Annex I. Pilot testing of the GHG Protocol Agricultural Guidance

A sector-specific GHG accounting and reporting protocol for Ethiopia

## I.1 The National MRV Project and Rationale of the Pilot Study

The National MRV System Project aims to design a system that can measure greenhouse gas (GHG) emissions reduction and enhanced sequestration and track performance towards low-carbon development goals. It is jointly implemented by Ministry of Environment and Forest (MEF) and World Resource Institute (WRI).

The National MRV System Project touches upon a range of sectors, although Agriculture remains the main focus. In the agriculture sector, a Technical Working Group (TWG) was formed that actively worked with the project team since the beginning of the project. Members of the TWG were drawn mainly from the Ministry of Agriculture (MoA) and Ethiopian Agricultural Research Institute (EIAR). The agriculture sector project set out two major activities:

1) Customize an International Agricultural Guidance/Protocol, prepared by WRI, to Ethiopia’s context; and

2) Pilot test the customized protocol in small and large scale farms (both for crop and livestock)

Accordingly, the project team recruited a number of both crop and livestock farmers in the country (working at small and large scale) to pilot the guidance using IPCC’s methodology and calculation tools (IPCC, 2006). Six types of farms piloted the guidance; namely, **Commercial Crop**, **Commercial/Outgrower Crop**, **Smallholder Crop**, **Commercial Dairy**, **Smallholder Dairy**, and **Commercial Fattening** farms.

This Annex profiles the various pilot farms and provides the calculated GHG results.

## I.2 Profiles of piloting farms

**1) Anno Agro Industry [Commercial, Crop]**

Anno Agro-industry is a commercial private farm that has been in the business of production and dissemination of improved crop seeds over the last 15 years. Its ownership is shared among five friends who pulled their knowledge and resource to establish the farm. This company focuses on generating income through the multiplication and dissemination of improved crop and livestock technologies to farmers. High emphasis is placed on the promotion of sustainable land use and training of farmers on the use and application of improved agricultural practices. The promotion of sustainable land use is achieved through soil and water conservation and maintenance via the use of crop field terraces with vetiver grasses, forest development, crop rotation and manure use. The company also targets creation of job opportunities for surplus rural and urban labor. Women and youth in the area have been exploiting this opportunity to enhance their economic status. Many students from nearby villages and towns have been benefited from jobs in this farm during school vacation. Farm households use this farm as model farm for improving their agric business as well as wage provider. The farm is physically located in Eastern Welega Zone of GobuSayo District at 260 km along the turmeric road connecting Nekemte town to Addis Ababa. The altitude of the land under this farm ranges between 1700-1900masland the mean temperature is around 26ºC while its annual mean rainfall is 1200mm. The climate is suitable for the production of cereals, pulses, oilseeds, fruits and vegetables. All species of livestock also do well under such agro-ecological zone. ***For this particular study, we considered Anno Agro Industry to be under the commercial crop production category.***

**2) AlemayehuMekonnen Farm [Commercial, Crop]**

Established in 2007, AlemayehuMekonnen farm is a mechanized private seed company in the SNNP Region debuting an exotic maize variety, SC-627, locally named as ABBA RAYA, which is now becoming one of the productive hybrid maize seed varieties in Ethiopia. The name of the farm is derived from the name of the person who owns and manages the company. Ato AlemayheuMekonnen’s farm can be referred as one of the very few modern ones in the country with in-house machineries and technologies such as combine harvester, threshing and packing technology, machines for minimum tillage technology, irrigation scheme sourced by a well dug down to 150 meters along with center pivot technology covering 40 ha of the farm, certified hybrid maize and wheat seed production farms and variety selection plots. ***For this particular study, we considered AlemayehuMekonnen Farm to be under the commercial crop production category.***

