

# Application of the GYGA approach to Niger



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## Description of cropping systems, climate, and soils

**In Niger, agricultural and pastoral activities are carried out in four distinct major agro-ecological zones namely:**

- i. the **semi-desert area** covering the northern part of the country and receiving **0 to 50 mm of rainfall per year****
- ii. the **sub-Saharan pastoral zone** extending in the longitudinal East-West band in the center of the country and receiving **50 to 200 mm of rainfall per year****
- iii. the Sahelian agro-pastoral zone extending in the central to southern part of the country and receiving **200 to 500 mm of rainfall per year, and****
- iv. the **Sudano-Sahelian zone** covering the southern part of the country, receiving **600 to 800 mm** of rain per year, and being most suitable for agriculture.**

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# Description of cropping systems, climate, and soils

**Two-third of Niger is desert and the climate is hot and dry, agriculture is mainly rain-fed.**

- **Less than 10% of the cropped area is under irrigation**
- **The cultivated crops are mainly staple crops, with a clear predominance of **pearl millet (46%), sorghum (18%) and cowpea (32%),****
- **There are other crops that are often grown under rainfed and/or irrigated conditions: **cassava, sweet potato, rice, corn, wheat and fonio,****
- **Other crops such as **cotton, groundnuts, Bambara groundnut and nutsedge,** are also cultivated in some regions, such as Maradi, Zinder and Dosso.**

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# Description of cropping systems, climate, and soils

- In Niger, the **agricultural systems are mixed** and there is no region, where farms are exclusively specialized in one particular crop.
- In some areas, the farmer may plant different crops (millet, sorghum, maize or legumes) in the same field.
- In Niger one crop is usually cultivated per year (during the rainy season).
- But, around rivers, there are some possibility to irrigate a second crop during the dry season (**maize, rice, wheat, tubers and vegetable crops**).
- In Niger there is a strong variability in rainfall that explains the low crop yields at both local and national levels

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# Description of cropping systems, climate, and soils

**Averages (over 1999-2004 and 2010-2012) for productions, harvested areas and yields of the major food crops in Niger (source: Stratégie de Développement Accéléré et de Réduction de la Pauvreté (2008-2012); SRP, cabinet du Premier Ministre)**

Crop	Yield (t/ha)	Harvested Area (Million ha)	Total Production (Million metric tonnes)
Millet	0,4492	6,0206	2,7360
Sorghum	0,3047	2,5618	0,8097
Cowpea	0,1857	4,1001	0,8178
Maize	1,0049	0,0082	0,0078
Rice	2,5489	0,0158	0,0447
Peanut	0,4143	0,4640	0,3790

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# Data sources and their use

More information about the applied GYGA approaches can be found at: <http://www.yieldgap.org/web/guest/methods-overview>

Data are collected on 11 localities covered by synoptic stations : *Tillabery, Niamey, Dosso, Gaya, Birni N’Konni, Tahoua, Maradi, Tessaoua, Zinder, Mirriah et Diffa* ;

Data collection is conducted through an investigation that involved representatives of national agricultural services, statistics services, farmer organizations, INRAN, the ONAHA and other structures involved in the agricultural sector at local level;

Data were collected on **millet, sorghum, maize, rice and wheat**;





# Data sources and their use

**Harvested area and actual yields** : Region (i.e. departement)-level data on annual actual yields were retrieved from INS, Niamey, Niger: **between 2002 and 2012 to calculate average actual yields per buffer zone**

**Soil data** have been derived by ISRIC from the Africa Soil profile data base (<http://www.isric.org/content/africa-soil-profiles-database-afsp>);

**Historical daily weather data sets** have been collected from Agrhymet Regional Center: **9 locations; 10 or more years of data.**





# Crop growth simulations and model calibration

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- The crop growth simulations (**sorghum and millet**) have been carried out with the crop growth simulation model **WOFOST** version 7.1.3
- For **rice**, a subversion of the **model ORYZA2000** version 2.13 was specially developed and used in the **GYGA** project.







