployed in line with current Malagasy norms and standards, including as regards the use of chemical fertilizers, pesticides and other inputs.

The System of Rice Intensification was first designed in Madagascar, and is well-known by most rice cultivators; however it is largely unapplied in many rural parts. It involves planting at earlier dates, and managing or reducing field flooding, as well as modified planting techniques. If needed, the SRI could be adapted to emerging climate conditions under each rice system type.

Interventions designed to enhance water mobilization and conservation infrastructure in rice cultivation areas will be conducted in strict adherence with Malagasy codes and legal texts regarding environmental impacts, when triggered. Strategic environmental assessments may also be conducted where necessary, although the project is deemed to not have any major negative environmental impacts (see Annex 6 for preliminary screening).

The project falls under the application of the following selected laws, regulations and standards in force in Madagascar and internationally:

- Seed Certification standards as applied by the Service de Certification des Semences, in accordance with regional (East Africa) and international standards (FAO, International Seed Testing Association). These specify the conditions for the production of foundation and multiplication seeds (isolation, field testing norms, minimum requirements for purity, humidity and environmental exposure). They vary according to variety of rice and cultivation system.

- Phytosanitary standards, such as guidelines on the use of pesticides and fertilisers, as produced by the Ministry of Agriculture. These also include minimum requirements for the installation and operation of storage facilities (frequency of verification, climate control, pest control).

- Minimum requirements for drinking water quality, as per WHO standards.

- Environmental impact assessment as specificed in decree No 2004-167 relating to 'Mise en Compatibilité des Investissements avec l'Environnement' (MECIE), administered by the Office National de l'Environnement.

- Law no 96-025 of 30 september, 1996 related to the local management of renewable resources. This law provides local communities with the authority and benefit of the management of their local resources.

- Decree n° 2005- 013, regarding the application of the Protected Areas Management Code.

- Decree N° 2003- 941 related to monitoring and control of waters destined for human consumptions and on the priorities of access to water.

- Law N° 94 – 027 bearing the Hygiene, security and environmental safety at work code.

- Law No 98-029 bearing Water Code in Madagascar which provides in article 10 that "no works may be executed upon surface waters (rainwater and permanent bodies, canals, rivers, navigation canals and diverted waters, rrigation canas, ponds, lakes, marshes and wetlands. Surface waters are part of public domain), whether it modifies the water body's regime or not, without proper authorization. Conditions for the delivery of authorizations shall be provided under the purview of the National Water and Sanitation Authority" (free translation).

- Law no-98-029, bearing Water Code in Madagascar in Article 29 also provides that "irrigation can be performed using surface or groundwater. All water extraction installations for irrigation shall adhere to crop-specific flow and debit standards set by decree. Water extracted shall not prevent the other water users from accessing water".

- The Land use plans of Ambatondrazaka, Amparafaravola and Andilamena, bearing rules for land use and land planning in and around public infrastructure, agriculture and agro-pastoral lands and in medium population density areas.

F. Describe if there is duplication of project / programme with other funding sources, if any.

The package of interventions proposed in this project is not currently being supported by any other source. However, this project relies on a number of ongoing development baseline efforts in the country and in the region, including efforts to modernize the rural and agricultural sectors, to improve governance, access to water and sanitation and to promote food security, as well as measures to improve watershed management and environmental conservation. This project will be delivered in close collaboration with other initiatives taking place in the targeted region, specifically through operational linkages with activities oriented towards agricultural productivity, extension services and market access. The project will also be delivered in collaboration with initiatives aiming towards watershed management in Alaotra region, since these will be providing valuable baseline services in terms of erosion control and reforestation. This project intends to implement additional interventions to those that are currently being implemented at the local level, selected specifically for their role in securing resilience in the rice sub-sector. Collaboration with ongoing initiatives will be sought through local authorities, as well as through the participation of beneficiaries and community-based associations, as well as through the use of project coordination mechanisms.

A number of relevant activities are underway, with which partnerships have been obtained[26]. The table below seeks to highlight the linkages between these projects and the current proposal, and their contribution to addressing the baseline issues noted above:

Title	**Partner/ Funding partner**	**Objective(s) and linkages**	**Amount (Million US$)**
Third Environment Program Support Project (TEPSP)	World Bank - GEF	Objective(s): Aims at improving the protection, and sustainable management of critical biodiversity resources at the field level, by mainstreaming conservation into macroeconomic management and sector programs, and establishing sustainable financing mechanisms. This project supports the third five-year phase of the Environmental Action Plan (PAE). The third phase aims to achieve the mainstreaming of environment into macroeconomic management and sector programs, mainstreaming into local governance and community initiatives, and putting into place sustainable financing mechanisms for the environment. Linkages: The TEPSP has provided funding support for the strengthening of capacity within the Ministry of Environment and the Office National de l'Environnement (policy capacity, human and financial means). As such, it contributes to the third component (supporting policy linkages) of the current proposal. The project has been temporarily postponed, however it contributed to creating a	139.9

[26] It should be noted that a number of partners have suspended, or partially postponed, some of their operations in Madagascar, with the exception of those that are deemed essential for humanitarian reasons. At time of writing some activities were slowly resuming in some parts of the country.

		baseline of environmental management capacity on which this project is building.	
Transport Infrastructure Investment Project	World Bank	Objective(s): To rehabilitate the country's major transport infrastructure in order to reduce transport cost and to facilitate trade. Linkages: rural road rehabilitation is an important and enabling part of the rice production cycle, and forms the the baseline on which Sub-component 2.3 of this project is building, by providing the means for producers to access markets and therefore completing the production chain. Some of the project's planned interventions have been delayed, however road rehabilitation works are continuing, particularly along RN44 (which crosses the targeted region), supported by government funds.	150
Rural Development Support Project for Madagascar	World Bank	Objective: To increase incomes and reduce poverty in rural areas, while preserving the natural resource base. The project is part of the Rural Development Action Plan, a broad-based program approved by the Government in 1999 to promote sustainable growth in agricultural production, foster food security, and enhance access to basic services in the rural areas. There are five project components. The first makes a partial contribution to demand-driven income-generating sub-projects proposed by farmer organizations and village groups. The second component provides extension and training services to rural communities and producer organizations. The third component strengthens rural communities and producer organizations by supporting the preparation of community development plans and business plans, developing organizational and managerial capabilities, and workshops. The fourth component establishes adequate statistical systems in the ministries responsible for agriculture and livestock, and strengthens environmental assessment. The fifth component supports project management and administration. Linkages: this project addresses baseline issues related to producer and community organization and capacity, and also helps farmers explore additional or alternative means of livelihoods. By providing training and extension to rural communities on the commercial aspects of agriculture, this project addresses baseline concerns regarding local capacity, pricing mechanism, access to markets, which are underlying causes of rural poverty but not related to climate change. The project also supports agricultural research rehabilitation and upgrade and works with the FOFIFA (Madagascar's agricultural research center) who is also a key partner in the current proposal. The project does not address additional constraints posed on key stakeholders by climate change but creates a baseline of research, scientific and community capacity on which the current proposal will build to address the additional impacts of climate change on the rice sub-sector (Component 2).	106.9
SIP – Watershed Management	World Bank	Objectives: To establish a viable basis for irrigated agriculture and natural resources management in four main irrigation sites and their surrounding watersheds: (i) Andapa (Sava Region), (ii) Marovoay (Boeny Region), (iii) Itasy Region, and (iv) Lac Alaotra – Sahalomano (Alaotra Mangoro Region). The project has 3 substantive components: (1) Development of Commercial Agriculture, (2) Irrigation Development, (3) Watershed Development.	6.2

		Linkages: this project is linked to component 1 of the current proposal in that it helps develop rice and general land management technologies, such as cropping technologies, agroforestry and irrigation management in rice cultivation. As such, this project is mostly concerned with the baseline issues facing rice farmers in various regions, namely sustainable land management. This project is also linked to the BV-Lac project (below), with which cooperation has been secured. The SIP project's interventions will provide valuable insight on land management and soil fertility, practices which will be examined for inclusion into the MIRR (component 1) to which a climate dimension will be added by the current proposal.	
Water and environment support project	UNDP	Temporary objective: to support technical aspects related to water management in Madagascar, such as field analyses towards the development of a national water and sanitation plan, an institutional study and technical studies on water transfers as a means to ensure drinking water to southern islanders. Potential linkages: This project could help contribute scientific and technical capacity as well as data for the water management aspects of the project.	1.9 million (2009)
PAPRIZ - projet pour l'amélioration de la production rizicole	JICA	Objective(s) : To increase rice productivity in the Central highlands, including parts of Alaotra region, through collaboration with the Coalition for African Rice Development (CARD). The project promotes research and the dissemination of cultivation practices designed to increase productivity. Linkages: This project has been temporarily postponed. Partners have however agreed to participate in the current proposal, particularly in terms of information sharing, sharing of technical guidelines as well as laboratory testing and other research performed on rice varieties and cultivation systems, which will provide a baseline on which to build the best resilient rice cultivation model foreseen under Component 1. Coordination will occur through project management structures.	TBC
Projet de Mise en Valeur et de Protection des Bassins versants du Lac Alaotra (BV-Lac and BP-PI)	Multi-partner: AFD-CIRAD, JICA, IFAD, WB	Objective(s): Increase the revenues of producers and conserve natural resources; secure irrigation investments through the enhanced watershed management, provide support to producers associations. The project includes activities related to land tenure and the capacity of local associations, micro-credit, reforestation and brush fire control, agricultural technology transfer, support to livestock, and investments in rural infrastructure such as roads. Linkages: Some of this project's interventions have been temporarily postponed, however partners have agreed that close collaboration with this project will be pursued in common geographic areas, so that the adaptation project can build on local community structures, institutions and investments created by the BV Lac and BV-PI projects. Joint implementation of reforestation and revegetation activities will be pursued in order to achieve greater coverage. Coordination will occur through project management structures. This initiative provides baseline for most of the project's activities, and addresses issues that are not related to climate change (for example livestock, fire control, micro-credit) but that are nonetheless essential contributions towards the removal of barriers to resilience in the region, and that contribute to addressing development baseline issues.	8,4 million Euros

The projects listed above are implementing different approaches to poverty reduction and are not focusing specifically on resilience or on the rice sub-sector. Although some of the projects above have activities in the broader Alalotra lake region, none of them have activities in this project's sites. It was agreed, during discussions with partners responsible for these projects, that similar approaches would be used, for example in procuring goods, using local labour and in promoting community-based natural resources management institutions and organizations. Where the watershed rehabilitation and reforestation activities are concerned, this project has focused the scope of its activities on reducing siltation in the immediately adjacent rice cultivation areas in project sites, rather than broader watershed services.

G. If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.

One of the objectives of this project is to create a body of knowledge and technology that will ultimately be transposable to other parts of the island. Lessons learned during project implementation will be exploited and the conditions for replicability in other regions will be analysed. Specific attention will be paid to lessons learned and conditions for replicability in activities under Component 3, as well as within the project's Monitoring and Evaluation Plan. In addition, the project will build partnerships with regional centers of excellence in agricultural research, such as the African Rice Development Center, the World Vegetable Center, West African Rice Development Agency, the International Rice Research Institute and other research partners.

Component 3 is specifically designed to gather the lessons learned from this pilot project in order to ensure that the conditions for upscaling and replication are in place, in a two-tiered process, recognizing that this pilot approach will need to be carefully assessed prior to replication to the broader region of Alaotra or to the rest of the country. The participation of research centres, universities, and the media will also contribute to awareness raising and the promotion of learning. Finally, the project's management structures will also include a broad group of partners working for development in Madagascar, in order to promote cross-fertilization and coordination among related initiatives.

H. Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation.

This project was extracted from the National Action Programme for Adaptation document and National Communications documents, which are based on consultations at all levels, from governmental authorities to vulnerable communities, including priority stakeholders and the most vulnerable segments of population. Activities in this project respond to multiple priorities expressed by vulnerable populations in the NAPA, including increasing rice yield, disaster management, water management and health.

A set of targeted consultations took place during project preparation. These included consultations at central levels with all relevant ministries and divisions, as well as discussions with development partners on potential linkages and cooperation agreements. As a result of these discussions, agreements were concluded between the Ministry of Environment and the Ministry of Agriculture, and a further set of Memoranda of Understanding were under development at the time of writing, for delivery of joint activities (with Water Directorate, Meteorological Services, Health). Informal agreements were also

concluded with bilateral partners (World Bank, JICA, AFD) and ongoing projects (BV-Lac) on future collaboration (pending re-initiation of programming), particularly regarding joint implementation of watershed rehabilitation activities. Discussions with regional centers such as IRRI and World Vegetable Centers were also under way at the time of writing, and the World Vegetable Center had expressed formal interest in participating in the project.

A technical site selection workshop was convened in March 2011, bringing together key technical partners for the project, which led to the compilation of all basic data and the selection of pilot sites within the Alaotra region. (see Annex 3).

Local consultations were undertaken with rice producers in Ilakana, Ambatondrazaka in February and from 2-5 March, and again in all three districts from 17-18 April, with representatives from the producers, water user associations, research institutes, and local authorities in the main districts of the Alaotra region. A set of further consultations for validation purposes were scheduled in March but had to be postponed indefinitely due to unforeseen flooding in the area. The most recent consultations, led by the Ministry of Agriculture and through its decentralized directorates, confirmed that producers are willing to participate in the project, and are "even willing to make in-kind contributions". Key issues raised by producers during consultations confirm that the project will be responding to their needs:

- Farmers have raised issues related to inadequate water supply and quality, soil erosion and deforestation and the increase of costs in irrigation due to siltation.
- Most farmers have also raised a need for updated climate information since, as it stands now, work is delayed until rainfall and the seasons have shifted, for example "March has become planting period when it used to be weeding time".
- Many farmers have complained about fires which are aggravating erosion and siltation.
- All farmers expressed concerns with the problem of price regulation, in particular the price of inputs such as seeds and fertilizers.

