



Dynamics in Aquaculture

Intrafish Summit 2016



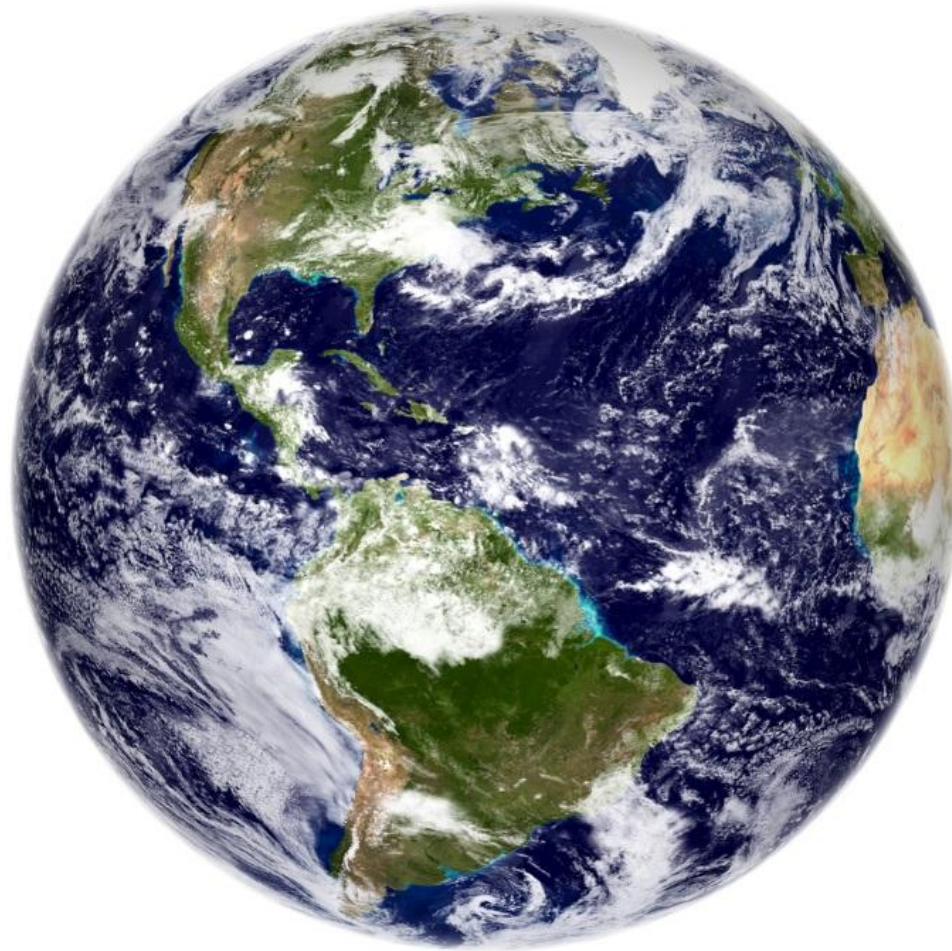
Jeroen Leffelaar
Managing Director Large Corporates Food & Agri
NYC 2016



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71% of the earth is covered with water, the most underutilised resource when it comes to food production

- **29% of our planet is covered by land. From this land about 12% is occupied by agriculture**
- **And nearly 98% our food is produced from this small section of the earth's surface**
- **Fisheries and aquaculture are the only industry which can utilize the remaining 71%**



