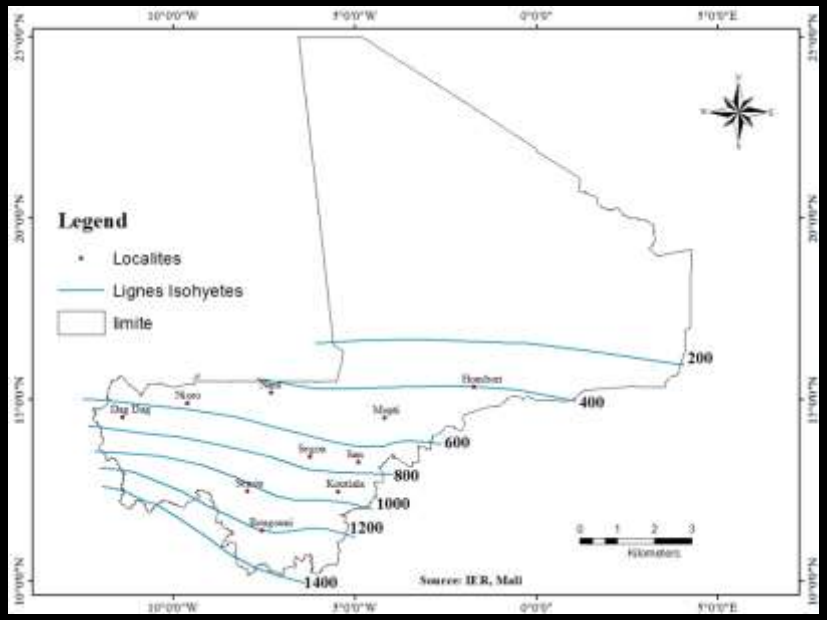
# Application of the GYGA approach to Mali

## I. Introduction




Mali is one of the largest countries in West Africa. It is located between the 10th and 25th degree north latitude. Its population was 14.5 million people with a population growth rate of 3.6% in 2009.

Mali is divided into four climatic zones along the north-south gradient:

-Sahara climate in the north occupies 2/3 of the territory, rainfall ranging from 50 to 250 mm per year.

- The Sahelian climate in the centre has an average annual rainfall ranging from 400-600 mm.

-The Soudanian climate, in the South has an average annual rainfall ranging from 700-900 mm.

- The Soudano-Guinean climate, of which the rainfall ranges from 1000 -1200 mm.

- There is a great diversity of grown crops.

## **Harvested area and actual yields in Mali (**major food crops )

| Crop | Yield (t ha-1) | Harvested Area (ha) | Total Production (t) |
|---|---|---|---|
| Millet | 0.772 | 1 489 904 | 1 146 139 |
| Sorghum | 0.938 | 908 460 | 859 963 |
| Rice | 2.521 | 457 045 | 1 195 200 |
| Maize | 1.769 | 373 432 | 690 742 |
| Fonio | 0.653 | 44 863 | 29 044 |
| Wheat/barley | 2.456 | 4 131 | 10 191 |
| Cotton | 0.971 | 414 315 | 408 686 |
| Cowpea | 0.347 | 271 362 | 94 560 |
| Groundnut | 0.867 | 250 946 | 220 458 |
| Bambara Groudnut | 0.645 | 30 579 | 20 037 |

The most major crop is millet followed by rice and sorghum. Other minor crops are groundnuts, Bambara groundnut and fonio which are very important for the economies of the small farmers especially women

# II. Method study of cereal yield Gap in Mali

- ***Soil data***

Soil data have been derived by ISRIC from the Africa Soil profile data base (http://www.isric.org/content/africa-soil-profiles-database-afsp). Within the AfSIS project (http://africasoils.net/services/data/soil-databases/) soil property maps were generated for Africa with available soil moisture fraction.

- ***Weather data and reference weather stations***

Historical daily weather data sets have been collected from the Direction Nationale de la Meteorologie du Mali. Weather sets are available for 15 locations in Mali and contain ten or more years of mainly historical weather data.

- Crop growth simulations and model calibration

The crop growth simulations for sorghum and millet in Mali have been carried out with the crop growth simulation model WOFOST version 7.1.3 (release March 2011) (Supit et al., 1994, 2012; Wolf et al., 2011). For maize the crop growth model Hybrid Maize version 2013.4.1 has been applied (Yang et al., 2006)……..etc.