# Calculation of mean water limited yield level and yield gap per buffer zone

**Crop growth simulations for the different RWS-soil, type-crop, type-sowing date combinations have been done for both potential (i.e. irrigated) and water limited (i.e. rainfed) conditions, to indicate the degree that yield levels may increase by application of irrigation water.**

**The water limited yields ( $Y_w$ ) have been used to calculate the yield gap.**

**The mean  $Y_w$  values per crop type per RWS buffer zone were calculated from the  $Y_w$  values simulated for each cropping system per zone, weighted to their relative areas.**

**The yield gap per RWS buffer zone is calculated as the difference between the mean  $Y_w$  value per zone and the mean actual yield per zone.**





# Results

Mean country values for the potential, water limited and actual yields (air dry), and the yield gaps for the main grain crops and the actual cropping intensity and the harvested area per crop<sup>1</sup>

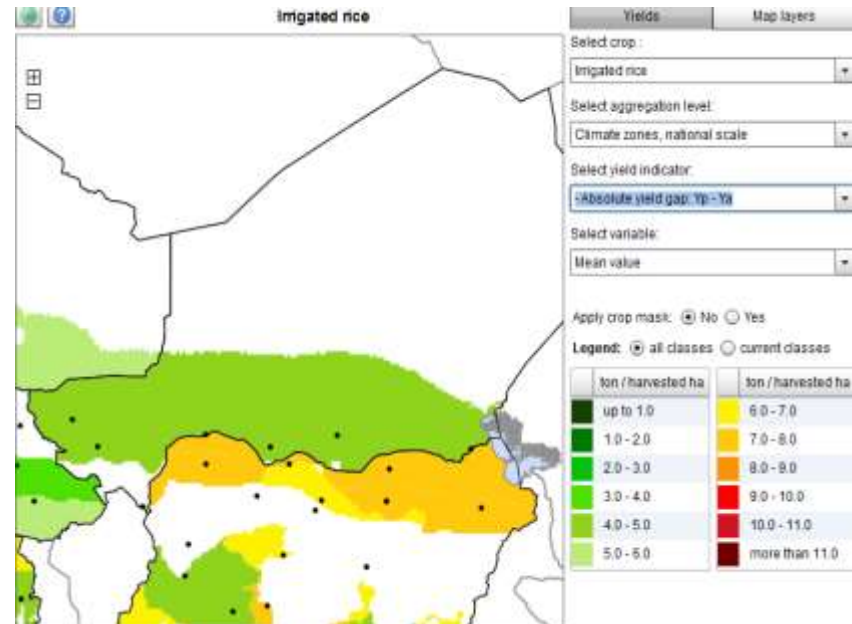
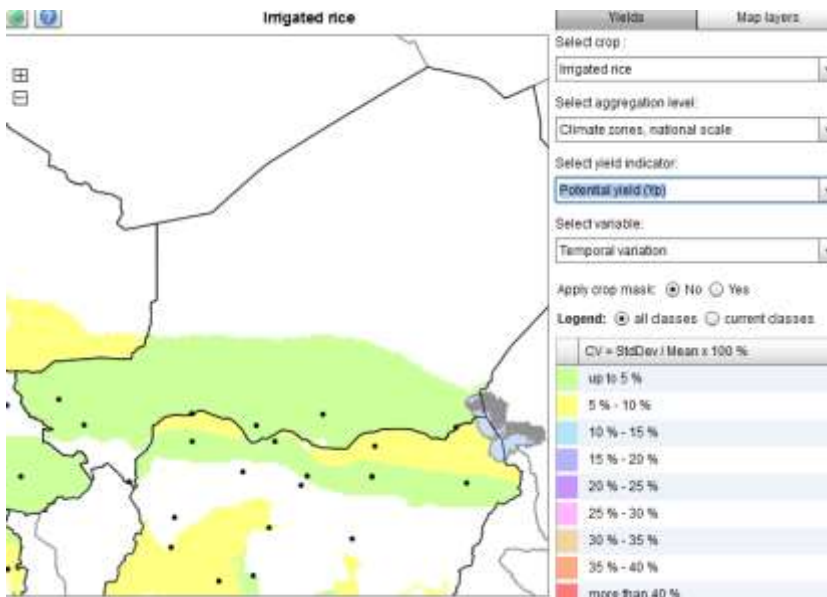
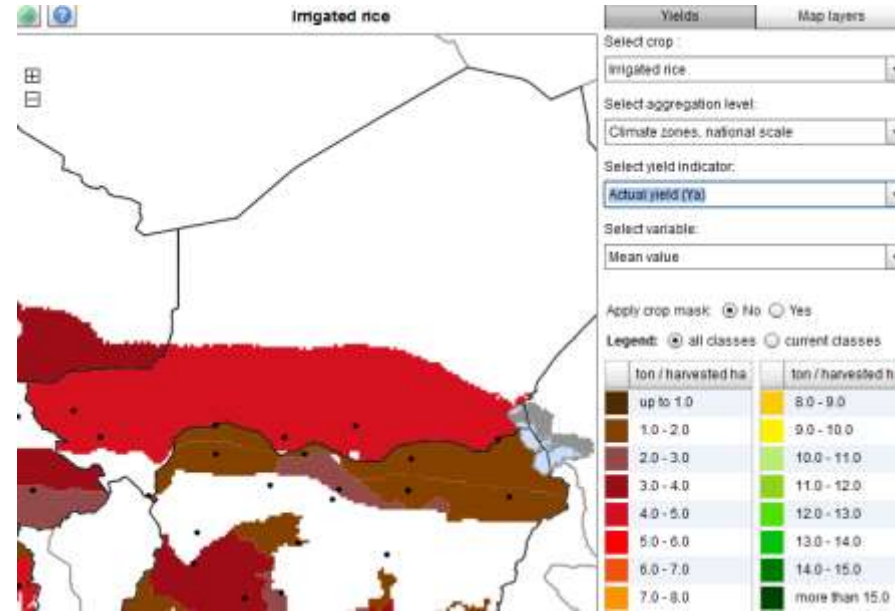
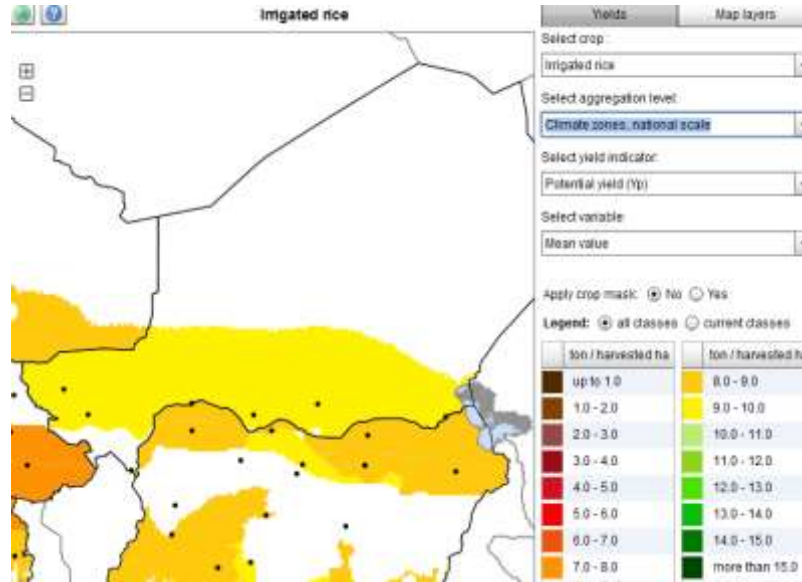
Country		Maize	Maize	Sorghum	Millet	Wheat	Wheat	Rice	Rice
		Irrigated	Rainfed	Rainfed	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
<b>Niger</b>	<b>Yield Wat-lim or Pot. (t/ha)</b>	n.a.	n.a.	3.3	1.1	n.a.	n.a.	9.2	n.a.
<b>Idem</b>	<b>CV of Yield Wat-lim or Pot (%)</b>	n.a.	n.a.	53.8	82.2	n.a.	n.a.	2.8	n.a.
<b>Idem</b>	<b>Yield actual (t/ha)</b>	n.a.	1.0049	0.3	0.6	n.a.	n.a.	4.4	4.6
<b>Idem</b>	<b>Yield gap (t/ha)</b>	n.a.	n.a.	3.0	0.6	n.a.	n.a.	4.8	n.a.
<b>Idem</b>	<b>Actual cropping intensity</b>	n.a.	n.a.	1	1	n.a.	n.a.	1.62	n.a.
<b>Idem</b>	<b>Harvested area (10<sup>3</sup> ha)</b>	n.a.	n.a.	3322.1	7253.2	n.a.	n.a.	20.1	n.a.