I

Demand – Seafood has the most unsatisfied demand function of any protein



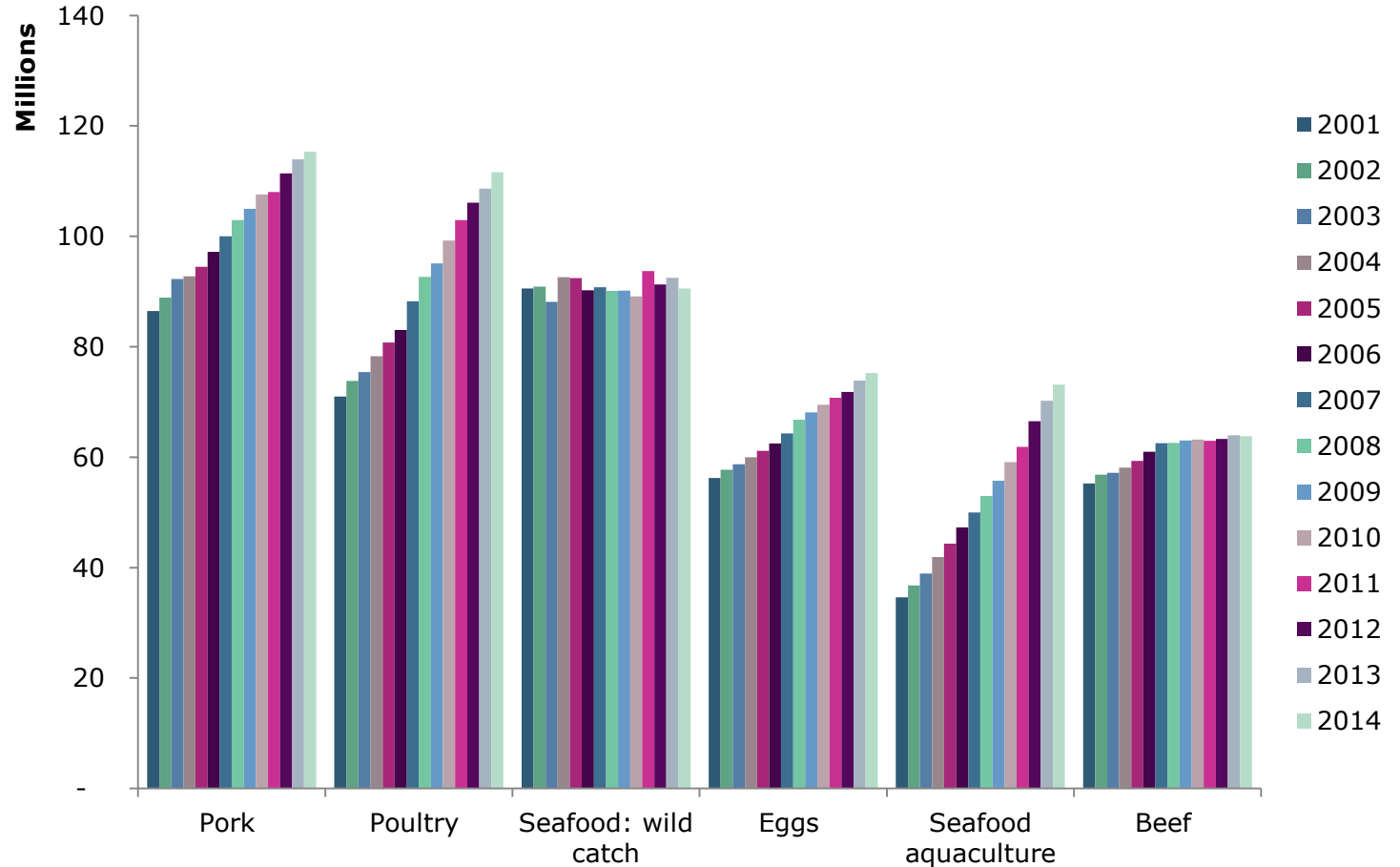
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Seafood is a major source of protein

The largest animals protein industries world wide (with the exception of dairy)

- **With over 500 million tonnes of production, animal proteins* are the most valuable part of the global agricultural industry**
- **Wild caught seafood represents 17.7% of animal protein, aquaculture 13.4%**
- **Note: About 20 million tonnes of wild caught fish is used for feed production**

