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INTEGRATED DECISION SUPPORT SYSTEM FOR EVALUATING SMALL SCALE IRRIGATION TECHNOLOGIES IN DIMBASINA WATERSHED, GHANA

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Project Components

- Farm family surveys of factors affecting adoption of small-scale irrigation,
- Demand-driven research demonstrations of small-scale irrigation interventions,
- Use of Integrated Decision Support System (APEX, SWAT, FARMSIM) to simulate production, environmental, economic, and nutritional impacts of small-scale irrigation, and
- Capacity building (IDSS training, graduate student support, on-farm farmers training, etc)

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INTERVENTION SITES

Feed the Future Innovation Lab for Small Scale Irrigation Integrated Decision Support System (IDSS) sites in Africa.

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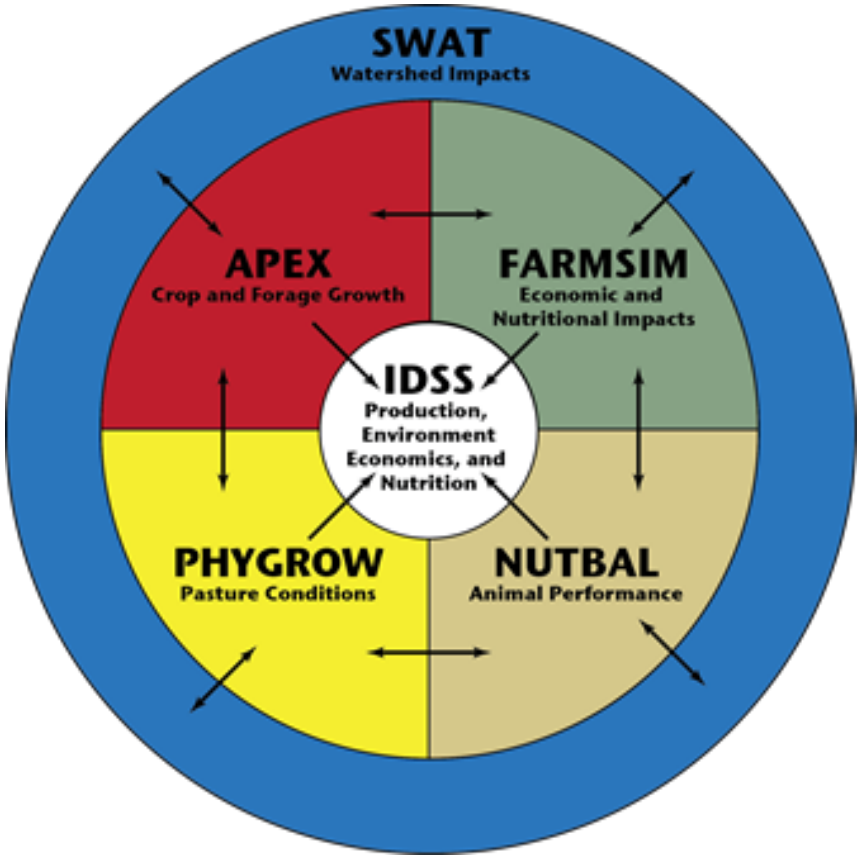
Integrated Decision Support System



