Crop Monitoring as an
E-agricultural tool in
Developing Countries

OFFICIAL STATISTIC DATA COLLECTION

Databases for Huaibei Plain and Morocco

Reference: ***E-AGRI_Deliverable21.3_Regional Statistic Database***
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Version: 1.0
Date: 27/5/2012

DOCUMENT CONTROL

Signatures

Author(s) :

Reviewer(s) :

Approver(s) :

Issuing authority :

Change record

Release	Date	Pages	Description	Editor(s)/Reviewer(s)
1.0	15/06/2012			Qinghan Dong
2.0				

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EXECUTIVE SUMMARY

There are two study areas in the deliverable_2.13. One is Huaibei Plain in China, the other is Morocco. This deliverable described the geography, climate, agricultural situation, official statistics and spatial distribution of crop production in the above two areas.

Huaibei Plain is part of North China Plain, which is the second largest plain in China. It lies between Yellow River flooding area and Huaihe River. Huaibei Plain is a conventional agricultural region where has a long agronomic history and predominantly rotation cropping system of wheat and maize. As a major grain-producing region in China, Agricultural production in Huaibei Plain strongly contributes to the GDP and country food security. Crop growth monitoring in Huaibei Plain will help us to achieve the food security, increase farmer incomes and protect local farmer interest.

Cereal grain production and planted areas are available at the city (prefecture-level city, an administrative division of the PRC, ranking below a province and above a county or district in China's administrative structure) level (6 cities) for all the years, starting from 2000 to 2009. Cereal datasets were collected from the Anhui Statistical Yearbook. All these Data come from the Agricultural Statistical Reporting System stipulated by the Agricultural Office of Anhui Statistical Bureau. Data on agriculture are collected, tabulated and processed by the statistical bureau in cities and counties, with sample survey, survey on key units and typical units and other surveys.

Agricultural production in Morocco strongly contributes to the Gross Domestic Product, with high year-to-year fluctuations due to high rainfall variability. Cereals (soft wheat, durum wheat and barley) which constitute the basis for food security in Morocco are cultivated mostly under rainfed conditions. Cereal datasets were collected from the Direction of Strategy and Statistics (DSS), of the Ministry of Agriculture. Cereal grain production and planted areas are available at the province level (40 provinces) for all the years, starting from 1978-1979 to 2009-2010 seasons. These datasets are compiled from sub-province sample surveys and released in official documents as provincial averages. Crop statistics are collected by DSS based on the Area Frame Sampling (AFS) methodology, for the agricultural lands which have significant potential, since year 1980. This method is quite satisfactory for major crops. The Moroccan AFS count for 3,000 segments (SSU) and cover 19 million hectares. Cereals occupy in average more than 5.1 million hectares, from which 2.2 million for barley, 1.9 million for soft wheat and 1.0 million for durum wheat (Data from 1990 to 2010). Cereals are produced in all over the country and, mainly in rainfed areas except in El Jadida province which is irrigated. They are grown on a wide range of environments: oasis (area insignificant), low rainfall (arid and semi-arid, 40% area), high rainfall (sub-humid and humid, 40% area), irrigated (10% area) and mountainous areas (10% area) and on a variety of soils and production systems. Soft wheat production is concentrated in the Atlantic plains of Morocco, from semi-arid to provinces

to sub humid provinces. Provinces that contribute most to national soft wheat production are Beni Mellal (11.4%), Sidi Kacem (10.0%), Kénitra (8.9%), Khémisset (6.7%), El Kalaa Sraghna (6.0%) El Jadida (5.7%), Settat (5.5%), Taounate (5.3%), Meknès (4.9%) and Fès (4.4%). Durum wheat production is concentrated in south west plains of Morocco, in semi-arid areas. Provinces that contribute most to national durum wheat production are Settat (12.4%), El Jadida (10.9%), Taounate (9.3%), Taza (7.1%), El Kalaa Sraghna (6.1%), Safi (6.1%), Beni Mellal (5.1%) and Sidi Kacem (4.4%). Barley production is concentrated in arid and semi-arid areas, and in mountainous and marginal areas. Provinces that contribute most to national durum wheat production are Settat (8.4%), El Jadida (7.2%), Safi (6.8%), Nador (6.6%), El Kalaa Sraghna (6.1%), Essaouira (5.3%), Oujda (4.6%), Khouribga (4.5%), Taza (4.4%) and Marrakech (4.2%). Cereal growth is adapted to fit the bimodal rainfall distribution of Morocco. The first rainfall peak in autumn-winter fills the soil moisture reserves and allows establishment of the crop. Sowing actually takes place between September and December, depending on the precocity of first significant precipitations in autumn. Harvest starts around May in the South and continues until June for the Northern regions, as temperatures rise first in the South.

1. Introduction

1.1. Huaibei Plain

Huaibei Plain is part of North China Plain, and North China Plain is the second largest plain in China. Huaibei Plain lies between Yellow River flooding area and Huaihe River. It located in the north of Anhui Province, bordered by Shandong Province on the north, by Henan Province on the west, by Jiangsu Province on the east. Its total land area is about 35000 km^2 and includes 6 prefecture-level cities (an administrative division of the PRC, ranking below a province and above a county or district in China's administrative structure).

Figure 1: Location of Huaibei Plain

In general, all these cities have similar features, topography is very flat and the population is densely. The main soil parent material is river alluvium, while Cambosols and Vertisols

are the main soil type in the study area. Huaibei Plain is a major grain-producing region in China. The predominantly crops are wheat, maize and soybeans, all of these cities have the predominantly cropping rotate system of wheat and maize.

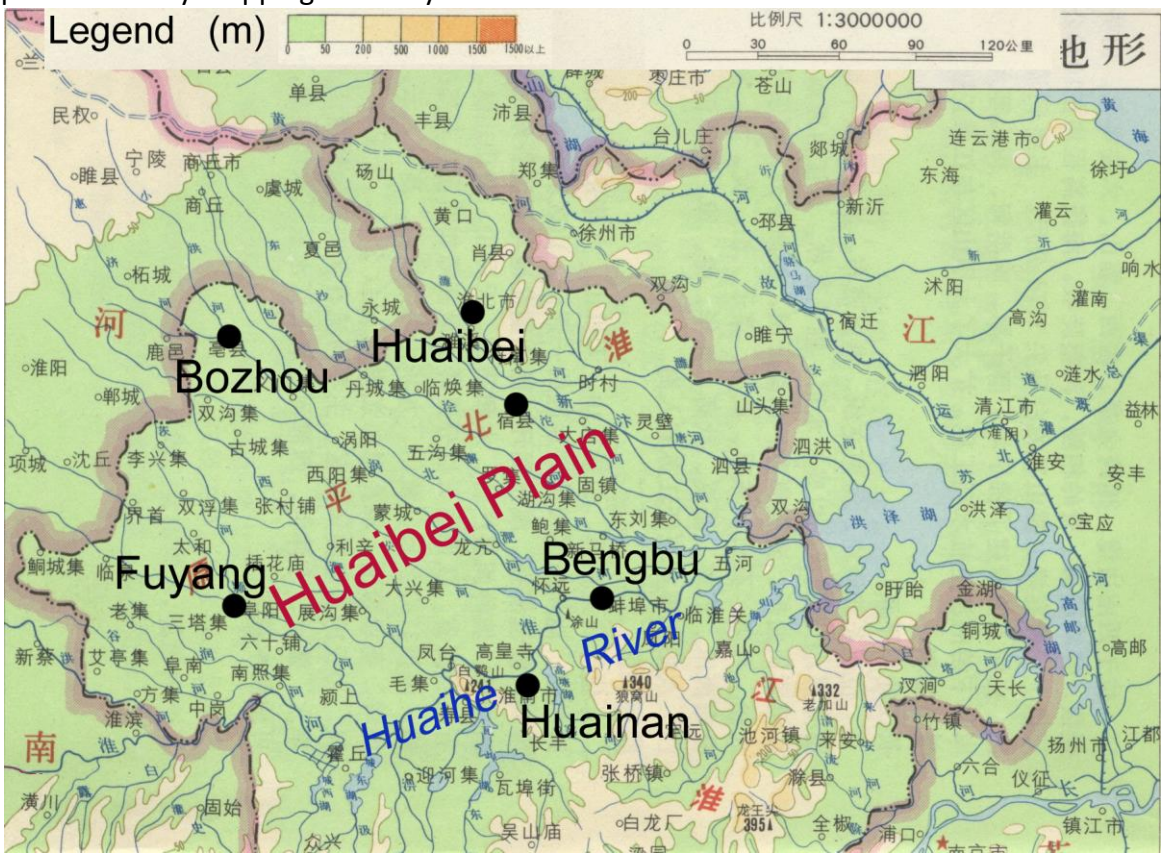

Figure 2: Topography of Huaibei Plain

Huaibei Plain is located on the south edge of warm temperate zone. Mean annual temperature is between 14°C to 15°C. The main disaster weather is flood and waterlog at summer and drought at spring. Otherwise, dry-and-hot wind, frost, hail are also important limited factors of weather.