A list of consulted stakeholders can be found in Annex 4.

I. Provide justification for funding requested, focusing on the full cost of adaptation reasoning.

Funding is being requested for the implementation of activities and the transfer of technology directly related to the modifications required in the rice sub-sector in order to strengthen its resilience to anticipated climate change impacts. Total funding required for this project is **5,104,925** US$, including execution and MIE fees. The project activities will be delivered in 4 locations in 3 districts of the Alaotra region, where conditions have been deemed favorable, and where potential for improvements in the rice sector are significant.

There are no ongoing adaptation activities in the country, and no activities that are directly considering the climate resilience of the rice sector, despite some ongoing programming in rice research and technology. Hence this project, although it relies on the deployment of business-as-usual rice sector activities, proposes a set of entirely additional activities.

<u>Component 1: Scientific and Technical Capacity</u>.

Baseline: Ongoing activities in the rural, agricultural and rice sector have so far failed to take climate change and its impacts into account. Although there are initiatives related to the dissemination of agricultural technologies and practices, including the SRI and other relevant rice cultivation practices, the capacity of the government's institutions to understand and broadcast climate change information, including extension services, is low. Ongoing rice research (e.g. through FOFIFA, MinAgri) in the country is focusing on current climate conditions and existing productivity constraints and is designed to provide yield-increasing varieties within current parameters; however there is significant research going on internationally that could be useful to provide adaptation avenues for rice in Madagascar.

Additionality: Additional adaptive activities proposed by this project will provide opportunities for testing climate resilient rice varieties developed nationally and internationally, as well as to understand the major constraints and opportunities faced by the different types of rice cultivation in Madagascar. A Model for Resilient Rice cultivation (MIRR) for the Alaotra region will be selected from the best available technologies and approaches. It is expected that this will support future rice policy and standard development. In addition, government technical services and ministries in the region and within central authorities will be provided with training and technical assistance in order to conduct crop modeling, thereby informing future land use policies. This will thus enable government services to disseminate better knowledge and technologies to local rice cultivators, through seasonal and early warnings, better crop calendars and recognized land management practices.

Baseline situation	Cost/Value	Additional activity and expected adaptation benefit	Cost
There are 2 staff trained in the development of DSSAT crop models. However, data collection has never been performed. Furthermore, the country has no capacity for modeling rice specifically.	The cost of training and salaries for the two trained staff, including the costs of DSSAT software is 200,000 annually. Ongoing CROPWAT modeling and other simulations are conducted by the Ministry of Agriculture as requested, in an ad hoc manner.	Oryza software and training will be acquired by the project to support rice-specific crop models. Data will be collected from field and other sources to allow for the simulations under both Oryza and DSSAT models, so as to provide a basis for comparison. Quantified outputs: - 4 rice models/maps for the region - 1 hydrological model for the region The adaptation benefit will be an increased capacity to evaluate, analyse and predict climate impacts on rice production country-wide. This will also enable the development of a replication strategy for the project outcomes.	108,000
There is no Early warning system operating in the Alaotra region, though there is an EWS being set up for droughts in the southern part of the country. There is however a well established communications system.	The estimated cost of an early warning system currently operating in the Southern region is approximately 1,000,000 US$. This system is focused on food security and based on a collection of data undertaken by main UN partners in Madagascar. It is	A basic Early Warning System will be installed in the targeted region, which will serve to secure investments and avoid losses of property, life and crops in extreme weather events. Agricultural calendars will be updated, and extension staff will be trained in climate risk management. Quantified outputs:	505,000.

	not focused on climate variability and does not provide agro-meteorological information to base users. Existing technological packets provided by the extension services do not take into consideration new climate variability data.	- 1 set of updated agricultural calendars for the region - 1 functional early warning system at local level The expected adaptation benefit is the avoidance of losses due to flooding and droughts through the provision of advance notice to producers. Additional benefits are expected to accrue from the provision of appropriate technology through extensions services, towards improved yields that will provide safety nets during climate shocks.	
Various rice cultivation models are being implemented throughout the country. None of these models have been tested for resilience to future climate conditions, and the application of integrated rice models is low in the Alaotra region.	The total rice chain in the country is worth billions of dollars, and occupies 60% of the labor force.	An Integrated model for resilience rice cultivation (MIRR) will be adopted and promoted through this project. Quantified outputs: - 1 MIRR model for the region This will provide the basis for adapting the rice sub-sector to climate change, by selecting a set of practices and inputs based on their ability to provide increased yields under climate change scenarios.	165,000.

Component 2: Adapted and Resilient Rice Production.

Baseline: As mentioned earlier, despite the technological advances presented by the SRI, this technology is not as widely disseminated as need be. In addition, the SRI practices – and indeed the entire spectrum of rice cultivation practices - need to be adapted to future climate conditions. Whereas all cultivation practices and technologies are based on current climate conditions, there has not yet been any major application of no-regrets climate resilient rice cultivation technology in the country. Ongoing rice cultivation practices are suffering from a number of constraints and unsustainable practices that not only limit yields, but also prevent resilience by degrading the ecosystem. Communities are still facing food insecurity, which is likely to be exacerbated by rainfall variability, droughts and floods, unless mitigated by appropriate risk management strategies. The country does benefit from a good basis from which to build a resilient rice model, including past and current research, breeding and multiplication of rice varieties for resistance to various stressors, including some climate stressors (such as flooding or aridity). However this research has been undertaken under the premise of normal climate evolution, whereas there is now a need to develop varieties that would also resist to future potential climate-related stressors. In addition, the country's agricultural extension systems are stretched and support to farming communities is not always optimal, both in terms of human capacity and in terms of technology transfer. Channels do exist for communication, applied research and multiplication at the decentralized level, and each ministry has decentralized offices allowing for

regional monitoring and service provision. However these services are not yet capacitated to address climate change issues and the technologies and approach they are transferring to local producers is at risk of creating maladaptation.

Large infrastructural investments also exist (e.g. roads, dams, reservoirs, grain reserves, silos, etc.), specifically those concerning water, but they have fallen into a state of relative disrepair due to the inability of user associations (specifically water user associations or farmer cooperatives) to deliver their mandates effectively. This has been due mostly to the low productivity and poverty in the region, which hampers the payment of dues and in turn means that maintenance works are not adequately or regularly performed. Hence increased productivity is also necessary to provide added revenue for the sustainability of infrastructural investments. Storage facilities also exist, although they will need to be upgraded in order to take new climate and product norms into consideration.

Ecosystems in the region also consist an often-overlooked baseline from which to start. Indeed, land and water are more abundant in the region than in many other rice-producing regions in the world. The regions' adaptive capacity will also depend on their capacity to continue to provide the ecosystem services useful to agriculture and development. There are remaining areas of forests and many areas have not yet been exploited for agriculture in the Alaotra region. These should be appropriately maintained and managed for continued water retention, filtration and soil fertility services, as well as in order to maintain the agro-biodiversity that is necessary in rice ecosystems. In addition to maintaining existing buffer systems such as wetlands and forests, existing degraded systems should be restored for added adaptive elasticity.

Additionality: Additional adaptation activities proposed by this project are in reality modifications to the ongoing practices of rice cultivation at all stages of the production cycle, from planting to harvest, in the targeted three districts of the Alaotra region. The project is intended to facilitate technology and knowledge transfers to local rice cultivators, using existing institutions, in order to accelerate the rate of uptake of sustainable practices. The project will therefore not seek to create new processes or institutions – for example the seed dissemination scheme or early warnings – but will rely on and, where needed, strengthen, existing mechanisms. The additional components of the project therefore reside in the new knowledge, better approaches, and capacity development efforts.

In the water sector, stronger investments have to be made in the development of new water mobilization and management techniques that take into account future predicted rainfall patterns, hence promoting water conservation and storage, rainwater harvesting or other irrigation techniques where they may not have been practiced before. Finally, this project will also support community-based watershed management and rehabilitation, which represents an additional adaptation measure targeted towards the restoration and maintenance of key ecosystem services.

Baseline situation	**Cost/Value**	**Additional activity**	**Cost**
There are currently a large number of rice varieties in use in Madagascar, some of which are demonstrating promising traits in term of resistance to pests	The value of historical rice research in Madagascar and worldwide is difficult to estimate. However, the cost of operating a research center such as FOFIFA is in the order of 2 million US$ annually.	The project will support the costs of field testing among a set of preselected rice varieties to determine those varieties demonstrating resilience characteristics, and usable in an integrated rice culture model, along with the implementation of a	540,000

and certain climate conditions such as drought, flooding.	FOFIFA counts 355 agents and works with 110 scientists in various specialization fields of agriculture. The total R&D budget in Madagascar in 2008 was 11,9 million US$. (Agricultural Science and Technology Indicators, IFPRI)	multiplication and dissemination scheme for identified genetic material. Suitable resilient fruit trees and other crops will also be identified. The adaptation benefit will be the existence of a body of knowledge, science and usable genetic material that will contribute to the resilience of rice. Quantified outputs: - 5 rice resilient rice varieties identified. - suitable resilient non-rice crops identified	
Agricultural practices and assets vary throughout the country. This project seeks to build resilience into ongoing agricultural activity.	The value of productive assets such as land, water, biomass, and labor in the targeted region is too large to estimate. However, total rice production in Madagascar in 1999 had an economic value of 71 billion US$.	This project will bring new approaches, technologies and tools to achieve a sustainable and resilient rice production. This will involve modifying seeds, inputs, cultivation practices, harvest and post-harvest methods. This will include transferring the best available land use methods for low land and tanety land uses, including rice, vegetable cropping, fruit tree and livestock management and interactions. Quantified outputs: - 50% increase in sustainable fertilizer use - training of 400 farmers in Integrated Pest Management - 1 to 2 T/ha increase in rice production - The adaptation benefit expected is the production of increased yields that are using environmentally sustainable technologies and that can be maintained in the face of climate change, leading to increased food security, reduced poverty and vulnerability among the targeted communities.	1,555,000
Existing water infrastructure is	The value of existing water infrastructure is in the	The project will support the rehabilitation of degraded	575,000

degraded, water reservoirs are silted.	order of hundreds of millions of US dollars of historical investments in the region (dams, irrigation canals, diversion systems, flood protection dikes, reservoirs and drainage infrastructure).	irrigation and drainage infrastructure as well as the construction of new water storage facilities where necessary. This will be accompanied by measures to promote sustainable water management and conservation. Furthermore the project will support the revitalization of water user associations so that they can effectively deliver on their commitments regarding the maintenance of water infrastructure. Quantified outputs: - 200 Km of irrigation canals cured, dredged and maintained - 3 main reservoirs and water retention structures drained - 35% increase in water availability in all seasons - 20% increase in WUE - 50% of producers use rice straws and by-products - 75% of post harvest storage facilities are operational The adaptation benefit will be the availability of water despite uncertainties and variabilities in the rainfall regime, and despite the prediction of increased droughts. This will enable food security as well as rice production to remain stable in the face of climage change.	
Watersheds in the region are degraded and erosion phenomena are causing siltation in the rice paddies, decreasing yields.	There are a number of investments in watershed management and ecological conservation in the area, but not directly in project sites. The estimated amount of these initiatives is 10 million Euros.	The project will support participatory reforestation and restoration of soil vegetative cover in sloped areas, using multi-purpose resilient tree species, in areas directly within the sites of the project, in order to reduce or halt paddy siltation. This will be undertaken in conjunction with training on agro-forestry, land use and other NRM training.	460,000

		Quantified outputs: - 8500 ha reforested around project sites - 300 farmers and land/forest users trained (50% women) - 50-75% reduction in erosion rates The adaptation benefits will be the restoration of ecosystem services and the decrease of siltation in targeted paddies, thereby lifting a constraint on climate resilient production. Additional resilience benefits are expected to accrue from the adoption of agro-forestry principles, such as increased sources of food, medicine, timber and income (under sustainable management), to both upland and lowland communities.	

Component 3: Leveraging policy change

Baseline: Although there are a number of national planning processes that have potential relevance to and bearing on the rice subsector (from sectoral to macro-economic policies), this project has chosen to focus its policy interventions on key elements of the policy make-up of the country. It also will rely on efforts being led by other partners to support broad-based rural development, water management, climate adaptation policy and governance. No efforts are currently targeted towards the rice sub-sector, and current rice policy (which is not formalized) and standards are not well applied or coordinated with other macro-level policies. There is an existing intersectoral platform for rice policy-making but it is not operations (Rice Platform); there is also an Observatory of Rice, which is a para-statal think-tank focusing on rice pricing monitoring. Policy-makers currently working on rice issues are focused on price and economic aspects of rice, rather than on technical aspects of production, and not at all considering issues of resilience.

Additionality: The additional activities being supported by this project are those directly targeted at the rice sub-sector, and will aim at reviewing existing policy and normative frameworks so as to determine the optimal conditions for adaptation in this vital sector of the economy. This will also involve an examination of current macro-level policies in order to determine if there are any maladaptations that could be corrected. A dialogue will be launched at the government level to discuss both technical and policy issues raised by these reviews, with a view to make recommendations towards the formulation of a rice resilience policy. A two-tiered replication and upscaling strategy will be developed, whereby successful outcomes and practices will be identified first for replication in the rest of the Alaotra region, and recommendations will be made for broader sector-wide upscaling within rice policy making.

Baseline situation	**Cost/Value**	**Additional activity**	**Cost**
There is no formal rice policy.	0	The project will develop an	170,000

		upscaling and replication strategy and provide recommendation on a rice resilience policy. Quantified outputs: - 1 white paper on rice resilience - 1 lessons learned report The adaptation benefit will be the existence of a pathway for the replication of project outcomes and for the replication of resilient practices in the rice sub-sector throughout the country.	
There are a few institutions involved in rice development, marketing and policy making in the country, at various levels. They are not always coordinated.	0	The project will support the coordination of the various existing stakeholders, from government and paragovernmental institutions (such as the Observatoire du Riz), to local stakeholders and CSOs through the establishment of a rice platform. Quantified outputs: - 1 operational national rice platform - 1 replication strategy and action plan for Alaotra region The adaptation benefit will be the existence of a dialogue on rice resilience which will facilitate the development of stronger policies and norms in the rice sub-sector and help eliminate the risk of maladaptations.	30,000

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for project / programme implementation.

