COUNTRY REPORTS

THE STATE OF **RWANDA'S** BIODIVERSITY FOR FOOD AND AGRICULTURE

Rwanda's Brief Report on the State of Biodiversity for Food and Agriculture




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STATE OF KNOWLEDGE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

Please consult referenced sections of the country report guidelines[1] for additional information, descriptions and definitions.

I. Assessment and monitoring of biodiversity for food and agriculture

1.1 General context[2]

a) Provide a brief account on the role of biodiversity for food and agriculture in your country.[3]

With agriculture being the main source of livelihood, income and employment particularly among the rural population, there is a diversity of crops and livestock breeds that are used for food production in Rwanda. The diversity of crops follows the ecological diversity of the country, leading to the definition of 12 different agricultural zones (Delepierre (1974) where crops are specific and regionally important.

In all zones, the number of cultivated varieties of maize, rice, banana, and cassava has been growing through Crop Intensification Programme (CIP) launched in Rwanda in 2007. The majority of the varieties have been tested introduced and are also frequently tested by Rwanda Agriculture Board (RAB) for adaptability, disease and pest resistance and productivity.

The main food crops in terms of cultivation and use are bean (*Phaseolus vulgaris*), maize (*Zea mays*), rice (*Oryzasativa*), wheat (*Triticum spp*), banana (*Musa spp.),* Irish potato (*Solanum tuberosum*), Cassava (*Manihot esculenta*), Sweet potato (*Ipomea batatas*), Sorghum (*Sorghum bicolor*), Wheat (*Triticum aestivum*) and Soja (*Glycine max*). Major cultivated horticultural species are oranges (*Citrus sinensis*), lemon (*Citrus limon*), mango (*Mangifera indica*), avocado tree (*Persea americana*) and pineapple (*Anana scomosus*). The main cash crops in Rwanda are coffee (*Coffea arabica*), tea (*Camellia sinensis*) and pyrethrum (*Chrysantemum cinerariifolium*) (RAB, 2012).

Other plant species that are important in Rwanda due to their adaptability and high-yielding potential are Amaranthe (*Amaranthus spp*.), pumpkin (*Cucurbitapepo*), green pepper (*Capsicum annuum*), garlic (*Allium sativum*), pepper (*Capsicum spp.),* eggplant (*Solanum spp*.), cabbage (*Brassica spp*.), sunflower (*Helianthus annus*) and onion (*Allium cepa*) (RAB, 2012).

The history of introduction of different major crops to Rwanda is not well documented. Different crop species were introduced to Rwanda at different periods and under different conditions. Maize was introduced to Rwanda in 15th century and adapted to various conditions. Wheat germplasm was introduced from CIMMYT and national programs of Burundi, Kenya, Tanzania, Uganda, Ethiopia, Zambia, Mexico, Canada, USSR and Turkey. These introductions were mainly carried out between 1970 and 1986. Bean was introduced a bit later around 16th century by Portuguese in East Africa. Soybean was introduced in 1930 and different varieties were tested and found to be adapted to different agro ecological zones. Cassava and soybean were introduced at same time by European missionaries. Cassava germplasm mainly came from IITA and CIAT. The research on Cassava became more active in 1940 with

[1] See http://www.fao.org/nr/cgrfa/biodiversity/guidelines/en/.
[2] Reference: questions 2, 3, 4, 5, 6 and 7 of country report guidelines.
[3] Reference: question 3 of country report guidelines.

the release of the first variety Eala 07 (Gitaminsi) (RAB, 2012).

Sweet potato and Irish potato, the two major tuber and root crops in Rwanda were introduced later in 18th and 20th century, respectively, by Rwandan army during the war of conquest and missionaries. Most of the of Irish potato varieties originated from CIP, Libramont-Belgium and CIP-Uganda and the research on the commodity became very active from 1979 when the potato research center (PNAP) was established, resulting to the release of 6 varieties in 1983. Sweet potato gained economic and dietary importance from 1966 to 1983. Coffee, as the main cash crop, was introduced before 1920 by the first missionaries; most of materials originated from Ethiopia and DRC (former Zaïre, Kivu Province). Tea research started in 1958 and tea varieties came from DRC, Burundi and Kenya while Pyrethrum research started in 1950s; germplasm was mainly introduced from DRC.

Horticulture research started way back in 1930s during the INEAC era. Major horticultural commodities included avocado, banana, citrus, pineapple and apple. Apple was introduced to Rwanda in 1982 from Zimbabwe. Several banana varieties were introduced from DRC and the research on the commodity started before 1953 (RAB 2012). Information on the introduction of forage species is scanty but the available documentation indicates that research on these commodities started in 1980s with species such as *Pennisetumspp, Setaria, Tripscum, Andropogon, Panicum, Desmodium, Mucuna, Glycine* and *Stylosanthes* (RAB, 2012).

Livestock has always been part of the Rwandan farming systems, whereby the pure pastoral production systems have slowly but surely been replaced by sedentary mixed farming systems. Livestock plays a key role in the intensification of production and increased value addition to crops, crop residues and grazing resources. The government acknowledges livestock as an important part in achieving food security, especially in terms of the protein requirements and also its potential role in poverty alleviation. MINAGRI is leading the national efforts to initiate, develop and manage suitable programmes for the transformation and modernization of agriculture and animal resources. Livestock is seen as a key pillar for economic growth, poverty reduction as described in the EDPRS. The challenge remains to design and develop the livestock production systems in such a way that they can contribute to both food security and poverty alleviation, especially in the smallholder sector, without leading to environmental degradation. Genetic improvement is only one of the many contributing factors to increased livestock productivity and production and with improving the nutritional status and health status of animals one of the key factors for this improvement in livestock production.

In Rwanda, old indigenous animal breeds have not been lost completely. However, there is a general concern that the genetic variation within indigenous animal genetic resources in Rwanda is disappearing through breed substitution, indiscriminate crossbreeding and the absence of breed development programs. Other threatening factors to domestic animal genetic resources include increasing human population that has led to intensified settlement in pastoral areas—thereby reducing the land available for livestock grazing, which have severely affected localized populations and accelerated admixtures and interbreeding among breeds. This situation has been worsened by livestock disease epidemics. Any reduction in the diversity of genetic resources narrows the scope to respond to changes in the environment, disease challenges or demand patterns. The gradual disappearance of indigenous breeds that are able to survive in extreme environments undermines food and livelihood security of the poor and the capacity of people to survive in marginal areas.

Rwanda has several native livestock breeds that are considered as the major genetic resources for livestock production systems in the country. The Inyambo cattle breeds have superior adaptive attributes to local environmental stresses (such as resistance to disease and drought) compared to exotic breed. The diversity of this 'genetic resource' is a key component of the ability of a pastoral agricultural system to overcome destabilizing factors given uncertainty over production environments in

the future such as climate change, disease and changing market demands. The Inyambo cattle breed are not well classified or are defined with very limited information available regarding the size of population and amount of genetic variations.

There is general concern that the genetic variation within indigenous cattle in Rwanda is disappearing through breed substitution, indiscriminate crossbreeding and the absence of breed development programmes. The gradual disappearance of indigenous breed that are able to survive in extreme environments undermines food and livelihood security and the capacity of people to survive in marginal areas. The conservation of inyambo is really needed in order to conserve these cattle which are carrying unidentified genes for increasing production or special adaptation in the future. There is need therefore, to ensure that Inyambo germplasm is safely conserved in Rwanda and made available for research, animal improvement and other purposes both in short term and long terms.

The local pig breed in Rwanda is a small-sized hardy animal with low productivity but also low exigencies, which fits perfectly in an environment with a low level of resources and management capacity. Local pigs are relatively easy animal to keep, prolific and thus easy to spread good genetics in a short time. Local pigs survive on crop residues and kitchen waste. It is obvious that there has been crossbreeding taking place in the past but it is hard to assess how much and where there are still pure traditional pigs.

The local pig breed is not characterized and there is no information available regarding the number of population and amount of genetic variation. The local pigs are resistant to diseases and present a high phenotypic variability that is conducive to a breeding action. It is important to ensure that local pigs germplasm is conserved and made available for research, animal improvement and other purposes both in short term and long term (LIP, 2014)

Local sheep (Fat tailed sheep) in Rwanda were raised together with cattle while grazing in natural pastures. However, in the high altitude zones, exotic breed with potential to produce hairs. Though sheep meat consumption was a taboo for many Rwandans, its skin was used to carry the children in the back. Due to those cultural mentalities and the arrival of clothes, the number of sheep kept falling down years after years especially for local breed. As they are being extinguished, it is imperative to preserve their genotypes in the framework of diversity maintenance.

The local goat of Rwanda is a cross from the east African local goat and Ghanaian goat. In Rwanda, goats are kept in low and mid altitude zones. They are browsed in the eastern savannahs where they find more shrubs and warm climate. Other goats are found in the southern zone where they are tethered either at home or in non-cultivated areas. However, goat meat is the most grilled meat. These local goats are being replaced by the crosses from exotic breed mainly from Europe, Asia and Africa to improve their body size. The introduced breeds are Toggenbourg, Alpines, Saanen, Anglonubian, Ethiopian gala, Boer goats.

The local chicken breed in Rwanda is a small, rustic and egg production does not exceed 50 eggs per year. The local chicken breed is not characterized and there is no information available regarding the number of chicken population and amount of genetic variation. They are resistant to diseases and present a high phenotypic variability. The objective of their conservation is to ensure that local chicken breed is safely maintained and made available for research and animal improvement.

Aquaculture in Rwanda mainly concerns *Tilapia nilotica*. This variety from Lake Albert was brought to restock some lakes in Rwanda. Little to nothing is known about the indigenous Tilapia genetics. There is need to develop a more systematic programme for “provenance” testing of the various Tilapia lines and breeds and identify and select the best variety for Rwanda.

Fish farming is integrated with small animal production (rabbits, poultry, pigs, goats/sheep) and using the effluent to irrigate vegetable plots, thus serving as source of fertilization and a water storage buffer in case irrigation water finishes. The country has promoted, through various programs, the construction of ponds and built the capacity for fingerling and fish feed production. In the past, uncontrolled access to the lakes, use of illegal and destructive gear and overfishing reduced the useable fish stock and thus the annual off-take of fish from the lakes. Extensive studies to improve the fish stocks in natural lakes through reduction of the quantity of predatory fish and restocking were done and specific management plans that included the re-introduction of Tilapia *nilotica* in some lakes were drawn up.

With the high level of illegal fishing of the past, the volume of the annual catch could not be determined accurately. Estimate of the highest production recorded is 9,050 Tons of fish valued at US$ 25 million. Consumption of fish per capita in Rwanda is 1kg. This shows that there is a potential market for the fish production in-country.

Aquaculture in the bottomlands is being promoted by the PAIGELAC project and the Kigembe fish hatchery plays an important role in the provision of fingerlings. There are currently around 800 ha of fishponds in Rwanda. The aquaculture is practiced in a subsistence low external input way. There is little pond management and with the breeding habits of Tilapia the fish will be many but of a small size. Aquaculture is in most cases a new venture for both the farmers and the advisory services of RAB.

Rwanda is importing more than 11,000 tons of dried fish from Uganda and Tanzania annually. This fish also plays an important role in the manufacture of poultry and pig feed and at the time of this study was trading for around US$ 800 Ton^{-1}.

Carried on across generations in Rwanda, bee keeping plays a major role in the livelihoods of the rural communities for its lucrative income-generating activity, as well as medicinal value, and in some communities, for brewing local beer. However, this trend is rapidly changing and Rwandans are increasingly taking up beekeeping as a business enterprise. Today, the honey that they harvest is primarily for sale, although the locals also use it as a table meal, and for medicinal purposes. But it's mostly for sale, since the demand is always there and the prices are good. The current demand for honey is 1715 MT from 1625 in 2006. The production for the last 6 years has increased from 38 Metric tons in 2005 to 321 MT in 2010. Import has been significantly increased from 129 MT to 1614 MT in 2012. The projected private investment in honey sector is estimated at US$ 7Million by 2017.

The beekeeping sector was initiated by government in the 1980,s, with the introduction and intensification of modern beekeeping. The beekeepers in Rwanda are divided into categories of:*(i) Semi-professional,* dedicating 40-60% of their time on beekeeping, (ii) *Side-line production system in which farmers* keeping some hives for some additional income, but not investing much time or money in this activity; and (iii) *Hobbyists,* keeping 2-3 hives for own use, relatives and friends. During honey harvesting/hunting, most honey collectors leave the most aggressive bees alone, which means that they have the best chance to survive, multiply and swarm and occupy empty hives. The more docile bee colonies are preferred for honey collection and are more disturbed and/or destroyed than their aggressive brothers/sisters. This management practice might over the years have led to a negative selection for more aggressive bees colonizing the traditional hives in the forest zones. This is however hard to prove. Without active hive management and production recording it is unlikely that any selection by beekeepers in the bee genetics has taken place in the past. Genetic selection in bees is usually geared towards 3 criteria namely production of the colony; aggressiveness and tendency to swarm. All of these characteristics have a relatively low hereditability and are hard to objectively measure. In Rwanda there are 3 distinct different "breeds" or ecotypes of the African honeybee viz. (i) the Nyungwe lowland forest type; (ii) he Virunga highland forest type, and (iii) the Akagera African savannah type. These bees have through natural selection adapted to their environment and are

probably unbeatable in terms of their genetics and suitability for the area where they were selected. However, unproductive colonies or empty hives have been reported in the country. It should be monitored whether this situation is caused by the spread of Cape honeybee (*Apes mellifera capensis*) that has a considerably lower honey production than the African honeybee, *Apis mellifera scutellata*. The presence and spread of Varroa infection needs to be monitored also.

In Rwanda, wild foods are commonly found in the following categories: plants used in traditional human and veterinary medicine, fodder, honey and melliferous plants, wild fruits, tree seeds, essential oils,,wild mushrooms, ornamental plants, game and fish and ecotourism. They have long been an important component of the livelihood of people particularly living in or in the vicinity of forests. Natural forests, savannah woodlots and gallery forests are the most important ecosystems that support these resources. In addition, the value of ecotourism in these forests is at 478.4 billion Rwandan Francs, contributing about 9.1 % of GDP in 2014.

Wild fruits are present in the forests but they receive little interest from the people, who prefer to consume fruits from agroforestry orchards. In Nyungwe National Park, woody plants producing edible wild fruits include *Clerodendron fuscum, Parinari excelsa*, and *Myrianthus holstii* (Murekezi, 1999). In savanna woodlands, edible fruits are produced by *Rumex maderensis, R. usambarensis, Cajanus cajan, Carica edulis, Rhus vulgaris, Solanum taitente* and other *Solanum spp.* (Dessouter, 1991). Wild fruits are generally harvested and eaten by children and by adults only during the periods of food deficit. Quantitative information on wild fruit production is not available.

Natural stands and plantations provide much of the supplies of tree seeds used in tree planting and afforestation activities the country. Wild mushrooms occur in most of Rwanda's forests and are associated with *Termitomyces* (Hayes, 1991). Artificial production of these mushrooms is not yet possible due to difficulties in collecting the micro-organisms (Murekezi, 1999). Thus the potential productivity of wild mushrooms is not sufficiently enhanced. Statistics for mushrooms collection are scanty but it is known that they are collected for home consumption and selling on local markets.

In the past, game meat was obtained from buffalo, antelopes, zebra, guinea fowl, and duikers among others, through hunting. Today, illegal hunting for bush meat is still underway in protected forests and savannah. As a result, hunting has reduced game population that is much sought after by illegal poachers for meat.