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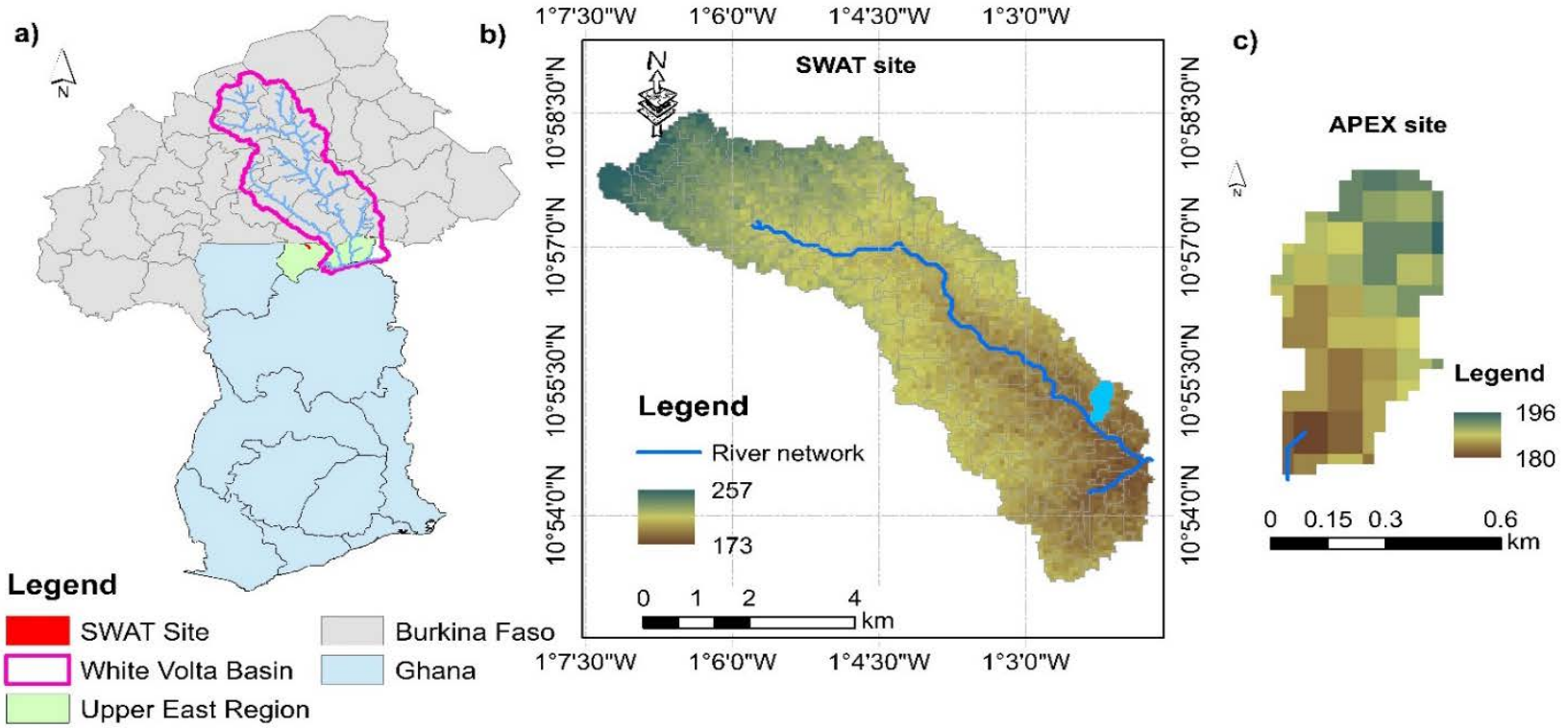

- SWAT calibrated parameters for a nearby watershed **White Volta** basin transferred to Dimbasina SWAT site;
- APEX was setup for SWAT subarea;
- APEX is calibrated for Corn and Sorghum and the calibrated parameters for these crops are transferred back to SWAT
- Calibrated crop yields are entered in FARMSIM for economic analyses