1.2. Morocco

Morocco is located in the northwest corner of Africa, bordered by the Mediterranean Sea and the Atlantic Ocean on the north and west, by Algeria on the east, and by Mauritania on the south. Its total land area is 710,850 km^2 and includes several zones, among which are agricultural plains and river valleys, plateaus, and mountain chains (Anon., 2004) (Figure 3).

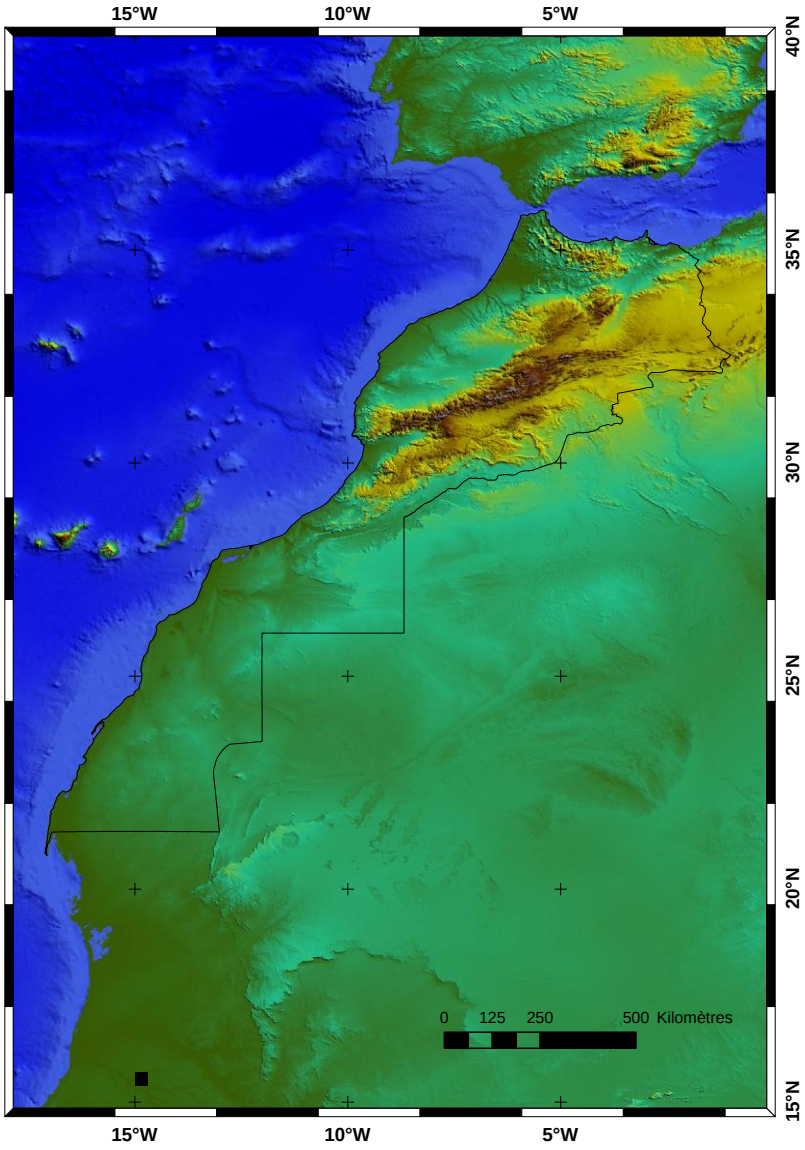

Figure 3: Topography of Morocco (Data source: The Shuttle Radar Topography Mission http://www2.jpl.nasa.gov/srtm/).

Most of lands are arid to semi-arid from which 75% are rangelands, 13% forests and 8% are cultivated (Figure 4).

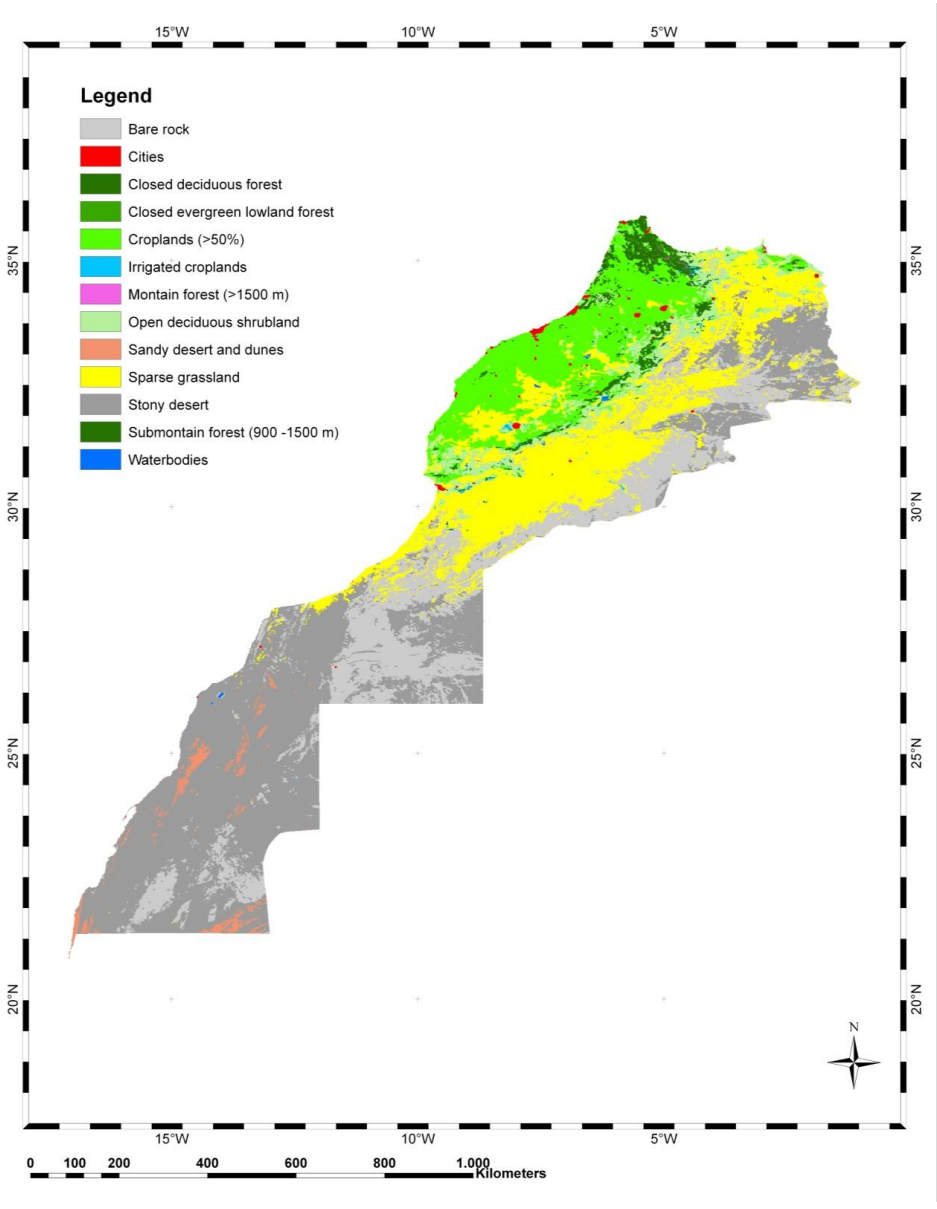

Figure 4: Land cover map of Morocco (Data source: Global Land Cover for Africa; version 5.0 http://bioval.jrc.ec.europa.eu/products/glc2000/products.php) (Balaghi, 2006).