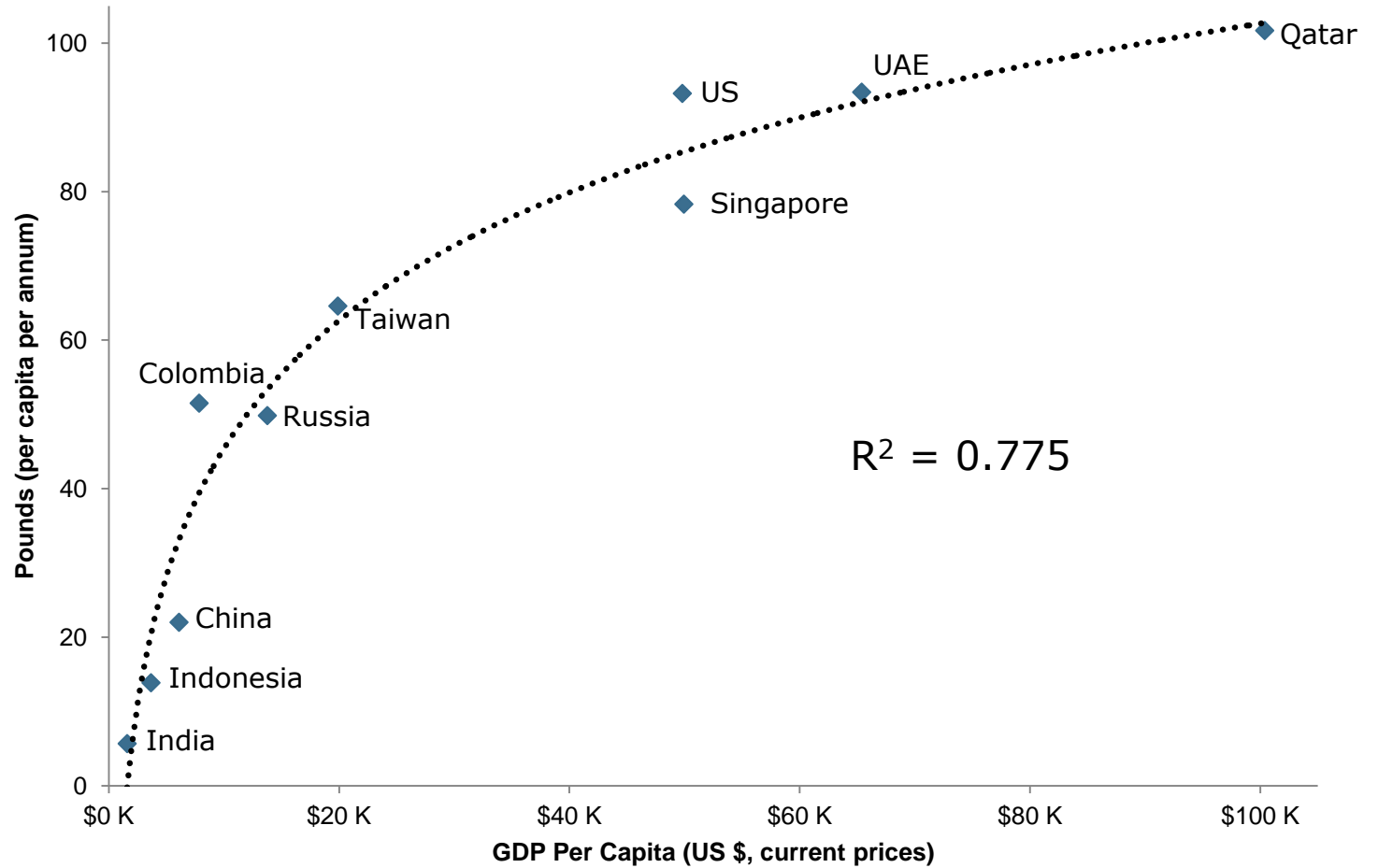
*** Dairy, Sheep meat and Algae/Seaweeds are not included**