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# Results : Rice Yield Gap

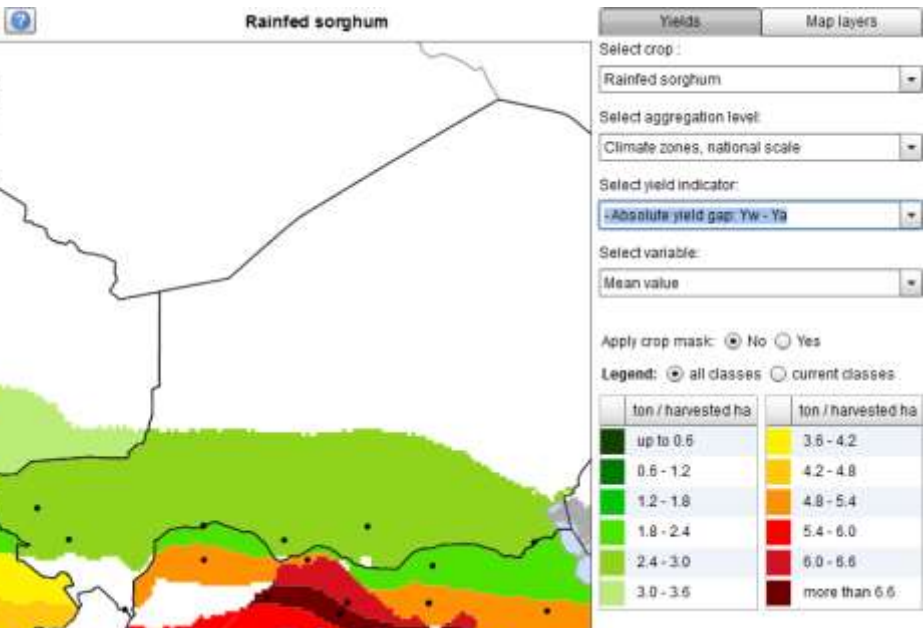
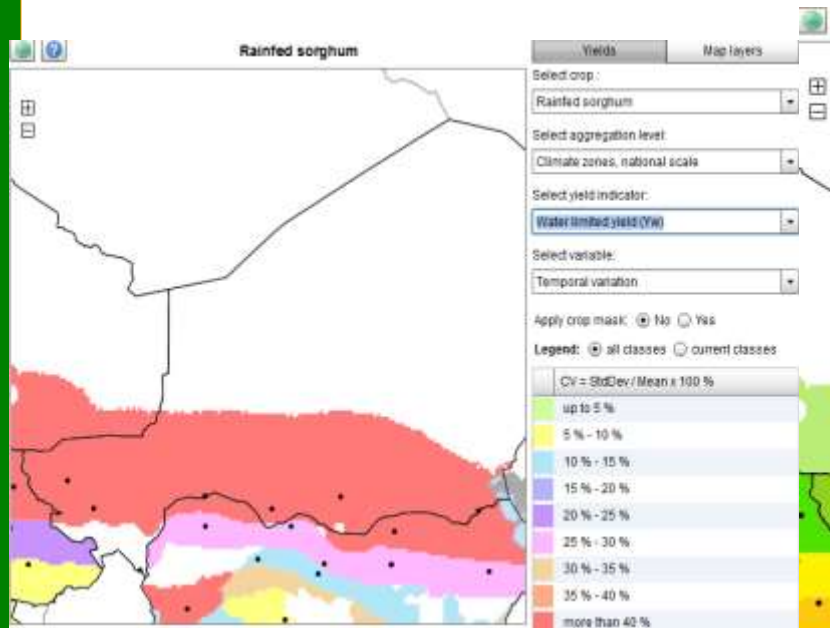