As presented previously, honey collection from forests is enhanced by the quality of their biotopes (natural forests, savannahs, forest plantations). Research indicates that about 27 melliferous plants have been identified in Nyungwe natural forest alone (Murekezi 1999). Forests and woodlands play an important role in beekeeping. Habiyambere (1999) reported a list of 27 plant species associated with honey production in Nyungwe Natural Forest and 14 plant species outside this Forest. The potential for honey production in natural forests and forest plantations is not fully exploited (Nyilimana, 1997). Because harvesting methods are still traditional and include the use of fire, forests are at high risk of burning.

Rwanda's forests and savannas are diverse. The country has a number of endemic plant and animal species which makes national parks and other protected areas attractive to tourism. Akagera National Park, Nyungwe Natural Forests and Birunga National Park are important wild lands that contribute a large share towards the availability of foreign exchange in the national economy. For instance in 2014, revenues generated by the National parks were 16.8 Million USD. Volcanoes National Park accounts 93% of all revenues generated by the parks. Among activities that national parks sell to visitors include a rich biodiversity including Chimpanzees, different flours and vegetation species, variety of bird species, the canopy walkway and the Kamiranzovu water fall all on the part of Nyungwe National Park, gorilla in

Birunga National Park and a variety of wildlife and birds in Akagera National Park.

Rwanda's forests and other natural ecosystems contain a wealth of plants used to produce medicines and perfumes. In 1996, about 59 woody plants used in traditional human and veterinary were inventoried (Mbarubukeye and Niang 1996. Some of the plant species producing valuable oils used for pharmaceutical purposes include *Plantago lanceolata, Calendula officinalis, Datura stramonium, Eucalyptus globulus, E. smithii, Capsicum frutescens, Neorautanenia mitis, Thymus vulgaris, Pentas longiflora, Pelarganium graveolens, P. raduta, Cymbopogon afronardus, C. winterianus, C. citratus* and *C. flexanomus* (MICOMART, 1998). Despite their value, medicinal plants are disappearing due to climate change and population pressure on land and forests for crop production, livestock farming and wood consumption (firewood, charcoal, timber).

Fodder plants and grasses are also found in forests and as part of the natural vegetation in the country. There are valuable sources of animal feeds. Unfortunately grazing is not allowed within forests but fodder collection is always done illegally by livestock farmers. In the case of Nyungwe Forest, silvopastoral practices were permitted in new forest plantations in the buffer zone. About 20 grass species were grazed by livestock on the ground layer of these plantations (Gasana, 1988). The Akagera National Park in the eastern region of the country contains palatable grass species, the most important of which are *Themeda triandra* and *Panicum maximum* (Mvukiyumwami, 1987).

In Rwanda, native fruits and vegetables form a considerable proportion of Rwandan's diets. Horticultural crops such as avocados were introduced by missionaries during the colonial period. Today, there is need for tropical and temperate fruits and vegetables to address nutrient deficiencies particularly of vitamins, minerals and fats through the consumption of fruits and vegetables. Horticulture in Rwanda is only economically practical and earns higher prices compared to staple crops as long as the population density remains low and land for new fields is readily available. Horticulture industry offers considerable potential which may contribute significantly to poverty reduction and economic development if adequately exploited.

Rwanda has a strong competitive base that hinges on its comparative advantages such as favorable climate, soils, abundant water resource, and abundant cheap labor force that can be exploited to produce quality and competitive horticulture products on the regional and international. Horticulture development can therefore increase and diversify Rwanda's export base, reduce dependence on coffee and tea whose prices continue to fall on international market.

Rwanda's early ornamental and amenity flora appeared to have been limited to 15–20 native species. These included *Erythrina abyssinica* "umurinzi," *Ficus thonningii* "umuvumu," *Euphorbia candelabrum* "umuduha," *Euphorbia tirucalli* "umuyenzi," *Dracaena afromontana* "umuhati," *Dracaena steudneri* "igihondohondo," *Markhamia lutea* "umusave," *Tetradenia riparia* "umuravumba," *Ricinus communis* "ikibonobono," *Solanecio mannii* "umutagara," *Cajanus cajan* "umukunde," *Gynandropsis gynandra* "isogi," *Solanum torvum* "inkarishya" and *Vernonia amygdalina* "umubilizi." This low species richness seems to have been maintained or did change a little at least until the dawn of the 20th centuries. A vegetation survey by Seburanga (2013) indicated that there was more ornamental tree species richness in cities than in surrounding rural areas, with species richness being positively correlated with city development index. Kigali city has the highest species richness of which the majority of species are exotic. Half the number of species is from Tropical Asia, Tropical America, and Australia.

a) Indicate which of the production systems listed in Table 1 below are found in your country[4] and briefly describe each of them (e.g. area under production, share of smallholders, importance of the production system to the incomes, livelihoods and well-being of rural communities, etc.).[5]

Table 1. Production systems present in the country.

Name of production system	Indicate if present in the country (Y/N)	Description	Area under production (indicate unit)	Contribution to the agricultural sector economy (%)
Livestock grassland-based systems	Y	Livestock farms are common in the land use systems of the eastern lowlands of Rwanda (Eastern plateau and Eastern Savannah) and in the highlands of the Volcanic highland (near Gishwati Natural Forest) and Congo Nile Crest. There also few livestock farms scattered in the land use systems of the Central plateau and Buberuka highland. Livestock breeding target mainly milk production, and to a limited extent the production of cheese. The agricultural landscape is dominated by crops that are specialized to the area. Milk collection centers have been established and supply milk to urban centres for home consumption and as raw material to the milk industry.	133,848.5 ha	Livestock and livestock products contributed 3 % to GDP in 2014-2015

[4] Reference: questions 4 and 5 of country report guidelines. For the purpose of this table, aggregated production systems are used (disregarding climatic zones).
[5] Reference: questions 5 and 7 (Table 3) of country report guidelines and FAOSTAT: http://faostat3.fao.org/home/E

Table 1 (continued)

Name of production system	Indicate if present in the country (Y/N)	Description	Area under production (indicate unit)	Contribution to the agricultural sector economy (%)
Livestock landless systems	Y	There are feedlot systems in Rwanda. The law prohibits free grazing systems and farmers are called to practice zero grazing systems in the country. The system is increasing through Girinka Program (One Cow per poor Family). Livestock feeds are produced on farms or purchased from neighbors' farmers. Commercial protein supplements are purchased by livestock farmers from local markets.	*70% of agricultural households in Rwanda are at the same time breeders.* From the 2008 NAS, it was noted that 70% of agricultural households are at the same time breeders, of which 22.9% kept small animals, 31% kept big animals with or without small animal and poultry, 16.9% kept poultry with or without small or big animals	See above, data not disaggregated by livestock systems
Naturally regenerated forests	Y	Naturally generated forest cover is about 52 % of the total forest cover of the country. Natural regenerated forests comprise bamboo stand, closed natural forest, degraded natural forests, shrubland and wooden savannah.		
Planted forests	Y	About 48% of the forest cover in Rwanda consists of forest plantations predominantly planted in the buffer zones of protected natural forests. The dominant species in planted forests is eucalyptus whose stands cover about 11% of the total forest cover of approx. 27 %. Forests are established both for protection and production	326780.4 ha in 2013	

Table 1 (continued)

Name of production system	Indicate if present in the country (Y/N)	Description	Area under production (indicate unit)	Contribution to the agricultural sector economy (%)
Self-recruiting capture fisheries	Y	Lake Kivu and small lakes in Akagera National Park are the main fishing area for commercial fisheries.	9,050 km^2	0.3% of GDP
Culture-based fisheries	Y	Fish Stockings are made where fish species in lakes are depleted. Rwanda Agriculture Board (RAB) implements this activity and ensures controlled fishing.	2 662 fish ponds	
Fed aquaculture	Y	Aquaculture production is made in many areas of the country. Aquaculture is made to avail fish in the country and to reduce importation. Usually farmers' cooperatives own fish ponds	4, 038 km^2 of land aquaculture production	
Non-fed aquaculture	Y	RAB own natural food ponds to produce fingerlings of fish for stocking in lakes and ponds. Production levels are increased by introduction of fish varieties and fertilization.		
Irrigated crops (rice)	Y	Rice is widely grown as an irrigated crop in Rwanda. Although rice is not a traditional crop, it has emerged as the most suitable crop for marshlands and inland valleys in the recent years. Rice is the only crop that thrives well and produces better yield than any other traditional crops especially during rainy season. The recently introduced varieties can yield up to 7t/Ha. Thus rice provides a viable alternate for millions of resource-poor rural farm families in Rwanda.	12,000 ha in 2009	

Table 1 (continued)

Name of production system	Indicate if present in the country (Y/N)	Description	Area under production (indicate unit)	Contribution to the agricultural sector economy (%)
Irrigated crops (other)	Y	Rwanda has 589,713 ha of irrigation potential out of which 63% is on hillsides (Rwanda Irrigation Master Plan, 2010). Annual rainfall ranges between 700mm- 1600mm, which is divided between 2 rainy seasons (February-May and September-December). Production is severely affected, both in terms of quantity and quality, by lack of water for crops during the dry seasons. Farmers inform that production could have doubled and vigour of their crops improved if they were able to use irrigated agriculture. The Project aims at increasing productivity and commercialization of hillside agriculture. A holistic approach of land-husbandry, water-harvesting and hillside irrigation is underway.	144,208.9 ha	
Rainfed crops	Y	Farmers in Rwanda, like those in the rest of rural sub-Saharan Africa, depend largely on rainfed agriculture. Crop and animal production depend heavily on natural precipitation. The modes of farming based on rain-fed agriculture cover 1,043,756 ha	205,160 ha of cereals; 427,697 ha of tubers and roots; 314,242 ha of banana; 322,210 ha of legumes and pulses; 20,386 ha of vegetables and fruits; and 78,464 ha of other crops. In total, 1,368,160 ha developed in 2015 Season B	33% contribution to GDP
Mixed systems (livestock, crop, forest and /or aquatic and fisheries)	Y	In Rwanda, most farming systems are mixed rainfed systems in high potential temperate and humid regions. The mixed farming systems occupy an area with a long length of growing period, of more than 210 days.	1,479,081.4 ha	
Others *[please specify]*				

[Insert rows as needed]

1.2. State, trends and drivers of change of biodiversity for food and agriculture

a) Describe the main features of the state and trends[6] of and the main drivers of change[7] affecting plant, animal, forest and aquatic genetic resources in the country's production systems as identified in Table 1.

Major changes have taken place in the status and trends of and the main drivers of change of biodiversity for food and agriculture in the country have been reported in the Fifth National Report to the Convention on Biological Diversity. The main negative changes occurring in biodiversity status in Rwanda are the following (GoR, 2014):

a) Converting process of Karama savannah natural forest covering an estimated area of 1,000 ha (REMA, 2011) into farming, grazing lands and other economic activities;

b) Massive logging of Nyungwe buffer zone forest for charcoal and timber production where New Forest Company (NFC) is exploiting around 11,000 ha of plantations for poles;

c) Mukura forest reserve degradation due to mining exploitation;

d) Water hyacinth invading lakes including lakes of Bugesera, Gisaka, Nasho and other water bodies, especially in Nyabarongo-Akagera rivers system and Akagera wetland complex;

e) Decreasing or extirpation of native fish species in lakes of Nyabarongo-Akagera rivers system due to the invasion and increase of predators species among which are *Protopterus aethiopicus* and *Clarias gariepinus*. The most threatened and disappearing species are : *Barbus kerstenii* PETERS, 1868; *Clarias liocephalus* BOULENGER, 1898; *Mastacembelus frenatus* BOULENGER, 1901; *Oreochromis macrochir* BOULENGER, 1912 (Ntakimazi, 2007);

f) Drying of water bodies (small lakes) in the summit of volcanoes' mountains of the Volcanoes National Park and altitudinal upward migration of species distribution due to climate change effects;

g) Underutilization and disappearance of landraces and local breeds due to crop intensification policy that favors high yields varieties and races.

The most existing cases of positive changes (GoR, 2014) include the ongoing Gishwati forest reserve rehabilitation which is now upgraded as a national park. In addition, the consecutive flooding disasters to Gishwati forest degradation are now controlled following interventions by different projects that rehabilitated and restored the area (ex. Gishwati Water and Land Management Project and Landscape Approach to Forest Restoration and Conservation project). Other positive changes include among others the following (GoR, 2014):

a) Increased number of primates troops and ungulates populations in Akagera National Park from 1998 to date;

b) Increased number of Mountain Gorilla population in Virunga Mountains from 1971 to date;

c) High participation and involvement of local communities around Akagera National Park (ANP) in restoring Akagera lakes;

d) Erection of the electrical fence completed in the South-Western parts of Akagera National Park;

e) Improvement of environmental education and awareness;

f) Boreholes, solar surface water pumps and small dams provided for communities outside ANP;

g) Revenue sharing program for funding socioeconomic activities that benefit the local communities living around national parks;

h) Initiation of Special Guarantee Fund to deal with compensation of damages caused by the wild animals.

i) The creation of the National Genebank within Rwanda Agriculture Board that is expected to be the source of basic breeding materials some of which have inherent traits that are potentially useful in combating adverse biotic and abiotic challenges.

Biodiversity has, over the years, been subjected to various threats causing loss within species richness, population sizes and ecosystems degradation. The most important threats behind changes in associated biodiversity in Rwanda included poaching, boundary encroachment, fires, alien invasive species, predation, deforestation, illegal mining, illegal grazing, human-wildlife conflict, damming, dropping water levels, fish and lions poisoning, commercial fishing, lack of proper regulations, infrastructures' development, water extraction, plant extraction, drainage of wetlands outside park, plant and animal diseases transmissible from livestock to wildlife, lack of connectivity, climate change, etc.

However, Rwanda has made tremendous efforts to address these threats through national programs and also through international cooperation including ratification of the Convention on Biological Diversity (CBD) and related protocols.

The agricultural sector is mainly dominated by the production of staple food crops although some have started production of high value crops including fruits, rice, sorghum and soybeans. Food crops account for 92% of cultivated lands. Banana under its different forms (fruit and beer) is by far the dominant crop and occupies more than a quarter of area under cultivation (28%), followed by beans (21%), sorghum (10%), sweet potatoes (12%) and cassava (8%). Cash crops (coffee and tea) follow with 6.3% and 1.6% of the cultivated area respectively.

Considering the limited land resources and the demographic pressure on land, intensification of existing production systems represents the most tangible approach to increasing food production in the country. However, agriculture intensification have unintended consequences of genetic erosion due to positive selection of priority crops and breeds in future. Sustainable agricultural production and food security for now and into the future are thus most successfully pursued by having a well conserved genetic resources base, as broad as possible, available and well-kept in the country. Generally, because of the currently narrowing base of natural resources for food and agriculture, Rwanda is not fully able to exploit the full potential of its gene pool. The good news is that a National Genebank is now available but has to be made fully functional for genetic resources conservation.

Associated biodiversity in livestock based systems continually exist in Rwanda, because of existence of demarcated ranches and restriction of extensive livestock husbandry and encouragement of zero grazing systems. Pasturelands have been delineated outside protected forests such as Gishwati and Akagera National Parks and restoration programs of degraded ecosystems are implemented. Girinka programs (eg. One Cow per Poor Family) and land husbandry practices are among important incentives for fodder production on farms, without having to rely on natural vegetation to supply livestock feeds. Across all agricultural zones of the country, the impact of Crop Intensification Programme is e making a difference through land consolidation, crop specialization and increased yields of priority crops.

Biodiversity across zones in enhanced by livestock breeding and land husbandry practices to control soil erosion, landslides and regenerate degraded ecosystems.