UNEP will be the Multilateral Implementing Entity (MIE) for the project and will oversee and provide technical backstopping to the project. UNEP benefits from broad experience in implementing adaptation projects and has excellent relations with the National Executing Agency (Ministry of Environment and Forests). As implementing entity, UNEP will take overall legal and financial

responsibility for ensuring project delivery and quality of outputs. The specific services and functions that UNEP undertake as MIE for AF funded projects include:

- *Overall coordination and management*. To manage and facilitate UNEP's MIE functions and responsibilities, and to facilitate interactions with the AFB and other stakeholders.
- *Oversight and management of project development and project implementation*. To provide countries with support for the development of project proposals and full project documents. Oversee and monitor the implementation of AF projects at country-level (this will include visits to project sites), through providing quality technical and advisory services, as well as backstopping support. Ensuring measurable results and impacts of identified project activities and components.
- *Financial management, including accounting, treasury, grant and trust fund management*. Ensure that financial management practices comply with AF requirements and manage, monitor and track financial transactions. Manage all AF financial resources through a dedicated Trust Fund. Ensure financial reporting complies with AF standards.
- *Information and communication management*. This includes maintaining information management systems and maintaining specific project management databases to track and monitor project implementation (includes risk management as well as tracking financial progress against project outputs and deliverables).
- *Quality assurance, including internal and external audits*. UNEP as MIE will play a critical role in project monitoring and evaluation. Quality assurance will be carried out at the project development phase and project performance will be evaluated and improved to ensure accountability and incorporation of lessons learned.
- *Overall administration and support* including trust fund administration, facilities and supplies, procurement and human resource management

In accordance with its standards and procedures, UNEP will enter into a contractual agreement with the lead national Executing partner, the Ministry of Environment and Forests, towards the delivery of project activities and outputs.

UNEP will work closely with the MEF and the Project Steering Committee (SC) during implementation to ensure quality of outputs and timely delivery of project results.

The Malagasy Ministry of Environment and Forests (MEF) is lead coordinator of all actions related to climate change adaptation in Madagascar. The Climate Change Directorate (DCC), particularly the Adaptation to Climate Change Service (SAECC), supervises and coordinates all projects related to climate change adaptation. These two structures are both located within the General Directorate for Environment of the Malagasy Ministry of Environment and Forests. Through the SAECC, the MEF cooperates with concerned sectors, from the highest level to local communities; and cooperates with public and private, international and national, institutions, working onto the implementation of climate change adaptation projects.

Through the Direction of Climate Change, the Ministry in charge of Environment will ensure the central-level Coordination of the project by housing the Project Coordination Unit (PCU). The PCU will be jointly accountable to UNEP and the MEF. It will be responsible for the project monitoring and evaluation (M & E) and for the day to day administration of project operations, including procurement and financial management. The Project Coordination Unit will be staffed by a Project Coordinator, a Financial Manager (who will administer funds and procurement), and an administrative officer who will be

housed in the Ministry. . The PC will lead the project team through the planning, implementation, and delivery of policies, reports, knowledge products, and other results approved in the project document and annual work plans. The PC will provide overall operational management for the successful execution and implementation of the programme. The PC will be responsible for financial management and disbursements, with accountability to the government and UNEP. The key functions of the project coordinator would be:

- Facilitating the day-to-day functioning of the project staff.
- Managing human and financial resources in consultation with the PSC to achieve results in line with the outputs and activities outlined in the project document.
- Leading the preparation and implementation of annual results-based work plans and logical frameworks as endorsed by the management.
- Coordinating project activities with related and parallel activities
- Monitoring project activities, including financial matters, and preparing monthly and quarterly progress reports, and organising monthly and quarterly progress reviews.
- Supporting the PSC in organizing PSC meetings.
- Coordinating the distribution of responsibilities amongst team members and organising the monitoring and tracking systems.
- Reporting and providing feedback on project strategies, activities, progress, and barriers to UNEP, PSC and project partners
- Managing relationships with project stakeholders including donors, NGOs, government agencies, and others as required.

The project will also secure the services of a Chief Technical Advisor (a rice expert) who will provide technical guidance throughout the project duration. The CTA will be accountable to UNEP and the MEF and will act as a key relay between national implementing partners and the MEF/UNEP task managers.

The key functions of the PCU will be:

- quality assurance and technical review of project outputs
- drafting terms of reference for technical consultancies
- drafting and monitoring memoranda of understanding with project partners
- developing and administering call for proposals and procurement calls as per national standards
- administer the project's M&E system, including annual work plans and budgets, quarterly reports, reports on indicators and targets
- provide advice on best suitable approaches and methodologies for achieving project targets and objectives
- perform knowledge management duties, including coordination with outside partners
- Coordination of the Steering Committee and with observer partners and development of partnership agreements

Though administratively housed within the Ministry of Environment, the Project Coordination Unit will operate under the supervision of and be accountable to UNEP in its day-to-day operations.

Through Memorandum of Understanding ratified between Ministries of Agriculture and Environment during project preparation, the Ministry of Agriculture (MinAgri) will be entrusted with the technical

coordination of the project and deployment of on-the-ground activities. Specific project activities will be delivered through sub-contracts with participating institutions, such as Ministries, NGOs, research institutions (particularly FOFIFA) and local organizations. Collaboration with the FOFIFA, as key project partner, will be further formalized through a tri-partite MOU between MEF, FOFIFA and MinAgri. FOFIFA will ensure local coordination of the project activities in the sites.

Memoranda of Understanding will also be ratified with the following partners, who will be involved in implementing selected project activities and components. This includes the World Vegetable Center and the IRRI, whose participation will be formalized during the inception period, once procurement and operational procedures have been finalized through UNEP.

Project implementation will be supervised by a national- level project steering committee (SC), in which all the major stakeholders will be represented, and who will be tasked with the regular monitoring of the project, including approval of annual programmes and budgets, reports and any significant policy decisions, In addition the SC will be tasked with facilitation of coordination of project activities across partner institutions and making decisions on issues brought to its attention by the PC, CTA and any other members of the project team. The PSC will steer the project implementation process and any problems encountered will be discussed during regular meetings (every 6 months, with additional meetings when necessary). The PSC will approve annual work plans, budgets and procurement plans, and review periodical project reports. Membership of Line Ministries and stakeholders in the SC will be as follows:

- MEF-SAECC - Chair
- MinAgri (Division of Rural Development) – Co-Chair
- MinAgri (Division of Water, Seed Certification Service, Extension Service, Division of Production)
- FOFIFA
- UNEP
- Water directorate
- Health Ministry
- Meteorological Service
- Commerce Ministry
- Regional Authorities
- District representatives
- Producers' cooperatives and associations (three)
- Federation of Water Users
- Private Sector (SILAC)

Technical Partners and other projects will also be included in the SC: World Bank, UNDP, IFAD, JICA, FAO, IRRI, World Vegetable Center, Plateforme du Riz, Observatoire du Riz.

Local supervision will be ensured by decentralized representatives (focal points) of the participating ministries, with lead responsibility entrusted to local MEF representatives and FOFIFA ensuring technical supervision of in field activities.

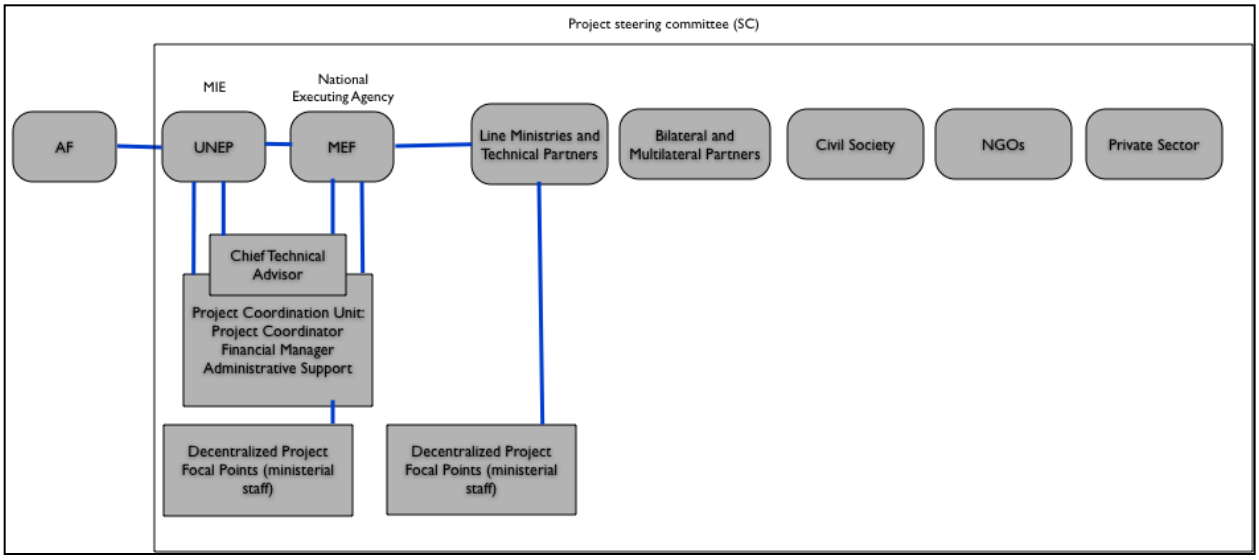


Figure 5: Project Management Structure

Anticipated execution costs

The execution costs of this project include standard project management planning and budgeting. This involves the hiring of personnel whose responsibility will be to coordinate and oversee the daily tasks of project implementation. Because many of the activities of the project involve procurement and sub-contract, the recruitment of a dedicated financial manager will be necessary in order to ensure that the PCU has the required capacity to monitor financial standards as per UNEP and AF requirements.

Project personnel	National project coordinator	90,000
	Financial Manager	75,000
	Administrative support	50,000
Travel		25,000
Incremental operating costs		20,000
Inception and steering meetings		17,000
Monitoring and Evaluation	Baseline study	30,000
	Mid-term evaluation	35,000
	Final evaluation	35,000
	Audit	15,000
	TOTAL	**392,000**

B. Describe the measures for financial and project / programme risk management.

Administration functioning is slow in Madagascar, due to lack of human and financial resources, as well as due to the transitional political situation. Institutional capacity building, particularly through the recruitment of PCU staff, is foreseen as a strategy to alleviate pressures on the administration, while ensuring proper project output delivery.

Another risk that may be encountered by this project is political changes that occur frequently in Madagascar. As a first mitigating strategy, the project will work with multiple partners (minimizing the impacts of changes within a single ministry), as well as with para-governmental partners such as FOFIFA, who can continue to deliver activities at the operational level. As a second mitigating strategy, central administration staff concerned by this project, as well as their regional counterparts will produce reports about their achievements and outputs of the project so as to facilitate transitions, in case of staff changes. In addition, a significant effort will be made to entrust the implementation of key activities to local and community based organizations, such as water user associations, in order to maximize learning at all stages.

Flooding occurs periodically around the Alaotra region during the rains, effectively reducing inter-regional transport, often for days at a time during the rainy season, due to inadequate roads. This may cause delays in performing required field visits and in delivery of inputs from other regions or from capital. However, intra-regional road networks are in relative better state and can allow for transportation of local staff to and from project sites. As a mitigating strategy, coordination of local activities will be entrusted to decentralized ministerial staff; regular communications between the central level PCU and local-level stakeholders will be maintained using telecommunications infrastructure. In addition, advance warning provided through the Early Warning System supported by this project will help scheduling and logistical planning more effectively.

Lack of population buy-in on project activities constitutes a potential risk, though a low one, considering the potential increases in productivity that this project could bring forward, and the recent declines in well-being in the region. Communications with local level producers will emphasize incentives and potential financial and socio-economic gains to be derived from the project, so as to encourage continued participation. Consultations undertaken during project preparation revealed high degreed of local level willingness to participate in this project.

Finally, there is a risk that the upscaling and replication strategy developed for this project might be insufficient in ensuring uptake of the approach to the rest of the country. Political instability in the country may delay or prevent the adoption of policy recommendations adopted by the project. It is hoped that this project will contribute to creating lasting institutional processes and capacity to consider and address barriers to rice resilience. Given the importance of rice in the country, there is a high degree of buy-in for this initiative at all levels. Therefore, while the sustainability strategy is somewhat dependent on activities included in Component 3, it is also expected that demonstrations of lasting productivity increases will act as an incentive and leverage for political and policy attention in the country. This is the reason for the selection of a two-tiered replication strategy: one that will work first in identifying elements of success, key barriers and factors required for replication of the MIRR in other areas at a technical level, and as a second tier, to work with policy and political institutions to create dialogue, and policy-relevant tools for the adoption of rice policy changes that can leverage change.

C. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan.

UNEP will develop a Supervision Plan during the project's inception phase that will be distributed and presented to all stakeholders during the Inception Workshop. The emphasis of the Supervision Plan will be on outcome monitoring, learning and sustainability, as well as financial management and implementation monitoring. Project risks and assumptions will be regularly monitored by UNEP. Risk assessment and rating is an integral part of the Project Implementation Review (PIR). The quality of the project's M&E will also be reviewed and rated as part of the PIR. Key financial parameters will be monitored annually to ensure the cost-effective use of financial resources.

The project will undergo an independent Mid-Term Evaluation at the mid-point. The Mid-Term Evaluation will determine progress being made toward the achievement of outcomes and will identify any course correction needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, ToR and timing of the Mid-Term Evaluation will be decided after consultation between the parties to the project document. The relevant GEF Focal Area Tracking Tools will also be completed during the Mid-Term Evaluation cycle.