2. Geography and Cereal calendar

2.1. Geography of six cities in Huaibei Plain

This chapter includes the location, population, topography, soil type, climate and agriculture features of six cities in Huaibei Plain.

2.1.1. Fuyang

2.1.1.1. Location and population

Fuyang (114°52′ E-116°37′ E，32°24′ N-34°5′ N) is a prefecture-level city in the northwestern of Anhui province. The total area of Fuyang is 9775 km2 with an arable land area of 5745 km2. It borders Zhoukou and Zhumadian of Henan Province to the west, Xinyang of Henan Province to the southwest, Bozhou to the northeast and Huainan to the southeast. The city faces Lu'an across the Huaihe River. With a population of 10.1 million, Fuyang is the most populous city in Anhui Province.

2.1.1.2. Topography and Soil type

The topography of Fuyang is very flat and with elevation ranging from 17.5 m to 42.5 m. The major rivers include Huaihe River and its tributary, such as Yinghe River, Quanhe River and Cihuaixinhe River. Cambosols and Vertisols are the main soil type in Fuyang City. The soil parent material of Cambosols is alluvium of these rivers and ancient Yellow River, the soil quality of Cambosols is higher than Verisols. The parent meterial of Vertisols is lake sediment. Verisols is one of problematic soils in Huaibei Plain because of the low soil fertility and poor soil structure.

2.1.1.3. Climate

Fuyang lies in the transition zone of subtropical zone and warm temperate zone, has a warm sub-humid monsoon climate with a mean annual temperature and precipitation of 15°C and 910 mm.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Avg. Temp °C	1.7	3.9	8.8	15.8	21.0	25.4	27.7	26.9	22.1	16.5	9.8	4.0	15.0
Avg. high °C	6.7	9.0	13.8	21.3	26.5	30.5	32.1	31.6	27.2	22.1	15.4	9.3	20.46
Avg. low °C	−1.9	0.0	4.5	10.9	16.1	20.8	24.1	23.3	18.2	12.2	5.5	0.1	11.15
Precipitation mm	26.6	32.6	56.8	56.6	81.5	161.9	189.2	95.9	87.3	63.8	40.0	17.8	910

Table 1: Climate data for Fuyang (1971–2000)

2.1.1.4. Agriculture

Fuyang is one of important major gain-producing areas in Anhui province, and it is also a production base for oil plants and cotton. Wheat production was about 3.16 million tons in 2010, approximately 25% of annual province wheat production. Maize production was about 1.17 million tons in 2010, approximately 38% of annual province maize production. Beans production was more than 0.36 million tons in 2010, approximately 30% of annual province production. Total agricultural output value was more than 20 billion Yuan in 2010.

2.1.2. Bozhou

2.1.2.1. Location and population

Bozhou (115°53′ E-116°49′ E, 32°51′ N-35°05N) is a prefecture-level city in the northwestern of Anhui province, which is located on the joint of Jiangsu Province, Shandong Province, Henan Province and Anhui Province and the hinterland of North China Plain. The total area of Bozhou is 8374 km2 with an arable land area of 4994 km2. It borders Huaibei to the northeast, Bengbu to the southeast, Huainan to the south, Fuyang to the southwest, and the province of Henan to the north. The population of Bozhou City is about 6 million.

2.1.2.2. Topography and Soil type

The topography of Bozhou is very flat, with elevation ranging from 22 m to 42.5 m, and gradient is only 1/9000. Only a few haystack hills are distributed at the east of Bozhou City. The major rivers include Guohe River, Xifeihe River, Beifeihe River, Cihuaixinhe River and Qianhe River; all of these rivers are the tributary of Huaihe River. Vertisols and Cambosols are the main soil type in Bozhou City.

2.1.2.3. Climate

Bozhou features a warm sub-humid monsoon climate with four distinct seasons. With an annual average temperature of 14.7 °C, monthly mean temperatures range from 0.6 °C (33.1 °F) in January to 27.3 °C in August.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Avg. Temp °C	0.6	3.1	8.2	15.3	20.7	25.5	27.3	26.4	21.6	15.7	8.7	2.7	14.7
Avg. high °C	5.9	8.6	13.9	21.4	26.8	31.2	32.0	31.1	27.2	21.8	14.7	8.3	20.2
Avg. low °C	−3.3	−1.2	3.5	9.8	15.1	20.3	23.4	22.6	17.2	10.9	4.1	−1.5	10.1
Precipitation mm	16.4	21.1	37.4	43.8	69.3	101.9	204.1	131.1	71.8	53.5	25.8	13.9	790.1
Sunshine hours	145.0	145.4	171.0	206.2	231.4	222.9	212.8	215.7	189.8	187.4	161.8	152.2	2,241.6

Table 2: Climate data for Bozhou (1971–2000)

Winters are damp and cold (yet the precipitation is low) while summers are hot and humid. Rainfall is heavily concentrated in the warmer months, as more than half of the annual total occurs from June to August.

2.1.2.4. Agriculture

Bozhou is one of important major gain-producing areas in Anhui province, Wheat production was about 2.94 million tons in 2010, and Maize production was about 1.11 million tons in 2010. Beans production was more than 0.37 million tons in 2010, Beans annual production of Bozhou is highest in Anhui province. Total agricultural output value was more than 16 billion Yuan in Bozhou, 2010.

Bozhou is one of important Chinese herbal medicine crop areas and has the name of "capital of Herbal Medicine". Nowadays the cultivated area of Chinese herbal medicine is more than 50 thousand hectare in Bozhou.

2.1.3. Huaibei

2.1.3.1. Location and population

Huaibei (116°23′ E-117°02′ E，33°16′ N-34°14′ N) is a prefecture-level city in the northern of Anhui province. The total area of Huaibei is 2725 km2 with an arable land area of 1359 km2. Huaibei is located at the junction of Jiangsu, Henan, and Anhui. It borders Suzhou to the east, Bengbu to the south, Bozhou to the west, and the province of Henan to the north. The population of Huaibei City is about 2.2 million. Huaibei has vast quantities of mineral reserves including marble, iron, copper, gold, silver, nickel, cobalt, fire clay and limestone. It also possesses 2.726 million tons of coal.

2.1.3.2. Topography and Soil type

The topography of Huaibei is flat with elevation ranging from 15 m to 40 m in most areas, and gradient is only 11/10000. The predominant landform is plain (95.3% of total area), low hill and monadnock are distributed along northern and northeastern border of Huaibei(4.7%). Elevation of these low hills is about 200 m, the highest hill in Huaibei City is Laolongji Hill, whitch has an altitude of 362 m. The major rivers in Huaibei City are Suihe River, Nantuohe River, Zhahe River, Longdaihe River, Daihe River, Longhe River, Hhuihe River and Beifeihe River; all of these rivers are the tributary of Huaihe River. Average width of these rivers is 50-60m.

Vertisols (54.8% of total area) and Cambosols(41.4%) are the predominant soil type in Huaibei City. In addition, Luvisols are also distributed in small patches.

2.1.3.3. Climate

Huaibei has a warm sub-humid monsoon climate with mild climate and four distinct seasons. Mean annual temperature and precipitation is 14.8°C and 830 mm, winters are

dry and cold while summers are hot and humid. Spring and autumn are shorter than winter and summer.

2.1.3.4. 3.4 Agriculture

Huaibei is the main agriculture base for producing and exporting grain, cotton, and domestic animals. The main crops are wheat, maize, cotton, broad bean, rice, and potato. livestock include cattle, horse, pig, goat, rabbit, and domestic birds, etc. More than 130 km² of land has been cultivated for fisheries that contain a large number of fish, shrimps, and crabs. Wheat production was about 0.83 million tons in 2010. Maize production was about 0.24 million tons in 2010. Beans production was more than 0.16 million tons in 2010 Total agricultural output value was more than 4 billion Yuan in 2010.

2.1.4. Suzhou

2.1.4.1. Location and population

Suzhou (116°09′ E-118°10′ E，33°18′ N-34°38′ N) is a prefecture-level city in northern Anhui province. It is the northernmost City in Anhui province. Suzhou is located at the junction of Jiangsu, Henan, Shandong and Anhui. It borders the prefectural cities of Huaibei and Bengbu to the southwest and south respectively, the province of Jiangsu to the east and north, and that of Henan to the northwest. The total area of Suzhou is 9787 km2 with an arable land area of 4811 km2. The population of Suzhou is about 6.42 million.