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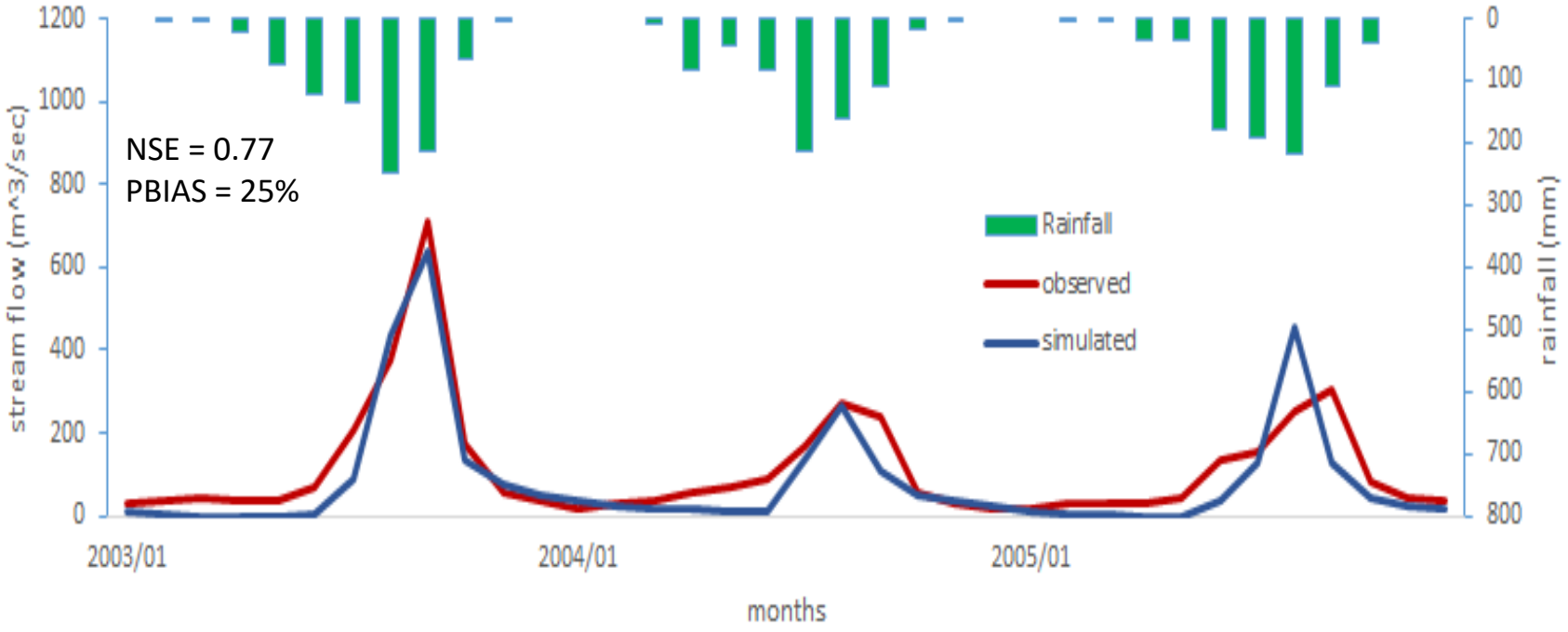
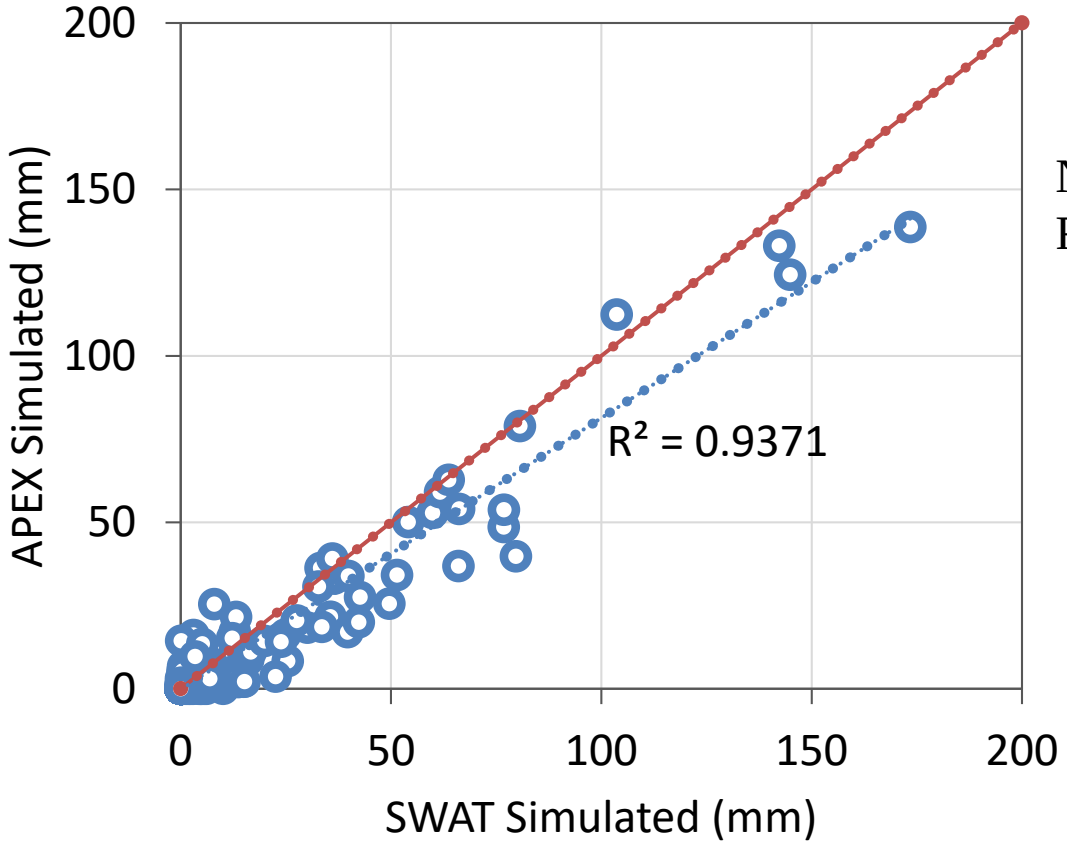
Result: Stream flow