An independent Final Evaluation will take place three months prior to the project end date in accordance with UNEP and GEF guidance. The Final Evaluation will focus on the delivery of the project's results as initially planned (and as corrected after the Mid-Term Evaluation, if any such correction took place). The Final Evaluation will assess the impact and sustainability of results, including their contribution to capacity development and the achievement of adaptation benefits. The Final Evaluation should also provide recommendations for follow-up activities and requires a management response which should be uploaded onto PIMS.

An Annual Project Review/Project Implementation Review (APR/PIR) will be prepared to monitor progress made since the project's start and in particular for the previous reporting period. The APR/PIR includes, but is not limited to, reporting on the following:

- Progress made toward the project's objective and outcomes - each with indicators, baseline data and end-of-project targets (cumulative).
- Project outputs delivered per project outcome (annual).
- Lesson learned/good practice.
- AWP and other expenditure reports.
- Project risk and adaptive management.

Periodic monitoring will be conducted through visits to the demonstration sites undertaken by relevant staff from UNEP. Visits will be jointly conducted based on the agreed schedule to assess project progress first hand. A summary of the M&E cost is provided in the table below:

M&E costs

Monitoring and Evaluation Costs/Type of activity	Responsible Parties	Budget ($, Excluding project team time)	Timeframe
Measurements of means of verification (baseline assessment)	PCU, UNEP TM	30,000	First quarter of year 1.
Direct Project Monitoring and Quality Assurance including progress and financial reporting (APR-PIR), project revisions, technical assistance and risk management	PCU Team, UNEP TM and FMO	(supported from staff costs included in Project execution, and from MIE fee)	Quarterly, half-yearly and annually and as needed
Evaluations (Mid-term review and Independent terminal evaluations)	UNEP EO, SC	70,000	At midpoint and at end of project implementation
Audit	UNEP TM, PCU	15,000	Annually at year-end

Inception meeting, field visits and steering committee meetings	UNEP, SC	17,000	Inception meeting within first 2 months and bi-annual PSC meetings (and sub-committee meetings)
	TOTAL	132,000	

D. Include a results framework for the project proposal, including milestones, targets and indicators.

Component	*Outcome*	Activities	EXPECTED CONCRETE OUTPUTS	Output indicator	Baseline	Target
1. Scientific and Technical Capacity						
	1.1 Knowledge base on best practices for climate resilience in rice, based on existing local knowledge and international research					
		Undertake a participatory comparative analysis of rice production techniques and technologies available in relation to their resilience and cost-effectiveness	1.1.1 Best Available Technologies and Integrated Resilient Rice Model (Modèle Intégré de Riziculture Résiliente - MIRR) selected and publicized	# of resilient rice model developed	there are currently various methods for rice cultivation (SRI, SCV, etc) that are site specific, but none integrate climate change	1 recommended resilient rice model for the region
		Organization of a seminar on resilient rice model (MIRR)				
		Publish technical guidelines for MIRR				
	1.2 Malagasy government, research institutions and local communities have the tools and methods to assess, monitor, and understand climate change impacts on rice.					
		Acquire software and deliver training sessions on Oryza 2000 (10 staff at central level)	1.2.1 Crop models are available for rice vulnerability mapping	# of vulnerability maps of future rice production	there is currently no rice model for madagascar due to lack of data, although there are 2 staff members trained for DSSAT	4 rice models/maps by end of project
		Perform data collection for DSSAT and Oryza model population				
		Develop and publish to alternative models, using DSSAT and Oryza for 2050 and 2100 for the region				
		Develop a climate based hydrological model for the Alaotra region for 2050 and 2100		# of hydrological models	no information available	1 hydrological model available at mid-term
		Adapt and disseminate agricultural calendars in relation to new climate trends and data, as per agreed methodology	1.2.2 Updated, dynamic agricultural calendars and climate early warnings taking into account current and projected variability disseminated to local population	timely availability of climate information, including flood early warnings	no updated calendars and early warnings in the alaotra region	updated agricultural information is avaialble at the start of the season and reaches 80% of agricultural producers
		Acquire, install and operate climate and hydrological monitoring equipment for early warnings				
		Ensure the transmission of climate and weather bulletins through radio				
		Climate Risk Management and agro-ecosystem approach training for decentralized personnel (including application of agro-forestry principles in a rice context)	1.2.3 Agricultural extension staff trained on climate risk management in an agro-ecosystem context	number of people trained (gender disaggregated)	10 persons trained	100 staff persons trained
2. Adapted and resilient rice production cycle						
2.1 Sustainable increase in rice yields (using MIRR)						

		2a - input management				
		Pre-select adapted varieties among existing strains (rice and non-rice crops)	2.1.1 climate resilient rice varieties selected through participatory field testing	availability of information on climate resilient rice varieties	there are currently 10 potential rice varieties showing various degrees of adaptability	at least 5 rice varieties tested and proven resilient in laboratory and field testing conditions
		Procure inputs and materials (seeds, tools)				
		Perform participatory field test of the adapted varieties in relation to identified climate stresses				
		Monitor the participatory variety selection programme over 2 seasons				
		Participatory variety selection validation (from a shortlist of resistant varieties)	2.1.2 An operational multiplication and dissemination scheme for adapted seed varieties	availability of seeds from resistant varieties	no certified resilient seeds available	100 Kgs of resilient certified seeds produced and disseminated to 10 multipliers
		Production of pre-base and foundation seeds				
		Multiplication and distribution of certified seeds				
		Update fertilisation formulas, guidelines and packets using climate change and MIRR models, considering socio-economic aspects	2.1.3 Updated fertilisation guidelines according to best available standards and taking climate conditions into consideration	change in use of organic fertilisers and sustainable bio-organic fertilisers	straws are commonly used, but provide insufficient input. bio-organic fertilisers are not commonly used	50% increase in sustainable fertilisers
		Use locally available fertilizer resources (eg compost, manure, agricultural residues, including rice straws and by products)				
		Implementation of Integrated Pest Management Best Practices through training and extension	2.1.4 Integrated pest management is implemented	# of people trained in IPM (gender disaggregated)	no training in IPM available	400 farmers trained in IPM (50% women)
		Rehabilitation of damaged gravitational irrigation infrastructure and canals	2.1.5 Water efficiency, management and conservation technologies and infrastructures are implemented	Km of rehabilitated irrigation canals	all irrigation canals are showing signs of degradation and blockage	200 Km of irrigation canals cured, dredged and maintained
		Dredging of silted water reservoirs		Number of reservoirs dredged	all reservoirs are showing signs of siltation	3 main reservoirs and water retention structures drained
		Installation of new irrigation, drainage and water conservation structures		% increase in water availability in all seasons	Quantity of water available for irrigation is dependent on rainfall and erosion	35% increase in water availability in all seasons

		Implementation of irrigation and water conservation (including water harvesting) practices adapted to new climate trends and conditions with related training of water users		% increase in water use efficiency	current water per ton usage approximately 30Kg per m3	20% increase in WUE
	2.2 Ecosystem services maintained					
		2b - production management				
		Implement and disseminate Integrated Resilient Rice Model (MIRR) for production through training and extension	2.2.1 Best available land preparation, production and harvesting techniques disseminated to reduce deforestation, maintain soil fertility and integrity, and to provide adequate growing conditions	% application of resilient rice model (gender disaggregated)	no farms currently applying resilient rice model	75% of targeted producers use resilient rice model (gender disaggregated)
		Introduce rice-vegetable rotation systems using disease resistant, water efficient resilient crops (leafy vegetables, legumes)		change in rice productivity	average 1.5 T per ha	1 to 2 T/ha average increase
		Develop and distribute technological packets and information documents				
		Participatory Revegetation of degraded slopes and forests, using multi-purpose resilient trees, grasses (vetiver) and participatory management of forest resources	2.2.2 Watershed rehabilitation in productive landscapes introduced, including through reforestation and adaptation of agroforestry practices	# of ha reforested	some reforestation underway in the broader basin but not in project sites	8500 ha reforested around project sites
		Training on sustainable agroforestry and land management (including in a climate change context)				
				# of people trained (gender disaggregated)	currently there are no people trained on SLM and agroforestry in the project sites	300 farmers and land/forest users trained (50% women)
		Adaptation and reintroduction of soil conservation methods for erosion control (tillage, sediment barriers, mulching) in upland and lowland uses	2.2.3 Soil conservation and livestock management techniques adapted to topography and landscape in light of future climate conditions	reduction in erosion rate	Average erosion rate in the region is 12 m m.yr.-1 ( )	50-75% reduction in erosion rates
		Training on the sustainable land use of inactive or stage 2 lavakas and tanety agriculture (for upland communities)				
		Assessment of resilience in livestock management within rice cultivation systems and adaptation of practices for resilience, erosion control, and increased productivity				
		Training, legal support and provision of administrative means for producers cooperatives, sub-basin management committees and water and natural resource user associations	2.2.4 Revitalization of producer's cooperatives and water user associations for collaborative natural resources allocations (e.g. land and water) and management	# of operational water user associations	out of the legally created associations, only 20% are curre tly operational	75% of associations are operational

	2.3 Health improved and new disease spread prevented					
		Perform local level water quality monitoring (including sediment content)	2.3.1 Water quality assessments	% change in water quality (e.g reduction in turbidity, pollutant content, microbial content)	data not available, will be obtained during first monitoring exercise	15% increase in water quality by end of project
		2c - harvest management				
	2.4 Post Harvest losses reduced			change in post harvest losses		
		Introduction of techniques and technologies for the utilization of rice straws in animal feed and for energy production (training and extension)	2.4.1 Increased utilization of rice by-product especially rice straw	% use of rice straws in feed and for briquetting	rice straw currently not being used for feed or briquetting	50% of producers use or commercialize rice straws
		Rehabilitation of storage facilities using upgraded phytosanitary and climate resilience norms on the basis of an inventory	2.4.2 Post-harvest storage facilities with phytosanitary control, serving as trading points and markets	# of operational storage facilities	20% of available facilities are operational	75% of existing facilities are operational
3. Leveraging policy change						
	3.1 Technical norms and standards in rice cultivation reviewed and where necessary modified to take climate change into account					
		Create a multi-partner and interministerial task form on rice resilience, including government, NGOs, private sector and local representatives)	3.1.1 gaps and possible maladaptationsin the current rice policy are identifed and recommendations on upscaling project outcomes towards rice policy reform are made	# of operational intersectoral mechanisms for rice policy making	there is currently 1 rice platform - it is not operational	1 broad national platform exists and is functional

		Identify options for upscaling and replication from MIRR application in broader Alaotra basin and in other regions		# of replication strategies	there is no replication strategy for Alaotra region	1 replication strategy and action plan for Alaotra region
		Develop recommendations on the rice sector transformation and propose a rice policy		# of recommendations on rice resilience	no such recommendation	1 white paper on rice
	3.2 Conditions in place for a full adaptation of the rice sub-sector					
		Engage a dialogue on the socio-economic conditions required for project sustainability	3.2.1 a report on best practices and lessons learned for rice adaptation in madagascar	# of lessons learned reports	0	1 report at end of project

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT[27] *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

Jane Alice Laurette Razanamiharisoa, Designated Authority for the Adaptation Fund, Ministry of Environment and Forests	Date*: 17 October 2011*

B. IMPLEMENTING ENTITY CERTIFICATION *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

6. Each Party shall designate and communicate to the Secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.
Ibrahim Thiaw, Director, Division of Environmental Policy and Implementation Implementing Entity Coordinator Tel: +254 20 7624782 Email: Ibrahim.thiaw@unep.org 
Date: *10 October 2011*
Project Contact Person: Ermira Fida, UNEP-GEF Adaptation Portfolio Manager, UNEP.
Tel. And Email: +254-20-762-3113, ermira.fida@unep.org

Annexes

1. Rice Cropping Systems in Madagascar
2. Annual Yields and Production data for Alaotra region
3. Site selection data
4. Consulted Stakeholders
5. Letter of Endorsement
6. Environmental Impact Screening
7. Detailed budget, annual expenditures and note on the use of MIE fee
8. Alignment of Project Objectives with Adaptation Fund Results Framework

Annex 1 – Rice Cropping Systems in Madagascar

This annex provides additional technical details on cropping systems found in the country and in the targeted region.

A cropping system is characterized by a set of factors (type of land, water supply, cultural techniques employed (seeds, fertilizer ...) mobilized by the farmer to manage the production activity in a specific rice growing environment (aquatic, rainfed, tavy).

- *Rainfed rice* is grown on non-irrigated plots whose water source is fully depending on rainfalls.

- Slash and burn (tavy) includes heavy work to clear all vegetation on newly to be established plots. Vegetation is subsequently burned in order to prepare topsoil for cropping. Tavy is usually practiced on steep hillsides. This ancestral practice has disastrous effects on the topsoil which is not covered any longer and, being exposed, rapidly degrades (losing its organic matter) and washed away downhill where it affects existing irrigation infrastructure.