GDP growth is driving demand for proteins

- *In general there is a close correlation between income and meat consumption*
- *Poultry is especially well correlated*
- *Poultry has a relatively elastic supply side and very few barriers on the demand side*

Correlation of GDP to Poultry Consumption

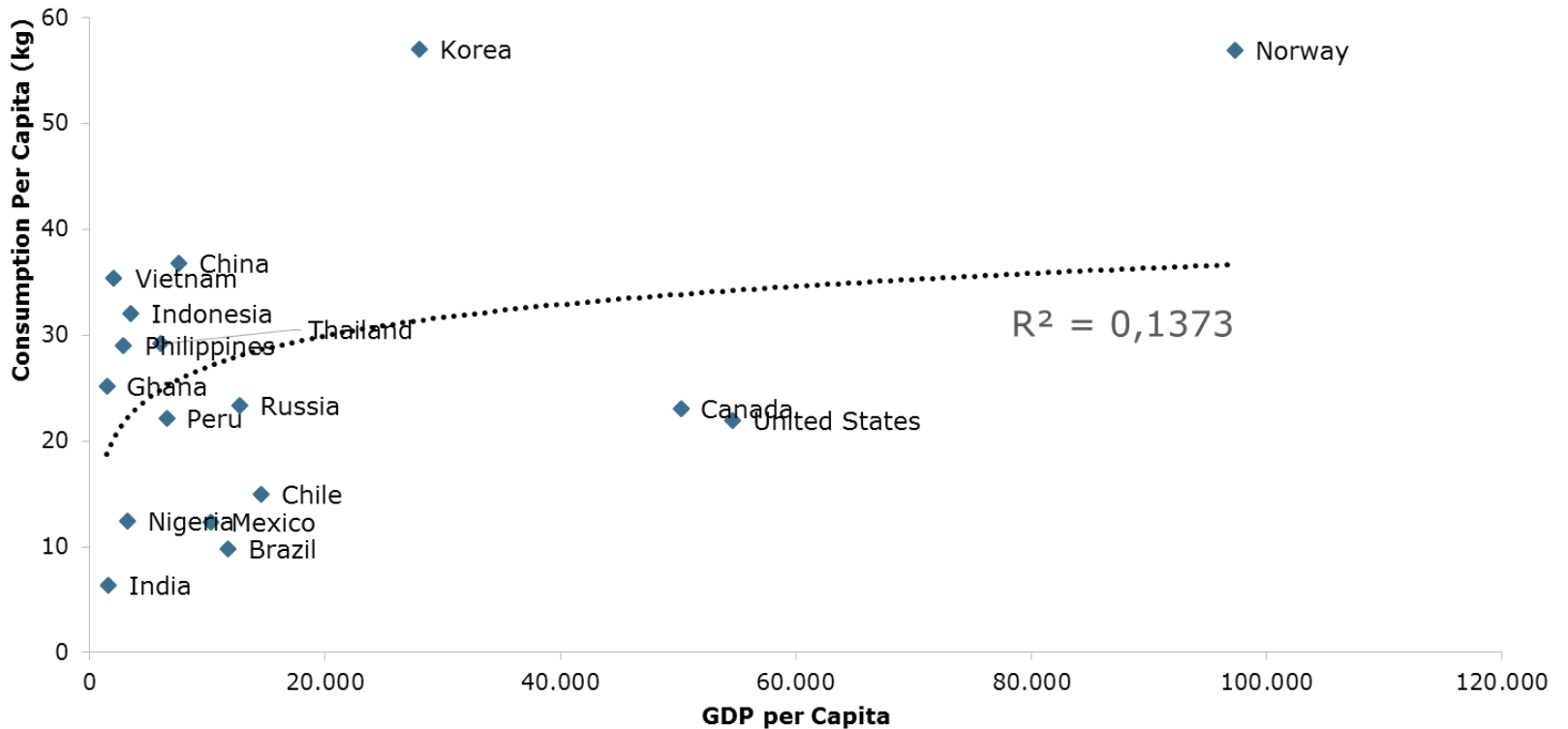


In the case of seafood GDP growth and consumption have a weak correlation

Correlation of GDP to Seafood Consumption

Doing the same exercise for seafood shows virtually no correlation

This is primarily because the supply side is less flexible and partly unable to respond to demand