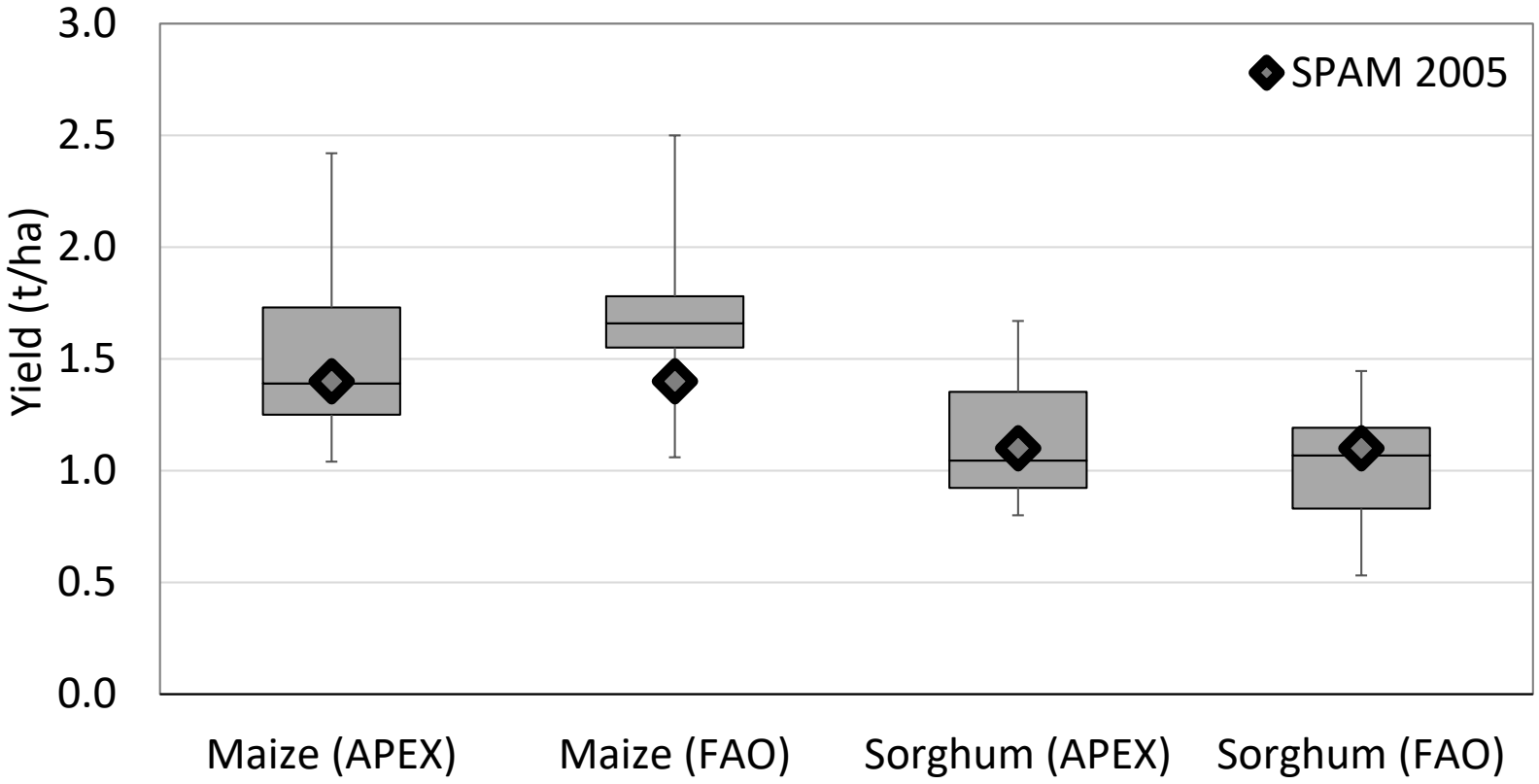
- SWAT model calibration was done using streamflow at the **Pwalugu river gauging** station in **White Volta** .

