GIS Mapping of Pond Aquaculture Potential in Southern Malawi, Africa

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Background and Approach

Figure 1

Smallholding aquaculture in Malawi is gaining popularity, particularly with the promotion of pond-fish culture within integrated agriculture-aquaculture (IAA) systems (Fig. 1). These systems benefit poor farm households through enhancing food security and supplementing farm income.

Location-specific successes of IAA need to be out-scaled to benefit more farm households. However conditions favoring adoption do not occur uniformly over geographical space.

GIS modeling techniques were used to identify and map the potential for smallholding pond aquaculture systems to aid aquaculture planning and management.

A resource evaluation framework was adopted (Fig. 2) and implemented for the Southern Region of Malawi.

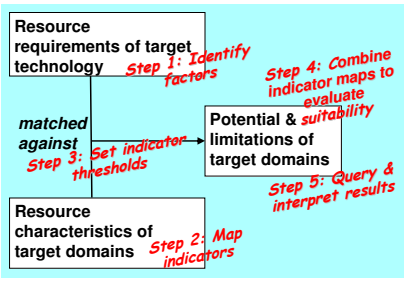

Figure 2

GIS Modeling and Results

Through literature review, consultations with aquaculture specialists and local experts, and carrying out multiple regression analysis, we identified five groupings of the key determinant factors and their indicators that are quantifiable and mapable. Listed below are the indicators (➢ bulleted) and their proxy functions (*blue italics*), by factor grouping.

BIOPHYSICAL FACTORS

- ➢ Duration of available pond water
  length of culture period
- ➢ Proximity to rivers & perennial streams
  supplemental water supply
- ➢ Land form
  low-lying areas prone to ponding
- ➢ Land use
  compatibility with pond aquaculture
- ➢ Frequency of flooding
  incidental water supply
- ➢ Slope steepness
  ease of pond construction
- ➢ Soil pH
  acidity constraint

SOCIO-ECONOMIC FACTORS

- ➢ Population density
  local demand
- ➢ Proximity to road, markets & urban centres
  physical access
- ➢ Poverty index
  affordability to purchase fish
- ➢ Literacy rate
  capacity to use knowledge
- ➢ Radio ownership
  access to broadcasted information
- ➢ Proximity to govt. station & innovative farmers
  info & seed source
- ➢ Cereal production
  crop by-product
- ➢ Small ruminants numbers
  livestock by-products
- ➢ Economically active population in 1° sector
  labour availability
- ➢ Economically active population in 2° & 3° sector
  opportunity cost of labour
- ➢ Incidence of abject poverty
  capital & assets
- ➢ Quality of housing
  capital & assets

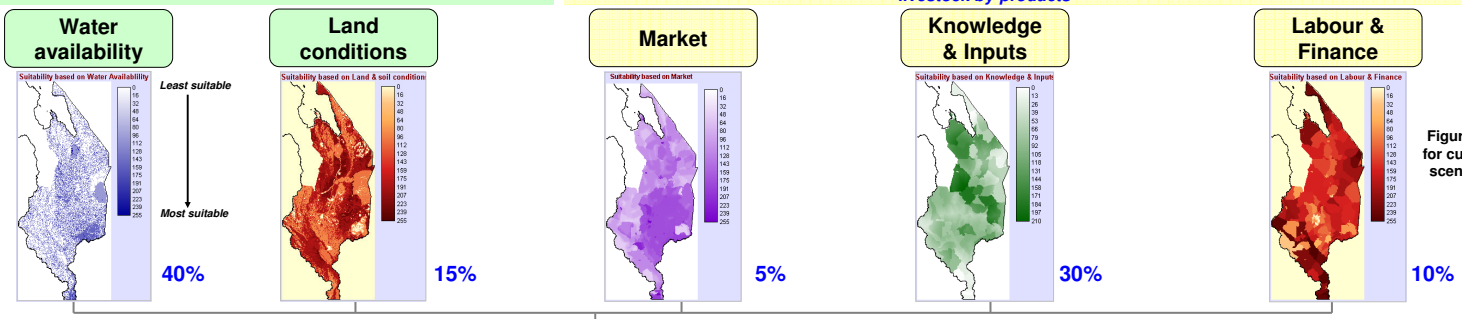

Figure 3a for current scenario

The multi-criteria evaluation technique (MCE), which is a weighted linear combination of the input indicator maps, was applied to each factor grouping as a sub-model. The mapped results (Fig 3a & 3b) were then combined in the final model for evaluating overall aquaculture suitability.