# II. Method study of cereal yield Gap in Mali following

***Data Data for model calibration***

Model calibration based on experimental information reported in the literature, we have compiled data for main crop characteristics for maize, sorghum and millet growing in Mali.

| Crop/zones in Mali | Period from emergence to maturity (days) | Period fractions from emergence to flowering and from flowering to maturity (%) | LAI-max ($m^2$ $m^{-2}$) | Total biomass above-ground (kg dry matter per ha) | Yield (kg dry matter per ha) | Harvest index(yield / total biomass above ground) |
|---|---|---|---|---|---|---|
| Grain maize, all zones | 62 – 137 | 50% - 50% | 3 to 7 | 7500 to 16000 | 3750 to 8000 | 0.45 to 0.55 |
| Sorghum, all zones | 62 – 137 | 55% - 45% | 2 to 7 | 6750 to 14000 | 2700 to 5600 | 0.35 to 0.45 |
| Millet, all zones | 62 – 137 | 62% - 38% | 2 to 7 | 6750 to 14000 | 2000 to 4200 | 0.25 to 0.35 |

Crop characteristics for main crop types in Mali to test and calibrate the model parameters

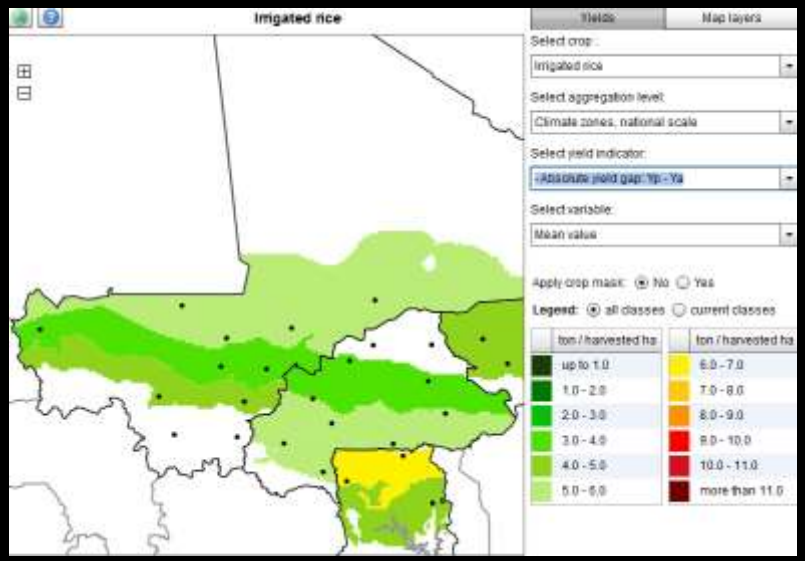
# *III. Results*

## *Climate zonation and mean national yield gaps*

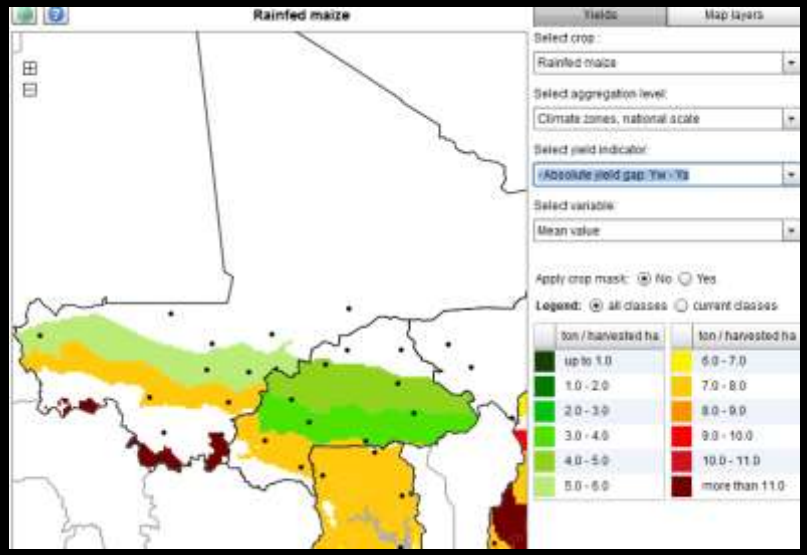
| Country | | Maize | Maize | Sorg-hum | Millet | Wheat | Wheat | Rice | Rice |
|---|---|---|---|---|---|---|---|---|---|
| | | Irrigated | Rainfed | Rainfed | Rainfed | Irriga-ted | Rainfed | Irriga-ted | Rainfed |
| **Mali** | **Yield Wat-lim or Pot. (ton/ha)** | **14.6** | **9.9** | **6.7** | **3.4** | **n.a.** | **n.a.** | **9.1** | **6.1** |
| **Idem** | **CV of Yield Wat-lim or Pot (%)** | **5.7** | **30.0** | **15.0** | **33.6** | **n.a.** | **n.a.** | **5.8** | **21.3** |
| Idem | Yield actual (ton/ha) | 1.9 | 1.9 | 0.9 | 0.8 | n.a. | n.a. | 4.1 | 2.9 |
| | **Yield gap (ton/ha)** | **12.8** | **8.0** | **5.8** | **2.6** | **n.a.** | **n.a.** | **5.0** | **Idem** |
| Idem | Actual cropping intensity | 1 | 1 | 1 | 1 | n.a. | n.a. | 1.2 | 1 |
| Idem | Harvested area ($10^3$ ha) | - | 504.3 | 1219.6 | 1462.6 | n.a. | n.a. | 431.9 | 254.6 |