Calibration SWAT/APEX – Runoff



Nash-Sutcliff Efficiency (NSE)= 0.88
R-square value of 0.94

Calibration of Baseline Crop Yield & 32 Yield Data

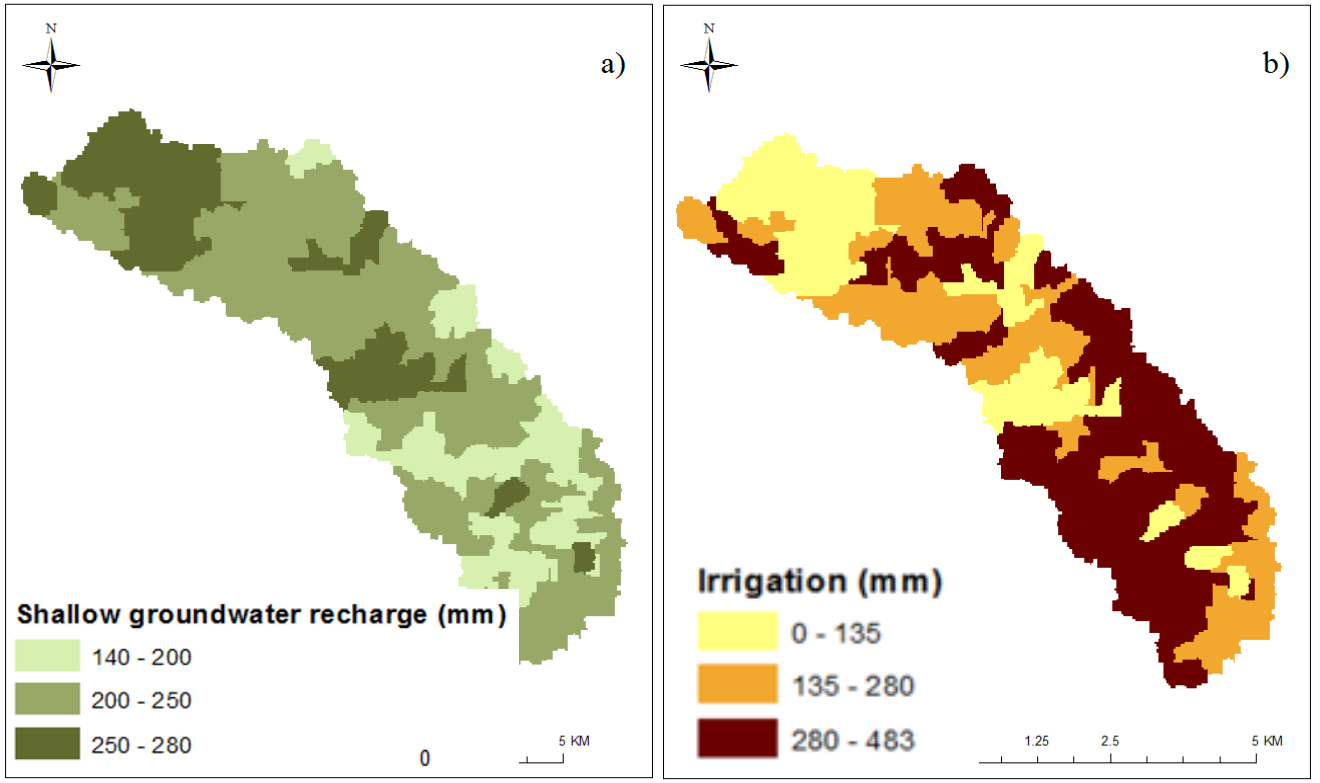


Comparison of APEX vs. FAOSTAT maize and sorghum yield from 1983 to 2013

Result:: Groundwater Availability

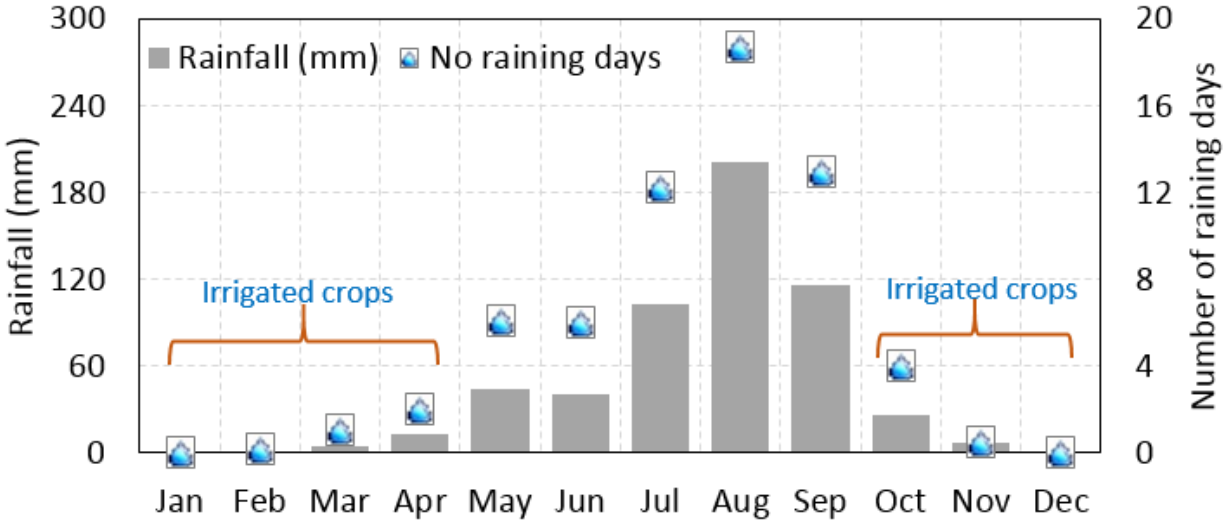
Crops were grown on suitable land based on there distribution for the baseline;

Irrigation water requirement > recharge



APEX Scenarios

- ***Scenario 1***: multiple cropping of fertilized maize with vegetables (fertilized maize + tomato, fertilized maize + pepper, fertilized maize + fodder);
- ***Scenario 2:*** multiple cropping of fertilized sorghum + tomato, sorghum + pepper, sorghum + fodder;