2.1.4.2. Topography and Soil type

The topography of Suzhou is flat with elevation ranging from 15 m to 55 m in most areas. The predominant landform is plain (91% of total area), low hill and monadnock (only 4.7% of total areas) are distributed in Xiaoxian County, Yongqiao District and Lingbi County. Elevation of these low hills is about 150-300 m. The major rivers in Huaibei City are Xinbianhe River, Tuohe River, Sanbahe River and Sumenghe River. Xinbianhe River and Tuohe River flow into Hongze Lake, which is the largest lake of the Huaihe River watershed. Vertisols and Cambosols are the predominant soil type in Suzhou City. Vertisols are distributed at the southern part of Suzhou City, while Cambosols are distributed at the northern part. In addition, Luvisols are also distributed at hill areas and Halosols are distributed along the ancient Yellow River.

2.1.4.3. Climate

Suzhou has a warm sub-humid monsoon climate with four distinct seasons. Mean annual temperature and precipitation is 14.4°C and 840 mm, winters are dry and cold while summers are hot and humid.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Avg. Temp °C	0.8	3	8	15	20.5	25.2	27.3	26.6	22	16.2	9.1	3	14.4
Avg. high °C	6.1	8.5	13.6	21	26.5	30.7	31.8	31.1	27.1	22	14.9	8.7	20.17
Avg. low °C	−3.2	−1.1	3.2	9.6	15	20.3	23.7	23.1	18	11.6	4.6	−1.2	10.3
Precipitation mm	19.3	27.2	45.7	51.7	64.3	115.4	218.22	115.7	81.8	56.4	29.2	14	838.9

Table 3: Climate data for Suzhou (1971–2000)

2.1.4.4. Agriculture

Suzhou is one of important major gain-producing areas in Anhui province, Wheat production was about 2.30 million tons in 2010, and Maize production was about 1.10 million tons in 2010. Beans production was more than 0.27 million tons in 2010. Total agricultural output value was more than 17 billion Yuan in Bozhou, 2010

2.1.5. Bengbu

2.1.5.1. Location and population

Bengbu (incl. its administrated counties), situated at north Anhui at 116.45°~ 118.04°E and 32.43°~33.30°N, borders Suixi County, Suzhou City, Lingbi county and Sixian County in the north, adjoins Huainan City and Fengyang County in the south, connects Mingguang City and Sihong County of Jiangsu Province in the east and neighbor on Mengcheng County and Fengtai County in the west. In Bengbu, Jinghu Railway goes through and Huaihe River flows throughout its southern territory from the west to the east, most of its area is in the southern end of Huaibei Plain. The total area of Bengbu is 5945 km2 with an arable land area of 2932 km2. The population of Bengbu is about 3.62 million.
Bengbu is located 135 kilometers (84 mi) north of Nanjing, on the Huai River. It is divided into two parts: greater Bengbu on the south bank of the river and little Bengbu on the north bank.

2.1.5.2. Topography and Soil type

The topography of Bengbu is flat. The predominant landform is plain. The major river in Bengbu City is Huaihe River.
Vertisols and Cambosols are the predominant soil type in Bengbu City. In addition, paddy soil is also distributed in the south area.

2.1.5.3. Climate

The area has a four-season humid subtropical climate with strong monsoon influences, cool, sometimes cold, winters, and hot and humid summers. The area lies in a climactic transition zone, as it is on the Qinling Mountain-Huai River boundary between the climactic regimes of northern and southern China.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Temp °C	1.8	3.8	8.7	15.7	21	25.2	27.9	27.2	22.6	16.9	10	4.2	15.7
Average high °C	6.5	8.5	13.7	21.1	26.4	30.1	32.1	31.6	27.3	22.1	15.4	9.3	20.3
Average low °C	−1.7	0.1	4.5	10.9	16.2	20.9	24.5	23.8	18.8	12.7	5.9	0.3	11.4
Precipitation mm	25.2	35.6	59	52.1	76.9	141.5	198.7	130.6	79.9	60.8	42.2	17.3	919.8
% humidity	71	70	70	68	69	72	79	80	76	72	71	68	72.2
Sunshine hours	146.8	142.5	162.1	177	202.5	214.8	208.7	232.4	175.8	190.6	161.6	152.7	2,167.50

Table 4: Climate data for Bengbu (1971–2000)

2.1.5.4. Agriculture

Wheat production was about 1.45 million tons in 2010; Maize production was about 0.32 million tons in 2010. Beans production was 0.083 million tons in 2010. Total agricultural output value was more than 11.7 billion Yuan in Bengbu, 2010

2.1.6. Huainan

2.1.6.1. Location and population

Huainan (116°21′ E-117°12′ E, 32°33′ N-33°1′) is a prefecture level city with 2.43 million inhabitants in central Anhui Province. The total area of Huainan is 2596 km2 with an arable land area of 1144 km2. It borders the provincial capital of Hefei to the south, Lu'an to the southwest, Fuyang to the west, Bozhou to the northwest, Bengbu to the northeast and Chuzhou to the east.
Huainan is a major production center for coal, with an output of 43.28 million tons in 2006.

2.1.6.2. Topography and Soil type

The major river in Huainan is Huaihe River, which separate Huainan into 2 parts. Panji District and Fengtai County lie to north of Huaihe River, while the other part lie to south of Huaihe River. The northern part belongs among the Huaibei Plain, and the topography of it is flat, the major soil type is Cambsols. The southern part belongs among the Jianghuai Hills Land; the soil type is Cambsols, Vertisols and Paddy Soils.

2.1.6.3. Climate

Huainan features a subtropical monsoon climate with four distinct seasons. Mean annual temperature and precipitation is 15.6°C and 960.1 mm . Winter is dry and cold while summer is hot and humid. Rainfall is heavily concentrated in the warmer months.

2.1.6.4. Agriculture

Wheat production was about 0.61 million tons in 2010. Beans production was more than 0.022 million tons in 2010. Planting area of Rice planting area is 93000 hectare and its production was 0.73 tons. Total agricultural output value was more than 7 billion Yuan in Huainan, 2010.

2.2. Climate and Agricultural situation in Morocco

2.2.1. Climate of Morocco

Morocco has a Mediterranean climate characterized by a dry and hot summer (4 to 6 months) and a short and cold winter in elevations. The North Atlantic Oscillation (NAO) is the main general circulation feature associated with the rainfall variability and the concurrent state of NAO is inversely related to precipitations. The relationship is in fact due to the major role played by the Azores high pressure. Four mountains chains (High Atlas, Anti-Atlas, Middle Atlas and Rif) represent 15% of total country area and 70% of water surface flow generated by precipitations. More than 50% of the precipitations are concentrated over only 15% of the country area. Rainfall distributions, between and within seasons, are highly erratic in Morocco, which creates situations of drought that can occur at any season and at any time during the season (Figure 5). Drought is by far the most important climate threat to agricultural production, as well as for other economic sectors.

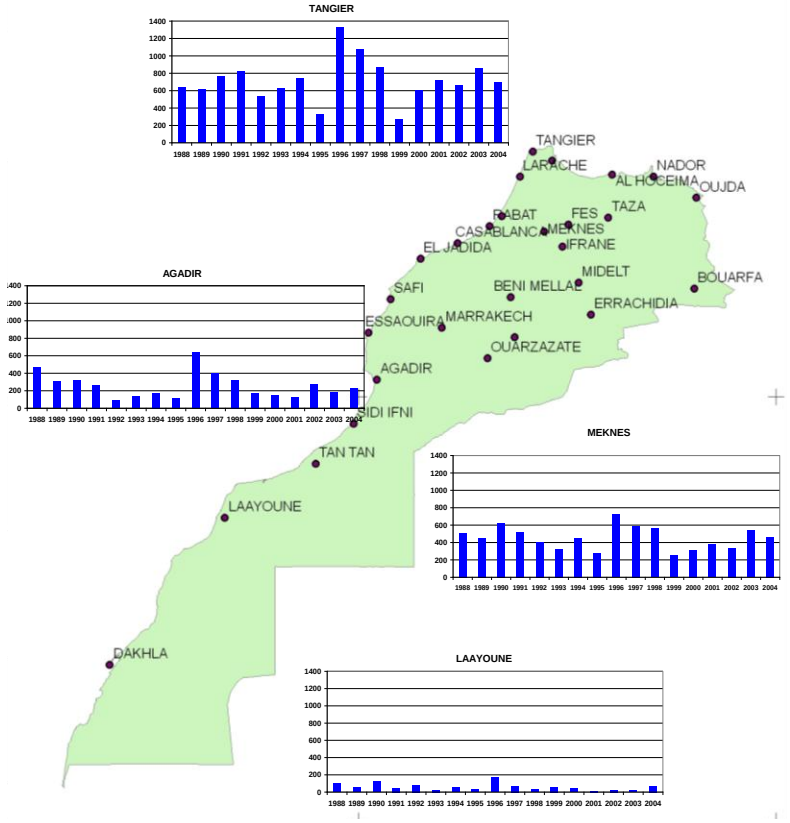

Figure 5: Spatial and temporal rainfall (mm) distribution in Morocco illustrated with some meteorological stations (Data source: National Meteorology Direction) (Balaghi, 2006).