**3) Wonji/Shoa Sugar Factory [Commercial/Outgrower, Crop]**

The Wonji–Shoa Sugar Estate lies downstream of the Koka Dam in the Central Rift Valley of Ethiopia in the Awash River Basin, 110 km southeast of Addis Ababa and 10 km south of Nazareth by road. Before the establishment of the estate the Wonji Plain was a sparsely populated area due to flood hazard of Awash River and Malaria infestation. On this plain a Dutch holding company, HVA, was granted a concession of 5,000 ha of land for the establishment of a sugar estate and factory. On March 20, 1954, the Wonji Factory was inaugurated and started producing the first bags of Ethiopian sugar. Because of the increasing demand for sugar in Ethiopia the Wonji Estate expanded itself and included an additional 1,600 ha of land at Shoa, which is within a 7 km distance from Wonji, and the Shoa factory started production of sugar in 1962. The Wonji Irrigation Scheme is considered as the first commercial large-scale irrigation project in Ethiopia. The Wonji-Shoa Irrigation Scheme is found at an altitude of approximately 1,500 meters above sea level (m.a.s.l.). In the estate, generally, the slope of the farm is very gentle and regular. More than 50 percent of the farm is heavy clay soil and the rest is light soil. It has a semi-arid climate and receives an average annual rainfall of 831.2 mm, peak daily evapotranspiration of 4.5 mm, mean annual maximum and minimum temperatures of 27.60 degree centigrade and 15.20 degree centigrade, respectively. The total farm size of the sugarcane plantation is approximately 11,988.03 ha of which 5, 742.01 ha is fully irrigated and controlled by the state and the remaining, 6, 246.02 ha (1, 066 ha irrigated) in under outgrower scheme. ***The main focus of this particular study on Wonji/Shoa is on the outgrower farm operation.*** Regarding employment, the Wonji Plain, which was not inhabited five decades ago, now has more than 4,000 regular employees and their dependents. This number rises well over 7,500 during the milling season. The Wonji-Shoa and plantation community as a whole, i.e., employees, their families and residents within the concession area, is about 30,000. ***For this particular study, we considered Wonji-ShoaSugar Factory to be under the commercial outgrower crop production category.***

**4) AJ Cattle Fattening PLC [Commercial, Fattening]**

AJ Cattle Fattening is a private company established in the year 2010. The farm is located in Adama City, former seat of the Oromia Regional State, which is 100 kms away from the main capital city, Addis Ababa. Specifically, AJ is located in East Shoa Zone, Adama Wereda, Kebele 13. AJ is basically engaged in fattening and exporting the borena breeds which are locally imported from borena area, south east of Ethiopia. The breeds are brought in their early stage of life and fattened to reach around 350 kg, which is also the minimum kg standard for export. AJ has the capacity to fatten 400 bulls at a time. In short, AJ’s business operation cycle goes from local importing, to fattening and finally to exporting which happens four times in a year. The feeding mechanism is a mix of barley, corn, wheat, soy press cake, milk replacer, wheat bran, bread pellets, sugar beet pulp, soy protein concentrate. ***For this particular study, we considered AJ Cattle Fattening PLC to be under the commercial fattening farm category.***

**5) FaituTera Dairy Farm [Commercial, Dairy]**

FaituTera Dairy Farm is a commercial dairy farm established in 2004 by person named by FaituTera. The farm is located around Holeta town, 40 kms outside Addis Ababa, FinfineZuria Zone, WelmeraWereda, and 02 Kebele. The farm is situated at an altitude of 2400 meters above sea level. Currently it is owned and managed by WroSerkalemAbebe. The company has a total of 75 breeds of which 3 are bulls and the rest are cows of varying ages. The farm has the capacity of producing, on average, 400 liters of milk per day. As a feeding mechanism, the company buys locally manufactured concentrate known as TEMETATAGNE from Kality Food Factory. FaituTera Dairy Farm has a total of 12 employees. ***For this particular study, we considered FaituTera Dairy Farm to be under the commercial dairy farm category.***

**6) Holeta Agricultural Research Center (HARC) [Commercial, Dairy]**

Holeta Agricultural Research Center (HARC) was established in 1966 under the Institute of Agricultural Research (IAR) now the Ethiopian Institute of Agricultural Research (EIAR). The center is located in the West Showa Zone of Oromia Regional State, in Holeta town, 45 km west of Addis Ababa at an altitude of 2400 meters above sea level. The average annual rainfall of the area is 1040 mm and the average maximum and minimum daily temperatures are 21 degree centigrade and 6 °C, respectively. This directory includes both government and external fund projects under five Research Processes and coordination; namely, Crop Research, Livestock Research, Soil and Water Research, Forestry Research Processes and Agricultural Economics Research Extension and Farmer Linkage Coordination. Under Crop Research Process four case teams are coordinated; Cereals (Tef, Wheat, Barley and Maize), POF (Highland Oil and Faba Bean and Field Pea), Root Crops and Temperate Fruit (Potato, Temperate Fruit and Enset), Plant Biotechnology and Plant Protection (Plant Biotechnology and Plant Protection). Livestock Research process coordinates one case team, Ruminant Research. Under Soil and Water research process four case teams are coordinated: Problematic Soils Research (Acid soil and Vertisols Management), Integrated Soil Fertility and Crop Productivity Improvement Research, Integrated Watershed Management Research and Irrigation, Drainage and Water harvesting Research. Forestry research Process coordinates two case teams; Bamboo and Rehabilitation. Agricultural Economics, Research-Extension, and Farmers' Linkage coordination's projects include Crosscutting and Collaborative Socioeconomic and Research-Extension activities. ***For this particular assignment, we have only considered the data in relation to the dairy cows in the research centre, which is considered to belong to the commercial dairy farm category.***