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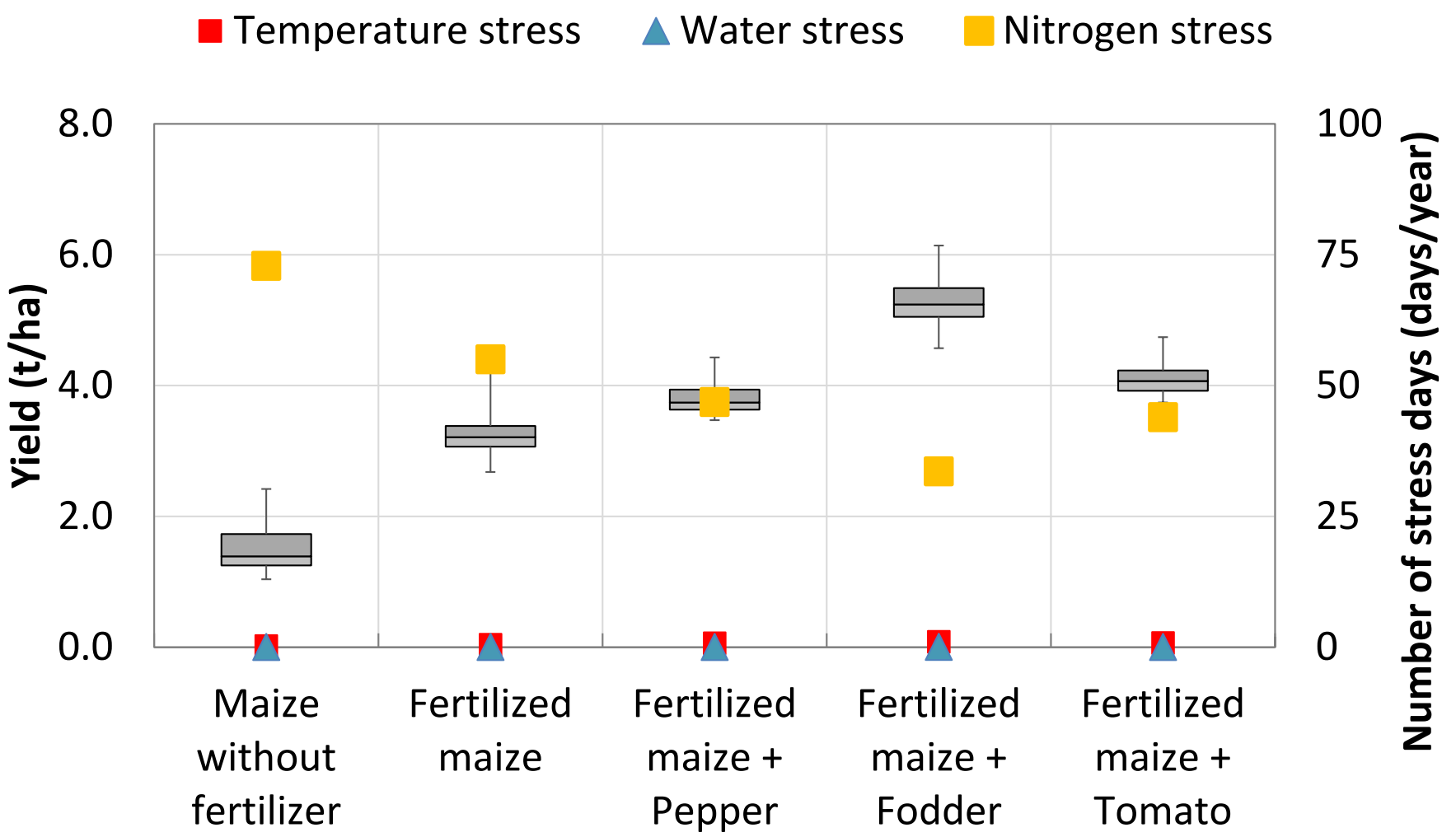
FARMSIM Scenarios