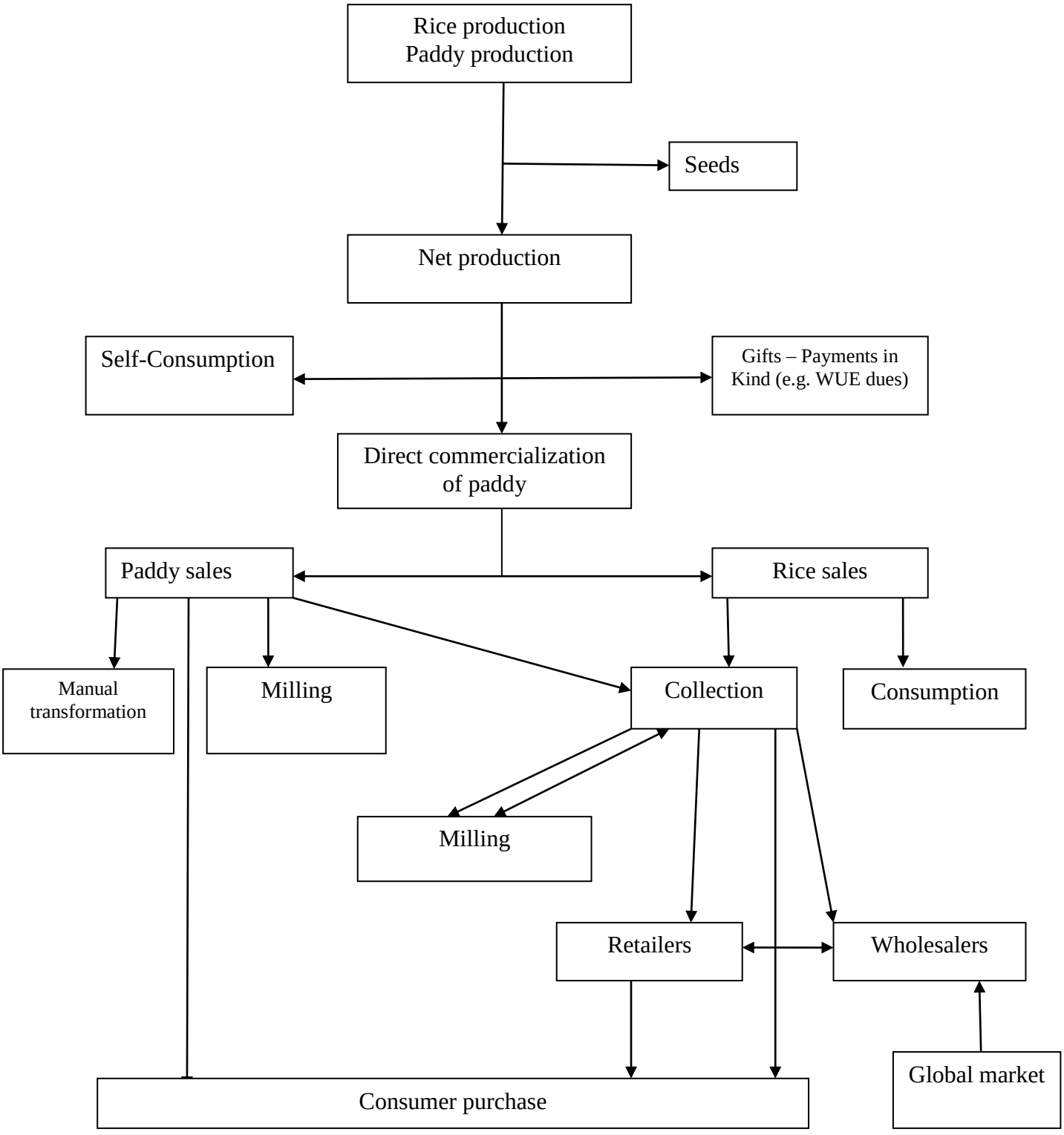
- The "riz aquatique en semis direct" involves direct seeding in lowlands areas; it requires that water management is relatively well-developed as water levels should be maintained in relation to the height of young rice plants. The system is appreciated for easy mechanization and limited weeding.

- The "riz aquatique repiqué en foule" is a traditional lowland transplanting system practiced by planting a number of rice seedlings into every hole. It is the most common system. This traditional practice is widely used because it limits the development of weeds. The transplantation method also allows to start growing rice seedlings in relatively small areas with good water availability (thereby lowering risks during plant establishment) in anticipation of the on-set of the rainy season.

- The" système rizicole amélioré (SRA)" (improved rice system) which is also practiced in low lands with permanent water coverage provides a set of recent techniques such as on-line transplanting which permits use of mechanical weeding, easier fertilizer and pesticide use.

- The "système rizicole intensif (SRI)" (System of Rice Intensification) is based on promoting the root development of rice plants by employing very young replants and replacing plot's permanent water coverage by a succession of temporary water coverage periods in order to maintain soil aerobic conditions for root expansion. It requires important organic manure inputs. This method which requires very good water management also has very demanding labor requirements for weeding (6-8 times per season). The SRI provides by far the best performance in terms of yield/ha but both the high labor requirements as well as the sophistication of required water management limits expansion of this cropping system; consequently, SRI areas remain marginal.

The rice sub-sector in Madagascar



Annex 2 – Annual Yields in Alaotra

This annex provides data on yields an-a production an-a prices in the Alaotra region.

Campagne agricole		Riz			
		Irrigué	Pluvial	Contre saison	TOTAL
1999/2000	Surface (ha)	n-a	n-a	n-a	140 865
	Production (t)	n-a	n-a	n-a	355 385
2000/2001	Surface (ha)	n-a	n-a	n-a	141 940
	Production (t)production (t)	n-a	n-a	n-a	387 610
2001/2002	Surface (ha)	n-a	n-a	n-a	143 030
	Production (t)	n-a	n-a	n-a	374 105
2002/2003	Surface (ha)	n-a	n-a	n-a	144 140
	Production (t)	n-a	n-a	n-a	371 350
2003/2004	Surface (ha)	n-a	n-a	n-a	146 375
	Production (t)	n-a	n-a	n-a	418 755
2004/2005	Surface (ha)	84872	4427	N-a	89299
	Production (tons)	283676	11344	N-a	295020
2005/2006	Surface (ha)	78510	4995	N-a	83505
	Production (tons)	306113	12988	n-a	319101
2006/2007	Surface (ha)	93190	3619	1495	98304
	Production (tons)	318394	4715	3608	326717
2007/2008	Surface (ha)	81782	2159	2620	86561
	Production (tons)	346339	3032	8254	357625
2008/2009	Surface (ha)	105850	5540	2820	114210
	Production (tons)	416762	14678	8660	440100
2009/2010*	Surface (ha)	104850	5773	n.d.	110623*
	Production (tons)	422900	16360	n.d.	439260*

*: temporary data. Doesnt take all perimeters into considération and latest data not available.
Source : DRDR Alaotra Mangoro

Evolution of paddy production between 2000 and 2010 in two districts, Alaotra région
Unit : tonne

année	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Ambatondrazaka	115450	126775	122975	117465	132600	137643	141773	145900	142985	165861	175996
Amparafaravola	135630	151100	143730	156200	176325	178786	186968	189515	202780	235224	262723

SOURCE : DSEC / MinAgri

Le bilan du paddy en 2009 se présente comme suit dans la région d'Alaotra Mangoro :

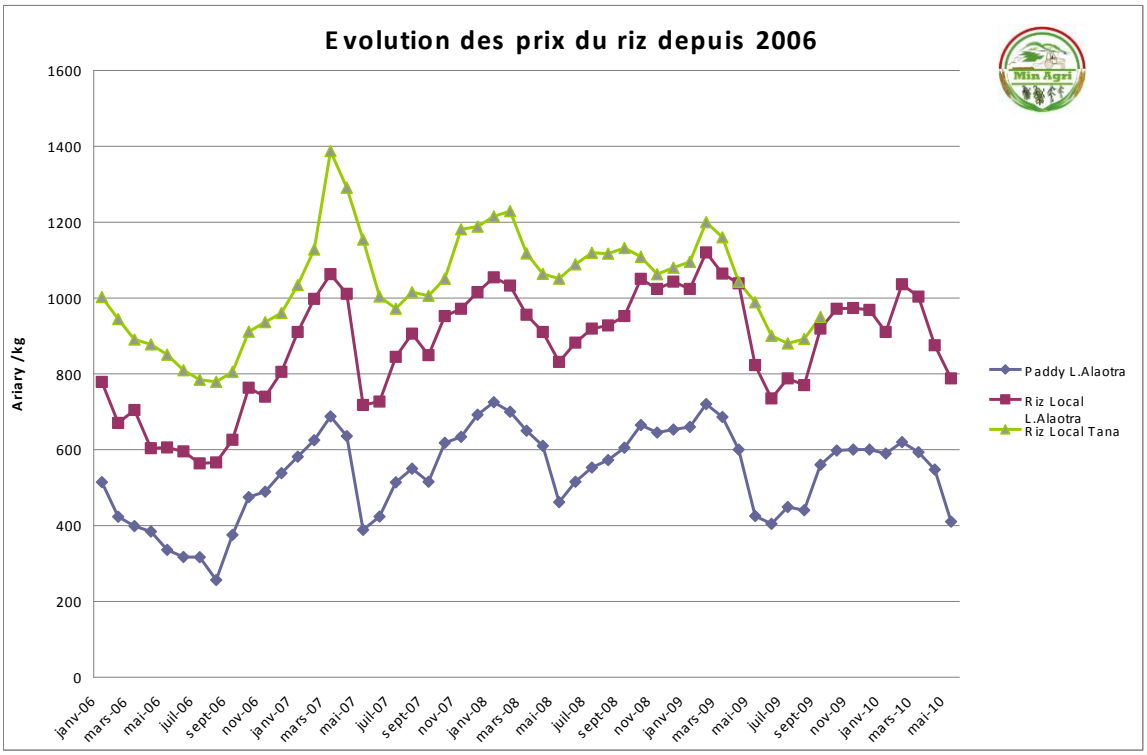
Production paddy : 567 600t; bilan consommation paddy : 348 996t; bilan consommation riz blanc : 226 847t;

Impact of technical support and extension on yields in three districts in 2000

District	Ambatondrazaka	Amparafaravola	Andilamena
Surface under enhanced technology	7590 ha	25976 ha	1084 ha
Additional production	14104 T	20294 T	2015 T

Source : MinAgri

Rice prices evolution since 2006 (source, Observatoire du Riz)



Price variations (local vs. Antananarivo)

Mois	Paddy L.Alaotra	Riz Local L.Alaotra	Riz Local Tana
11			1 008
12			1 029
janv-06	514	778	1 002
févr-06	423	670	944
mars-06	399	704	890
avr-06	384	604	877
mai-06	336	606	850
juin-06	317	595	810
juil-06	317	564	784
août-06	256	566	779
sept-06	375	626	805
oct-06	475	763	911
nov-06	489	739	936
déc-06	538	805	961
janv-07	582	910	1 034
févr-07	625	998	1 128
mars-07	687	1063	1 388
avr-07	636	1011	1 291
mai-07	388	718	1 154
juin-07	424	727	1 004
juil-07	514	844	972
août-07	550	906	1 015
sept-07	515	849	1 006
oct-07	618	952	1 051
nov-07	634	971	1 181
déc-07	692	1015	1 188
janv-08	725	1 054	1 215
févr-08	700	1 033	1 229
mars-08	650	956	1 117
avr-08	610	910	1 063
mai-08	461	831	1 051
juin-08	515	882	1 089
juil-08	553	919	1 119
août-08	573	928	1 117
sept-08	605	952	1 132
oct-08	665	1 050	1 108
nov-08	645	1 024	1 063
déc-08	653	1 043	1 080
janv-09	660	1 024	1 095
févr-09	720	1 120	1 200
mars-09	686	1 064	1 160
avr-09	600	1 038	1 043
mai-09	425	823	988
juin-09	404	735	900
juil-09	449	788	880

août-09	440	770	892
sept-09	560	919	950
oct-09	598	971	
nov-09	600	973	
déc-09	600	968	
janv-10	590	910	
févr-10	620	1 036	
mars-10	593	1 003	
avr-10	548	875	
mai-10	410	788	

ANNEX 3 – Site Selection Data

Sélection des sites du projet

	Facteurs climatiques				Facteurs socio-économiques								Facteurs agricoles							Facteurs environnmentaux					Facteurs institutionnels						Faisabilité		
Site Présélection né	séchéresse récente	inondation récente (5)	Tendances de Température moyenne mensuelle (5)	Niveau de pauvreté (revenu, indice pauvreté)	nombre de personnes affectées	Nb hectares affectés	qualité et quantité de l'alimentation	prévalence des maladies liées à l'eau (paludisme et diarrhées)	Nombre de chefs de ménage féminins	disponibilité et qualité de l'eau potable	type de riziculture (inn, pluv, scv)	superficie (ha)	rendement et productivité (selon Statistique Agricole 2004-2005)	accès aux intrants (pest, engrch., eng. Org)	Type de semence	type et état des systèmes d'irrigation (+efficacité)	degré de mécanisation	caractérisation du système de collecte	état infrastructures de stockage (GCV)	érosion / lavakisation	déforestation	ensablement des rizières	présence d'un PCD	accès aux services de vulgarisation (présence CSA)	existence d'ONG	organisations paysannes (fédérations) et multiplicateurs potentiels	association des usagers de l'eau	existence d'opérateurs économiques	FOFIFA opérationnel (ou potentiel)	accessibilité et enclavement	accès télécom et média
Ambatondrazaka (Ilakana)	x (retard des pluies) durant tout le mois de février 2010 hauteur de pluie moyenne normale 244,7mm contre 111,4mm en 2010	en février 2010 la hauteur de pluie ne dépasse pas 111,4mm déficit hydrique	xtemérature moyenne normale mensuelle 23,6° C	moins de 100 dollars par an per capita	zpopulation district Ambatondrazaka 321 517 80% de la population	Superficie district 6492 km2 superficie commune Atsangasanga 50 km2	médiocre	paludisme-infections respiratoires aigües-diarrhées-infections cutanées-affections buccodenraires	20,54 %	rainfed avec irrigation (barrage) insuffisante	pluvial assité d'irriqation	superficie rizicole au niveau district Ambatondrazaka: 40 690 ha dont 3000 ha à Manakambahiny et Atsangasanga	3,1 T/ha	faible accès	X 265 - riz hyb ride	mauvais état	faible	monopole des groupes restreints de collecteurs	nombre insuffisant	oui	oui sur les versants	oui, dû à l'érosion	tbc		EZAKA, VONONA		oui	SILAC	accessibles		
Ambatondrazaka (Communes suburbaines)	x (retard des pluies)	x	xtemérature moyenne normale mensuelle 23,6° C	moins de 100 dollars par an per capita	zpopulation district Ambatondrazaka 321 5172 80% de la population pauvre à Feramanga	Superficie district 6492 km2, superficie de la commune 70 km2	médiocre	paludisme-infections respiratoires aigües-diarrhées-infections cutanées-affections buccodenraires	20,54 %	rainfed - insuffisance d'eau potable	strict element pluvial sans conservation de l'eau	600	3,1 T/ha. En général, baisse de rendement	faible accès	X 265 - riz hyb ride	aucune	moyen	monopole des groupes restreints de collecteurs	nombre insuffisant	oui	oui sur les versants	oui, réduction de 10% da la surface rizicole à cause de l'ensablement	tbc		Plus de 75 associations		oui	SILAC	basé		