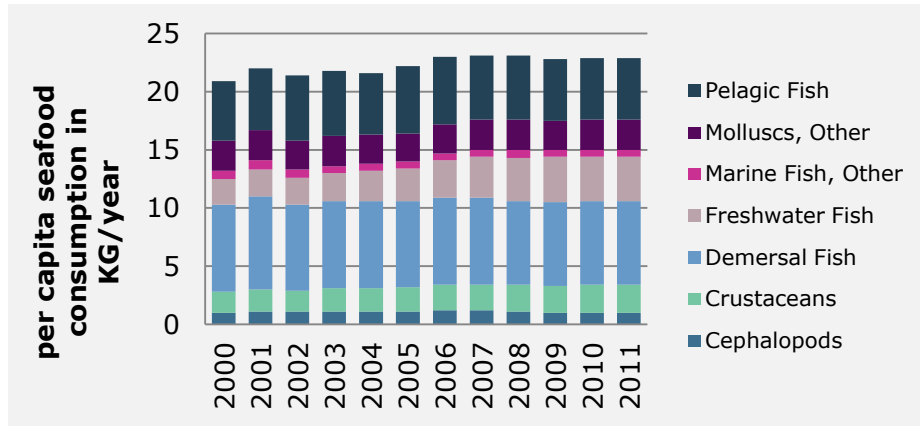


Rabobank, FAO 2016

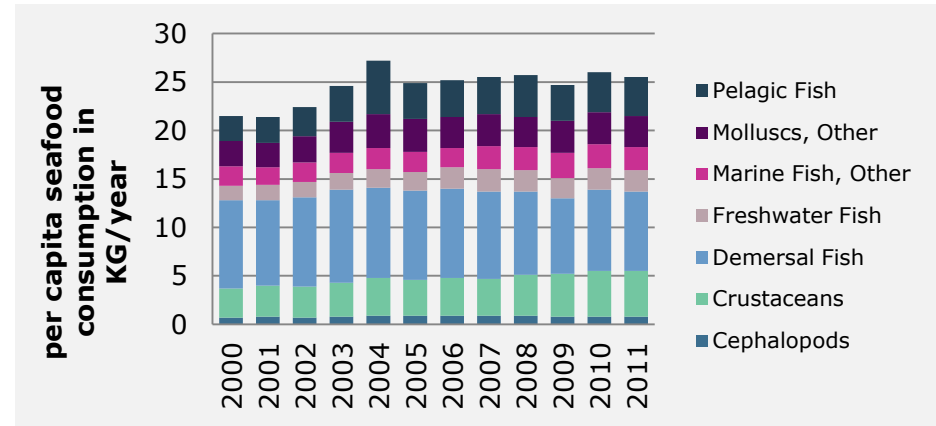
In developed countries it is hard to spot a growth of seafood per capita consumption over time