The constraints to fish culture in Rwanda are diverse in nature and include physical factors as well as social and economic factors (Karen, 1999). Physical constraints such as cool temperatures, acid soils, and soft water limit fish production. Social and Economic factors that constrain fish culture in Rwanda include high population density that leads to paucity of available inputs for fish culture, land tenure, eating habits, and poor cash flow in rural areas. Many of these constraints actually favored fish culture over other forms of agriculture. The physical constraints affecting fish culture also impeded the production of other agricultural crops, so few modes of production outperformed fish culture. The scarcity of inputs was easier to overcome in fish culture than in animal husbandry because pond culture, even with minimal amounts of feeds and fertilizers, produces quite efficiently. Additionally, a wide variety of inputs can be used in fish culture. The pond itself is also able to generate by products that can be used for other agricultural practices (e.g., left-over compost makes a good soil amendment). Because of limited cash in rural areas, farmers viewed fish farming as a way to generate much- needed income.

Climate change affects Rwanda's plant, animal and aquatic genetic resources in different production systems in several ways. More importantly, outbreak of many diseases and pests threaten crops, livestock, bees, trees and fish, resulting into reduced performance of traditional crops and livestock breeds. Erosion is an important factor for low agricultural production and food insecurity areas.

Climate change scenarios show that crops destruction risks and high silting-up particularly in swamps and shallows might occur. In addition changes in weather conditions are foreseen to threaten the financial sustainability of existing commercial and subsistence farming operations and rural livelihoods, which will translate into reduced net revenue per hectare for existing crop types and shifting/ shrinking ranges for certain crops types and cultivars. This will lead to potential for introduction of new species for commercial exploitation and reduced yields from irrigated crops will occur especially in marginal areas.

Climate change will escalate the scarcity of forest and biomass resources (such as timber, construction materials, medicine and fuel wood) and associated biodiversity such as wild food, medicinal plants, and wildlife. The main pattern will be the positive and negative changes in ecosystem composition, with negative impacts being more important than positive ones. Positive effects of climate change will relate to the occurrence of new species and varieties in the original ecosystems. Negative impacts may be particularly severe for species, habitat types and biodiversity hotspots in the major natural ecosystems of the country. For instance, climate change will alter wildlife distribution patterns which will lead to migration of wildlife in search of food and suitable habitats. As a consequence, conflicts between human activities and biodiversity conservation, including wildlife-human conflicts around parks and protected forests related to water, food and other resources are likely to increase. The loss of biodiversity and genetic resources-especially of rare species will be important since their sensitive habitats will be lost next to effects of climate change.

Anthropogenic factors are likely to exacerbate the impacts of climate change on area, flora and fauna composition in natural forests. Water shortage for the wildlife especially in the years with low rainfall is one of the main challenges facing the management of parks, protected forests and other natural ecosystems. It is anticipated that serious lack of rainfall will lead to wildlife mortality.

Although no data is available on the incidence of pests and diseases in planted forests, the outbreak is expected to increase and cause seriously decline in productivity. Presently, planted forests are dominated by eucalyptus monoculture; hence disease outbreak could lead to total loss of the plantations and negative impact on livelihood and environment. Possible disease outbreak is already

showing signs as eucalyptus are now attacked by unidentified aphids.

Some of the few remaining landscapes with freely flowing water- are now under stress and destruction from agriculture and other productive activities. Increasingly low and unreliable rainfall as consequence of climate change will cause many farmers to resort to wetlands which have already a steady water supply. This has the effect of reduced climate moderation ability, decline in water availability for downstream domestic and commercial users, fish production and ecosystem maintenance, among others. Increased pollution of water resources would result in further decline of water quality and water supply disruptions, and habitat quality for fish. Increased droughts will exacerbate the pressure on wetlands for agricultural production, reduce the level of water in wetlands and threaten aquatic ecosystems.

b) Indicate whether the country has any national information system in place on associated biodiversity and identify the most frequently monitored components of associated biodiversity.[8]

The country has no sound information system set out for associated biodiversity which makes it difficult to plan and monitor biodiversity status and trends. Data are scattered across different institutions and there is a great need for genetic resources to be documented for optimal conservation, access and efficient use. Documentation of passport data, morphological and agronomic characters, viability results, pertinent ethno-botanical information and indigenous knowledge are not readily available for proper gene bank management. A data management system or GIS technologies can be used to assist in the conservation efforts but also to add value (in the form of information) to the genetic resources. Among its focus, the National Genebank is responsible for setting up a sound documentation system for crops, livestock, forest and microbial genetic resources.

c) List associated biodiversity species that are actively managed in production systems for the provision of ecosystem services in Table 2.

Table 2. List of associated biodiversity species that are actively managed in production systems for the provision of ecosystem services.[9]

Associated biodiversity species	Ecosystem functions and services provided by the species in the production system
Vascular plants	Habitat provisioning, erosion control, soil stability and nutrient cycling in naturally regenerated forests, planted forests
Wild food (vegetables, mushrooms)	Food provisioning: naturally regenerated forests, planted forests
Mammal species (ex. *Loxodonta africana*, Several monkey, species, etc.)	Maintenance of a balanced ecosystems as grazers, predators, pollinators and seed dispersers in Naturally regenerated forests
Bird species	Pollination: Livestock grassland-based systems, Naturally regenerated forests, Planted forests, mixed systems, irrigated crops, rain-fed crops

[9] Reference: question 27 of country report guidelines.

Table 2 (Continued)

Associated biodiversity species	Ecosystem functions and services provided by the species in the production system
Reptiles and amphibians	Biological pest control and seed dispersal: Naturally regenerated forests, planted forests
Several taxa of insects including honey	Pollination, biological pest control: all production
Native and exotic fish species	Ecosystem rehabilitation: naturally regenerated forests, planted forests, rain-fed crops; mixed systems
Native and exotic tree species	Erosion control, ecosystem restoration and rehabilitation, soil fertility enhancement: naturally regenerated forests, planted forests, rainfed crops;
Phytoplankton	Nutrient cycling; food provisioning: Culture based fisheries, fed aquaculture, non-fed aquaculture

d) Provide in Table 3 a list of wild food species known to be harvested, hunted, captured or gathered for food in your country. Indicate the change in state of the species over the last 10 years (strongly increasing (2), increasing (1), stable (0), decreasing (-1), or strongly decreasing (-2), or not known (NK)).

Table 3. Wild food species used for food in the country.[10]

Wild food species	**Change in state (2,1,0,-1,-2, NK)**
Many fruit species	-1
Many vegetable species	-1
Many mushroom species	-1
Game	-1

[Insert rows as needed]

e) If available, provide information on the proportion of the population in your country that uses wild food on a regular basis for food and nutrition.[11]

No data

f) Briefly summarize the state and trends[12] of and the drivers of change[13] affecting:

- **Associated biodiversity[14]: micro-organisms, invertebrates, vertebrates, plants**
- **Ecosystem services[15]: regulating, supporting**

[10] Reference: question 34 of country report guidelines.
[11] Reference: question 59 of country report guidelines.
[12] Reference: questions 21, 22, 23, 24, 29, 34 and 35 of country report guidelines.
[13] Reference: Annex 3 and questions 9, 10, 12, 14, 44, 45 and 55 of country report guidelines.
[14] Annex 1 of the country report guidelines provides a definition of associated biodiversity.
[15] Annex 4 of the country report guidelines provides a definition of ecosystem services.

- **Wild food resources**[16]

In Rwanda, changes in associated biodiversity were caused by a variety of threats including: poaching, boundary encroachment, fires, alien invasive species, predation, deforestation, illegal mining, illegal grazing, human-wildlife conflict, damming, dropping water levels, fish and lions poisoning, commercial fishing, lack of proper regulations, infrastructures' development, water extraction, plant extraction, drainage of wetlands outside park, plant and animal diseases transmissible from livestock to wildlife, lack of connectivity and climate change. Most of these changes occurred between 1990 and 1995. Since then, measures to protect the biodiversity have been taken and as a result, the populations of many species, are increasing. While associated biodiversity in the major production systems such as protected forests, parks and aquatic ecosystems are the process of restoration and legally protected, the present biodiversity loss in Rwanda is much related to the effect of climate change. However, the extent at which alterations in habitat change and associated biodiversity loss is not precisely known.

Associated biodiversity, including medicinal plants and wild foods are under threat mainly due to the intensity of use without measure to sustain the resource for the future. Associated biodiversity in agriculture landscapes depend largely on measures to control soil erosion, the integration of livestock production system and agroforestry as part of the farming system. For particular land use systems, livestock are kept in ranches but for the majority of the country, zero-grazing system is practiced with much of the animal feed being harvested from farms. In rainfed crops systems, the production of fodder for livestock is enhanced by the need to protect the land from erosion with grass and agroforestry species. Across all land use systems, the government of Rwanda adopted various programmes such Crop Intensification Programme (CIP), Livestock Intensification Programme, Land Husbandry and Water management practices that drive the conservation of biodiversity on hillsides and marshlands.

From the time the Fourth National Report to the CBD, threats on biodiversity in parks, protected forests, planted forests and wetlands have now decreased following a series of actions undertaken to improve biodiversity of these ecosystems. These actions include:

i) Establishment of regulatory buffer zones for lakes and rivers;

ii) Restoration of lakeshores and riverbanks;

iii) Restoration of degraded forests including 15,000 ha restored through the Forest Conservation Project (PAFOR) with financial support of the African Development Bank (AfDB);

iv) Development of forest management plans targeting 30 Districts (MINIFOM, 2010);

v) Development of laws and related decrees to protect biodiversity, wildlife, forests, wetlands, threatened species, to ensure environmental impact assessment is conducted for any project susceptible to have adverse impact on environment;

vi) Awareness raising through media, television and radio broadcasts, celebration of environment, biodiversity and wetland days;

vii) Restoration/rehabilitation and maintenance of Akagera National Park (ANP) water bodies using the community approach;

viii) Creation of environmental schools and clubs around ANP and the implementation of the Greening Schools Project;

[16] Reference: question 34 of country report guidelines.

ix) Establishment of District environmental committees in 30 districts; and

x) Establishment of an internship programme to improve environmental mainstreaming at central (sectoral ministries and private sector federation) and decentralized (Districts) levels.

The key drivers behind positive changes in biodiversity conservation derive mainly from strengthened policy, institutions, legal and strategy frameworks. A number of new key policies, laws and strategies have been adopted by the Government of Rwanda toward towards biodiversity conservation and socio-economic development. They include the following among others:

i) Economic Development and Poverty Reduction Strategy (EDPRS) II (2013-2018);

ii) National Climate Change and Low Carbon Development Strategy (2011);

iii) Rwanda Biodiversity Policy (2011);

iv) Rwanda Wildlife Policy (2013);

v) Rwanda Protected Areas Concessions Management Policy (2013);

vi) National Forestry Policy (2010);

vii) National Policy for Water Resources Management (2011);

viii) National Energy Policy and National Energy Strategy (2008-2012);

ix) National Industrial Policy (2011);

x) Biodiversity Law (2013);

xi) Forestry law (2013);

xii) Protected areas law (2013);

xiii) New Land law (2013);

xiv) Law establishing Rwanda National Climate and Environment Fund (FONERWA) (2012);

xv) Law establishing Rwanda Natural Resources Authority (RNRA, 211);

xvi) Decrees for protection of biodiversity, Payment of Ecosystems Services (PES) regulatory framework preparation, etc.

Institutions that have been established and whose role is relevant to the conservation of biodiversity include:

i) Rwanda Natural Resources Authority (RNRA);

ii) Rwanda National Climate and Environment Fund (FONERWA);

iii) CBD Steering Committee, and

iv) Centre of Excellence in Biodiversity and Natural Resources Management.

Moreover, the Government of Rwanda is committed to equal sharing of the benefits derived from the use of biological resources. In the process, related achievements are:

i) Ratification of Nagoya Protocol;

ii) On track development of enabling regulatory framework for domestication of the Nagoya Protocol;

iii) Development of communication-education and public awareness, capacity building;

iv) Establishment of Clearing House Mechanism; and

v) On-going process of genetic resources valuation.

It is worth mentioning that, threats to biodiversity in both agricultural and forestry systems through increase biomass harvesting for energy, remain challenging. Programmes promoting the use of alternative sources of energy such as biogas, peat, solar energy and improved cookstoves are underway to alleviate the impact of fuelwood consumption on biodiversity.

For associated biodiversity, information on ecosystem services across all production systems is incomplete or unknown. Research on ecosystem processes relevant to associate biodiversity has to be conducted across the variety of production systems in the country. Researchable areas could include: nutrient cycling, pollination, biological control, habitat provisioning and water purification. In addition, the economic and conservation values of medicinal plants and wild food (vegetables, mushrooms) from protected forests, parks and planted forests have to be undertaken. Such studies should also be extended to microorganisms, birds and other insect pollinators not only in forest ecosystems but also in agroecosystems and aquatic ecosystems.

BOX 1. Describe one or two examples of countermeasures that have been taken in the country to reduce adverse effects of drivers on associated biodiversity, ecosystem services and/or wild foods.[17]

A. Countermeasures taken for improved biodiversity conservation in protected areas and wetlands:

- Development and implementation of National Park Management Plans (for NNP and VNP);
- Restoration of degraded forests (i.e. Nyungwe National Park, Gishwati forest reserve;
- Erection of the electrical fence completed Southern-Western of Akagera National Park that eradicates the crop raiding by wildlife, hence contributing efficiently to prevent conflicts between local people and park managers and creating positive attitude among local communities;
- Development forest management plans;
- Inventory of biodiversity on critical wetlands and islands;
- Mapping of threatened remnants natural forests;
- Restoration of lakeshores and riverbanks.

B. Countermeasures taken for improved community-based biodiversity conservation

- Using the community approach in restoration and rehabilitation of ecosystems and maintenance
- Establishment of District environmental committees
- Revenue sharing program representing 5% of income generated from national parks based tourism are allocated for funding socioeconomic activities that benefit to local communities living around national parks
- A Special Guarantee Fund was established by the Government to deal with compensation cases resulting from human-wildlife conflicts.

[17] Reference: question 19 of country report guidelines.

1.3 Needs and priorities

a) Identify the country's main needs and priorities in terms of the state of biodiversity for food and agriculture, and in particular of associated biodiversity, wild foods and ecosystem services.[18]

From the presentation above, many activities have been successfully achieved in reducing the threats to biodiversity. However, some gaps need to be filled:

- Incomplete inventory of the biodiversity in terms of species, value and ecosystem functions and services; studies should focus on associated biodiversity, microorganisms, invertebrates and plants,
- Insufficient technical capacity in biodiversity and related fields;
- Insufficient linkage with other international instruments for complementarities and take advantage of their provisional opportunities;
- Conflicting priorities based on institutional mandates;
- Lack of appropriate financing mechanisms for the implementation of activities in the National Biodiversity Strategy and Action Plan (NBSAP);
- Weak mobilization and coordination of donors supporting biodiversity conservation and economic development;
- Absence of established benefits sharing mechanisms in agro-ecosystems production and initiation of new stimulating incentives to protect agro-biodiversity;
- Inadequate staffing and scale of actions of the National Genebank;
- Underdeveloped biotechnology.

II. Sustainable use and conservation of biodiversity for food and agriculture

2.1 Sustainable use

a) List in Table 4 management and diversity based practices that support the maintenance and use of biodiversity for food and agriculture in production systems.

[18] Reference: questions 28, 48 and 49 of country report guidelines.

Table 4. Management[19] and diversity based[20] practices that support the maintenance and use of biodiversity for food and agriculture in production systems.