Andilamena (Bemaintso)	arrivée tardive des pluies dans l'ensemble de la zone, la ressource en eau est sèche	haute de pluie maximale 111,4mm	x23,6 °C	moins de 100 dollars par an per capita	zpopuation district Andilamena 68 352, dont 80% à Bemaintso	Superficie district 7526 km2, superficie de la commune de Bemaintso 510 km2	médiocre	paludisme-infections respiratoires aigües-diarrhées-infections cutanées-affections buccodenraires	20,87 %	difficulté en eau potable	riz irrigué	superficie riz au niveau district: 9870 ha et au niveau de la commune de Bemaintso 1745 ha	2,7 T/ha diminution du rendement	accès difficile	accès aux semences hybrides mais chères (3500Ar)	mauvais état, néczsité de réhabilitation des infrastructures	faible	monopole des qroupes restreints de collecteurs	nombre insuffisant	oui	oui sur les versants	oui, une grande partie des rizières sont ensablées à cause de l'érosion dû àn de fortes précipitation	oui			existe mais pas opérationnelle (dépend du budget communal pour opérer)	SILAC	accessibles
Amparafaravola (Ambohijanaharry)	arrivée tardive des pluies dans l'ensemble de la zone durant le mois	haute de pluie maximale 111,4m déficit hydrique	z 23,6° C	moins de 100 dollars par an per capita	zpopuation district Amparafaravola 206 400, 80% de la population	Superficie district 6966 km2 dont superficie de la commune Amboijanahary 230 km2	médiocre	paludisme-infections respiratoires aigües-diarrhées-infections cutanées-affections buccodenraires	17,29 %			superficie riz au niveau district: 46 470 ha dont 5460 ha dans le district d'Amboijanahary	3,3 T/ha	faible accès	X 265 - riz hybride	mauvais état	moyen	monopole des groupes restreints de collecteurs	nombre insuffisant	oui	oui sur les versants		tbc	AID , AKAMA, ANDRY, APM, TIAKO FAHAZAVANA	oui	SILAC	accessibles
Ambatondrazaka (Andaingo)	arrivée tardive des pluies dans la zone durant le mois de février 2010	déficit hydrique haute de pluie maximale 111,4mm	x23,6 °C	moins de 100 dollars par an per capita	zpopuation district Ambatondrazaka 321 517	Superficie district 6492 km2	médiocre	paludisme-infections respiratoires aigües-diarrhées-infections cutanées-affections buccodenraires	20,54 %				3,1 T/ha	faible accès		mauvais état	moyen	monopole des groupes restreints de collecteurs	nombre insuffisant	oui	oui sur les versants		tbc			SILAC	accessibles

Annex 4 – List of consulted Stakeholders

NGOs and community organizations	Activity
ANAE	Agroforestry- soil protection
ADRA	Training of health agents at local level
ASOS	Support and training for environmental protection NGOs and groups
ANGAP	Rural infrastructure – school rehabilitation
FISA	Family planning
SOAN'ALAOTRA	Agricultural training and support
FANILO	Agriculture, livestock, roofmaking
Tranoben'ny Tantsaha	Suppport to producers and farmers
Governmental and para-governmental	
GSDM	Multisectoral partnership on soil fertility
FOFIFA	Agricultural research and extension support
MinAgri	Ministry of Agriculture, Divisions of Rural Development, Water Planning, Hydrological Engineering, Vegetal production, Agricultural production
MEF	Ministry of Environment and Forests
ONE	Office National de l'Environnement
Meteo	National Meteorological Service
Ministry of Finance	
Observatoire du Riz	Monitors rice prices and policy
Other partners	
World Bank	Rural infrastructure programming
JICA	Project PAPRIZ and Bassins Versants Lac Alaotra (BV-LAC)
AFD	Project BV-Lac and BV-PI
UNDP	Early Warning System, BV Lac
IFAD	Project BV-Lac and BV-PI, support to rural finance, rural production, technical support to agricultural research
Local communities	
Regional chief	Ambatondrazaka
Production agents	Andilamena
Mayor and assistants	Andilamena and Bemaitso
Mayor and technical team	Ferramanga, Ambatondrazaka
Farmers	Ambatondrazaka
Mayor	CR Manakambainy
Farmers	Ilakana

Annex 5 – Letter of endorsement

REPUBLIC OF MADAGASCAR
Fitiavana-Tanindrazana-Fandrosoana

MINISTRY OF ENVIRONMENT AND FORESTS

SECRETARY GENERAL

DIRECTION GENERAL OF ENVIRONMENT

DIRECTION OF CLIMATE CHANGE

Ref No: 079/11. 17 October 2011

To: The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

ENDORSEMENT OF "PROMOTING CLIMATE RESILIENCE IN THE RICE SECTOR THROUGH PILOT INVESTMENTS IN ALAOTRA-MANGORO REGION" IN MADAGASCAR.

In my capacity as designated authority for the Adaptation Fund in the Republic of Madagascar, I confirm that the above national project proposal is in accordance with the government's National Climate Change priorities including the National Policies of Climate Change, the National Adaptation Programme of Action (NAPA) in implementing adaptation activities to reduce adverse impacts of, and risks posed by climate change in Madagascar.

Accordingly, I am pleased to endorse and re submit the above project proposal with support from the Adaptation Fund. If approved, the project will be implemented by UNEP as a Multilateral Implementing Entity and executed by Ministry of Environment and Forests.

Your consideration and cooperation is highly appreciated.

RAZANAMIHARISOA Jane
For : HEAD OF ADAPTATION SERVICE

Annex 6 - Preliminary Environmental and Social Impact Assessment

Under the guidance of the Ministry of Environment and Forests, a preliminary screening of Environmental and Social Impacts was undertaken for this project. Findings are summarized below using the recently developed template for UNEP Environmental and Social Safeguards. Detailed ESIA will be undertaken for specific activities during project implementation, as per Madagascar laws and regulations.

Project location:		Yes	No	Comments and scope of impact
Is the project area in or close to -				
	- densely populated area		X	The project is expected to reach a high number of farmers and rice producers. Although it is taking place in an area where population density is high, it is not expected to have any significant impact on settlements.
	- cultural heritage site		X	
	- protected area	X		The project is located near Lake Alaotra Protected Area. Proposed project activities are directly contributing to enhancing environmental conditions in the area, thereby assisting in the implementation of established management goals and plans.
	- wetland	X		The Lake Alaotra Wetlands are Ramsar designated sites. The proposed project activities are directly contributing to wetland rehabilitation and management in accordance with Malagasy policies and plans.
	- mangrove		X	
	- estuarine		X	
	- buffer zone of protected area		X	
	- special area for protecting biodiversity		X	
Environmental impacts, i.e. will the project cause		*Yes*	*No*	*Comment/explanation*
	Need for temporary or permanent support facilities?		X	
	- Increase in soil erosion and siltation?		X	The project intends to reduce soil erosion and siltation.
	Increase in peak and flood flows? (including from temporary or permanent waste waters)		X	Through activities designed to increase soil cover, it is expected that floods will be reduced
	- Loss of downstream beneficial uses (water supply or fisheries)?		X	
	- Impairment of ecological opportunities?		X	
	- Any loss of precious ecology?		X	
	- Threat to local biodiversity due to invasive species?		X	No alien species will be introduced. Alternative crops and reforestation activities will be undertaken using locally viable and adapted species.
	- Loss of downstream ecological and economic functions due to any construction of social infrastructure		X	

	(e.g., road, training or information center, office or housing)?			
	- Unnecessary loss of ecological value and decreased biodiversity by replacement of natural forest with plantation with limited number of species?		X	Reforestation and wetland rehabilitation will be undertaken using locally adapted species and in respect of the ecosystem, using integrated approaches.
	- Ecological problems due to land clearance prior to reforestation (e.g., soil erosion, disruption of hydrological cycle, loss of nutrients, or decline in soil fertility)?		X	No land clearance is expected to take place during the project. Agricultural productivity increases are expected to take place without an expansion of area under cultivation.
	- Other ecological problems (e.g., pollution of water bodies from fertilizers, pesticides, and herbicides used in plantation)?		X	For agricultural elements of the project, the use of organic fertilization methods will be priviledged. Where absolutely necessary, chemical fertilizers may be used, subject to Madagascar standards and regulations.
	- Increased waste production?		X	
	- Increased traffic?		X	
	Polluting emissions to air?		X	
	Other environmental problems, e.g. noise?		X	
Social impacts, i.e. will the project cause		Yes	No	Comment
	- Dislocation or involuntary resettlement of people?		X	The project does not intend to create relocation or resettlement of populations.
	- Disproportionate impact to women or other disadvantaged or vulnerable groups?		X	There will be a beneficial impact on women and youth during the project due to job creation, and increased water and energy availability.
	- Impairment of beneficial uses of traditional areas?		X	The project will not intervene in traditional areas.
	- Impairment of recreational opportunities?		X	
	- Impairment of indigenous people's livelihoods or belief systems?		X	
	- Possible conflicts with established management policies?		X	The project has been designed to supplement and enhance current management policies in order to promote resilience.
	- Social problems and conflicts related to land tenure and access to resources?		X	The project will work within established tenure and property regimes
	- Technology or land use modification that may change present social and economic activities?	X		The project intends to promote more sustainable land use patterns and agricultural practices in order to achieve higher productivity and promote alternative patterns of livelihoods. These initiatives will be undertaken with communities full participation and on a voluntary basis, and are expected to lead to positive impacts on communities' overall well being.
	- Uncontrolled in-migration (short- and long-term) with opening of roads to area and overloading of social infrastructure?		X	
	- Increased local or regional		X	

	unemployment?			
Other considerations		Yes	No	Comment
	Does national regulation in affected country (-ies) require EIA and/or ESIA for this type of activity?	X		EIA will be undertaken as per requirements specified in Madagascar Laws and Regulations.
	Is there national capacity to ensure a sound implementation of EIA and/or SIA requirements present in affected country (-ies)?	X		The Ministry of Environment and Forests, through the Office National de l'Environnement, is legally responsible for the administration and oversight of the EIA requirement in the country. It has the capacity to administer EIA effectively.

Annex 7 – Financial Annex

7.1 Detailed Budget per expenditure item

			Expenditure by project component/activity (provide description)						*Insert actual year						
			Add additional components/activities as required						Add additional years as required						
									Expenditure by calendar year						
UNEP Budget Line			1	2	3	PM	M&E	Total	Year 1*	Year 2*	Year 3*	Year 4	Year 5	Total	Notes
10	**PERSONNEL COMPONENT**														
	1100	Project personnel													
	1101	project coordinator				90,000		90,000	18,000	18,000	18,000	18,000	18,000	90,000	1
	1102	national financial manager				75,000		75,000	15,000	15,000	15,000	15,000	15,000	75,000	2
	1199	**Sub-total**	**-**	**-**	**-**	**165,000**	**-**	**165,000**	**33,000**	**33,000**	**33,000**	**33,000**	**33,000**	**165,000**	
	1200	Consultants												-	
	1201	national agriculture and rice experts	60,000					60,000	60,000	-	-	-	-	60,000	3
	1202	international rice experts	60,000					60,000	60,000	-	-	-	-	60,000	4
	1203	mapping services consultancy (NC)	35,000					35,000	35,000	-	-	-	-	35,000	5
	1204	national hydrological experts	35,000					35,000	-	35,000	-	-	-	35,000	6
	1205	international crm expert	85,000					85,000	-	85,000	-	-	-	85,000	7
	1206	national extension specialists)	20,000					20,000	-	20,000	-	-	-	20,000	8
	1207	national agriculture researchers		75,000				75,000	25,000	25,000	25,000	-	-	75,000	9
	1208	national agriculture experts (4)		50,000				50,000	-	50,000	-	-	-	50,000	10
	1209	national agriculture experts		100,000				100,000	50,000	50,000	-	-	-	100,000	11
	1210	national fertilisation expert		65,000				65,000	25,000	25,000	15,000	-	-	65,000	12
	1211	international IPM expert		35,000				35,000	-	35,000	-	-	-	35,000	13
	1212	International Rice Expert (CTA)		150,000				150,000	30,000	30,000	30,000	30,000	30,000	150,000	14
	1213	national riziculture experts (4)		60,000				60,000	-	20,000	20,000	20,000	-	60,000	15
	1214	legal expert		20,000				20,000	-	-	20,000	-	-	20,000	16
	1215	national water expert		20,000				20,000	20,000	-	-	-	-	20,000	17
	1216	national agriculture expert		35,000				35,000	-	20,000	15,000	-	-	35,000	18
	1217	socio-economist		40,000				40,000	-	25,000	15,000	-	-	40,000	19
	1218	livestock expert		35,000				35,000	-	20,000	15,000	-	-	35,000	20
	1219	economist		20,000				20,000	20,000	-	-	-	-	20,000	21
	1220	national agriculture policy consultants			80,000			80,000	-	20,000	20,000	20,000	20,000	80,000	22
	1221	national agriculture policy consultants			30,000			30,000	-	-	-	20,000	10,000	30,000	22
	1222	national agriculture policy consultants			30,000			30,000	-	-	-	-	30,000	30,000	22

