Assessment of comparative advantage in aquaculture
Framework and application on selected species in developing countries

$\,$

FAO
FISHERIES AND AQUACULTURE TECHNICAL PAPER 528

FAO
FAIT PAULS
Cover photographs:
Background: A commercial aquaculture farm in Kigembe, Rwanda; courtesy of Nathanael Hishamunda.
Inset bottom left: Shrimp being cleaned for freezing in Manila, The Philippines; © FAO/Freeby Maimone.
Inset bottom right: Commercial aquaculture can help poor fishers increase food security; ©FAO/Alessandra Benedetti.
Assessment of comparative advantage in aquaculture

Framework and application on selected species in developing countries

by

Junning Cai
Assistant Professor
Chinese Academy of Finance and Development
Central University of Finance and Economics
Beijing, China

PingSun Leung
Professor
College of Tropical Agriculture and Human Resources
University of Hawaii at Manoa
Honolulu, Hawaii, United States of America

Nathanael Hishamunda
Fishery Planning Officer
Fisheries and Aquaculture Economics and Policy Division
FAO Fisheries and Aquaculture Department
Rome, Italy
Preparation of this document

Within the framework of its continued efforts to alleviate poverty and enhance food security, the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations (FAO) has initiated a number of studies to improve decision-making in both private and public sectors. This study provides two methodologies to estimate comparative advantage that can assist entrepreneurs and government policy-makers in developing countries in deciding which species and which export markets offer the most potential for commercial aquaculture.

While the methodologies can be applied anywhere, the focus of this report is on two case studies: the shrimp export market and farmed production of freshwater finfish. The studies were conducted within the Fisheries and Aquaculture Economics and Policy Division at FAO.
Abstract

International trade in fishery products has increased, together with the absolute and relative importance of aquaculture, as a source of fish production. Shrimp and salmon are two examples of species grown in developing countries that are traded internationally. How successful a country is in competing against other producers depends in part on transport and on satisfying food standards, but also on its costs of production. Comparative advantage is a means of comparing relative costs and indicating the species and markets where there is the greatest likelihood of success. There are problems with estimating comparative advantage: the method can be static rather than dynamic and may not indicate long-run opportunities. However, it is a useful tool for planners who devise aquaculture strategies and for individual fish farmers.

Two methods exist for estimating comparative advantage – both have been applied to aquaculture. The domestic resource cost (DRC) method relies on production cost data to compare efficiency. Distortions may require the estimation of shadow prices to reflect true social opportunity costs but, when adjusted, the country that has the lowest DRC has a comparative advantage. The DRC method is dynamic, providing useful information to decision-makers; however, cost data may be difficult to obtain and shadow pricing is problematic. The second method is revealed comparative advantage (RCA) whereby comparative advantage is inferred from an ex post assessment of actual trade and specialization. From trade statistics, estimates are obtained to examine whether a country exports a species to a particular country more than to the rest of the world; if so, it is judged to have a comparative advantage in that particular market. The RCA method is more descriptive and has less predictive potential than the DRC approach but it has the advantage of data availability.

This paper illustrates the concept of comparative advantage and some of its policy implications by presenting two case studies: the first one focuses on shrimp exporting countries while the second one is based on freshwater aquaculture production of carp, catfish and tilapia. The RCA method is used in both cases.

Cai, J.; Leung, P.; Hishamunda, N.
Assessment of comparative advantage in aquaculture: framework and application on selected species in developing countries.
# Contents

Preparation of this document iii  
Abstract iv  
List of tables vii  
List of figures viii  
Foreword ix  

1. Introduction 1  

2. Comparative advantage in aquaculture: an assessment framework 3  
   2.1 Concept of comparative advantage 3  
   2.2 Comparative advantage versus competitive advantage 4  
   2.3 Comparative advantage: an assessment framework 5  
      2.3.1 The domestic resource cost/benefit-cost approach 5  
      2.3.2 The RCA approach 7  
   2.4 Comparative advantage assessment: a synthesis framework 9  
      2.4.1 The DRC/BC approach: merits and problems 9  
      2.4.2 The RCA approach: problems and merits 10  
      2.4.3 A terminology issue 10  
      2.4.4 DRC/BC and RCA: policy applications 10  