Production system	**Management/ diversity based practice[21]**	**Trends in the application of the practice over the past ten years**
Irrigated crops, Rainfed crops, Mixed systems	Sustainable crop production intensification	2
Livestock landless systems	Sustainable livestock intensification	1
Naturally regenerated forests, planted forests	Landscape restoration and management	2
Irrigated crops, Rainfed crops, Mixed systems	Land consolidation	1
Irrigated crops, Rainfed crops, Mixed systems	Land husbandry practices	2
Irrigated crops, Rainfed crops, Mixed systems	Sustainable soil management practices	2
Irrigated crops, Rainfed crops, Mixed systems	Irrigation and water management	1
Rainfed crops, Mixed systems	Agroforestry	2
Planted forests	Reforestation	2
Irrigated crops, Rainfed crops,	Agricultural Mechanization	1
Irrigated crops, Rainfed crops, Mixed systems	Input use and input markets	2
Irrigated crops, Rainfed crops, Mixed systems	Development of priority value chains: food crops and cash crops	2
Livestock grassland based systems, Livestock landless systems	Development of priority value chains: dairy, meat	2
Self-recruiting capture fisheries, culture based fisheries, fed aquaculture, no-fed aquaculture	Development of priority value chains: fisheries	1
Rainfed crops, Mixed systems	Kitchen gardening	1
Livestock landless systems, culture based fisheries	Conservation hatcheries	1
Irrigated crops, Rainfed crops, Mixed systems	Diseases and pests control and management	1
Rainfed crops, Mixed systems	Conservation/evergreen agriculture	1
Irrigated crops, Rainfed crops, Mixed systems	Development of new varieties for priority crops	1

[Insert rows as needed]

[19] Annex 5 of the country report guidelines describes a list of management practices supporting the use and conservation of biodiversity for food and agriculture.
[20] Annex 6 of the country report guidelines describes a list of diversity based interventions supporting the use and conservation of biodiversity for food and agriculture.
[21] Reference: questions 52, 53 and 56 of country report guidelines.

BOX 2. Describe a successful programme or project that has been undertaken in the country to support one of the practices listed in Table 4.[22]

In the period between 1933 until the mid of 1970s, Gishwati natural forest reserve constituted the relic of the ombrophyllous montane forests. It was covering in its extent approximately 280 km^2. In the early 1980s, Gishwati has lost 100 km^2 converted to pasture and another 100 km^2 to pine plantations. Beside the developing projects, the main cause of deforestation was the increase in population in the Gishwati area during the 1980s which led to an increase in livestock numbers, hence increasing demand for grazing, settlement, crop land and fuel food.

Thereafter, Gishwati has been deforested for cattle ranching development, followed by resettlement of refugees after the 1994 genocide against Tutsi from when land has been degraded due to free-grazing of livestock, over crop farming exploitation and plantations of non-native trees species. In 2005, more than 90% of Gishwati was cultivate), the remaining remnant forest was 600 hectares.

Consequently, the forest reserve has lost most of its natural habitats and rich biodiversity, plagued with flooding, landslides, erosion, decreased soil fertility, decreased water quality and heavy river siltation, all of which aggravated poverty within population surrounding the ecosystem. Recently, through different management plans, Gishwati natural forest reserve is gradually restored and is now upgraded to a national park. In 2005 - 2006, with efforts of PAFOR to restore the forest, 286 hectares were added. From 2008 to 2011 the Great Ape Trust/Gishwati Area Conservation Program (GACP) worked on conservation and restoration of the Gishwati Forest Reserve and reforested more 598 hectares using indigenous species. This increased the current Gishwati Forest Reserve superficies, estimated to 1484 hectares.

Building on GACP achievements, a grassroots organization called "Forest of Hope Association (FHA)" has been initiated in Rutsiro District in order to facilitate local community to play an active role in the protection of Gishwati forest, through the establishment of a Community Forest Protection Initiative (CFPI), (Hughes *et al.*, 2014). Since then, illegal use of forest resources has been prevented due to the commitment and collaboration of all stakeholders including local communities.

Currently, the area has been divided into three main parts which are: Natural forest area, Cattle ranching farms and Cultivated area for crop production. People settlements are supposed to be shifted out of the area for ecosystem restoration and biodiversity conservation purpose.

Successful restoration interventions initiated from 2002 to date contributed efficiently to halt flooding and loose of human life, control of erosion and diminution of siltation phenomenon in streams and marshlands areas. The cultivated site is now regenerating with the plantation of nursed trees and the forest fallow is composed mostly by *Neoboutonia macrocalyx* and *Polyscias fulva*. The introduced trees, including Eucalyptus, Reeds, Avocadoes, Cyprus and Acacia are growing as well.

b) Provide examples whereby the diversity *per se*,[23] or its lack,[24] had a direct effect on productivity; food security and nutrition; rural livelihoods; ecosystem services; sustainability; resilience; or sustainable intensification.

The biodiversity provides various and useful ecosystems services and goods which are fundamental elements for country economic development, specifically for Rwanda as developing country mostly relying on natural resources for its development and for its population welfare. Therefore, negative changes in ecosystems and other components of the biodiversity can make them unable to provide such services with serious implications on the society and economy development, since main sectors are heavily dependent on biodiversity and ecosystem services.

[22] Reference: question 54 of country report guidelines.
[23] Reference: question 58 of country report guidelines.
[24] Reference: question 57 of country report guidelines.

The degradation of Mukura and Gishwati forest reserves is one of the examples that illustrate the consequences of biodiversity degradation, as this degradation caused drastic reduction in water flow of upper streams and lowlands drying, because the forest that used to serve as natural sponge feeding downstream water system has been disrupted. Furthermore, downstream water users for crop production and domestic needs have suffered either from water shortage or loss of water quality, because of heavily accumulated soil sediments carried out from upstream by uncontrolled soil erosion. The recent management and conservation programs planned and in execution have halted Gishwati forest reserve's degradation and substantially contributed to reduction in flooding phenomenon, landslides, decreased soil fertility, improper water quality, and heavy river siltation, all of which lead to aggravated poverty within local population. Socio-economically, the loss of agro biodiversity leads to fewer options for ensuring more diverse nutrition, enhancing food production, raising incomes, coping with environmental constraints and sustainably managing ecosystems.

Genetic resources and agro-biodiversity constitute the foundation upon which agriculture development and food security is based. Thus, the loss of agro-biodiversity due to changes in climate conditions undermines such foundation, by posing serious threats to food security, poverty alleviation, and increases the economic risk for human community. While little quantitative data is available on the direct effects of diversity on these aspects, there is, however, increasing evidence that the diversity of crops and varieties, livestock and trees could lead to increased productivity, resistance to pests and diseases and climate change risks if matched with local conditions. To this end, specialization of trees and crops has resulted in increased productivity and reduced vulnerability to extreme weather conditions (drought, heavy rains, landslides, etc.). Although mixed cropping systems appear common in the country, the Rwanda's Ministry of Agriculture and Animal Resources (MINAGRI) has embarked on a simplified land use consolidation model whereby farmers in a given area grow the priority food crops (maize, rice, wheat, Irish potato, cassava, soybean and beans) in a synchronized fashion in order to raising productivity levels in smallholder farms.

Over the last decade intense research efforts are carried out to develop new varieties for priority crops. Several new varieties have been developed and released. Research and extension services are strengthened to develop high yielding varieties and breeds, adapted to local local conditions, resistant to diseases and pests and to ensure that are disseminated widely to the farmers. Breeders therefore continue to rely on diverse plant, animal and forest genetic resources to facilitate the improvement of yields, and research is being carried out to develop new adaptable breeds with improved qualities.

Dependence on forests for energy affects the availability and diversity of medicinal plants, wild foods and microorganisms. In particular, the collection of dead wood as source of energy for cooking affect the availability of decomposers, affecting nutrient recycling and food web in forest ecosystems.

In fisheries, the population of some fish species (e.g. *Barbus kerstenii, Clarias liocephalu*) have decreased probably due to fisheries pressure and the competition of introduced larger piscivorous species *Clarias gariepinus* during aquaculture development. In general, introduction of voracious species is eliminating all indigenous species and causes serious impact on fisheries development in the country.

c) List in Table 5 examples whereby the use of biodiversity for food and agriculture contributed to cope with climate change, invasive alien species, and natural or human-made disasters

Table 5. Examples whereby the use of biodiversity for food and agriculture (BFA) contributed to cope with climate change, invasive alien species, and natural or human-made disasters

Objective	Description
Use of BFA to adapt to and mitigate climate change[25]	- Focus on rehabilitation and reclamation of degraded land, reforestation, and conservation, management and protection of natural resources. - Encourage activities that reduce poverty, protect assets, diversify livelihoods and simultaneously conserve and protect the ecosystem. - Promoting drought-resistant plants and crop species easily adaptable to areas with moisture stress and interventions to rehabilitate and maintain biodiversity of dry land and fragile Ecosystems.
Use of BFA to manage the spread of/control invasive alien species[26]	- BFA has not been used to control the spread of invasive alien species. Water hyacinth has been removed physically from lakes in ANP through community participation
Use of BFA to prevent natural or human-made disasters and/or reduce their effects on livelihoods, food security and nutrition[27]	- Conservation of selected genetic diversity of crop varieties, livestock breeds and races; - Program for improving natives species by crossing for more agro-pastoral productivity or saving genetic resources - Rehabilitation of natural forests reserves (Mukura & Gishwati) through removal of exotic species and extension of land to be reforested preferably with indigenous species - Restoration of fish stocks and increasing fishery yield - Promoting sustainable use of fish resources through stock recovery - Promotion of new alternatives for improving sustainable use of natural resources - Promotion of Zero Grazing at National level

[25] Reference: question 69 of country report guidelines.
[26] Reference: question 46 of country report guidelines.
[27] Reference: question 43 of country report guidelines.

d) List and briefly describe ecosystem/landscape/seascape approaches[28] that have improved the management and use of BFA in the country.[29]

With respect to implementing ecosystem approaches for improving the management and sustainable use of BFA in Rwanda, the target is that, By 2020, at latest 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes. These ecosystem approaches are: are: Protected Areas (PAs) management plans, PAs rehabilitation, Poaching control, Support to Community conservation, Revenue sharing scheme, Trans-boundary management mechanisms, Establishment of Special Guarantee Fund (SGF) for compensation, Wildlife policy and Protected Areas concessions management policy. The country's achievements in improving the management and use of BFA include:

- Increased protected area to maintain biological diversity (from 10,1 to 10,3%) and forest cover (up to 30%) have been set in Vision 2020
- Management plans of the three principal protected areas: AKagera National Park (ANP), Viringa National Park (VNP) and Nyungwe National Park (NNP) have been elaborated, including ecosystems' rehabilitation;
- Key policies, legislations and a set of decrees have been adopted to support biodiversity conservation (i.e. Biodiversity Policy and Law, FONERWA Law);
- Wildlife policy adopted and wildlife law as well as PES regulatory framework;
- Rwanda Forest Landscape Restoration Initiative set as a national policy

- The Landscape Approach to Forest Restoration and Conservation (LAFREC) has been used to improve the management and sustainable use of BFA in Rwanda through increased forest cover, climate change adaptation efforts together with combating land degradation. The approach was developed with the Multi-Focal Area/Sustainable Forest Management objectives at its core and also around a landscape approach which will bring the forest ecosystems into better management and develop multiple benefits. It helped reduce the negative impacts of human activities on forested landscapes and wetlands that depend on them. But also it transformed degraded areas into a healthier, more fertile and productive working landscapes to meet the needs of local communities and natural ecosystems. More specifically, The approach was applied to Gishwati forest area by using financial resources granted by GEF to support activities to increase and conserve the area of

[28] The ecosystem approach concept is generally understood to encompass the management of human activities, based on the best understanding of the ecological interactions and processes, so as to ensure that ecosystems structure and functions are sustained for the benefit of present and future generations. Ecosystem approaches include the Convention on Biological Diversity's Ecosystem Approach, Integrated Land Use Planning, Integrated Water Resource Management, Sustainable Forest Management, Code of Conduct for Responsible Fisheries, Ecosystem approach to fisheries management, etc.
- A "landscape approach" means taking both a geographical and socio-economic approach to managing the land, water and forest resources that form the foundation – the natural capital – for meeting our goals of food security and inclusive green growth. By taking into account the inter-actions between these core elements of natural capital and the ecosystem services they produce, rather than considering them in isolation from one another, we are better able to maximize productivity, improve livelihoods, and reduce negative environmental impacts.

[29] Reference: questions 60, 61 and 80 of country report guidelines.

protected forests as habitat for native biodiversity, as well as encourage farmers to establish diverse agroforestry plots and woodlots using native trees that provide benefits to food security and decrease pressure on forests as sources of livelihoods, including fuel wood.

e) Provide examples of activities undertaken to maintain and use traditional knowledge of associated biodiversity and wild foods.[30]

Traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, have been considered in the development of national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the National Biodiversity Strategy and Action Plan (NBSAP) with the full and effective participation of indigenous and local communities. Traditional knowledge of farmers and indigenous people has been used in planning biodiversity conservation and management across the country. The country recognizes that indigenous knowledge provides the basis for grassroots decision-making, much of which takes place at the community level through indigenous organizations and associations where problems are identified and solutions to them are determined.

In Rwanda, Problem solving approach is based on farmers' needs, interests and priorities leading to experimentation by research institutions as well as the appraisal of knowledge and technologies introduced to them. Currently, the Rwanda National Genebank seeks to understand the indigenous management strategies of farmers that foster diversity in crops, livestock, forests, underutilized species and wild species that can help in the implementation of programmes for in-situ and ex-situ conservation in the country. The Genebank explores further indigenous knowledge related to wild and domesticated plants and animals and the soils and water upon which they depend. Research programs on crops at Rwanda Agricultural Board (RAB) is already involving farmers in the process of developing, promoting and growing utilization of high yielding, multiple diseases resistant varieties so that they contribute to conservation and breeding. Since Rwandan farmers conserve a wealth of biodiversity and breed local crop varieties for improved production using informal innovation systems based on their indigenous knowledge, research focuses on conducting inventories of knowledge that can be of primary utility in conservation and development programs. Examples include indigenous crop pest management systems, farmer perceptions of positive and negative characteristics of crop varieties, and indigenous approaches to the management of soil, water, and biodiversity resources.

f) Identify possible needs and priorities in terms of the sustainable use of biodiversity for food and agriculture, and in particular of associated biodiversity and wild foods.

In Rwanda, several aspects sustainable use of biodiversity for food and agriculture need to be strengthened to meet current and future challenges. Needs and priorities that have been reported in various documents are shown below.

Possible needs:

i) In order to know and understand the diversity present in the country, an inventory of plant, animal and aquatic genetic resources must be carried out. This would help policy makers to guide the development and implementation of the NBSAP and ensure that appropriate actions are taken. Emphasis should be go to the inventory of associated biodiversity in the various production systems of the country

ii) There is a need to strengthen the national capacities in the development of plant, animal, forest and aquatic genetic resources;

[30] Reference: questions 32, 33, 38 and 39 of country report guidelines.

iii) There is an urgent need to put in place policies, strategies and protective legislation, for plant, animal, forest and aquatic genetic resources development;

iv) Strong enforcement of existing policies and laws and protection of biodiversity outside the protected areas as well as the endangered species and associated biodiversity;

v) A stronger private sector-based seed value chain should be built to stimulate conservation and sustainable use of biodiversity;

vi) A monitoring and evaluation framework on plant genetic resources should be established at the national level under the active coordination of a national committee for the conservation and sustainable use of plant genetic resources,

Possible priorities:

i) Generate data on the status of associated biodiversity and support continuous availability of information on BFA, using modern tools and techniques including Geographical Information Systems (GIS);

ii) Improve the systems of in-*situ* and *ex-situ* conservation, including genebank- and on-farm management of BFA;

iii) Secure human and financial resources to the make The RNGB fully operational, in partnership and engagement of private sector and local communities;

iv) Domesticate wild plants for food, medicine and fodder so as to reduce pressure on parks and natural habitats;

v) Create a local research network linking partners that are involved in conservation and sustainable use of biodiversity for food and agriculture;

vi) Training agricultural extension officers and farmers on efficient use and conservation of plant, animal and aquatic genetic resources;

vii) Train more research staff in conservation of plant, animal and aquatic genetic resources;

viii) Strengthen national capacity for taxonomy, ethno-biology and ecology;

ix) Harmonize other existing policies and laws that relate to the protection of biodiversity and genetic resources;

x) Build capacity for effective enforcement of these policies and laws, including the development and application of appropriate economic instruments.