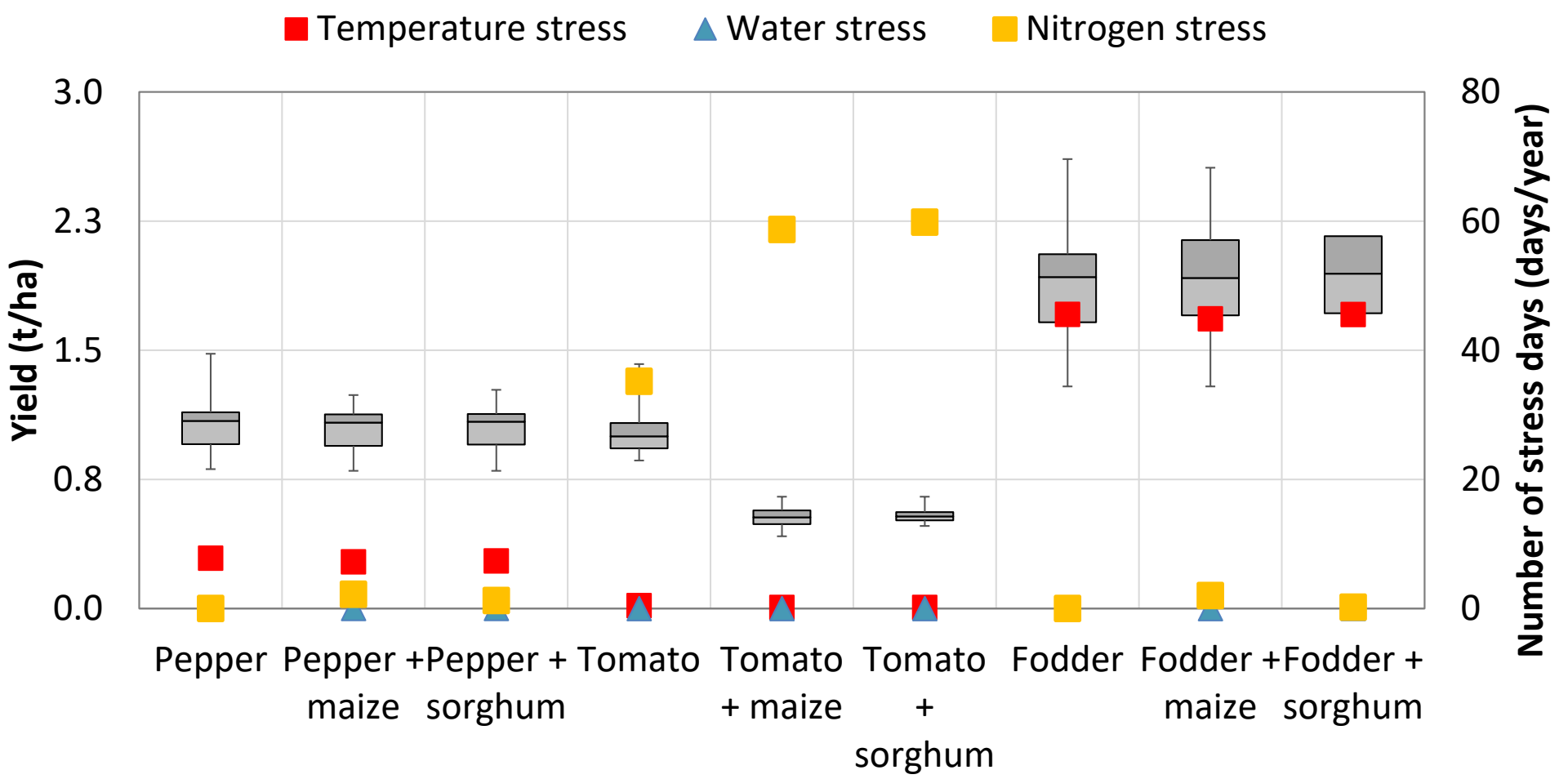
- Scenario description
  - Baseline scenario: low fertilizer + no irrigation
  - Alternative scenarios (5):

  Irrigation of tomatoes, red pepper and fodder (vetch & oats) + recommended fertilizers + dual cropping of veg./fodder with sorghum or maize + use pulley, diesel and solar pump for irrigation
- Water lifting technologies:
  - Pulley/bucket: 8 liters/min
  - Motor pump operated by diesel: 120 liters/min
  - Motor pump operated by solar power: 40 liters/min
- Total potential irrigable land: 450 ha

MAIZE YIELD


Temperature stress
Water stress
Nitrogen stress
Yield (t/ha)
8.0
6.0
4.0
2.0
0.0
100
75
50
25
0
Number of stress days (days/year)
Maize without fertilizer
Fertilized maize
Fertilized maize + Pepper
Fertilized maize + Fodder
Fertilized maize + Tomato

VEGETABLE CROP YIELD



Dimbasinia community

- Analysis of alternative irrigation technology in Dimbasinia community given the following:
  - Agricultural land: 2,064 ha (60% suitable for irrigation slope less than 6%)
  - Fodder (slope 6 to 8%), other 50% paper and tomato
  - Dryland maize and sorghum (grown in wet season) and irrigated tomatoes and red pepper (grown in dry season)
  - Number of cows: 771
  - Number ewes and nannies: 835 and 1975
  - Number of families: 374
- Irrigation costs:
  - Equipment costs: 2260 to 3000 GH₵ /family (Diesel and solar pump + accessories)