2.2.2. Importance of cereals in agriculture

Agricultural production strongly contributes to the Gross Domestic Product[1] (16.1% of GDP averaged over the period 1982-2003), with high year-to-year fluctuations due to high rainfall variability (Figure 6). The majority of agricultural lands (85.4%) is rainfed, and consequently high vulnerability to drought. Irrigated lands (1.36 million hectares), which represent only 14.6% of the agricultural areas, contribute for 45% to the added value (up to 75% in dry years) and produce nearly 75% of agricultural exports (Bzioui, 2005). However, cereals (soft wheat, durum wheat and barley) which constitute the basis for food security in Morocco are cultivated mostly under rainfed conditions (in more than 92% of cereal lands).

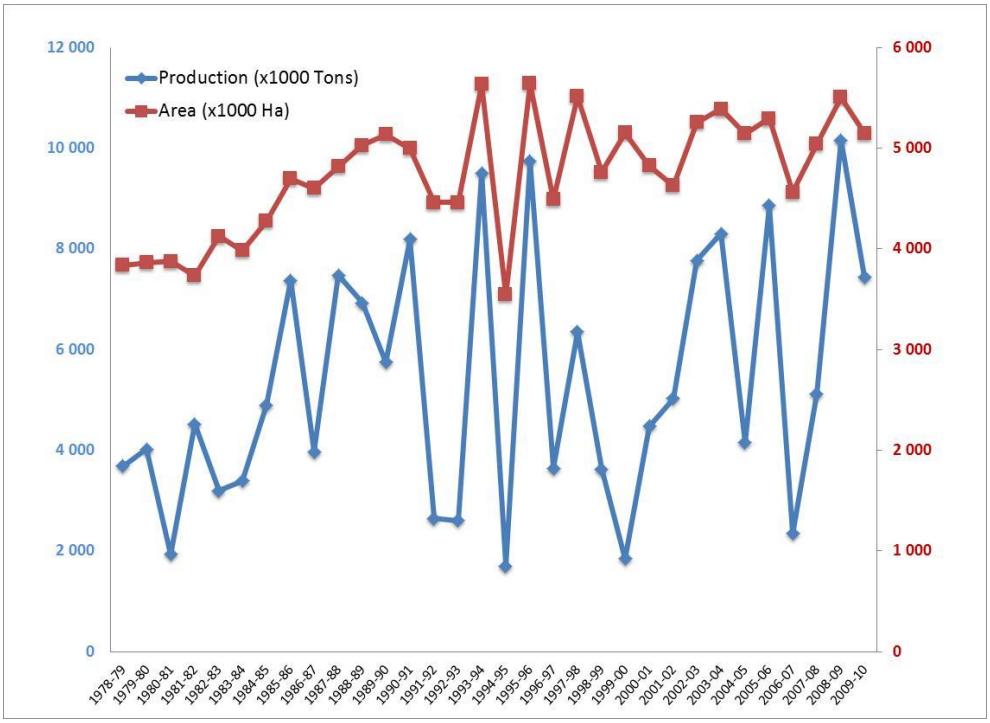

Figure 6: Inter-annual variation of cereals production and area in Morocco at national level (Data source: Direction of Strategy and Statistics of the Ministry of Agriculture).

Cereals are a strategic food in Morocco with a consumption of 210 kg per capita, one of the highest in the world (159 kg at world level) which is still not entirely covered by local production. The coverage ratio[2] of the cereal needs strongly fluctuates from year to year. It was 114, 21, 118 and 47% in 1994, 1995, 1996 and 1997, respectively. In fact, cereal yields are low and the production satisfied only 62 % of population needs during the 1994-98

[1] The total market value of all the goods and services produced within the borders of a nation during a specified period.
[2] Capacity of a country to satisfy its dietary needs from local production.

time period, whereas it was 85%, 25 years ago, between 1970 and 1974. In year 2002, cereals represented 38% of the cost of all agricultural imports (Anon., 2003). Wheat (*Triticum aestivum* L.) is the most consumed cereal and represents 30% of the costs of total agricultural imports. The three cereals (soft wheat, durum wheat and barley) occupy more than 5.1 million hectares, from which 2.2 million for barley, 1.9 million for soft wheat and 1.0 million for durum wheat (average data, from 1990 to 2010, data source: Direction of Strategy and Statistics).

2.2.3. Climate and Cereal calendar in Morocco

Figure 7 shows the normal growth cycle of cereals in Morocco, in relation with temperature and rainfall. Crop growth is adapted to fit the bimodal rainfall distribution. The first rainfall peak in autumn-winter fills the soil moisture reserves and allows establishment of the crop. Sowing actually takes place between September and December, depending on the precocity of first significant precipitations in autumn. Harvest starts around May in the South and continues until June for the Northern regions, as temperatures rise first in the South.

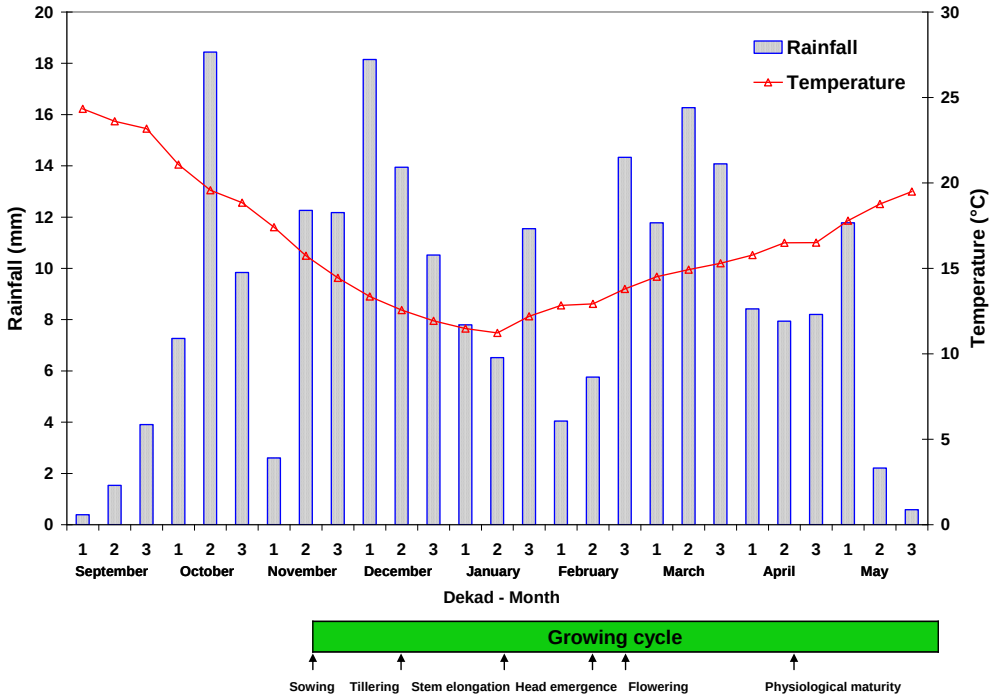

Figure 7: Typical weather conditions during the wheat growing cycle in Morocco (Median rainfall and average temperature from 1987 to 2004; data source: National Meteorology Direction of Morocco) (Balaghi, 2006).