2.2. Conservation

a) Describe the status of *in situ* conservation of <u>associated biodiversity</u> and <u>wild food species</u> in your country[31]:

1. **List and describe any existing national *in situ* conservation initiative(s).**
2. **Indicate which species/groups of species are being conserved and with what objective(s).**
3. **Describe any existing subregional/regional *in situ* conservation initiative(s) the country is involved in.**

In Rwanda, there are two complementary approaches to *in situ* conservation, which include *in situ* conservation of wild plants and crop wild relatives (CWR) for their protection in natural environment

[31] Reference: questions 31 (Table 13) and 37 (Table 17) of country report guidelines.

and on-farm management of plant genetic resources mainly concerned with the use and maintenance of local crops and varieties grown in agricultural systems and home gardens. Both aspects are recognized as essential in order to ensure the maintenance of a genetically diverse portfolio. Despite an increased awareness of *in situ* conservation and on-farm management in Rwanda, major gaps and needs with respect to their conservation, management, research and sustainable use still remain.

Crop Wild Relatives (CWR) are mainly confined in Rwanda's three major conservation areas of Akagera National Park, Volcanoes National Park and Nyungwe forest. Each of these ecosystems bears a large array of different plant and animal species of which some are in danger of extinction or registered for special conservation status under CITES. In order to ensure the conservation of genetic diversity in these parks and other protected indigenous forests measures to contain fires, encroachments and poaching are being taken. In addition, management plans for parks and natural reserves have been elaborated and their implementation has already started. Some of the crop wild relatives found in natural reserves include sorghum, sweet potato, banana and strawberry.

Research results by Rwanda Agriculture Board (RAB) indicated that about 47% of the conservation of plant genetic resources for food and agriculture is done through in situ/on-farm. On-farm conservation is still not yet formally organized at county level, and strategies for farmers to enhance on-farm management of local crops and varieties including landraces need to be established. In addition, farmers are largely encouraged to use improved varieties, instead of landraces, especially with regard to the key food security crops. The fact that very few efforts are targeting the conservation and enhanced use of local crops and varieties poses a threat for genetic erosion. There are however a number of species which are mainly kept at farmers' level. These include finger millet, yam, finger potato, *Colocasia spp*. and *Xhantosoma spp*. Other species, including indigenous vegetables and medicinal plants, exist but are underexploited because of lack of knowledge on their use and nutritional values are Isogi (*Cleome gynandra*), Isogo (*Amaranthus spinosus*).

Most efforts to promote the conservation of local varieties have been done through participatory crop improvement and support to local seed producers. Through participatory plant breeding programmes, local communities have been involved in the selection of varieties and in the improvement/breeding process. There are several examples of small scale seed production units such as INGABO association for cassava, URUGAGA IMBARAGA for maize and Irish potato and beans, IMPUYABO for soybean etc. that have been developed and set up by local communities as part of participatory plant breeding programmes. Additionally, farmers in some areas, still growing bean, sorghum, banana, sweet potato landraces. These landraces are grown due to farmers' preferences linked to traditional values and genetic traits like earliness, resistance/tolerance to diseases etc. In highlands there are pigeon pea, sorghum, finger millet and banana landraces grown there while in mid and low altitudes there are bean, sorghum, taro, yam, ground nut, sweet potato, banana and vegetables landraces that are still grown. This is particularly important in areas that are experiencing periodic shortages of seed of improved varieties, and for farmers that cannot afford the cost of certified seed.

For animal genetic resources *in situ* conservation of cattle and small ruminants (goat, sheep) is on-going and focuses on keeping native breeds on government research institution owned land in various research stations such Songa and Rubona in the Southern Province, Karama and Nyagatare in the Eastern Province of Rwanda. Because milk and meat yields of these local breeds are considerably smaller than those of exotic animal breeds, their *in situ* conservation requires special attention with regard to exploiting the advantages of local breeds in breeding programmes involving crosses with exotic breeds. In fact local breeds of cattle and goat have many adaptive characteristics which make them ideal for the local farmers. In particular the exotic breeds produce more milk but their survival rates are considerably lower than the local breeds due to their failure to conceive repeatedly on the

very low input diets available, their relatively high susceptibility to prevalent parasites and diseases and their intolerance of environmental conditions. In the national strategy for improvement of animal genetic resources, conservation through utilization of native animal breeds is emphasized and crossing local breeds with exotic ones target specialized dairy and beef production.

Many public institutions are involved in AnGR related activities in Rwanda but only RAB and Rwanda Development Board (RDB) carry out in situ conservation whereby the former deals with domestic indigenous cattle and goat and the latter with wild animals and birds namely crested crane and Gorillas. This shows that there is an urgent need to characterize other genetic species and come up with planned conservation by use program so as to maintain these indigenous breeds competitive.

Fish production in Rwanda is in its natural form as fishing in lakes and harvesting in fishponds. The former is strengthened by the reduction of predatory species and the introduction of *T. nilotica* from Lake Albert. The changes set in motion in lake management and promotion of aquaculture need strong support and facilitation from government side. Care should be taken that this emerging fish industry will become competitive and private sector driven. There is potential for Tilapia fillets to be exported to high-end markets, but this would require compliance with the demanding SPS requirements for such trade. This requires the building of a complete fish value chain, in which currently the cold chain, filleting plants complying with international (Codex Alimentarius) food safety standards and the trading channels are missing.

In forestry, most of the forest genetic conservation efforts has been associated with protected areas consisting of protected natural forests and national parks. The three national parks namely Nyungwe, Birunga and Akagera are legally gazetted. Other forests including Gishwati, Cyamudongo, Busaga and savannah woodlands are areas also protected for the conservation of genetic resources. In an effort to cope with the rapid depletion of forests in recent years, the Government has undertaken conservation related activities. Also, demarcation of boundaries has been partly done and buffer zone plantations established between the communities and the protected forests. However, uncontrolled, illegal cutting and encroachment prevail. The challenge is to be able to conserve the remaining forest genetic resources, which have been eroded due to deforestation and changes in land use, over grazing, inappropriate harvesting practices and climate change.

b) Describe the status of *ex situ* conservation[32] of <u>associated biodiversity</u> and <u>wild food species</u> in your country:

1. **List and describe any existing national *ex situ* conservation initiative(s).**
2. **Indicate which species/groups of species are being conserved and with what objective(s).**
3. **Describe any existing subregional/regional *ex situ* conservation initiative(s) the country is involved in.**

As far as ex-situ conservation is concerned, there is a national genebank for the conservation of genetic resources mainly through Rwanda Agriculture Board. Most of the ex situ collections are currently maintained through crop based research programs at Rwanda Agriculture Board (RAB). RAB is therefore responsible for most of the ex situ collections held at the genebank, field stations, experimental/regeneration sites, herbariums and botanical gardens in the country. In 2013, there was 1787 accessions in storage through these programmes, but the number of accessions that were actively stored in the key programmes was about 814. RAB maintains these collections for research,

[32] Reference: questions 30 (Table 12) and 36 (Table 16) of country report guidelines.

multiplication and dissemination purposes. Targeted and planned collections are being conducted in many rural areas of the country. In terms of species collection, more efforts have been concentrated on cultivated species, but RAB also maintains an arboretum where forest indigenous and exotic species are maintained. In the field of agrostology, RAB is also maintaining a good collection of fodder plants (at least 14 species) in two stations: Karama and Rubona. In addition to the collections maintained by RAB, germplasm is also conserved by other national stakeholders. As an example National Industrial Research Agency (NIRDA, formal Institut de la Recherche Scientifique et Technologique (IRST)) is conserving one threatened species namely the finger potato, *Plectranthus esculentus* (Impombo).

Though it is difficult to calculate the exact number of accessions that has been collected in Rwanda and are conserved abroad, Rwanda has been partaking in international cooperation and networks of germplasm exchange. As examples, there has been collaboration between the RAB Bean Program and the International Center for Tropical Agriculture (CIAT) - Columbia, the RAB Irish Potato and Sweet potato Program with the International Potato Center (CIP)- Peru, and the RAB Maize and Wheat Program and the International Maize and Wheat Improvement Center (CIMMYT) Mexico. The partnership is mainly based on germplasm exchange. There are therefore a number of accessions collected in Rwanda and stored at genebank facilities abroad. Totally 1040 accessions from 29 different species have been identified, and a complete table of these accessions can be found in Annex 3.

A review of Rwanda animal genetic resources indicates that there is a general concern that the genetic variation within indigenous animal genetic resources in Rwanda is disappearing through breed substitution, indiscriminate crossbreeding and the absence of breed development programs. Other threatening factors to domestic animal genetic resources include increasing human population that has led to intensified settlement in pastoral areas—thereby reducing the land available for livestock grazing, which have severely affected localized populations and accelerated admixtures and interbreeding among breeds. This situation has been worsened by neglect and livestock disease epidemics. Any reduction in the diversity of genetic resources narrows the scope to respond to changes in the environment, disease challenges or demand patterns. The gradual disappearance of indigenous breeds that are able to survive in extreme environments undermines food and livelihood security of the poor and the capacity of people to survive in marginal areas

It is against this background that Rwanda National Gene Bank (RNGB) is concerned with *ex situ* conservation that involves the conservation of animal genetic resources. In collaboration with the Livestock Research Program, the Rwanda National Genebank is initiating the collection and conservation of Inyambo semen, conservation of local livestock Inyambo and endangered local inkungu livestock. The RNGB also envisions collecting and conserving beneficial microbial genetic resources (mushroom mycelium, rhizobia) and conserving small stock animal genetic resources (goats, pigs, chicken, sheep).

Fish production in Rwanda is in its natural form as fishing in lakes and harvesting in fishponds. The former is strengthened by the reduction of predatory species and the introduction of T. nilotica from Lake Albert. The changes set in motion in lake management and promotion of aquaculture need strong support and facilitation from government side. Care should be taken that this emerging fish industry will become competitive and private sector driven. There is potential for Tilapia fillets to be exported to high-end markets, but this would require compliance with the demanding SPS requirements for such trade. This requires the building of a complete fish value chain, in which currently the cold chain, filleting plants complying with international (Codex Alimentarius) food safety standards and the trading channels are missing.

In forestry, *ex situ* conservation activities are carried out through a network of tree seed sources. These supply about 10 tons annually for afforestation and agroforestry practices in Rwanda. The bulk of the seeds supplies are collected from identified and established seed sources in different seed zones of Rwanda, defined based on the adaptability of the species owing to their ecological requirements. There are about 80 seed stands scattered in the country and more than 500 ha of selected seed stands for seed collection in natural and planted forests. In addition, tree seeds are also harvested from selected plus trees dispersed in the agricultural landscape. Forest plantations for protection and production of fuelwood, poles, and saw logs total an estimated 301,500 ha, most of which is found in the Congo Nile ecological zone. Agroforestry plantations and trees outside forests are estimated to cover 162 800 ha corresponding to 31 % of the national forest area.

In forest plantations, eucalyptus species are dominant and occupy about 65% of the total plantation area. Presently, some 10 eucalyptus species are found in rural landscape, the most common being *Eucalyptus camaldulensis Dehnh, E. globulus Labill., E. grandis W. Hill ex Maiden, E. saligna Sm. and E. tereticornis Sm. Next to Eucalyptus spp., Pinus spp*. are also planted widely. Other tree species in planted forests include *Acacia melanoxylon R. Br. Ex Aiton, Callitris robusta F. Muell, C. calcarata (A. Cunn.) R. Br., Grevillea robusta A. Cunn., Casuarina equisitifolia L. and C. cunninghamiana Miq*. A few local tree species such as *Polyscias fulva (Hiern) Harms, Podocarpus falcatus (Thunb.) R. Br. Ex Mirb., P. latifolius (Thunb.) R.Br. ex Mirb., Maesopsis eminii Engl. and Albizzia spp*. are planted, particularly in buffer zones around indigenous forest reserves (Habiyambere 1999).

Besides seed stands and forest plantations for *ex situ* conservation of forest genetic resources, Rwanda has an Arboretum that is an essential facility for the purpose of both research and conservation. Since its establishment in 1930, the eucalyptus species have retained the attention of the management of the arboretum due to their merits worldwide. In fact, as they dominate the landscape of the country, they remain dominant in the Arboretum of Ruhande and the number of Eucalyptus species planted in the arboretum of Ruhande constitutes about 34% of all species found in there. The arboretum has an area of about 200 ha subdivided into about 529 numbered plots of which 454 plots are planted with introduced tree species (both indigenous and exotic species). The size of each plot is generally 50 x 50m (0.25ha). The arboretum of Ruhande counts now 203 tree species established plots with varying frequencies and sizes. Among these species 146 are broadleaved species of which 18 are indigenous and 128 are exotic, 69 being Eucalyptus species. There are also 56 conifers of which two are indigenous and three species of bamboos of which 2 are indigenous.

Important tree genetic resources, of both exotic and local tree species, are also found in the agricultural landscape of Rwanda in the context of agroforestry. Agroforestry systems particularly the home gardens farming and scattered trees on croplands involve the combination of food, fodder and tree crops. To a certain extent, these systems can satisfy the multiple needs of farmers. Some multipurpose trees are integrated with crops to improve the productivity of crops while providing much of the needed wood products and services from trees. About 150 different tree species are registered on farms and include indigenous tree species managed or retained by farm owners. The growth forms include shrubs and trees. However, the genetic diversity of the tree resources on farms are threatened by pressure on land for crop production, the perception that trees compete with crops, and increasing demand for woodfuel for cooking. The RNGB plans to conserve forestry genetic resources starting with endangered varieties/ species.

c) Identify possible needs and priorities in terms of the conservation of biodiversity for food and agriculture, and in particular of associated biodiversity and wild food species.

Needs and priorities for in situ conservation

Possible Needs in in situ conservation:

i) There is a need to address the existing gaps in knowledge, documentation and public awareness of the conservation of biodiversity for food and agriculture, and in particular of associated biodiversity and wild food species,

ii) Rwanda needs to address *in situ* conservation and on-farm management through the National policies and the NBSAP, to be able to fulfill the obligations set forth in the International Treaty and the Convention on Biological Diversity (CBD);

iii) There is a need to identify and address the capacity needs among national stakeholders for addressing *in situ* conservation and on-farm management;

iv) Appropriate activities needs to be identified and implemented to promote on-farm management of plant, animal and forest genetic resources in Rwanda;

Possible priorities in in situ conservation:

i) Create or updated inventories of plant species, including crop wild relatives (CWR), wild food plants, local varieties and other underutilized species,

ii) More research should be done on underexploited species including medicinal plants, indigenous vegetables, wild fruit and mushrooms and farmers should be supported to be able to conserve these species in their fields;

iii)

iv) Initiate a training system in conservation of genetic resources for food and agriculture to engage farmers and the private sectors.