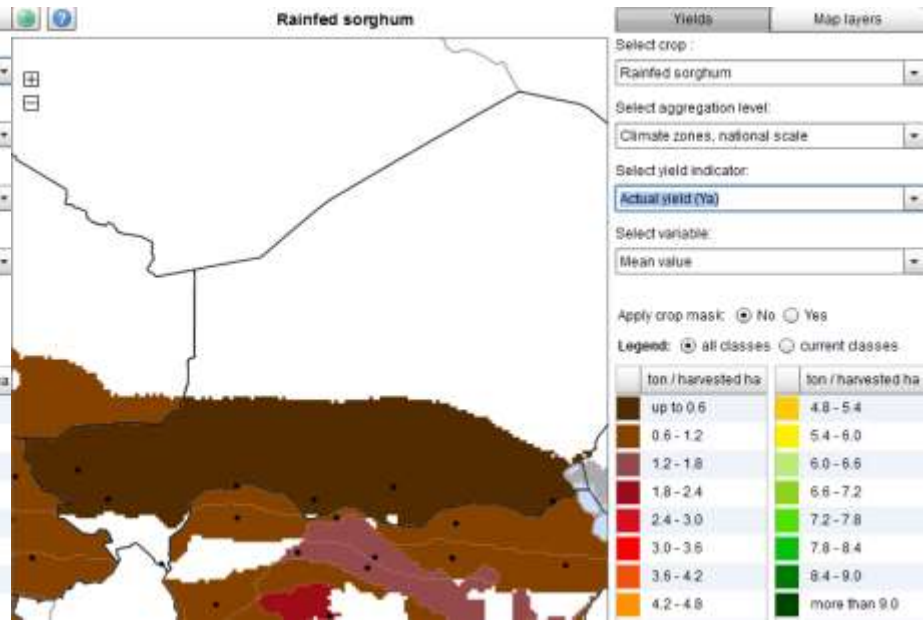
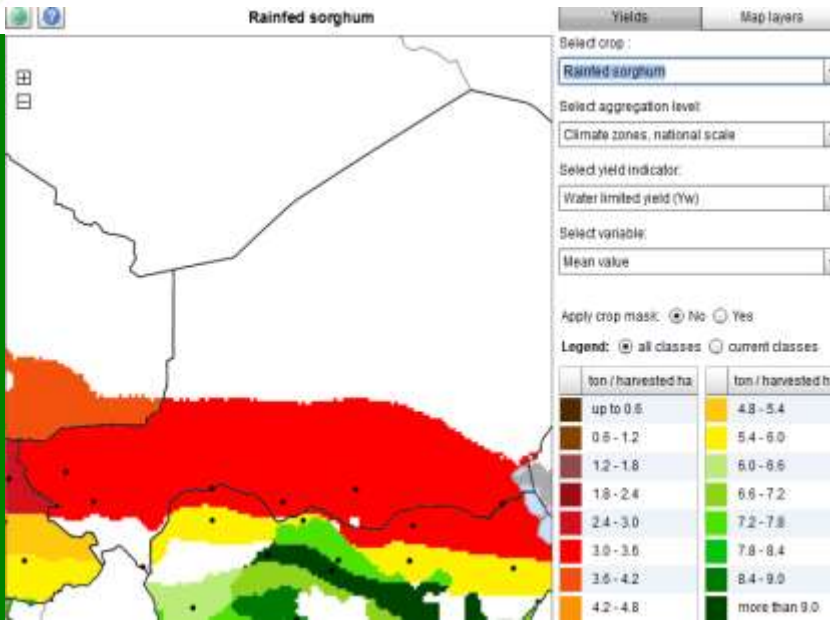
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# Results : Sorghum Yield Gap