3. Main crop production

3.1. Official crop production statistics in Huaibei Plain

Here are some tables for the main crop production, sown areas and yield of 6 cities in huaibei plain. All these datasets were collected from the AnHui Statistical Yearbook.

3.1.1. Wheat

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Huaibei	345424	477707	415215	372276	502799	536571	632387	684150	783538	787445
Bozhou	1358561	1604121	1401113	1320905	1894178	1996854	2206958	2300935	2753725	2833487
Suzhou	1202075	1504879	1311621	1173753	1708458	1681579	2052657	1976607	2201542	2213803
Bengbu	734485	654659	761668	480413	966236	1029740	1220542	1210739	1380953	1405438
Fuyang	1844165	2036692	1722216	1433391	2269859	2179748	2467789	2604616	2973388	3029159
Huainan	270249	208766	306722	182871	413590	429218	502545	523525	577538	596025

Table 5: Wheat Production of 6 cities in Huaibei Plain (2009-2000) (tons)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Huaibei	93496	90663	89152	86992	93502	100679	104501	116585	121762	123101
Bozhou	325926	311040	306705	299758	337366	361370	371779	391181	406372	415619
Suzhou	327498	302956	307610	305051	319031	339873	354259	359287	370587	376368
Bengbu	180391	155112	183904	179171	189343	203717	216495	221123	235180	239179
Fuyang	433262	417120	429623	423335	427996	447970	460039	474157	489446	496787
Huainan	79591	72309	76782	74837	83562	88450	91936	97954	101248	101448

Table 6: Sown Areas of Wheat of 6 cities in Huaibei Plain (2009-2000) (hectare)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Huaibei	3.69	5.27	4.66	4.28	5.38	5.33	6.05	5.87	6.43	6.40
Bozhou	4.17	5.16	4.57	4.41	5.61	5.53	5.94	5.88	6.78	6.82
Suzhou	3.70	4.97	4.26	3.85	5.36	4.95	5.79	5.50	5.94	5.88
Bengbu	4.07	4.22	4.14	2.68	5.10	5.05	5.64	5.48	5.87	5.88
Fuyang	4.26	4.88	4.01	3.39	5.30	4.87	5.36	5.49	6.08	6.10
Huainan	3.40	2.89	3.99	2.44	4.95	4.85	5.47	5.34	5.70	5.88

Table 7: Wheat Yield of 6 cities in Huaibei Plain (2009-2000) (tons/hectare)

3.1.2. Maize

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Huaibei	126194	157566	101822	101822	176655	150423	216748	178057	188855	**216239**
Bozhou	482405	493433	295435	295435	626141	526388	621149	701862	773004	**1071646**
Suzhou	805969	916176	478673	478673	960588	782889	1008141	828422	938400	**1056588**
Bengbu	158660	218015	157008	157008	286718	217161	286421	224129	283700	**312749**
Fuyang	476213	462912	301629	301629	853266	700970	949263	784903	1018491	**1127704**
Huainan	4870	20082	13730	13730	27049	22651	17209	18064	14837	**4838**

Table 8: Maize Production of 6 cities in Huaibei Plain (2009-2000) (tons)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Huaibei	25345	29244	33597	34072	29800	30838	35301	39923	40561	**39575**
Bozhou	93581	105317	113633	113211	106634	102610	101307	138153	135362	**176204**
Suzhou	141312	150381	155894	154787	159626	165055	170084	190411	191679	**200167**
Bengbu	29840	40137	50813	55015	49593	50194	51495	54630	56967	**61543**
Fuyang	95876	110565	131189	157565	146204	149775	156394	194730	187106	**205150**
Huainan	920	3759	4941	4565	4731	4525	3326	3749	2895	**2396**

Table 9: Sown Areas of Maize of 6 cities in Huaibei Plain (2009-2000) (hectare)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Huaibei	4.98	5.39	3.03	2.99	5.93	4.88	6.14	4.46	4.66	**5.46**
Bozhou	5.15	4.69	2.60	2.61	5.87	5.13	6.13	5.08	5.71	**6.08**
Suzhou	5.70	6.09	3.07	3.09	6.02	4.74	5.93	4.35	4.90	**5.28**
Bengbu	5.32	5.43	3.09	2.85	5.78	4.33	5.56	4.10	4.98	**5.08**
Fuyang	4.97	4.19	2.30	1.91	5.84	4.68	6.07	4.03	5.44	**5.50**
Huainan	5.29	5.34	2.78	3.01	5.72	5.01	5.17	4.82	5.13	**2.02**

Table 10: Maize Yield of 6 cities in Huaibei Plain (2009-2000) (tons/hectare)

3.2. Official crop production statistics in Morocco

3.2.1. Official cereal statistics in Morocco

Cereal datasets (soft wheat, durum wheat and barley) were collected from the Direction of Strategy and Statistics, the Ministry of Agriculture (DSS). Cereal grain production and planted areas are available at the province level (40 provinces) for all the years, starting from 1978-1979 to 2009-2010 seasons (Figure 8). These datasets are compiled from sub-province sample surveys and released in official documents as provincial averages. Provincial yields for the three cereals are not explicitly mentioned, but can be easily derived by dividing the productions with the cultivated areas. All these

statistics can be managed using a Geographic Information System, based on available vectorial (shape files) administrative boundaries (Figure 9).
Crop statistics are collected by DSS based on Area Frame Sampling (AFS) for the agricultural lands which have significant potential, since year 1980. This method is quite satisfactory for major crops. The Moroccan AFS count for 3,000 segments (SSU) and cover 19 million hectares (Figure 8).

Stratum Number	Name of Strata
10	Rainfed area
20	Irrigated Land
30	Plantations
40	Forest
50	Ranges (pastures)
60	Small Towns
70	Cities
80	Villages (Douars)
90	Uncultivated area
100	Water

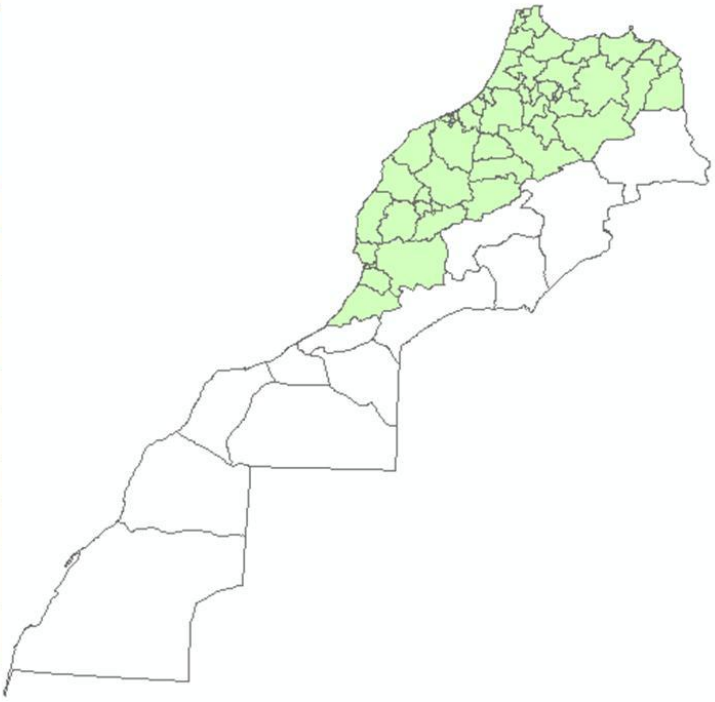

Figure 8:: Area covered by the area frame sampling by the Ministry of Agriculture in Morocco (Source: Direction of Strategy and Statistics of the Ministry of Agriculture).

Basically, AFS is a complete listing of the entire population of units to be sampled. In AFS methodology, the units to be sampled are areas of land. The procedure consists in dividing the total 'land area of the country into small areas of defined size using natural boundaries. These small geographic areas must be located, listed, and measured. This listing, along with its size measurements, gives the AFS. Aerial photography, topographic maps, other thematic maps, SPOT images are used as control data for breaking out these areas and for classifying them into groups with similar characteristics. A random sample of these small areas, referred to as the selected segments, is then visited by enumerators who interview the farmers and landowners found in the segment. Data obtained by these interviews is used to make statistical estimates about agricultural commodities.