Possible needs and priorities for sustaining *ex situ* conservation

Possible needs in ex situ conservation:

There are a number of constraints in sustaining *ex situ* collections in Rwanda, and the following reflect the urgent needs:

i) Secure staff and funding for full operation of the Rwanda National Genebank

ii) There are an urgent need for more skilled staff in ex-situ collections and conservation, particularly in the context of animal and forest genetic resources

iii) More equipment is needed in the storage facilities, and the facilities need to be strengthened with mechanisms for addressing the irregular electrical supply and natural disasters (including flood, pest and diseases);

iv) More knowledge about the existing genetic diversity is needed, including characters' variability and their patterns of distribution;

v) The collaboration between scientists and policy makers at national, regional and international levels needs to be strengthened, and arrangements should be made for maintenance and duplication of samples with other genebank facilities.;

Possible priorities in ex situ conservation:

i) Ensure that the National Genebank gets fully operational;

ii) Strengthen the existing field genebanks, including building the capacity of staff;

iii) Support activities to strengthen the coordination and cooperation between stakeholders at national level;

iv) Support activities to collect, characterize and evaluate plant, animal and forest species/varieties, including underutilized species and crop wild relatives (CWR);

v) Assist in the set up and management of community genebanks and strengthen local communities' ability to collect their material and document knowledge.

2.3 Access and exchange[33]

a) Describe in Table 6 the main measures in the country (i) regulating access to; and (ii) ensuring the fair and equitable sharing of benefits arising from the utilization of biodiversity for food and agriculture (BFA).

Table 6. Description of the main measures in the country (i) regulating access to; and (ii) ensuring the fair and equitable sharing of benefits arising from the utilization of biodiversity for food and agriculture (BFA).[34]

Components of BFA	**Description of measures governing access to BFA**	**Description of measures regulating the fair and equitable sharing of benefits arising from the utilization of BFA**
Genetic resources		
PGRFA	- Legal and institutional frameworks to control and regulate access to Rwanda's genetic resources - Detailed guidelines for biodiversity prospecting by domestic and foreign companies - National Clearing House to administer	- Mechanisms for equitable sharing of benefits arising from the use and commercialization of Rwanda's genetic resources and related traditional knowledge among the current generation (intra-generational equity) and between generations (inter-generational equity); - Mechanisms to ensure equitable sharing of benefits arising out of the use of accessed genetic resources, their by-products, innovations and practices associated with their use and applications and knowledge relating thereto; - Mechanisms to ensure to benefits are channeled to
AnGR		
FGR		
AqGR		
Associated biodiversity		
Micro-organisms		
Invertebrates		
Vertebrates		
Plants		
Wild foods		

[33] Reference: questions 72 and 73 of country report guidelines.

[34] Measures facilitating access to the different components of biodiversity for food and agriculture usually vary according to the intended use of the resource (e.g. any use, research and development, commercial use). Examples of possible measures consist of the need to obtain prior informed consent (PIC), sharing benefits based on mutually agreed terms (MAT), having special considerations in place for access to resources held by indigenous peoples and local communities, etc.

	all collections and exchanges of genetic resources - Permit system and fee structure for the collection of biological or genetic resource	the concerned holders of genetic resources/traditional knowledge in a manner which treats men and women equitably; - Mechanisms to ensure that concerned local community or communities participate in devising benefit sharing schemes. - Guidelines for equitable sharing of benefits from commercial use of genetic resources and related traditional knowledge

[Insert rows as needed]

Access and benefit-sharing (ABS) is a key element of both the CBD and the International Treaty. In a world where countries are dependent on each other for BFA to sustain food production and meet the increasing challenges of disease and climate change, Rwanda wish to both be able to contribute to and benefit from the opportunities that lies in shared access to these resources.

Rwanda has been a beneficiary of the activities of Bioversity International, other CGIAR centers and the International Food Policy Research Institute (IFPRI), and the access to genetic resources has improved greatly in the country. Today, Rwanda is receiving germplasm accessions used for research and breeding purposes from a number of institutions abroad. The CGIAR centers, including International Maize and Wheat Improvement Center (CIMMYT), International Rice Research Institute (IRRI), International Center for Tropical Agriculture (CIAT), World Agroforestry Centre (ICRAF), Center for International Forestry Research (CIFOR), International Potato Center (CIP), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Institute of Tropical Agriculture (IITA) , and International Livestock Research Institute (ILRI) have all been actively involved in training and exchange of germplasm through international nurseries and regional networks. This includes wheat and maize from CIMMYT, sweet potato from CIP, rice from IRRI and sorghum from ICRISAT. Currently there is no well-planned system of tracking the number of germplasm introduced in Rwanda or exchanged with other partners and this is the area where emphasize should put it on. All accessions are obtained responding to priorities of Rwandan government. New varieties have been released based on materials received from these centers particularly of maize, beans, sorghum, wheat and rice. Many other materials have been used in breeding programmes as sources of genes or as reference varieties. Since the last County Report (1995), Rwanda has not developed any national policy or legislation to ensure appropriate access and benefit-sharing related to the conservation and use of plant and forest genetic resources in the country. However, with the implementation of the NBSAP Programme and development of national conservation facilities, the collection of germplasm is becoming a country-driven process based on national priorities. Even though many BFA were received from CGIAR centers, Rwanda has got in the past various genetic materials from foreign countries through bilateral cooperation and assistance. For instance, some rice varieties like zong ngeng, yun yin and yun keng were from People's Republic of China, Taiwan and North Korea. The Belgian Colonial Power and the Catholic Church of Rwanda introduced export crops varieties like coffee and tea and many horticultural and vegetable crops such as orange, lemon, tree tomato, mango, spinach, cabbage, eggplants, carrot, onion and others.

Except from with the CGIAR centers, Rwanda has not undertaken any action to enhance the access to other genetic material located outside the country. Therefore, the access to PGRFA is generally unsatisfactory and should be increased. There is a plan to put the materials in the genebanks under the MLS.

As far as equitable sharing of the benefits of plant genetic resources is concerned, breeding of new varieties are currently under Rwanda Agriculture Board mandate, hence varieties developed are first benefited by Rwandan farmers and those varieties can be shared by other research institution or CGIAR centers. Crop varieties introduced or developed by RAB are distributed to farmers through partnerships with non-governmental and governmental development projects, and farmers' associations working in rural areas. The agricultural extension services helped in training farmers on how to grow those crop varieties by the application of improved cultivation techniques to increase yields and consequently crop production.

b) Identify possible needs and priorities in terms of the policies and regulations governing the access to and ensuring the fair and equitable sharing of benefits arising from the utilization of biodiversity for food and agriculture, and in particular of associated biodiversity.

(i) There is a need to build the capacity to develop, implement and enforce domestic legislative, administrative or policy measures on access and benefit-sharing, thereby contributing to the conservation of biological diversity and sustainable use of its components are needed, including through:

- Identification of relevant actors and existing legal and institutional expertise for the implementation of the Nagoya Protocol;
- Taking stock of domestic measures relevant to ABS in light of the obligations of the Nagoya Protocol; Development and/or amendment of access and benefit-sharing legislative, administrative or policy measures with a view to implementing their obligations under the Nagoya Protocol;
- Establishment of ways to address trans boundary issues;
- Establishment of institutional arrangements and administrative systems to provide access to genetic resources, ensure benefit-sharing, support compliance with prior informed consent and mutually agreed terms and monitor the utilization of genetic resources and traditional knowledge associated with genetic resources, including support for the establishment of check points.

(ii) Building the capacity of Parties to negotiate mutually agreed terms to promote equity and fairness in negotiations in the development and implementation of access and benefit-sharing agreements, including through enhanced understanding of business models and intellectual property rights,

(iii) Building the capacity of Parties to develop their endogenous research capabilities to add value to their own genetic resources and traditional knowledge associated with genetic resources through, inter alia, technology transfer; bio prospecting and associated research and taxonomic studies; and the development and use of valuation methods,

(iv) Addressing the capacity needs and priorities of indigenous and local communities and relevant stakeholders; in particular, projects that would:

- Encourage their participation in legal, policy and decision-making processes; and
- Assist in building their capacity related to genetic resources and traditional knowledge associated with genetic resources, such as through the development of community protocols, model contractual clauses and minimum requirements for mutually agreed terms to secure the fair and equitable sharing of benefits.

(v) There is a need to raise awareness of the importance of genetic resources and traditional knowledge associated with genetic resources, and related access and benefit-sharing issues, notably through the development and implementation of national and regional awareness-raising strategies;

(vi) Since the plant genetic resources in the country are scattered in different stations, institutions and farmers' homes, there is a need to have duplicates within the National Genebank for conservation and easy access;

(vii) At regional and international levels, some local PGR stored in CGIAR genebanks have not duplicates available in the country, there is a need to create duplicates and make exchange;

(viii) Some local research institutions such as universities do not have framework to access BFA for research purposes. There is a need to establish a formal framework to access germplasm from local, regional or international genebanks;

(ix) Farmers need assistance for the management of traditional and landrace varieties at their disposal and this will enable exchange with research institutions;

(x) There is a need for strong collaboration with the Management of Parks and Natural Reserves to preserve and use of associated biodiversity for food and agricultural research purposes.

III. Policies, institutions and capacity

3.1 Policies, programmes, institutions and other stakeholders

a) Describe relevant policies and programmes the country has adopted and is implementing to support the conservation and sustainable use of biodiversity for food and agriculture, and specify to which extent they address associated biodiversity and wild foods.[35] Relevant policies and programmes are those that aim at:

- **the coordinated use and conservation of sectoral genetic resources**
- **addressing food security and nutrition[36]**
- **the sustainable use and conservation of associated biodiversity**
- **the maintenance of ecosystem services**
- **improving resilience and sustainability of production systems**
- **supporting farmers, livestock keepers, forest dwellers and fisher folk to adopt and maintain practices that strengthen the conservation and use of biodiversity for food and agriculture**
- **the application of an ecosystem/landscape/seascape approach[37]**

The Rwanda Vision 2020 provides guidance for the development of the overall national policies, regulations, strategies and programmes including those related to biodiversity conservation and associated biodiversity as well. It states that Rwanda will implement adequate land and water management techniques, coupled with a sound biodiversity policy, in order to ensure sustainable development. Cross-sectoral environmental, including biodiversity mainstreaming has been initiated from 2005 with the support of the "Poverty and Environment Initiative (PEI)" country project and has

[35] Reference: questions 66, 67 and 78 of country report guidelines; Policies and programmes can include incentives or benefits, such as payments, provision of inputs and subsidies, to support activities for the conservation and sustainable use of biodiversity for food and agriculture.

[36] The relevant policies and programmes should have an explicit reference to associated biodiversity and/or wild foods.

[37] Reference: question 67 of country report guidelines.

been strengthened through inclusion of an annex on environment and climate change mainstreaming in the budget call circular from 2011 by the Ministry of Finance and Economic Planning.

In addition, various sector ministries in charge of Local Government and Good Governance, Agriculture, Natural resources; Infrastructure, Energy, Transport, Communications, Trade and Industry are supported to integrate environmental sustainability in their policies and plans. Furthermore Rwanda has decided to take the Green Economy pathway as safer and sustainable approach to economic development and human well-being. The green economy approach is one of the priorities of the Second Economic Development and Poverty Reduction Strategy that take into account the preservation of biodiversity and ecosystem services.

Moreover, the country has promoted a Sector Wide Approach (SWAP) for mainstreaming environmental (including biodiversity) sustainability into all development processes. The approach also contributes to strengthen sector coordination and build synergy in mobilizing and allocating funding, bring together stakeholders and enhance effective planning and follow-up.

However some sectors or institutions or policies integrate well the biodiversity whilst others do not and others partly integrate the biodiversity considerations. The following table 8 presents some of the main sectors whose interventions integrate well or not or partly the biodiversity conservation needs.

In Rwanda, nineteen national targets for biodiversity conservation were defined in line with the Aichi Biodiversity Targets of the Strategic Plan for Biodiversity 2011-2020. Specifically Target 16 refers to the development and adoption of a policy instrument r to support the conservation and sustainable use of biodiversity for food and agriculture. In addition, target 17 is about integrating values of traditional knowledge, cultural heritage and practices of local communities into national policy and legal framework for the conservation of biodiversity. The country has started by implementing an effective, participatory and updated National Biodiversity Strategy and Action Plan (NBSAP). It has assigned the relevant ministries to implement the strategy by working together with the private sector and other stakeholders. Besides a Biodiversity Policy in 2011 and a Biodiversity Law in 2013, a number of new key policies, laws and strategies have been adopted, including the Economic Development and Poverty Reduction Strategy (EDPRS) II (2013-2018), National Climate Change and Low Carbon Development Strategy (2011), Rwanda Wildlife Policy (2013), Rwanda Protected Areas Concessions Management Policy (2013), National Forestry Policy (2010), National Policy for Water Resources Management (2011), National Energy Policy and National Energy Strategy (2008-2012), National Industrial Policy (2011), Forestry Law (2013), Protected Areas Law (2013), New Land Law (2013), Law establishing the Rwanda National Climate and Environment Fund (FONERWA) (2012), Law establishing Rwanda Natural Resources Authority (2011), Decrees for the protection of biodiversity, Payment of Ecosystems Services (PES) regulatory framework preparation, etc.

Regarding the rational use of biotechnology, the following instruments have been developed National Biosafety Framework, including the National Biotechnology and Biosafety Policy, the National Biosafety Bill and related institutional framework.

From the time the fourth report to the CBD, biodiversity-based institutions have been established. and include: Rwanda Natural Resources Authority (RNRA); Rwanda National Climate and Environment Fund (FONERWA), CBD Steering Committee, and Centre of Excellence in Biodiversity and Natural Resources Management in course of establishment.

The National Centre of Excellence (CoE) for Biodiversity Conservation is legally mandated to oversee the cross-sectoral implementation of the NBSAP and biodiversity mainstreaming into sectoral plans and policies. In addition, proposal has been made through the revised NBSAP that partnership and

collaborative mechanisms should be developed between the CoE and others institutions involved either biodiversity conservation or biodiversity utilizers such as the Ministry of Agriculture and Animal Resources (MINAGRI), the Ministry of Infrastructure (MININFRA), the Ministry of Trade and Industry (MINICOM), the Ministry of Finance and Economic Planning (MINECOFIN), the Ministry of Local Administration (MINALOC), the Ministry of Disasters and Repatriation (MIDIMAR), the Ministry of Education (MINEDUC), the Ministry of Health (MINISANTE), Rwanda Agriculture Board (RAB), National Agricultural Export Development Board (NAEB), Rwanda Natural Resources Authority (RNRA), Energy Water and Sanitation Authority (EWSA), Rwanda Transport Development Authority (RTDA), Rwanda Biomedical Center (RBC), Gender Monitoring Office, Cities and Local administrations, Judiciary, Parliament and Senate.

b) Provide a short analysis of the strengths and weaknesses of the policies and programmes mentioned above and indicate their level of implementation.[38]

Specific knowledge for biodiversity is still at a very low level among sectors stakeholders, even though environment awareness has been improved in general. Thus, specific contribution of biodiversity to poverty reduction and community wellbeing is not well accounted in sectoral planning due to a number of issues that needed to be addressed, such as:

i) Insufficient institutional capacity to efficiently and effectively manage wildlife and conservation;

ii) Insufficient skills in conservation management;

iii) Key stakeholders are not systematically involved in conservation, and

iv) Weak national level conservation-planning framework, especially conservation of the biodiversity outside of protected areas.