    Note: a pulley/bucket system: 235 GH₵
  - Operational costs (fuel, maintenance, rental): 235 - 290 GH₵/ ha

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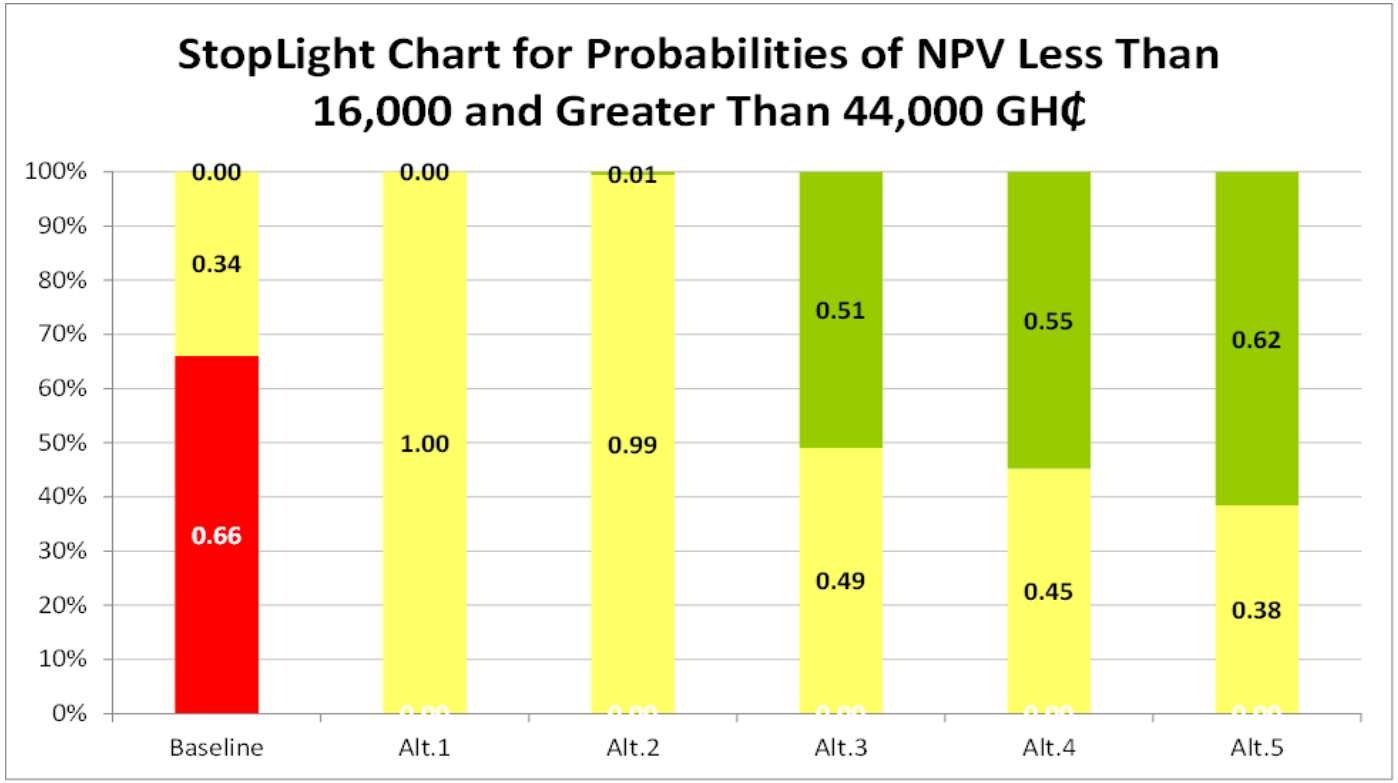
Net Present Value (NPV)



Legend

Baseline :	**No irrigation**	Alt.2 :	**Rope-WS**	Alt.4 :	**Diesel_PO-SV**
Alt.1 :	**Pulley-SV**	Alt.3 :	**Diesel_PR-SV**	Alt.5 :	**Solar_P-SV**

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Nutrition Results

- Increase in quantity available per day and per adult equiv. under alt. scenarios for calories, proteins and fat
  - Improvement from the baseline (High level)

- Levels of Ca, Iron and Vitamin A increased also from Baseline to Alternative scenario:
  - Improvement from baseline (adequate level)

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Conclusions

- There is large water resources potential in the Dimbasinia watershed. However, the average annual irrigation water requirement for cultivating pepper/tomato and fodder was more than the average annual shallow groundwater recharge.
- Addition of 50 kg/ha of urea and 50 kg/ha of DAP doubled simulated maize and sorghum yields.
- Additional fertilizer, multiple cropping and irrigation performed better than baseline scenario.
- Solar pump was the preferred water lifting technology – less maintenance cost and environmental friendly.

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