**7) Smallholder Farmers in Holeta(Small scale Crop & Livestock practice)**

***For this particular study, we considered five smallholder farmers who practice mixed agriculture i.e. crop and livestock production.***

The project team decided to consider smallholder farming practice for the very reason that agriculture in Ethiopia is dominated by smallholder farms where over 90% of the country's grain is produced. The farming practice of these smallholder farmers is also quite different in many aspects from those working at large scale.

For our smallholder agriculture (both crop and livestock farming) pilot study, with the help of HARC, the project team approached five farmers residing around Holeta town (FinfineZuria Zone, WelmeraWereda and SidamoKebele). These smallholder farmers, five in number, are mixed agriculture practitioners which imply the practice of small scale crop and livestock farming. These households have five to eight family members where most of the family members devote their time by working on activities related with farming practices.

Each household under our study owns two hectares of land. The soil type is low activity soil (LAC). They grow improved varieties of wheat, potato and teff on their cropland. They apply, on average, 200 to 300 kgs of artificial fertilizers annually on their farmlands. Some of the farmers also apply manure on their cropland (to enhance soil fertility) in addition to artificial fertilizer use. We have also observed that, the smallholder farmers considered in our study do not practice crop irrigation.

These smallholder farmers also own a combination of crossbreed cows, local breed cows and local bulls; although their population size slightly varies from one household to another. The cattle production system is mainly for dairy production and also as a source of draft power for crop cultivation. Milk production from these crossbreed and local breed cows differ significantly. Moreover, the milk produced from these households are partly consumed at home and partly sold. We have also noted that, local cows, heifers and young bulls are kept for crop trashing. The feeding mechanism, for crossbreed dairy cattle, is zero grazing which includes a combination of crop residue, forage & hay, and supplement concentrate. For local breeds, crop residue plays the main role in addition to grazing. Supplement concentrate is sometimes given to local species ox. Their manure management systems include storing manure in pit, spreading manure on pastures, storing manure in open spaces, and producing dung cakes.

## I.3. Pilot testing results

**a) Cropland/Soil Pilot Test Results**

The information for cropland is presented in three sections: general info, biomass analysis and soil carbon analysis.

General Information

|  |  |
| --- | --- |
|  | **General Information** |
| **Farm No** | **Site** | **Farm/Farmer\_Name** | **Crop\_Type** | **Crop\_Name** | **AC in ha** | **Climate region** |
| 1 | Wonji-Shewa | Wonjishewa\_Farm | perennial crop  | Sugercane | 11,988.00 | tropical dry  |
| 2 | Alaba | AtoAlemayehu\_Farm | Annual crops  | Maize,wheat&Teff | 529 | tropical dry  |
| 3 | AnoAgriIndustry | AnoAgri\_Industry | Annual crops  | Teff | 527 | tropical dry  |
| 4 | Holeta | AtoBegnaEgdu | Annual crops  | Wheat | 0.5 | tropical dry  |
| 5 | Holeta | AtoBedadaReassa | Annual crops  | Teff | 1.25 | tropical dry  |
| 6 | Holeta | AtoDeroLundi | Annual crops  | Wheat | 0.5 | tropical dry  |
| 7 | Holeta | W/roBerkeDereje | Annual crops  | Potato | 0.5 | tropical dry  |
| 8 | Holeta | AtoKumaAnbese | Annual crops  | Potato | 0.75 | tropical dry  |

Biomass Analysis

The Biomass analysis is only for Wonji-Shewa farm as sugarcane is the only perennial crop in the pilot study.

|  |
| --- |
| **Biomass Analysis**  |
| **AH in ha** | **G in tonnes of C ha-1 yr-1** | **L in tonnes C ha-1 yr-1** | **∆CB tonnes of C yr-1** |
| 8,100.00 | 1.8 | 9 | **#######** |