Currently, Rwanda has adopted different policies and institutions that specifically address the conservation and sustainable use of biodiversity for food and agriculture. These policies are implemented in partnership with national, regional and international institutions to promote and support the maintenance and restoration of the integrity, functioning, and health of natural systems.
A comprehensive system for monitoring and reviewing the implementation of the NBSAP has been established. The Centre of Excellence in Biodiversity and Natural Resources Management (CoE) is now established with the mandate of coordinating and monitoring all activities relevant to biodiversity conservation and management. It coordinates, oversees and monitors the cross-sectoral implementation of the NBSAP, through collaborative and partnership mechanisms with different stakeholders.

[38] Reference: questions 66 and 67 of country report guidelines.

BOX 3. Provide up to three examples to highlight how stakeholder groups in the country, such as groups or associations of farmers, forest dwellers, fisher folk and livestock keepers, NGOs or other civil society organizations, have actively contributed to the improved sustainable use and/or conservation of biodiversity for food and agriculture and the maintenance of ecosystem services.[39]

1. The Association Rwandaise des Ecologistes "ARECO" is an environmental and development organization founded in 1991 by people concerned with environment degradation in Rwanda characterized mainly by soil erosion, deforestation, loss of biodiversity, climate change, water and air pollution, etc. The term "RWANDA NZIZA" was added to the former name "ARECO" to express that the founders were committed to contribute to make Rwanda "more beautiful", the literal meaning of "NZIZA" in native language kinyarwanda. ARECO - RWANDA NZIZA brings together about one hundred members around the country and abroad and works with local communities putting mostly emphasis on their women and youth groups who play a major role in the natural resources management. These groups are also the most affected by the natural resources degradations. RECO - RWANDA NZIZA seeks to promote a sound and pleasant environment for a sustainable social and economic development. Its vision is to fight for a durable, planned and equitable management of natural resources in a bid to protect environment and fight against poverty among the population, especially the most vulnerable and marginalized members of society. Main objectives include raising people's awareness of environment protection, protecting and conserving of natural resources and the environment, and promoting eco-tourism. ARECO's Main activities are the following :

- Community mobilization and capacity building;
- Around 16600 community members gathered into associations, cooperatives and school clubs are currently facilitated by ARECO. 70% of beneficiaries are women;
- Follow up and evaluation of cooperatives created;
- Advocacy for local communities;
- Tree nurseries for household and community forestry development. Specifically, ARECO supports the production of tamarillo in 38 cells;
- Development of horticulture crops in Burera, Rutsiro and Musanze Districts;
- Beekeeping development for the conservation of Mukura forest reserve;
- Bamboo promotion for the conservation of the Volcanoes National Park and the Rugezi wetland in northern Province of Rwanda;
- Organization of trainings to the local communities about bamboo multiplications techniques and bamboo processing;
- Support and trainings on bamboo nursery management;
- Trainings on climate change mitigation and adaptation strategies.

2. Rwanda Environmental Conservation Organization (RECOR) is a national environmental conservation NGO, working on climate change, biodiversity conservation, renewable energy, education for sustainable development, forestry, agroforestry, water, hygiene and sanitation. It involves local communities in looking for suitable and sustainable solutions to local environmental challenges. RECOR was founded in 2000 and was legally registered in 2003. It has been started by a movement of students of the National University of Rwanda as a wildlife club. Later it extended further to other higher institutions of learning, to primary and secondary schools. After the realization of national environmental challenges, the youth from the above said institutions gathered and formed a National Non-Governmental Organization to work nationwide.

[39] Reference: question 77 of country report guidelines.

3. The SACOLA (Sabyinyo Community Livelihood Association) has been created in 2004 by Kinigi District authorities in collaboration with the former Rwanda Office of Tourism and National Parks that is currently a department of RDB. SACOLA has the following objectives: (i) improve and promote the lives of population surrounding the park who were suffering heavily from the consequences of the guerilla war of 1997-1998; (ii) protect the park against human activities and disease transmission from humans to gorillas. SACOLA uses, supports and synchronizes services provided by local organizations and communities. It promotes profit sharing with surrounding communities. It uses as tools community cooperatives such as UNICOPAV (i.e. ex-poachers), ANNICO (i.e. producers of tourism products from bamboos), etc. By offering, positive incentives to local communities and jobs to vulnerable people, SACOLA prevents them to invade protected areas for poaching and commit other illegal threats. SACOLA has recorded many achievements: construction of houses for genocide survivors and other vulnerable; revenue sharing from Silver Back Lodge; Gorilla naming ceremony introduced in 2005 to create awareness for safeguarding of the mountain Gorillas that are in danger of extinction etc.. With all revenues, SACOLA invests back in the community and by the way contribute to biodiversity conservation in protected areas.

c) Provide examples of successful interministerial cooperation in the area of conservation and sustainable use of biodiversity for food and agriculture and describe the relevant collaboration mechanisms.[40]

Rwanda has established The National Centre of Excellence (CoE) for Biodiversity Conservation intended to strengthen inter-ministerial and institutional collaboration in the area of conservation and sustainable use of biodiversity for food and agriculture. All the natural resource plans, strategies and programmes in Rwanda have been developed through collaborative work in task forces and working groups including a wide representation of stakeholders in policy decision making, local authorities, resource managers and users, donors, researchers and development partners. Notably, the Ministry of Natural Resources (MINIRENA) through Rwanda Environment and Management Authority (REMA), has been very effective in bringing together stakeholders concerned with biodiversity and environment to jointly develop plans, strategies and programs in these sectors.

The preparation process on most of the national strategies and enabling framework described in this report has involved representatives of ministries, several government institutions, NGOs and some other institutions. In general, sectors whose interventions integrate well or not or partly the biodiversity conservation needs play a key role in conservation-planning framework. These sectors include tourism, agriculture, land use, forestry, water resources management, water supply and energy, mining, industry and urbanisation and rural settlements. Cooperation will continue to play a key role in the implementation of RBSAP activities. These activities will be implemented through action plans, developed with the contributions of broad-based cooperation between the Ministry of Rwanda Natural Resources and other ministries, NGOs, stakeholders integrating biodiversity considerations and various economic sectors.

d) Identify possible needs and priorities in terms of policies, programmes and institutions governing biodiversity for food and agriculture, and in particular associated biodiversity and wild food species.[41]

Possible needs in terms of policies, programmes and institutions governing biodiversity for food and agriculture, and in particular associated biodiversity and wild food species:

The policies and enabling frameworks that govern biodiversity conservation are generally complex, and have to be implemented to respond to national targets of achieving food security and sustainable economic development.

[40] Reference: questions 81 and 82 of country report guidelines.
[41] Reference: question 88 of country report guidelines.

Their implementation often requires both financial and human resources. It also frequently involves dealing with trade-offs such meeting the community needs and conservation interests, direct and indirect benefits, short term and long term advantages, economic and environmental externalities, or whether implementation is to be done by the public institutions, private sector or both. Therefore, the implementation process could lead to conflict and resistance from the population if awareness campaigns have not been carried out successfully.

Information on the status and trends of genetic resources for food and agriculture, particularly for associated biodiversity is usually availed by research and academic institutions in Rwanda but the linkages and collaboration are lacking. Moreover, the capacity to do research in different areas of biodiversity conservation and associated biodiversity is low, particularly in areas of ecology, taxonomy, valuation and EIA, which complicate data collection, processing and analysis, monitoring and assessment of the status and trends in biodiversity.

Sectors integration of biodiversity conservation needs are confronted with positive and negative outcomes with respect to the development of sectoral policies and their implementation. The outcome of the sectoral policies are often contradictory and involve serious trade-offs. For example in the energy sector, the promotion of renewable energy source *(e.g. biogas, solar…) and c*leaner production (*e.g. improved cooking stoves*) leads negative outcomes to biodiversity conservation through ecosystem transformation by constructing dams/hydropower plants and producing charcoal. Positive actions in the agriculture sector including the establishment of gene banks, agro-forestry, erosion control and land husbandry, zero grazing policy, Organic farming system, fish restocking in lakes and fish farming and apiculture/beekeeping are partly contradicted by Conversion of natural ecosystems to agro-ecosystems, biodiversity degradation, pollution though pesticides and fertilizers and threats to landraces and local breeds. Therefore, trade-offs have to establish between the positive and the negative outcomes of biodiversity conservation needs.

Possible priorities in terms of policies, programmes and institutions governing biodiversity for food and agriculture, and in particular associated biodiversity and wild food species

i) Enhance continuous cooperation across institutions and sectors integrating biodiversity conservation

ii) Mobilize financial resources for funding biodiversity conservation and research on associated biodiversity and wild food on long term basis

iii) Ensure short and long term training of staff in specialized areas of conservation and resource use.

iv) Carry out economic valuations of biodiversity conservation and sustainable use;

v) Carry out research in biodiversity with the involvement of expertise from different stakeholders;

vi) Reinforce EIA for programmes and projects to balance positive and negative outcomes as far as actions for biodiversity conservation are concerned;

vii) Develop mechanisms for increased institutional participation in planning, implementing and monitoring the conservation and sustainable use of biodiversity for food and agriculture, in particular associated biodiversity and wild food.

3.2 Capacity

a) Identify and prioritize training and education needs that target the conservation and sustainable use of associated biodiversity and describe possible constraints.[42]

Specific training and education needs that target the conservation and sustainable use of biodiversity and associated biodiversity are detailed in the Rwanda's Biodiversity policy that deals with overall biodiversity. This policy aims to provide for the development of a whole range of scientific, technical and managerial skills necessary for planning, conservation and management of biodiversity, as well as multi-stakeholder participatory processes and skills for joint planning, research and community participation.

[42] Reference: questions 85, 86 and 90 of country report guidelines.

Government is committed to human resource development and to providing training and developing skills required for biodiversity management. Training is recognized as important not only for those charged with managing the use of natural resources, but for senior decision- makers, industrialists, and local communities. Actions in training and education relevant to conservation and sustainable use of biodiversity in Rwanda focus on two dimensions, first at building human and technical capacity to conserve biodiversity, and manage its use , secondly at improving knowledge and understanding about biodiversity on the part of the public. Below are some priority training and education needs relevant for biodiversity for food and agriculture derived from the Rwanda's Biodiversity policy document, the Fifth National Report to the Convention on Biological Diversity (2014), other literature and working groups.

(1) *Build human and technical capacity to conserve biodiversity, and manage its use:*

i) review of the status quo of research on biodiversity;

ii) Awareness and appreciation, of the value and importance of biodiversity ;

iii) Targeted public awareness and sensitization programmes for different target audiences;

iv) Public-Private-NGO Partnerships in capacity building;

v) Integration of biodiversity in national education programmes;

vi) Production of awareness materials for different sectors ;

vii) Targeted short-term training courses in biodiversity conservation and sustainable use tailored to different stakeholders including business, communities, teachers, resource managers, non-governmental organizations, and senior decision-makers;

viii) Maintaining existing skills and expertise, and improve the capacity of public servants, non-governmental organizations, and communities to conserve and sustainably use biodiversity, by providing attractive terms and conditions of service;

ix) Support to existing institutions that provide training for biodiversity management, with specific emphasis on those institutions that have historically been denied opportunities

(2) *Improving knowledge and understanding about biodiversity;*

i) Undertaking conservation knowledge needs assessment and identify gaps and priorities.

ii) Development of a multidisciplinary national biodiversity research plan

iii) Support to research to fill gaps in biodiversity knowledge

iv) Provision and/or mobilization of resources to support diverse areas of multi-disciplinary biological research.

v) Development of curricula for Extension agents at sector and District levels

vi) Monitoring of the effectiveness of the training and use information in adaptive feed-back mechanisms to fine tune the training programme and field manual of techniques

vii) Provision of incentives to attract qualified individuals to careers in biodiversity management by ensuring that biodiversity management offers a coherent career path, with specific emphasis on the training of people from disadvantaged communities;

b) Identify and prioritize research needs to strengthen the conservation and sustainable use of associated biodiversity, wild foods and ecosystem services and describe possible constraints.[43]

Some biological research has been conducted in Rwanda in past years, resulting in the development of a knowledge base and understanding concerning aspects of the country's biodiversity. However, the existing biological knowledge is patchy, and more research is required to improve our understanding of the interactions between biological and social processes and the underlying causes of the decline in biodiversity. The approach pursued by the Rwanda's Biodiversity Policy is to accelerate research and the translation of results into applied action, and so promote the conservation and sustainable use of biodiversity. Other priority research needs include:

- Conducting research on biodiversity status, associated biodiversity in the three national parks of Rwanda;
- Research on biodiversity inventory and mapping of threatened remnant terrestrial ecosystems outside protected areas;
- Conducting research on inventories of aquatic biodiversity;
- Production of biodiversity catalogue;
- Research on ecosystems services valuation relevant to biodiversity, associated biodiversity and wild food.

Major constraints to the implementation of research in biodiversity in Rwanda lie in the insufficient number of trained Rwandans to carry out the tasks required, and a lack of clear career opportunities in biodiversity conservation and sustainable use. A certain cadre of natural scientists exists, but few researchers are experienced in biodiversity research, or have the breadth of knowledge required to address biodiversity conservation problems. In addition, research in biodiversity requires considerable financial resources that are unlikely to be adequate in the near future. Moreover, collaboration among institutions concerned with biodiversity in developing research projects, implementing and monitoring them appear to be very difficult. There is limited continuous involvement in the validation of research findings for some stakeholders and lack of communication system of environment related research findings/projects between research institutions and potential users/implementers of research finding. An integrated framework for biodiversity research, which would assist in the follow up of research findings and/or recommendations is also among obstacles to advancing specific research strategies in biodiversity conservation.

IV. Regional cooperation

4.1 Regional initiatives the country is involved in to conserve and use biodiversity for food and agriculture

a) Describe in Table 7 relevant regional policies and programmes embedding the conservation and/or use of biodiversity for food and agriculture, and in particular associated biodiversity, wild food species and ecosystem services.