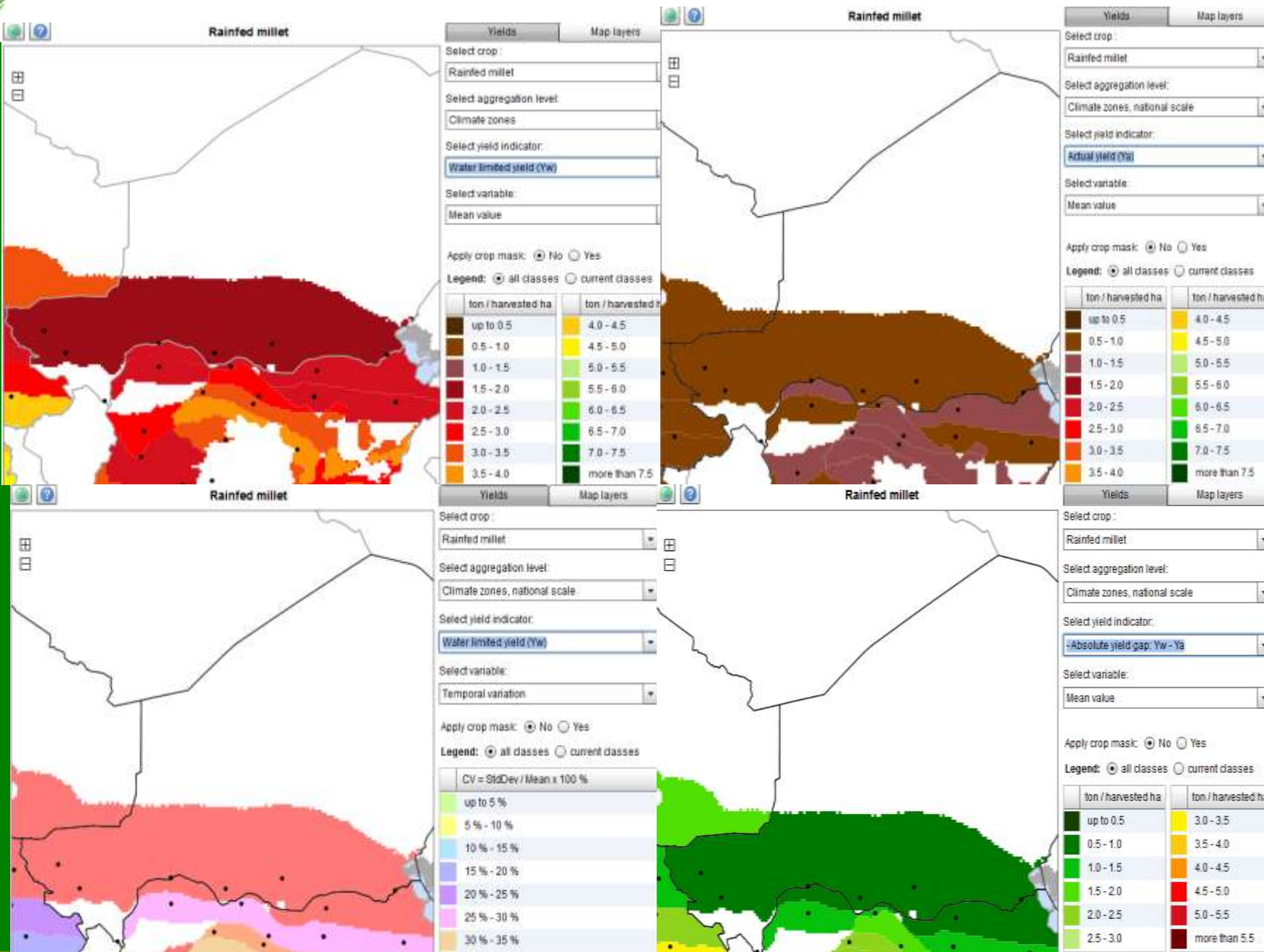
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# Results : Millet Yield Gap

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# Discussion

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- **Rice** : Improved varieties with high potential yield exist in Niger
- The only factors limiting rice yields boil down to **climate stress, producers poverty, lack of subsidies, lack of agricultural inputs access and lack of investment in large-scale irrigation.**
- **Sorghum and Millet** : the Yp varies depending to soil type and local climate conditions;
- There is a huge yield gap if compared with the actual yield obtained in farmers' fields in Niger;





# Discussion

- **This yield gap can be explained by factors that are all related to climate, soil and farmers socioeconomic conditions :**
  - **Strong dependence of crops growth to rainfall conditions (irrigated millet/sorghum is almost non-existent in Niger)**
  - **High soil poverty**
  - **Short rainy season which do not allow rainfed crops to complete thier growth cycle in good water conditions,**
  - **Low rainfall and often very poorly distributed in time and in space,**
  - **Farmers poverty (very low capacities of investment)**
  - **Very archaic agricultural technologies,**
  - **Insufficient or lack of farmers supervision**
  - **Small access to climate information and to agro-meteorological advices,**
  - **The weakness of government support in the rainfed cereals sector**
  - **Etc.**



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**Thanks**

**Questions?**