[1] Mean values are area-weighted averages for the actually cultivated areas (SPAM data for year 2005) per crop type; actual yields refer to ten-year period around year 2006 and harvested areas are derived from FAOSTAT and apply to year 2010

# *III. Results*

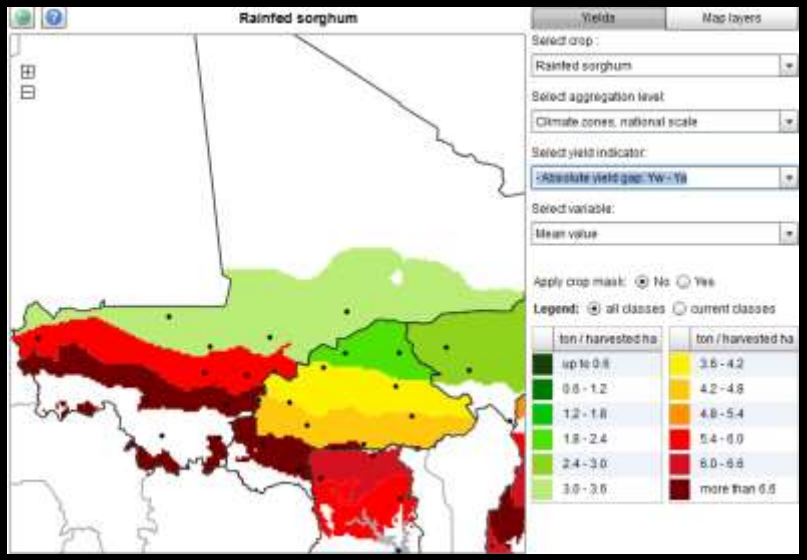



*Potential yields, actual yields, CV of potential yields and yield gaps for irrigated rice in Mali*

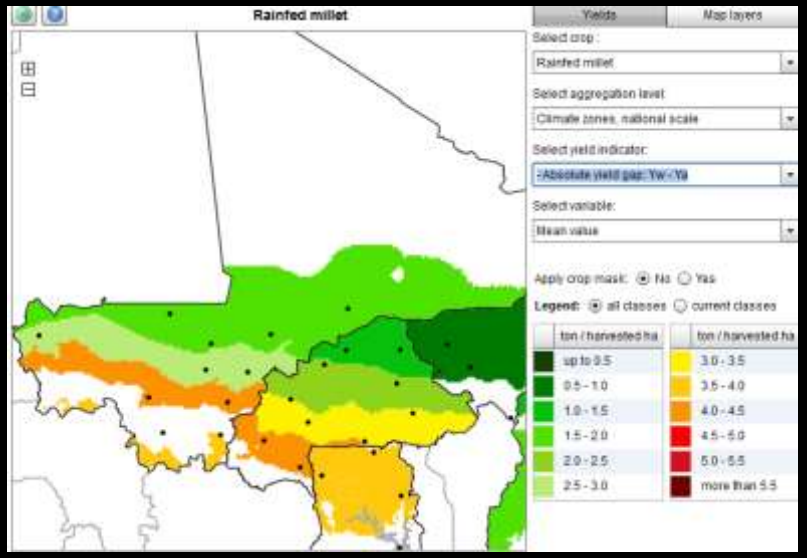



*Water limited yields, actual yields, CV of water limited yields and yield gaps for rainfed maize in Mali*

# III. Results




*Water limited yields, actual yields, CV of water limited yields and yield gaps for rainfed sorghum*




*Water limited yields, actual yields, CV of water limited yields and yield gaps for rainfed millet in Mali*

# Discussion

General summary of findings noting differences among crops in magnitude of Yg (as % of Yp or Yw) are relative yield gaps smaller for some crops than others and why that might be?

Yield gap distributions that correspond well (or not) with the best areas to increase food production per country according to the CAs
Which general changes in farming are required to close the yield gaps and which are the main constraints?

Data quality and uncertainty?

Bio-physical and management explanations of yield gaps
Possible uses and applications of the information from GYGA

# Conclusions

Yield gaps study of irrigated, upland rices and rain fed crops conducted in Mali indicates the existence of a large gap between the genetic potential and models simulated yields of current smallholder farms in Mali.
However, one can draw lessons from this information to better guide policy makers to well planning of agricultural policy in supporting smallholder farms while encouraging draught animal utilisation with the slogan "One Family -One Plow-One Chart" while developing at the same time road network that will promote trade flows between rural producers, merchants and urban consumers.

Realization of this challenge will promote the change in self sufficient production objective to marketing, only guarantor of food sovereignty and the fight against poverty and preserve the rural population into mass exodus to cities.


THANK YOU FOR YOUR ATTENTION