Soil Carbon Analysis

|  |
| --- |
| **Soil Carbon Analysis** |
| **Farm No** | **FI default value** | **SOC in tones C-0** | **Land use (FLU)** | **FLU default value** | **Tillage (FMG)** | **FMG default value** | **Input (FI)** | **FI default value** | **SOC in tones C 0-t** | **Default Year** | **Net in tones C per year soil C**  |
| 1 | 0.95 | 432,766.80 | Perennial/Tree crop  | 1.o | Reduced | 1.09 | Low | 0.95 | 471,715.81 | 20.00 | **1,947.45** |
| 2 | 0.95 | 11,076.20 | Long term cultivated | 0.58 | Reduced | 1.09 | Medium  | 1 | 12,708.48 | 20.00 | **81.61** |
| 3 | 0.95 | 11034.33 | Long term cultivated | 0.58 | Reduced | 1 | Medium  | 1 | 12660.44 | 20.00 | **-81.3** |
| 4 | 0.95 | 10.47 | Long term cultivated | 0.58 | Reduced | 1 | Medium  | 1 | 12.01 | 20.00 | **-0.08** |
| 5 | 0.95 | 26.17 | Long term cultivated | 0.58 | Reduced | 1 | Medium  | 1 | 30.03 | 20.00 | **-0.19** |
| 6 | 0.95 | 10.47 | Long term cultivated | 0.58 | Reduced | 1 | Medium  | 1 | 12.01 | 20.00 | **-0.08** |
| 7 | 0.95 | 10.47 | Long term cultivated | 0.58 | Reduced | 1 | Medium  | 1 | 12.01 | 20.00 | **-0.08** |
| 8 | 0.95 | 15.7 | Long term cultivated | 0.58 | Reduced | 1 | Medium  | 1 | 18.02 | 20.00 | **-0.12** |

|  |  |
| --- | --- |
| AC= Area cultivated  |  |
| AH= Area harvested |  |
| G= Rate of C-accumulation  |  |
| L= Rate of C-losses  |  |
| ∆CB= Net change in carbon stocks (above-ground)  |

 **b) Livestock Pilot Test Results**

|  |
| --- |
| **Livestock Emission Result of Pilot Test Farms** |
| **Pilot Farm Type** | **Name of Farm Owner/Farmer** | **Unit** | **CH4** | **N2O** |
| Smallholder Dairy | FikaduYigezu | KG/Farm | 218.8888 | 1.725825 |
| Smallholder Dairy | Wondimu | KG/Farm | 259.1797 | 2.55846 |
| Smallholder Dairy | TesfuGebisa | KG/Farm | 291.6806 | 3.926944 |
| Smallholder Dairy | AskaleHunde | KG/Farm | 337.4237 | 3.241206 |
| Commercial Dairy | Holeta Agricultural Research Centre | KG/Farm | 20740.12 | 304.5068 |
| Commercial Dairy | SerkalemAbebe | KG/Farm | 1841.336 | 22.92819 |
| Commercial fattening | AbdulbasitJeylan | KG/Farm | 3424.698 | 148.3053 |

Emissions on a per farm basis

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CATEGORY** | **SUB-CATEGORY** | **CH4 EMISSION FROM ENTERIC FERMENTATION (Kg/animal/year)** | **CH4 MANURE (kg/animal/year)** | **TOTAL CH4 EMISSION (Kg/animal/year)** | **N20 EMISSION (kg/animal/year)** |
| Local Animal |
|  | Local cows | 22.49 | 1 | 23.49 | 0.25 |
|  | Local heifers | 17.57 | 1 | 18.57 | 0.14 |
|  | Local breeding bull | 21.53 | 1 | 22.53 | 0.21 |
|  | Oxen | 27.99 | 1 | 28.99 | 0.32 |
| Crossbred Animal |
|  | Crossbred cow | 34.01 | 1 | 35.01 | 0.49 |
|  | Crossbred heifers | 21.24 | 1 | 22.24 | 0.32 |
|  | Crossbred bull | 28.59 | 1 | 29.59 | 0.46 |
|  | Crossbred female calves | 20.01 | 1 | 21.01 | 0.17 |
|  | Crossbred male calves | 11.34 | 1 | 12.34 | 0.08 |
| Feedlot |
|  | Growing cattle feedlot | 17.25 | 1 | 18.25 | 0.2 |
|  | Mature steers feedlot | 24.59 | 1 | 25.59 | 0.39 |

Emissions on a per animal basis