3.2.2. Spatial distribution of cereal production

Cereals are produced in all over the country and, mainly in rainfed areas except in El Jadida province which is irrigated (Figure 9). Cereals occupy nearly two thirds of agricultural lands. They are grown on a wide range of environments: oasis (area insignificant), low rainfall (arid and semi-arid, 40% area), high rainfall (sub-humid and humid, 40% area), irrigated (10% area) and mountainous areas (10% area) and on a variety of soils and production systems. Cereals are part of almost all practiced rotations, in addition to cereals planted after cereals. Production is highly influenced by rainfall amount and distribution, varying from 1.7 million metric tons registered during 1995 cropping season to 9.7 registered the subsequent season.

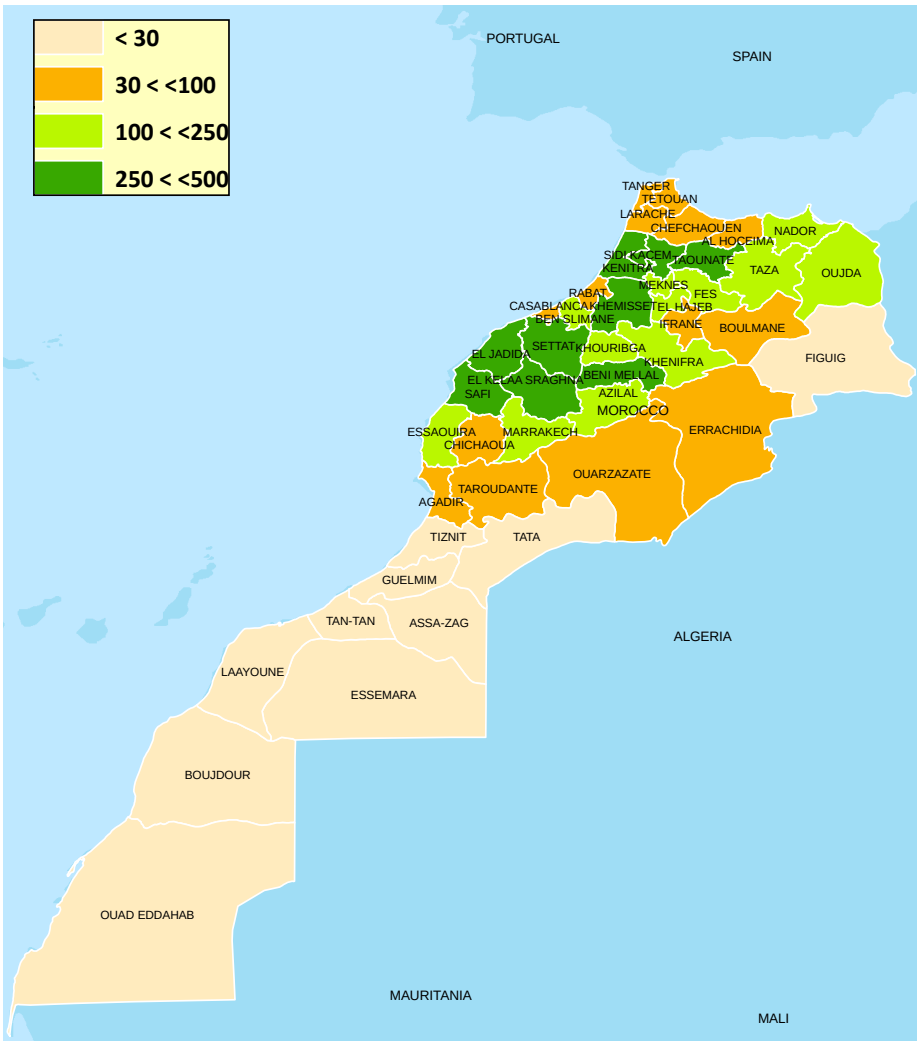

Figure 9: Provinces of Morocco with their average cereal production (x1000 tons) (1990-2010; Data source: Direction of Strategy and Statistics of the Ministry of Agriculture).

3.2.2.1. Soft wheat

Soft wheat production is concentrated in the Atlantic plains of Morocco, from semi-arid to provinces to sub humid provinces (Figure 10). Provinces that contribute most to national soft wheat production are Beni Mellal (11.4%), Sidi Kacem (10.0%), Kénitra (8.9%), Khémisset (6.7%), El Kalaa Sraghna (6.0%) El Jadida (5.7%), Settat (5.5%), Taounate (5.3%), Meknès (4.9%) and Fès (4.4%) (Data from 1990 to 2010). Each of the remaining provinces contributes less than 4% to national soft wheat production.

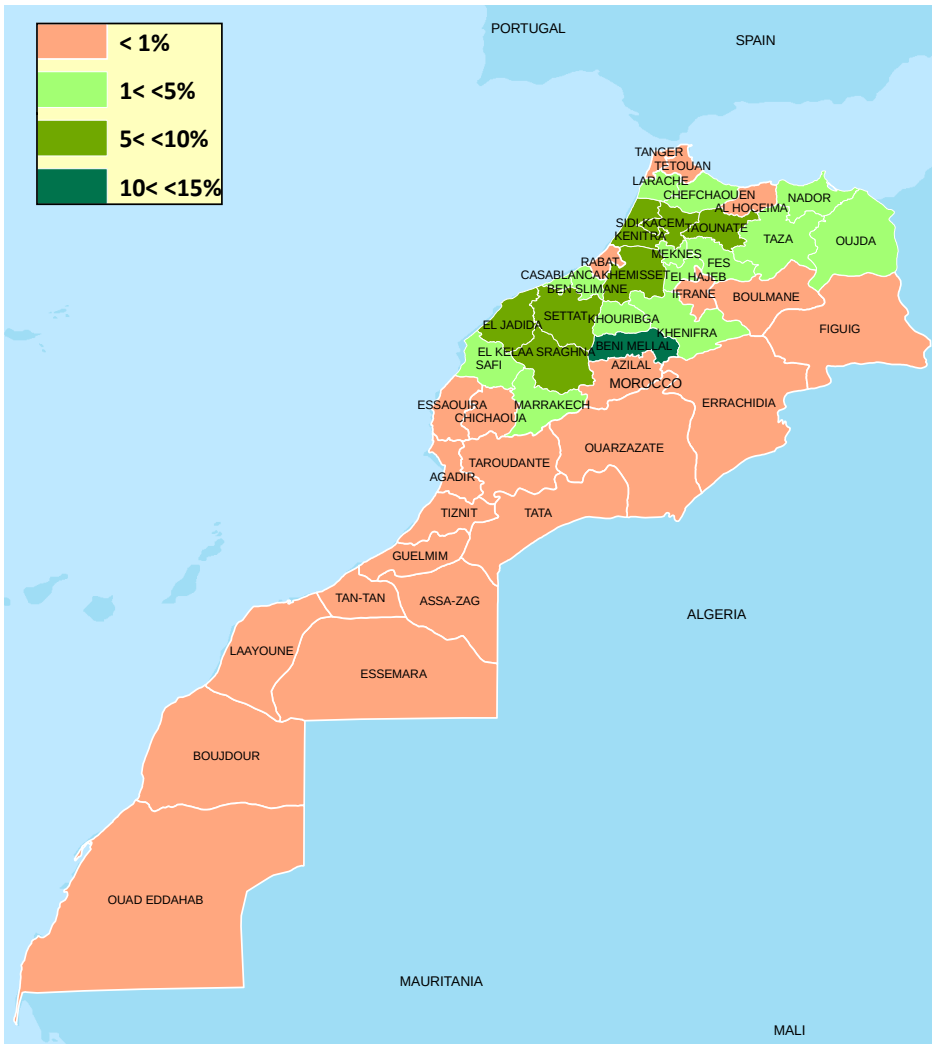

Figure 10: Provinces of Morocco with their average contribution (%) to national soft wheat production (1990-2010; Data source: Direction of Strategy and Statistics of the Ministry of Agriculture).

3.2.2.2. Durum wheat

Durum wheat production is concentrated in south west plains of Morocco, in semi-arid areas (Figure 11). Provinces that contribute most to national durum wheat production are Settat (12.4%), El Jadida (10.9%), Taounate (9.3%), Taza (7.1%), El Kalaa Sraghna (6.1%), Safi (6.1%), Beni Mellal (5.1%) and Sidi Kacem (4.4%) (Data from 1990 to 2010). Each of the remaining provinces contributes less than 4% to national durum wheat production.

