Annex II (Sub-Report)

Supplementary Information in the field of Carbon Stock

For 2018 UNCCD Reporting, China

1. A brief introduction of special carbon program

In 2011, the Chinese Academy of Sciences (CAS) initiated the program on carbon revenue and expenditure certification and relevant problems in response to climate change, a CAS Strategic Priority Research Program, also one of the A programs launched by CAS. This special carbon program analyses the key technological problems related to carbon revenue and expenditure, conducts surveillance, research and scientific estimate of the overall carbon revenue and expenditure of the land eco-system through systematic research. The results of the program will be used in major international negotiations on climate change and green and low-carbon development strategies.

The special program set up three project groups to address eco-system carbon sequestration. The project groups made investigation into and observation of the carbon stock volume and carbon sequestration abilities of different eco-systems like forests, grassland, bushwood and farmland. The program also made research into the carbon revenue and expenditure characteristics of China's terrestrial ecosystem, the law of space-time distribution, and the carbon sequestration effect of national ecological engineering and related policies whose results provide the relevant scientific basis for national policy making and international negotiation.

1.1 unified, standard and systematic investigation, research and technical methods

In order to ensure the quality of the survey data and get accurate, scientific and systematic research results, the "ecosystem carbon sequestration" project group has compiled a complete set of investigation standards. During the 5 year implementation period of the project, more than 350 researchers from 35 research institutes affiliated to the Chinese Academy of Sciences, universities, ministries and commissions have made systematic investigation into the carbon reserves and distribution of China's terrestrial ecosystems in accordance with the unified experimental design and investigation methods. More than 17000 samples were looked into and about 600,000 samples of various plants and soil samples were collected. The relevant samples were kept for a long time by the "ecosystem carbon sequestration library" constructed by the plant unit of the organization. This is the largest field survey project in the world today. It not only provides a large amount of field data for the special carbon program "ecosystem carbon sequestration" project group, but also provides important background

information for the planning, protection and utilization of China's land and resources, and the construction of ecological civilization and the construction of beautiful China.

1.2 Cross-department joint investigation, multi-unit collaborative research and sharing of data resources

In order to dig fully into the scientific value of field survey data, a model of cross-department joint investigation and multi- unit collaborative research has been adopted from the launching of the project to realize the complete sharing of data among different departments and multiple units. Through the unified data collation, data quality control and mining, the system analyzes characteristics of carbon source and sink of the land eco-system in China, its driving factors and the corresponding ecosystem functions in China.

The results of the research clarify the carbon budget of terrestrial ecosystems in China:

（1）China's terrestrial ecosystem has been playing an important carbon sequestration role for the past few decades. During the 2001-2010 year period, the entire terrestrial ecosystem has sequestrated about 200 million tons of carbon (equivalent to 740 million tons of CO2) annually, equivalent to the offsetting of 14.1% of China's fossil fuel carbon emissions in the same period.

（2）It proved for the first time that China's major ecological projects and the implementation of straw returning to farmland policy has made important contributions to carbon absorption in China's terrestrial ecosystem, contributing 36.8% and 9.9% respectively to the total carbon sequestration of the country.

（3）It explained for the first time the stoichiometric mechanism of vegetation productivity formation by the validation of the quantitative relationship between ecosystem productivity and plant nutrients.

（4）For the first time, it proved from the national level that biodiversity in natural ecosystems not only improves biological productivity, but also increases soil carbon reserves and soil sink.

2. Soil carbon results

The “special carbon program”, on a nationwide scale, accurately assessed the stocks of soil organic carbon within 0-100 cm below the surface in forests, shrublands, grasslands, and croplands. Among them, forests refer to a region with arbor species that has a canopy density of 0.2 or above (including 0.2) and a continuous area of 0.067 hectares or above; shrublands refer to a region with shrub species that has a shrub height at less than 5 meters and a shrub coverage of over 30%; grasslands refer to a region dominated by herbs. The assessment results showed that the forest soil carbon stock was 19.98±2.41 billion tons (mean±standard deviation, the same below), the shrubland soil carbon stock was 5.9±0.5 billion tons, the grassland was 24.03±2.52 billion tons, and the cropland was 15.77±0.57 billion tons. Regarding the soil carbon density in different ecosystems, the forest was 106.1±11.2

tons/hectare, the shrubland was 79.5±6.8 tons/hectare, the grassland was 85.4±9.0 tons/hectare, and the cropland was 92.04±4.06 tons/hectare.

Table 2-9 Soil Carbon Stocks in Major Terrestrial Ecosystems in China

Type	Carbon stock (1 billion tons, Pg)	Carbon density (tons/hectare, Mg/Ha)
Forests	19.98±2.41	106.1±11.2
Shrublands	5.9±0.5	79.5±6.8
Grasslands	24.03±2.52	85.4±9.0
Croplands	15.77±0.57	92.04±4.06

3. Spatial distribution of soil carbon

Ecosystem carbon density (carbon stock per hectare) of forests, shrublands, and grasslands showed large spatial variations at the national scale. Both biomass and litter carbon densities decreased from the northeastern, southern, southeastern, and southwestern regions to the northern and northwestern regions and to the Qinghai-Tibet Plateau. However, the soil carbon density displayed complex variations: the maximum density occurred on the Greater Khingan Mountains and the Lesser Khingan Mountains in the northeast region, the Qilian Mountains and the Bayan Har Mountains in Qinghai, and the Tianshan Mountains and the Altai Mountains in northern Xinjiang, followed by the southern and southeastern regions. The lowest soil carbon densities were in the lower basins in Xinjiang, the Hexi Corridor in Gansu, and on part of the Loess Plateau.

4. Comparison with previous research estimates in China

The extensive field survey in the present study has provided a full picture of the ecosystem carbon stocks in the forests, shrublands, grasslands, and croplands of China. The estimates of carbon density of shrublands and grasslands were similar to most of the previous estimates. The estimate of China's forest biomass carbon density was higher than that in previous studies. This difference probably resulted from the changes in forest areas and age structures as well as inconsistency in methodology. Both forest area and biomass carbon density have significantly increased in recent decades. Studies have shown that forest area expansion and forest growth have nearly equally contributed to the forest carbon density. This suggests that the differences between these estimates and previous estimates are largely attributed to changes in forest area and forest growth. The previous soil carbon density estimates were 1.6-1.8 times higher than these measurements. This difference was largely because that most of the previous studies were based on data from the national soil survey and ignored gravel in soils and spatial discrepancies of soil depths.

The data come from a monograph written according to the official achievements report of the special carbon program, and the monograph is as follows: Xuli Tang, Xia Zhao, Yongfei Bai, et al. Carbon pools in China's terrestrial ecosystems: New estimates based on an intensive field survey, PNAS April 17, 2018. 115 (16) 4021-4026; https://doi.org/10.1073/pnas.1700291115.