   3.1 Introduction 13  
   3.2 Methodology and data 14  
      3.2.1 Degree of dominance (market power) 14  
      3.2.2 Size advantage 15  
      3.2.3 Comparative advantage 16  
      3.2.4 Market share variation 16  
      3.2.5 Revealed comparative advantage variation 18  
      3.2.6 Data 19  
   3.3 Results 20  
      3.3.1 The Japanese market 21  
      3.3.2 The United States of America market 26  
      3.3.3 The European Union market 30  
   3.4 Summary 33  

4. Comparative advantage in freshwater fish farming 35  
   4.1 Background 35  
   4.2 Methodology 35  
      4.2.1 Production RCA index 36  
      4.2.2 Production RCAV index 37  
      4.2.3 Two interpretations of RCA 38  
   4.3 Data 38  
   4.4 Results 38  
      4.4.1 Freshwater fish farming comparative advantage in Asia 38  
      4.4.2 Freshwater fish farming comparative advantage in Latin America and the Caribbean 48
# Tables

1. Policy analysis matrix (PAM) 7
2. Data template for the DRC/BC approach 11
3. A profile of major shrimp farming countries 15
4. Cultured shrimp exports to the world market 22
5. Cultured shrimp export performance in the Japanese market 24
6. Cultured shrimp export performance in the United States of America market 28
7. Cultured shrimp export performance in the European Union market 32
8. Annual freshwater finfish farming production 40
9. Freshwater fish farming comparative advantage (East Asia) 42
10. Freshwater fish farming comparative advantage (Central Asia) 43
11. Freshwater fish farming comparative advantage (Middle East) 44
12. Freshwater fish farming comparative advantage (South Asia) 46
13. Freshwater fish farming comparative advantage (Southeast Asia) 47
14. Freshwater fish farming comparative advantage (Caribbean) 50
15. Freshwater fish farming comparative advantage (Central America) 51
16. Freshwater fish farming comparative advantage (South America) 54
17. Freshwater fish farming comparative advantage (eastern sub-Saharan Africa) 56
18. Freshwater fish farming comparative advantage (western sub-Saharan Africa) 58
19. Freshwater fish farming comparative advantage (southern sub-Saharan Africa) 60
20. Freshwater fish farming comparative advantage (northern sub-Saharan Africa) 60
21. Freshwater fish farming comparative advantage (central sub-Saharan Africa) 61
# Figures

1. World cultured shrimp production
2. Cultured shrimp exports to various markets
3. Cultured shrimp exports to the Japan market
4. Cultured shrimp exports to the United States of America market
5. Cultured shrimp exports to the European Union market
6. Freshwater fish farming specialization patterns in the world
7. Freshwater fish farming specialization patterns in Asia
8. Freshwater fish farming specialization patterns of Asian countries
9. Freshwater fish farming specialization patterns in Latin America and the Caribbean
10. Freshwater fish farming specialization patterns of Latin America and the Caribbean countries
11. Freshwater fish farming specialization patterns in sub-Saharan Africa
12. Freshwater fish farming specialization patterns of sub-Saharan Africa countries
Foreword

This report aims at assisting countries determine in which species and in which export markets they should specialize. Comparative advantage is a concept almost two-hundred years old suggesting that countries can trade and benefit from trade even if they have no absolute advantage. Thus even a country with limited resources and cost disadvantages can specialize and gain from trade just as the most efficient producer. For decision-makers, comparative advantage provides insights if they want to “pick winners” among the sectors of an economy.

The conclusions and methodologies in this report are not specific to any particular country and while data limitations may preclude the use of one method, both should apply consistently to all sectors. This report concentrates on the aquaculture sector with data coming from more than 100 countries. Case studies indicate which countries have a comparative advantage in shrimp production (for the export market) and freshwater production of fish.

I would like to acknowledge the considerable contribution of Dr Nathanael Hishamunda of the FAO Fisheries and Aquaculture Development and Planning Service, who led this project and guided it to fruition, and Drs Junning Cai and PingSun Leung, who initiated the report writing.

Jean François Pulvenis de Séligny
Director, Fisheries and Aquaculture Economics and Policy Division
FAO Fisheries and Aquaculture Department