	1223	national agro-forestry experts	25,000	60,000				85,000	-	45,000	20,000	20,000	-	85,000	23
	1224	Soil conservation consultancy		200,000				200,000	-	50,000	50,000	50,000	50,000	200,000	24
	1225	Resilient livestock management expertise		70,000				70,000	-	25,000	25,000	20,000	-	70,000	25
	1299	**Sub-total**	**320,000**	**1,035,000**	**140,000**	**-**	**-**	**1,495,000**	**325,000**	**580,000**	**270,000**	**180,000**	**140,000**	**1,495,000**	
	1300	Administrative Support						-							
	1301	administrative support				50,000		50,000	10,000	10,000	10,000	10,000	10,000	50,000	26
								-						-	
								-						-	
	1399	**Sub-total**	**-**	**-**	**-**	**50,000**	**-**	**50,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**50,000**	
	1600	Travel on official business												-	
	1601	Travel				25,000		25,000	5,000	5,000	5,000	5,000	5,000	25,000	27
	1602	travel	20,000					20,000	-	20,000	-	-	-	20,000	28
	1699	**Sub-total**	**20,000**	**-**	**-**	**25,000**	**-**	**45,000**	**5,000**	**25,000**	**5,000**	**5,000**	**5,000**	45,000	
1999	**Component total**		**340,000**	**1,035,000**	**140,000**	**240,000**	**-**	**1,755,000**	**373,000**	**648,000**	**318,000**	**228,000**	**188,000**	**1,755,000**	
														-	
20	**SUB-CONTRACT COMPONENT**													-	
	2100	Sub-contracts (MOUs/LOAs for cooperating agencies)												-	
	2101	sub-contract for extension services		45,000				45,000	-	15,000	15,000	15,000	-	45,000	29
	2102	sub-contract Ministry of forests		255,000				255,000	-	85,000	85,000	85,000	-	255,000	30
	2103	Sub-contract Ministry of water		45,000				45,000	15,000	-	15,000	-	15,000	45,000	31
	2199	**Sub-total**	**-**	**345,000**	**-**	**-**	**-**	**345,000**	**15,000**	**100,000**	**115,000**	**100,000**	**15,000**	**345,000**	
	2200	Sub-contracts (MOUs/LOAs for supporting organizations)												-	
	2201	sub-contract with IRRI (and FOFIFA)		65,000				65,000	65,000	-	-	-	-	65,000	32
	2202	Sub-contract for SLM Community Training		105,000				105,000	-	-	35,000	35,000	35,000	105,000	33
	2203	sub-contract with Rural Radio Network	80,000					80,000	-	20,000	20,000	20,000	20,000	80,000	34
	2299	**Sub-total**	**80,000**	**170,000**	**-**	**-**	**-**	**250,000**	**65,000**	**20,000**	**55,000**	**55,000**	**55,000**	250,000	
	2300	Sub-contracts (for commercial purposes)												-	
	2301	publication services	10,000					10,000	10,000	-	-	-	-	10,000	35
	2302	sub-contract with BIOTECH Madagascar (for Taroka)		185,000				185,000	-	100,000	85,000	-	-	185,000	36
	2303	sub-contract with GUANOMAD (for Guano)		185,000				185,000	-	100,000	85,000	-	-	185,000	37
	2304	sub-contract with water engineering firm		200,000				200,000	-	100,000	100,000	-	-	200,000	38

	2305	sub-contract with civil engineering firm		200,000				200,000	-	200,000	-	-	-	200,000	39
	2306	sub-contract with water engineering firm		50,000				50,000	-	-	50,000	-	-	50,000	40
	2307	sub-contract private sector firm		50,000				50,000	25,000	25,000	-	-	-	50,000	41
	2399	**Sub-total**	**10,000**	**870,000**	**-**	**-**	**-**	**880,000**	**35,000**	**525,000**	**320,000**	**-**	**-**	**880,000**	
2999	**Component total**		**90,000**	**1,385,000**	**-**	**-**	**-**	**1,475,000**	**115,000**	**645,000**	**490,000**	**155,000**	**70,000**	**1,475,000**	
														-	
30	**TRAINING COMPONENT**													-	
	3200	Group training												-	
	3201	training workshop (IRRI)	18,000					18,000	18,000	-	-	-	-	18,000	42
	3202	group training	50,000					50,000	-	50,000	-	-	-	50,000	43
	3203	IPM training workshops		40,000				40,000	-	40,000	-	-	-	40,000	44
	3204	water management training workshops		35,000				35,000	-	-	35,000	-	-	35,000	45
	3205	MIRR training		60,000				60,000	-	60,000	-	-	-	60,000	46
	3206	Water user Association training workshop		20,000				20,000	-	-	20,000	-	-	20,000	47
	3207	training on community-managed reserves		15,000				15,000	-	15,000	-	-	-	15,000	48
	3208	Training and monitoring on adaptation of soil conservation in various land use types		60,000				60,000	-	20,000	20,000	20,000	-	60,000	49
								-						-	
	3299	**Sub-total**	**68,000**	**230,000**	**-**	**-**	**-**	**298,000**	**18,000**	**185,000**	**75,000**	**20,000**	**-**	**298,000**	
	3300	Meetings/Conferences												-	
	3301	MIRR selection and validation workshop	35,000					35,000	35,000	-	-	-	-	35,000	50
	3302	Climate Risk Management workshop	50,000					50,000	-	50,000	-	-	-	50,000	51
	3303	inception and steering meetings					17,000	17,000	5,000	3,000	3,000	3,000	3,000	17,000	52
	3304	meetings and workshops (replication plan)						-	-	15,000	15,000	15,000	15,000	60,000	53
	3399	**Sub-total**	**85,000**	**-**	**-**	**-**	**17,000**	**102,000**	**40,000**	**68,000**	**18,000**	**18,000**	**18,000**	**162,000**	
3999	**Component total**		**153,000**	**230,000**	**-**	**-**	**17,000**	**400,000**	**58,000**	**253,000**	**93,000**	**38,000**	**18,000**	**460,000**	
														-	
40	**EQUIPMENT AND PREMISES COMPONENT**													-	
	4100	Expendable equipment												-	
	4101	agricultural inputs (seeds, fertilizers, land and tools)		50,000				50,000	50,000	-	-	-	-	50,000	48
	4102	agricultural inputs		300,000				300,000	50,000	100,000	100,000	50,000	-	300,000	48
	4103	trees and seedlings		50,000				50,000	-	25,000	25,000	-	-	50,000	49
	4104	equipment and office supplies		60,000				60,000	-	15,000	15,000	15,000	15,000	60,000	50
	4105	laboratory and expendable equipment		15,000				15,000	5,000	-	5,000	-	5,000	15,000	51

	4106	Incremental operating costs				20,000		20,000	4,000	4,000	4,000	4,000	4,000	20,000	52
	4199	**Sub-total**	**-**	**475,000**	**-**	**20,000**	**-**	**495,000**	**109,000**	**144,000**	**149,000**	**69,000**	**24,000**	**495,000**	
	4200	Non-expendable equipment												-	
	4201	software and hardware acquisition	20,000					20,000	20,000	-	-	-	-	20,000	53
	4202	synoptic weather stations	200,000					200,000	-	200,000	-	-	-	200,000	54
	4203	irrigation equipment		90,000				90,000	-	-	90,000	-	-	90,000	55
	4204	equipment rental		50,000				50,000	-	-	25,000	25,000	-	50,000	56
	4205	equipment and construction material		45,000				45,000	25,000	20,000	-	-	-	45,000	57
	4299	**Sub-total**	**220,000**	**185,000**	**-**	**-**	**-**	**405,000**	**45,000**	**220,000**	**115,000**	**25,000**	**-**	**405,000**	
4999	**Component total**		**220,000**	**660,000**	**-**	**20,000**	**-**	**900,000**	**154,000**	**364,000**	**264,000**	**94,000**	**24,000**	**900,000**	
														-	
50	**MISCELLANEOUS COMPONENT**													-	
	5500	Evaluation												-	
	5501	Baseline					30,000	30,000	30,000	-	-	-	-	30,000	58
		mid-term evaluation					35,000	35,000	-	-	35,000	-	-	35,000	59
		final evaluation					35,000	35,000	-	-	-	-	35,000	35,000	60
	5502	audit					15,000	15,000	3,000	3,000	3,000	3,000	3,000	15,000	61
	5581	0					-	-	-	-	-	-	-	-	
	5599	**Sub-total**	**-**	**-**	**-**	**-**	**115,000**	**115,000**	**33,000**	**3,000**	**38,000**	**3,000**	**38,000**	**115,000**	
5999	**Component total**		**-**	**-**	**-**	**-**	**115,000**	**115,000**	**33,000**	**3,000**	**38,000**	**3,000**	**38,000**	**115,000**	
														-	
99	**GRAND TOTAL**		**803,000**	**3,310,000**	**140,000**	**260,000**	**132,000**	**4,645,000**	**733,000**	**1,913,000**	**1,203,000**	**518,000**	**338,000**	**4,705,000**	
													MIE fee	399,925	
													TOTAL	5,104,925	

Notes

1 Project Coordinator Contract
2 Contract for financial and administrative assistant to the project in charge of procurement and financial accounts
3 Consultancy contract to two national rice experts for desk study on available rice models and best practices under Output 1.1.1
4 Consultancy contract for 2 international rice experts for study on available rice models and best practices under Output 1.1.1
5 Consultancy or sub-contreact for the provision of mapping services following the production of crop models under output 1.2.1
6 Consultancy contract for hyrdological expertise towards the production of hydrological model for the region under output 1.2.1
7 Consultancy contract for the provision of advice and training material on climate risk management in rice cultivation under output 1.2.2
8 Consultancy contract towards the provision of expert advice and training on adapting Madagascar's extention services to climate change under Output 1.2.3
9 Consultancy contract for 2 agricultural researchers for the selection of resilient rice varieties under Output 2.1.1
10 Consultancy contract for 4 agriculture or rice experts to guide the operationalization of the seed multiplication and dissemination system under output 21.1
11 Consultancy contract for 2 agricultural experts towards the development of rice cultivation guidelines, speficially fertilisation guidelines under Output 2.1.3 and pest management under output 2.1.4
12 Consultancy contract for the provision of expert advice on best practices for resilient rice, focusing on fertilisation formulas, under Output 2.1.3
13 Consultancy contract for a expert on integrated pest management on the application of IPM practices to the MIRR model in Madagascar under output 2.1.4
14 Consultancy contract for high-level rice expertise to act as chief technical advisor and provide expert advice on resilience in rice cultivation under Output 2.2.1
15 Consultancy contract for 4 national riziculture experts on the application of the MIRR set of practices in the field
16 Consultancy for the provision of advice to water user associations regarding the collection and administration of membership dues under Output 2.2.3
17 Consultancy for a national water and irrigation advice on the application of water conservation and management practicesand on water quality monitoring under Output 2.2.3
18 Consultancy for the provision of technical advice and guidance on the use of rice by-products for fertilisation, feed and energy under output 2.4.1
19 Consultancy for the provision of expert advice on the potential economic feasibility and profitability of the use of rice by-products including identification of potentially innovative uses, under Output 2.4.1
20 Consultancy for the provision of expertise on livestock management and the potential uses of rice by-products in feed including health and productivity implications, under Output 2.4.1
21 Consutlancy for the provision of economic advice on post-harvest storage mechanisms and facilities and towards the negotiation of appropriate price regulating mechanisms
22 Consultancy for expert policy advice towards the development of a report on best practices, recommendations on a rice policy from project outcomes and on the management of an intersectoral institutional mechanism on rice under Outputs 3.1.1 and 3.2.1
22
22
23 Consultancy contract for agro-forestry expertise towards the provision of technical advice on integration of agroforestry principles in the MIRR and in climate risk management
24 Consultancy for the provision of scientific and technical advice on the monitoring and controlling of soil erosion
25 Consultancy for the provision of advice on livestock management in a climate change context with an accent on livestock-rice interactions
26 Salary costs for an administrative, secretarial and clerical functions for the project
27 Travel for project management purposes from Madagascar to Project sites, calculated on the basis of 2 annual missions of 4 people (Project Coordinator, CTA, MEF and MinAgri Representatives)
28 Travel costs and DSA for 100 participants to the training of extension services under Output 1.2.3
29 Sub-contract to local extension services under MinAgri towards the training of local producers in the selected land and water use practices, as well as supplementary costs incurred from increased support to farmers and towards yield monitoring during the project
30 Sub-contract to the Ministry of Forests to execute and supervise the reforestation and community-based watershed management elements of the project
31 Sub-contract to the Ministr of water towards the execution of water quality assessments in rice cultivated perimeters
32 MOU with IRRI and FOFIFA to execute and monitor the research components and field testing of varieties in accordance with participatory research protocols
33 MOU with a local NGO for the delegated delivery of training sessions on sustainable land management and agroforestry applications. The NGO will be selected among those already active around the Lake and already having demonstrated working experience with agro-forestry and SLM

MOU with the Rural Radio Network for the provision of regular climate bulletins and early warning systems through its member stations. Costs will cover some initial training of speakers and
34 the provision of technial means for the reciept and transmission of information. Data will be provided by the Meteorological Authority

35 Printing and binding services for the publication of a white paper on rice resilience in Madagascar and MIRR workshop proceedings, including mapping publications

36 Purchasing agremenent with Biotech for provision of Taroka fertilizing material and for the organization of a long-term supply scheme

37 Purchasing agreement with Guanomad for Guano fertilizing supply for participating farmers and towards the development of a local supply scheme for the long-term

38 Sub-contract for the delivery of cleaning, dredging, and rehabilitation works on irrigation canals (Component 2). Costs include staff and equipment