Table 7. Description of relevant regional policies and programmes that embed the conservation and/or use of biodiversity for food and agriculture, and in particular associated biodiversity, wild food

[43] Reference: questions 87 and 91 of country report guidelines.

species and ecosystem services. [44]

Regional policies and programmes	Description
Greater Virunga Transboundary Collaboration (GVTC)	It is a strategic management system for the Greater Virunga landscape, through transboundary and collaborative mechanisms, which help to address both conservation and socioeconomic and political issues, in a landscape defined by ecosystems rather than administrative boundaries. This is in accordance with the Convention on Biological Diversity that advocate for the use of landscape and ecosystem approaches for managing biodiversity in the region, in recognition of the need for increased regional cooperation
Africa Land Policy Framework and Guidelines (ALPFG):	The Guidelines emphasize regional convergence on the sustainable management and utilization of land and associated resources shared by two or more member states in various 18 parts of Africa. The ALPFG provides the guiding principles for land policy development and implementation in Africa. It offers the following: - A basis for commitment by African member states to the formulation and operationalization of sound land policies as a basis for sustainable human development that includes social stability through a joint land dispute management strategy, maintaining economic growth and alleviating poverty and protecting natural resources. - A consensus for shared principles as the basis for securing access to land for all users, enhancing agricultural productivity and sustaining livelihoods. Furthermore, it underscores the need for popular participation in land policy formulation and implementation so as to facilitate improved governance of land resources. - A basis for more coherent partnerships between states, citizens and development partners in land policy formulation and implementation on the continent.
Environment and Climate Change International Conventions and -Regional Frameworks	This strategic plan also aims to strengthen linkages with existing International conventions and regional frameworks and Natural Resources Management and regional integration related activities implemented by Regional Economic Communities (RECs) and Intergovernmental Organizations (IGOS), such as the East African Community (EAC), the Economic Community of the Great Lakes Countries (CEPGL), and the International Conference on the Great Lakes Region (ICGLR). This will lead to further dissemination of experiences and good practices among countries in the sub-region. The EAC policy on climate change is one of the key frameworks that aim at guiding Partner States and other stakeholders on the preparation and implementation of collective measures to address Climate Change in the region while assuring sustainable social and economic development. The policy is based on three pillars namely adaptation, mitigation and climate change research. The pillars will be supported by the following critical capacity building areas; technology development and transfer,

[44] Reference: question 84 of country report guidelines.

	finance, education, training and public awareness, information and knowledge management systems. The National Green Growth and Climate Resilience Strategy preparation was guided by the EAC policy on Climate Change. Lake Victoria Environment Management Programme, Nile Basin Initiative (NBI), Kagera Transboundary Agro-Ecosystems management are some of the initiatives in which Rwanda is taking part and meant to sustainably manage mainly the transboundary ecosystems, river basins and resources.
The Nile Basin Initiative (NBI)	NBI is an intergovernmental partnership of 10 Nile Basin countries, namely Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, The Sudan, Tanzania and Uganda. Eritrea participates as an observer. It provides a forum for consultation and coordination among the Basin States for the sustainable management and development of the shared Nile Basin water and related resources for win-win benefits. The objectives of the NBI are: • To develop the Nile Basin water resources in a sustainable and equitable way to ensure prosperity, security, and peace for all its people, • To ensure efficient water management and the optimal use of the resources, • To ensure cooperation and joint action between the riparian countries, seeking win-win gains, • To target poverty eradication and promote economic integration • To ensure that the program results in a move from planning to action Leadership The highest decision and policy-making body of NBI is the Nile Council of Ministers (Nile-COM), comprised of Ministers in charge of Water Affairs in each NBI Member State. The Nile-COM is supported by the Nile Technical Advisory Committee (Nile-TAC), comprised of 20 senior government officials, two from each of the Member States.
Central African Forests Commission (COMIFAC)	The legal basis for the Central African Forests Commission (COMIFAC) was laid in 1999 with the Yaoundé Declaration, concluded during the Summit meeting of the Heads of State of Cameroon, the Republic of Congo, Chad, Equatorial Guinea, Gabon, and the Central African Republic. The Declaration recognizes the protection of the Congo basin ecosystems as an integral component of the development process and reaffirms the signatories' commitment to work together to promote the sustainable use of the Congo basin forest ecosystems. The COMIFAC Convergence Plan, adopted by the Head of State of Central Africa in 2005, defines a common regional intervention strategy for the countries of the sub region and their international development partners. The ten strategic axes of the Convergence Plan: (1) harmonizing forest policy and taxation; (2) resource knowledge and inventory; (3) ecosystem management; (4) biodiversity conservation; (5) sustainable use of forest resources; (6) alternative income generation; (7) capacity development and training; (8) research; (9) innovative financing mechanisms and (10) regional cooperation and partnerships

The Lake Victoria Environmental Management Programme (LVEMP)	The Lake Victoria Environmental Management Programme, Project Phase II (LVEMP-II) is an East African Community (EAC) regional initiative coordinated by the Lake Victoria Basin Commission (LVBC) Secretariat and currently implemented by the Five EAC Partner States under Adaptable Program Loan 1 (APL 1) (Kenya, Tanzania and Uganda) and APL 2 (Burundi and Rwanda). The purpose of LVEMP II is to contribute to the EAC's Vision and Strategy Framework for the Management of the Lake Victoria basin – "a prosperous population living in a healthy and sustainably managed environment providing equitable opportunities and benefits". The objectives of the Project are to contribute to: - the improvement of the collaborative management of the trans-boundary natural resources of the LVB among the Partner States; and - the improvement of environmental management of targeted pollution hot-spots and selected degraded sub-catchments for the benefit of communities who depend on the natural resources of LVB. The project has four components namely: (i) strengthening institutional capacity for managing shared water and fisheries resources; (ii) point source pollution control and prevention; (iii) watershed management; and (iv) . Project Coordination and Management. During Phase 1 of the programme, the following achievements were made: Water hyacinth infestation had been reduced by over 80%, although Kagera River, which drains Burundi and Rwanda, continuous to bring into the lake an estimated 0.8 ha of the weed daily. At the start of LVEMP in 1997, the weed covered an estimated 12,000 ha of the Lake surface; Recovery of indigenous fish species once feared extinct from Lake Victoria has been established and strategies to conserve and/or protect them made; Quantification of nutrient balance for the lake based was made whereby atmospheric deposition accounts for 75% of phosphorus loading while municipal and industrial source accounts for only 6%. 1. Inventory of all industries, shoreline settlements and urban centers in the basin, quantity of wastewater generated including the current capacity for wastewater treatment was made as a basis for future management; 2. A total of 56 in-lake water quality monitoring stations were established for regular monitoring of water quality; 3. 'Hot spot' areas adjoining shoreline settlements including cities and towns, gulfs and bays receiving nutrients from agricultural land have been identified and strategies to improve of water quality in those areas, was made and implementation started; 4. Mapping of land use/cover and soil erosion hazard in the Lake

	Basin was accomplished and soil and water conservation mitigation measures initiated; 5. Models were developed for Lake Victoria Water Quality and for Buffering Capacity for Wetlands to be used as a tool for the Sustainable Management of the Lake Basin; 6. The project ensured ownership by local communities and sustainability of its activities through their involvement in project implementation; and 7. LVEMP facilitated human capacity building in all implementing institutions, which include 28 PhDs, 88 MSc, 3 BSc, 10 Diplomas and 1487 attended short courses and over 3500 participated in seminars/workshops
The Transboundary Agro-ecosystem Management Project for the Kagera River Basin (Kagera TAMP)	The project was approved by the Global Environment Facility (GEF) in June 2009. The Project Goal is to adopt an integrated ecosystems approach for the management of land resources in the Kagera Basin that will generate local, national and global benefits including: restoration of degraded lands, carbon sequestration and climate change adaptation and mitigation, protection of international waters, agro-biodiversity conservation and sustainable use and improved agricultural production, leading to increased food security and improved rural livelihoods. The project works in four countries namely Burundi, Rwanda, Tanzania and Uganda. The Kagera TAMP use inter-sectoral approaches that will allow to address the land use-livelihood system as a whole, considering both the environmental and socio-economic benefits that can be obtained from more integrated land use systems and better resource management practices (i.e. improved efficiency and ecological functions of sustainable, diversified systems generating improved productivity and income with reduced inputs and costs) while contributing to the conservation of resources, restoration of degraded lands and maintenance of ecosystem services. The project contributes to the implementation of the various national strategies and plans in a coherent, harmonious and effective way, through working closely with local governance and communities to build the capacity of technical and district level staff. Kagera TAMP works also at international level to harmonize strategies across the basin for the generation of global environmental benefits through reversing land degradation, conserving biodiversity, enhancing carbon sequestration and thereby contributing to protection of the shared water resources.

International Gorilla Conservation Programme (IGCP)	The International Gorilla Conservation Programme (IGCP) was formed in 1991, bringing together three international conservation organizations and three protected area authorities: the African Wildlife Foundation (AWF), Fauna and Flora International (FFI) and the World Wide Fund for Nature (WWF); the Institut Congolais pour la Conservation de la Nature (ICCN), the Office Rwandais de Tourisme et des Parcs Nationaux (ORTPN) and the Uganda Wildlife Authority (UWA). The goal of IGCP is to ensure the conservation of the regional afromontane forest habitats of the mountain gorillas in Rwanda, Uganda and the Democratic Republic of Congo. One of the principal characteristics of IGCP is that it is regional, basing its activities in the afromontane forest habitat that lies across the shared borders of these three countries. Emphasis is placed, at all levels, on regional collaboration, to ensure that the three countries work together to protect and conserve this area. Regional activities include: ecological monitoring and surveillance; tourism development; joint training, communication and sharing of experiences; planning; community participation and management planning.

[Insert rows as needed]

4.2 Needs and priorities

a) Identify possible needs and priorities in terms of embedding biodiversity for food and agriculture, and in particular associated biodiversity, wild foods and ecosystem services into regional and international initiatives.

Rwanda has ratified a number of regional and international agreements that are important for sustainable use and conservation of biodiversity. In this context, Rwanda aligns its policy with regional and international obligations. Possible needs and priorities in terms of embedding biodiversity for food and agriculture, and in particular associated biodiversity, wild foods and ecosystem services into regional and international initiatives include:

i) Establishing and strengthening coordination mechanisms to ensure consistent negotiations, implementation and reporting in multilateral and regional environmental agreements critical for sustainable biodiversity management;

ii) Promoting and supporting the establishment of transboundary and/or transfrontier biodiversity conservation and management initiatives;

iii) Keeping and regularly updating a register of all regional environmental agreements and initiatives to which Rwanda is a party and ensure their domestication and effective implementation and reporting;

iv) Mobilizing resources from financing mechanisms under Multilateral Environmental Agreements (MEAs), such as the Global Environment Facility (GEF), to support sustainable biodiversity management for national development;

v) Mainstreaming sustainable biodiversity management into regional and sub-regional trade regimes and other initiatives to which it is a member.

V. Synthesis of needs and priorities and the possible way forward

Countries may wish to use Table 8 to summarize their needs and priorities, and possible actions to be undertaken, with respect to the four priority areas of the guidelines.[45]

Table 8. List of the country's needs and priorities, and possible actions to be undertaken, to conserve and use biodiversity for food and agriculture.

Priority areas	Needs and priorities	Possible actions to be undertaken[46]
1. Assessment and monitoring	Develop and implement approaches to monitor biodiversity including associated biodiversity that are managed in different production systems of the country	- Development of monitoring systems for biodiversity, ecosystems and their management and sustainable use - Elaboration of strategies to assess biodiversity and ecological trends and the impacts of human activities - Develop capacity for monitoring in institutions engaged in managing components of biodiversity, - Develop and apply effective tools (videography and regional-scale (satellite image analysis) for monitoring biodiversity - Develop, publish and disseminate a "National Biodiversity Framework" integrated, coordinated and uniform approach to biodiversity management and monitoring
2. Conservation and sustainable use	- Develop in situ and ex-situ conservation of Rwanda's species diversity and enhance the maintenance and recovery of viable populations of species - Create conditions and Incentives that support the conservation and sustainable use of biodiversity ; - Promote and develop	- Detailed species management strategies and plans for keystone and indicator spp. - Research to identify new areas of economic potential for Rwanda's indigenous and traditional biological and genetic resources. - Assessments and guidelines for determining sustainable harvesting and utilization levels for species - Framework for identifying and listing endangered and threatened

[45] See sections 1.3 (a), 2.1 (f), 2.2 (c), 2.3 (b), 3.1 (d), 3.2, 4.2 (a) of the present guidelines.
[46] Reference: questions 92, 93, 94, 95, 96 and 97 of country report guidelines.

	economic opportunities that are compatible with and which complement the conservation and sustainable use of biodiversity; - Enhance the capacity necessary to conserve and sustainably use Rwanda's biodiversity - Conserve, integrate and use sustainably biodiversity in all production systems and avoid or minimize adverse impacts on the biodiversity of such systems - Restore and rehabilitate degraded ecosystems, and strengthen and further develop species recovery plans as a contribution to the conservation and sustainable use of biological diversity.	species - Recovery plans (ex-situ) for survival of endangered and threatened spp. or re-introduction of spp - Management of migratory and transboundary spp. - Integrated land-use planning and priority setting to incorporate biodiversity. - Development and Coordination of a comprehensive national strategy for ex-situ conservation - Build human and technical capacity for ex-situ conservation, - Strengthen delivery of extension services and capacity for management of biodiversity. - Develop and harmonize methods for data collection on agro-biodiversity - Develop methods for domestication and cultivation of natural plants such as medicinal plants and fodder trees - Identify and map critical watersheds and catchments and develop catchment-specific partnerships and joint management plans - Formulation of management plans for biodiversity conservation in different production systems with a focus on wetlands and other aquatic systems - Create and apply incentives to promote conservation and sustainable use of biodiversity - Develop systems for valuing and marketing ecological services such as carbon sequestration and watershed functions. - Develop innovative public private partnerships and mechanisms to promote investment in biodiversity-based business,

		including investment in natural product and service industries - Detailed guidelines for biodiversity prospecting by domestic and foreign companies. - Fully operationalize the National Genebank to administer all collections and exchanges of genetic resources - Efficient permit system and fee structure for the collection of biological or genetic resource - Develop guidelines for equitable sharing of benefits from commercial use of genetic resources and related traditional knowledge - Propagation and planting of indigenous crops and trees to build the local resource base and to improve living environments.
3. Policies, institutions and capacity	- Ensure that existing and proposed national policies, plans and programmes support the conservation and sustainable use of biological resources and minimize adverse impacts on biodiversity; - Require all government departments responsible for activities affecting biodiversity to develop sector-specific plans based upon agreed guidelines; - Establish a national mechanism, representative of key sectors, to oversee, coordinate, and better integrate government policies which directly or indirectly affect biodiversity; - Establish a system for accounting and adopt	- Mainstream biodiversity into all relevant sectors - Develop sectoral and cross sectoral plans and guidelines for biodiversity - Formulate Integrated Environmental Management (IEM) principles and appropriate apply environmental procedures in land planning controls - Identify and analyze biodiversity stakeholders - Partnerships and stakeholders participation strategy to enhance biodiversity management. - Promote investments in biodiversity initiatives and programmes by providing appropriate fiscal and economic incentives. - Establish mechanisms for resolving and managing conflicts over resources

	measures to allow for the full reflection of environmental, social and economic costs and benefits to be reflected in economic markets, in national indices of economic status, the system of national accounts, trade and investment policies; - Build human and technical capacity of relevant institutions to conserve biodiversity, and manage its use	
4. Regional and international cooperation	Align biodiversity policy with international and regional Conventions and Agreements	- Develop coordination mechanisms for consistent implementation of regional and international environmental agreements - Establish and invigorate transboundary biodiversity conservation initiatives and regional coordination of Multilateral Environmental Agreements (MEA) implementation - Mainstream biodiversity into regional and sub-regional trade regimes

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APPENDIX 1

Figure 1. Recommended scope of *The State of the World's Biodiversity for Food and Agriculture*.

	Ecosystem services	
	Mainly provisioning	**Mainly supporting and regulating**
Biological resources	Food and non-food products provided by cultivated and wild species and genetic resources of plants, animals (vertebrate and invertebrate), aquatic resources and micro-organisms. Examples include trees (timber, fuelwood), crops (food, feed, fodder and dye), livestock (meat, eggs, hides, fur skins and fibre), fish, wild plants (food, medicine), wild relatives, edible fungi, edible insects, bush meat, crustaceans and mollusks (pearls).	Associated biodiversity: species and genetic resources directly involved in supporting and regulating production systems. Examples include soil and planktonic microbes, pollinators, symbionts and kelp forests.
Relevant CGRFA assessments	Plant genetic resources: First and Second Reports on the *State of the World's Plant Genetic Resources for Food and Agriculture* Animal genetic resources: First and Second Reports on the *State of the World's Animal Genetic Resources for Food and Agriculture* Forest genetic resources: *The State of the World's Forest Genetic Resources* Aquatic genetic resources: *The State of the World's Aquatic Genetic Resources for Food and Agriculture* (expected 2017)	***The State of the World's Biodiversity for Food and Agriculture* (expected 2017)**

Note: The scope of ***The State of the World's Biodiversity for Food and Agriculture*** includes interactions between plant, animal, forest and/or aquatic genetic resources, ecosystem services (mainly supporting and regulating), associated biodiversity and wild foods.