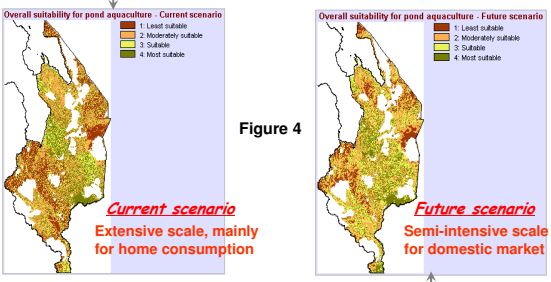

Figure 4

Experts were consulted to assign weights for combining the indicator maps for each sub-model and for the overall model. Two sets of weights were assigned for the current and a future scenario of pond aquaculture development in Southern Malawi. Fig. 4 shows the resulting overall pond-aquaculture suitability maps.

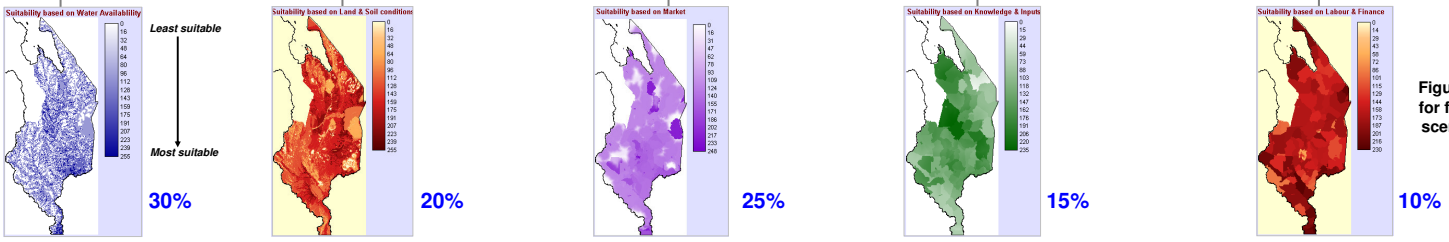

Figure 3b for future scenario

Querying results to identify limitations

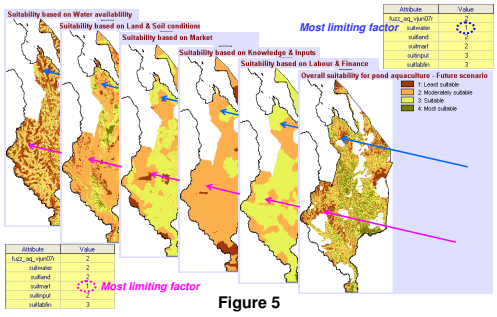

Figure 5

Knowing the limitations at specific places helps determine what interventions are needed to overcome them

For aquaculture planning and management purposes, it is not enough to produce suitability maps. The same rating of low potential at two locations may be due to different sets of limitations (Fig. 5).

For the convenience of target users, we developed the Suitability Analysis and QUery for Aquaculture (SAQUA) freeware for MCE modeling and for conducting drill-down query and filtering of multiple map layers, such as the overall suitability map and its component input maps (Fig. 6).

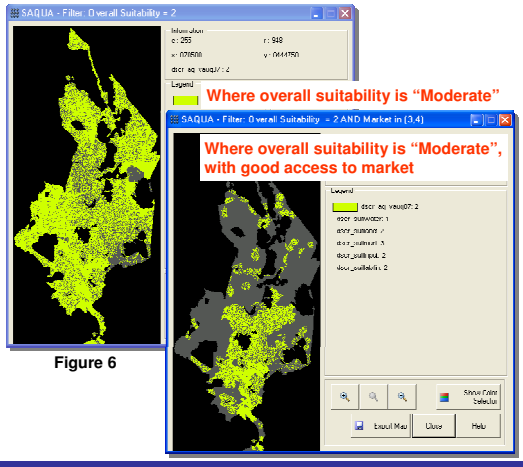

Figure 6

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