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SUSTAINABLE AQUACULTURE FOR A SECURE FUTURE

Title: A strategic reassessment of fish farming potential in Africa

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Abstract: The present study is an update of an earlier assessment of warm-water fish farming potential in Africa, by Kapetsky (1994). The objective of this study was to assess locations and areal expanses that have potential for warm-water and temperate-water fish farming in continental Africa.

The study was based on previous estimates for Africa by the above author, and on estimates of potential for warm-water and temperate-water fish farming in Latin America by Kapetsky and Nath (1997). However, a number of refinements have been made. The most important refinement was that new data allowed a sevenfold increase in resolution over that used in the previous Africa study, and a twofold increase over that of Latin America (i.e. to 3 arc minutes, equivalent to 5 km x 5 km grids at the equator), making the present results more usable in order to assess fish farming potential at the national level.

A geographical information system (GIS) was used to evaluate each grid cell on the basis of several land-quality factors important for fish-farm development and operation regardless of the fish species used. Protected areas, large inland water bodies and major cities were identified as constraint areas, and were excluded from any fish farming development altogether. Small-scale fish farming potential was assessed on the basis of four factors: water requirement from ponds due to evaporation and seepage, soil and terrain suitability for pond construction based on a variety of soil attributes and slopes, availability of livestock wastes and agriculture by-products as feed inputs based on manure and crop potential, and farm-gate sales as a function of population density. For commercial farming, an urban

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market potential criterion was added based on population size of urban centres and travel time proximity. Both small-scale and commercial models were developed by weighting the above factors using a multi-criteria decision-making procedure.

A bioenergetics model was incorporated into the GIS to predict, for the first time, fish yields across Africa. A gridded water temperature data set was used as input to a bioenergetics model to predict number of crops per year for the following three species: Nile tilapia (*Oreochromis niloticus*), African catfish (*Clarias gariepinus*) and Common carp (*Cyprinus carpio*). Similar analytical approaches to those by Kapetsky and Nath (1997) were followed in the yield estimation. However, different specifications were used for small-scale and commercial farming scenarios in order to reflect the types of culture practices found in Africa. Moreover, the fish growth simulation model, documented in Kapetsky and Nath (1997), was refined to enable consideration of feed quality and high fish biomass in ponds.

The small-scale and commercial models derived from the land-quality evaluation were combined with the yield potential of each grid cell for each of the three fish species to show the coincidence of each land-quality suitability class with a range of yield potentials. Finally, the land quality-fish yield potential combinations were put together to show where the fish farming potential coincided for the three fish species.

The results are generally positive. Estimates of the quality of land show that about 23% of continental Africa scored very suitable for both small-scale and commercial fish farming. For the three fish species, 50-76% of Africa's land has the highest yield range potential, and the spatial distribution of this yield is quite similar among the species and farming systems. However, the spatial distribution of carp culture potential was greater than for Nile tilapia and African catfish. Combining the two farming system models with the favourable yields of the three fish species suggest that over 15% of the continent has land areas with high suitability for pond aquaculture.

The final fish farming potential estimates for the three species together show that about 37% of the African surface contains areas with at least some potential for small-scale farming, and 43% for commercial farming. Moreover, 15% of the same areas have the highest suitability score, and suggest that for small-scale fish farming, from 1.3 to 1.7 crops/y of Nile tilapia, 1.9 to 2.4 crops/y of Africa catfish and 1.6 to 2.2 crops/y of Common carp can be achieved in these areas.

Estimates for commercial farming range from 1.6 to 2.0 crops/y of Nile tilapia, 1.3 to 1.7 crops/y of Africa catfish and 1.2 to 1.5 crops/y of Common carp.

From a country viewpoint, the results are also generally positive. For small-scale farming of the three species, 11 countries scored very suitable in 50% or more of their national area. The corresponding results for commercial farming were that 16 countries scored very suitable in 50% or more of their national area.

Farm location data from Zimbabwe, Kenya, Uganda and Malawi were used to verify the GIS-based predictions of fish farming potential, from the standpoint of the farming system models combined with fish yields. This verification procedure indicated that the models used in the study are in general fairly accurate for strategic planning of aquaculture development.

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