39 Sub-contract for the delivery of dredging, reconstruction and rehabilitation works on water reservoirs and dams under Component 2. Costs include staff and equipement

40 Purhasing and service agreement for tbe installation of small scale water conservation infrastructures, including training and demonstrations, and maintenance services

Service agreement with a private sector firm for the operation, surveillance and maintenance of post harvest facilitites. Firms will be selected based on calls for tender, among local compagnies
41 already working in the collection and distribution of rice harvests.

training workshop the acquisition and performance of crop models specific to rice. This includes staff and travel costs as well as incremental operating costs such as computers and expendables.
42 Meeting space and participation costs to be covered from in-kind contributions from project partners. Calculated on the basis of a 2 day workshop for 20 people

training on the development and dissemination of climate early warnings and on the elaboration of upgraded agricultural calendars based on climate change. Includes costs for trainers,
43 materials, travel costs and DSAs for outside participants and operating costs for a 3 day workshop for 20 people

Training on the application of integrated pest management. Training for 400 people in 3 districts, on-farm. Costs include travel and DSA for outside participants and costs of materials and
44 trainers

45 Costs of organizing a water management workshop and demonstration, on-farm, for water user associations. Csts include participation of at least 3 representatives from each active WUE

Costs of organizing training (in-class and on-farm) on the application of the MIRR. Include trainer costs, material costs, space rental when necessary and travel or DSAs for participants in need
46 of assistance. Calculated on the basis of 1 workshop per district

Costs of travel and DSAs, and trainer salary for the organization of a workshop for water user associations on the reformulation of statutes, collection and administration of dues. Calculated on
47 the basis of 1 workshop held in central location in the region, with 1 representative per WUE

Costs of on-site training for private and semi-private entities on the management of community-based harvest reserves. Includes space rental requirements, trainer costs. Calculated based on
48 a single workshop, for 10 participants

purchasing orders for seed and genetic material, small implements, laboratory and field testing equipment. Rices estimated based on subsidised costs, purchasing through regular government
48 certified channels

48

49 Costs of training on the adaptation and development of soil conservation techniques in a resilience and rice production context for both upland and lowland cultivators

49 purchasing orders for seedlings and saplings from existing nurseries for reforestation purposes. Estimated costs at 2$ per tree

Logistical costs towards the organization of a workshop on the selection and validation of the Resilient Rice Model (MIRR). Costs include space and equipment rental, publicity and dissemination and incremental staff costs for participating ministries. Participating expert costs, and travel costs are to be covered from above consultancies. Calculated on the basis of 1 workshop for a
50 maximum of 60 people.

50 expendable office equipment for water user associations including computers and software, telecommunications costs, paper and meeting costs

Logistical and travel costs for the organization of a workshop on climate risk managemnet in rice systems among extension and agricultural private sector. Costs include space rental, travel
51 costs for outside participants. Expert costs to be covered from consultancies.

51 laboratory equipment for water quality monitoring, to be made available through Ministry of Health and Ministry of Water-approved channels, as per specifications

Travel costs for the organization of the inception meeting and regular meetings of the project steering committee. Meetings are expected to rotate from site to site and in capital. Costs include
52 expendables.

52 expendable equipment and incremental operating costs for the Project Coordination unit, including computers and software, internet and telephone communications and small expendables.

53 Costs of meetings and workshops and consultancies towards the development of a replication plan and strategy

53 acquisition of computers, networking capacity and modeling softwares for performance of crop and hydrological models

acquisition and operation of three synoptic climate monitoring stations (estimated cost of 80,000 per station plus operation and data transfer and collection fees) to be performed through
54 Meterorological Service

55 acquisition and installation of irrigation equipment including tubes, pipes, gates and pumps where necessary. Estimated costs of 30,000 per site in required additional equipment. À

56 rental of trucks, tractors, mobile irrigation units and other tools as well as supervision and operating costs for reforestation works

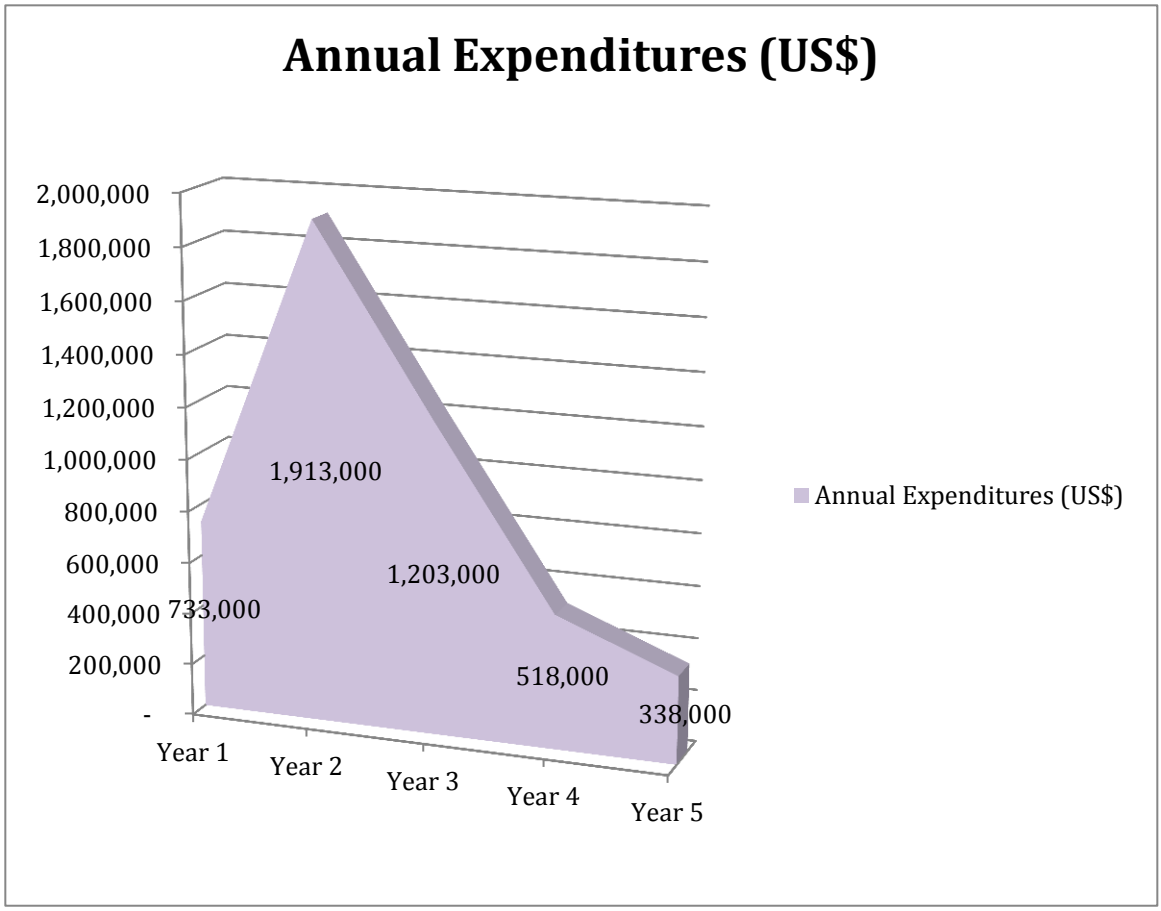
57	construction raw materials for the rehabiltiation of post harvest storage facilities including cement, tiling, membranes, fencing. Costs estimated based on average rehabilitation needs of 5000 US$ per facility
58	consultancy cost for the establishemnt of a baseline study for sicentific quantification of project baseline and indicators
59	consultancy costs for performance of mid-term evaluation. Includes 1 national and 1 international consultant as well as travel costs.
60	consultancy costs for performance of final evaluation. Includes 1 national and 1 international consultant as well as travel costs.
61	sub-contract with audit firm for performance of annual financial audit and statements. Estimated annual cost of 3000 US$.

7.2 Anticipated Annual Expenditures

	Year 1	Year 2	Year 3	Year 4	Year 5
Annual Expenditures (US$)	733,000	1,913,000	1,203,000	518,000	338,000

Schedule of Disbursement

Milestone	Month (1-60)	Amount	Note
Approval	1	489,925	includes MIE fee, and year 1 project execution fees (advance)
Inception	4	643,000	Year 1 project operation expenditures (advance)
Y1 APR, baseline study and MIRR workshop report, ESIA report	12	985,500	50% advance year 2 expenditures and year 2 project execution
Y2 Semi-annual PIR	18	927,500	50% year 2 expenditures
Y2 APR	24	648,000	50% advance on year 3 expenditures and Year 3 project execution
Y3 Semi annual PIR	30	555,000	50% year 3 expenditures
Y3 APR and MTE	36	288,000	50% advance on year 4 expenditures and Year 4 project execution
Y4 Semi-annual PIR	40	230,000	50% year 4 expenditures
Y4 APR	46	215,500	50% advance on Year 5 expenditures and Year 5 project execution
Y5 Semi-Annual PIR	52	73,500	30% year 5 expenditures
Y5 APR, Final Evaluation Report, Financial statements and closing reports	60	49,000	20% Year 5 expenditures
		5,104,925	


Annual Expenditures (US$)
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
-
1,913,000
1,203,000
733,000
518,000
338,000
Year 1
Year 2
Year 3
Year 4
Year 5
Annual Expenditures (US$)

7.3 Note on the use of the Implementing Entity Project Fee

Madagascar- Adaptation Fund MIE fee budget	Project	MIE fee (8.5%)
Project Costs	**4,705,000.00**	
Overall coordination and management		81,985.00
Oversight and management of project development and project implementation		103,180.00
Financial management, including accounting, treasury, grant and trust fund management		62,388.00
Information and communication management		21,996.00
Quality assurance including internal and external audits (Note 1)		39,993.00
Overall administration and support costs		90,383.00
Total indirect costs (Note 2)		**399,925.00**
TOTAL	5,104,925.00	
Note 1: This portion of the MIE fees is used to oversee the M&E function of the project by the IE		
Note 2 - Direct costs will be recovered from the project		

ANNEX 8 - ALIGNMENT OF PROJECT OBJECTIVES/OUTCOMES WITH ADAPTATION FUND RESULTS FRAMEWORK

Any project or programme funded through the Adaptation Fund (AF) must align with the Fund's results framework and directly contribute to the Fund's overall objective and outcomes outlined. Not every project/programme outcome will align directly with the Fund's framework but at least one outcome and output indicator from the Adaptation Fund's Strategic Results Framework must be included at the project design stage.

Project Objective(s)[28]	**Project Objective Indicator(s)**	**Fund Outcome**	**Fund Outcome Indicator**
To initiate the transformation of the rice sub-sector to make it more resilient to current climate variability as well as expected climate change and associated hazards	% uptake of the MIRR rice cultivation model Change in rice productivity	4. Increased adaptive capacity within relevant development and natural resource sectors	4.1 Development sectors services responsible to evolving needs from changing and variable climate
Project Outcome(s)	**Project Outcome Indicator(s)**	**Fund Output**	**Fund Output Indicator**
1.1 Knowledge base on best practices for climate resilience in rice, based on existing local knowledge and international research	# of resilient rice models developed	4. vulnerable physical, natural, social assets strengthened in response to climate change impacts including variability	4.1 Development sectors services responsible to evolving needs from changing and variable climate
1.2 Malagasy government, research institutions and local communities have the tools and methods to assess, monitor, and understand climate change impacts on rice.	# of vulnerability maps of future rice production # of hydrological models timely availability of climate	4. vulnerable physical, natural, social assets strengthened in response to climate change impacts including variability	4.1 Development sectors services responsible to evolving needs from changing and variable climate

[28] The AF utilized OECD/DAC terminology for its results framework. Project proponents may use different terminology but the overall principle should still apply

	information, including flood early warnings		
2.1 Sustainable increase in rice yields (using MIRR)	% application of resilient rice model (gender disaggregated) change in rice productivity	6. Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas	6.1 percentage of households and communities having a more secure (increased) access to livelihoods assets
2.2 Ecosystem services maintained	# of ha reforested change in erosion rates	5: vulnerable physical, natural, social assets strengthened in response to climate change impacts including variability	5.1 No and Type of resource assets created, maintained or improved to withstand conditions resulting from climate variability and change
2.3 Health improved and new disease spread prevented	% change in water quality	4. vulnerable physical, natural, social assets strengthened in response to climate change impacts including variability	4.1.2 No and type of health or social infrastructure developed or modified to new conditions resulting from climate variability and change
2.4 Post Harvest losses reduced	Change in post harvest losses	6. Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas	6.1 percentage of households and communities having a more secure (increased) access to livelihoods assets
3.1 Technical norms and standards in rice cultivation reviewed and where necessary modified to take climate change into account	# of operational intersectoral mechanisms for rice policy making # of replication plans # of recommendations on rice resilience	7. Improved integration of climate resilience strategies into country development plans	7.1 No, type and sector of policies introduced or adjusted to address climate change risks
3.2 Conditions in place for a full adaptation of the rice sub-sector	# of lessons learned reports	7. Improved integration of climate resilience strategies into country development plans	7.1 No, type and sector of policies introduced or adjusted to address climate change risks

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ANNEX 3: DISBURSEMENT MATRIX

	Upon Agreement signature USD	One Year after Project Start[a/] USD	Year 2[b/] USD	Year 3 USD	Year 4[c/] USD	**Total** USD
Scheduled Date	April 2012	October 2013 (note 1)	October 2014	October 2015	October 2016	
Project Funds	1,211,250	1,735,500	1,031,750	473,000	253,500	4,705,000
Implementing Entity Fee	102,956	147,518	87,699	40,205	21,547	399,925

[a/]Use projected start date to approximate first year disbursement

[b/]Subsequent dates will follow the year anniversary of project start

[c/]Add columns for years as needed

Notes:

1 The inception workshop is scheduled to take place in September 2012. And therefore one year after project start date, is October 2013.