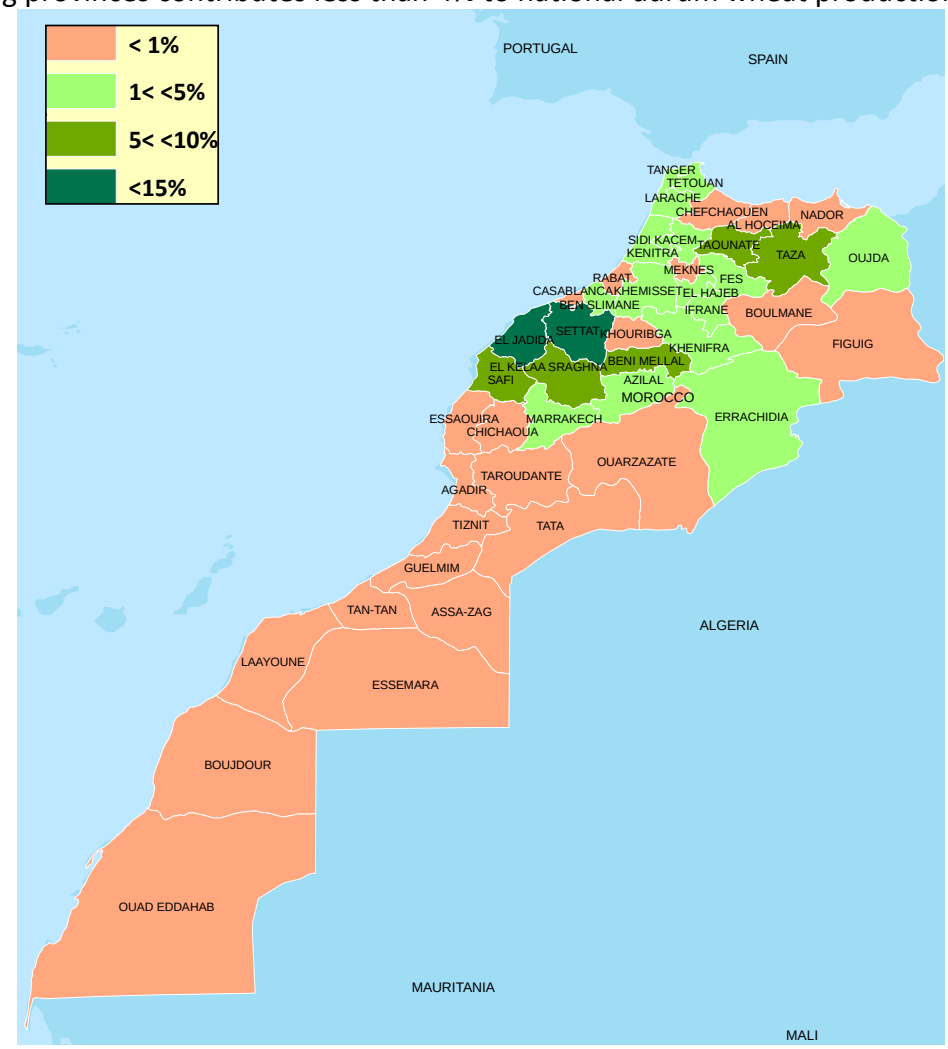

Figure 11: Provinces of Morocco with their average contribution (%) to national durum wheat production (Average 1990-2010; Data source: Direction of Strategy and Statistics of the Ministry of Agriculture).

3.2.2.3. Barley

Barley production is concentrated in arid and semi-arid areas, and in mountainous and marginal areas (Figure 12). Provinces that contribute most to national durum wheat production are Settat (8.4%), El Jadida (7.2%), Safi (6.8%), Nador (6.6%), El Kalaa Sraghna (6.1%), Essaouira (5.3%), Oujda (4.6%), Khouribga (4.5%), Taza (4.4%) and Marrakech (4.2%) (Data from 1990 to 2010). Each of the remaining provinces contributes less than 4% to national barley production.

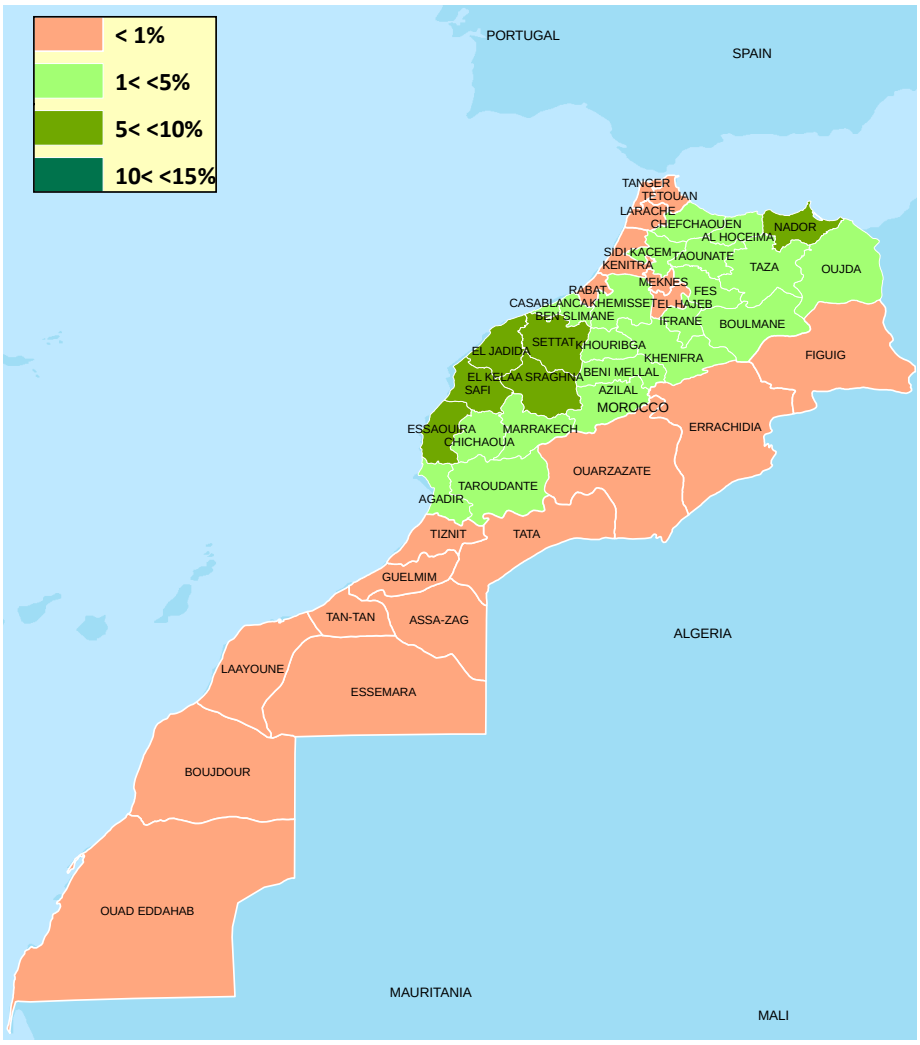

Figure 12: Provinces of Morocco with their average contribution (%) to national barley production (Average 1990-2010; Data source: Direction of Strategy and Statistics of the Ministry of Agriculture).

4. Conclusion

The official statistical data were collected in both study regions, Huaibei Plain in China and in Morocco.

The wheat and maize yield statistics related to the 6 prefectures on the Huaibei plain cover the period between 2000 and 2009, while the Moroccan partner collected the yield statistics for a much longer period (from 1978 till 2009) and for the cereals including soft wheat, durum wheat and barley.

As these historical data are used to calibrate the crop yield forecasting models dealt in the work-packages 22, 23 34, 43 and 44, the longer times series provided by Moroccan Ministry of Agriculture will enable the experts to make predictions with much higher confidence and accuracy.

On the other side, in order to raise the reliability of crop yield prediction using remote sensing indicators on Huaibei Plain, the study region in China will be extended to the whole province of Anhui. Accordingly, the collection of the official statistics will be extended as well and is proposed to be performed in WP 41.