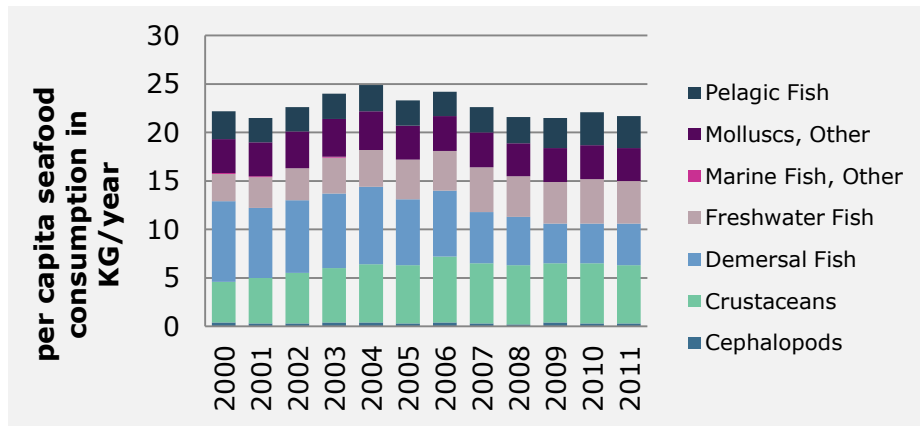
EU



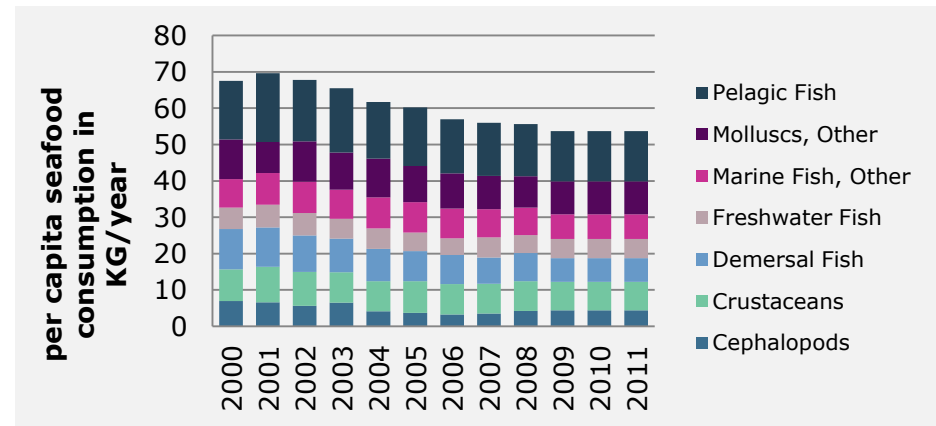
Australia



US

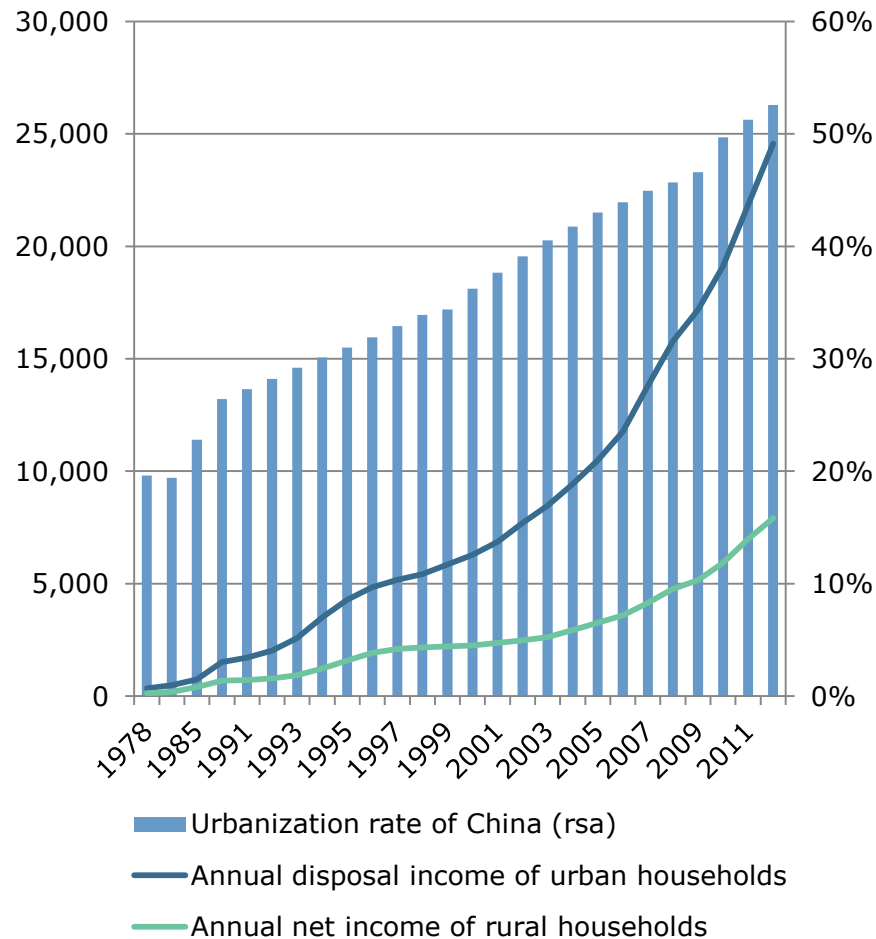


Japan



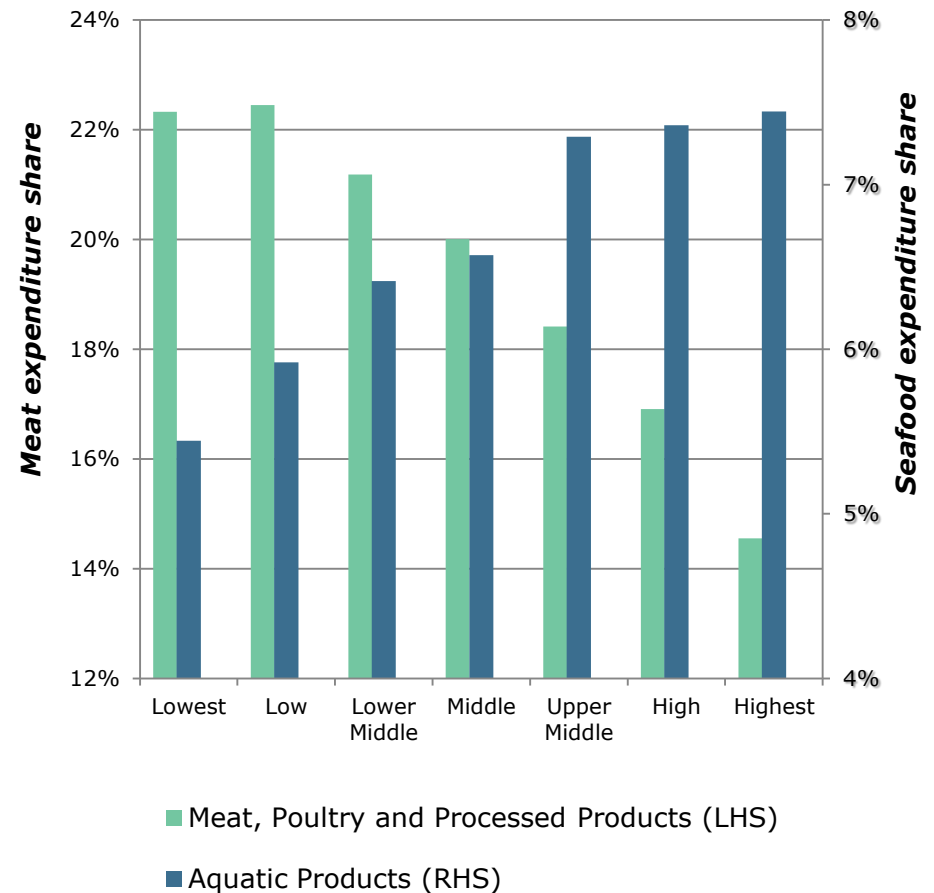
China has a very high income elasticity of demand and supply elasticity (high share of aquaculture)

Urbanization & disposable income growth China



National Bureau of Statistics of China, Industry reports, 2014

Relative seafood and animal protein expenditure per income group



China Statistical Yearbook 2011

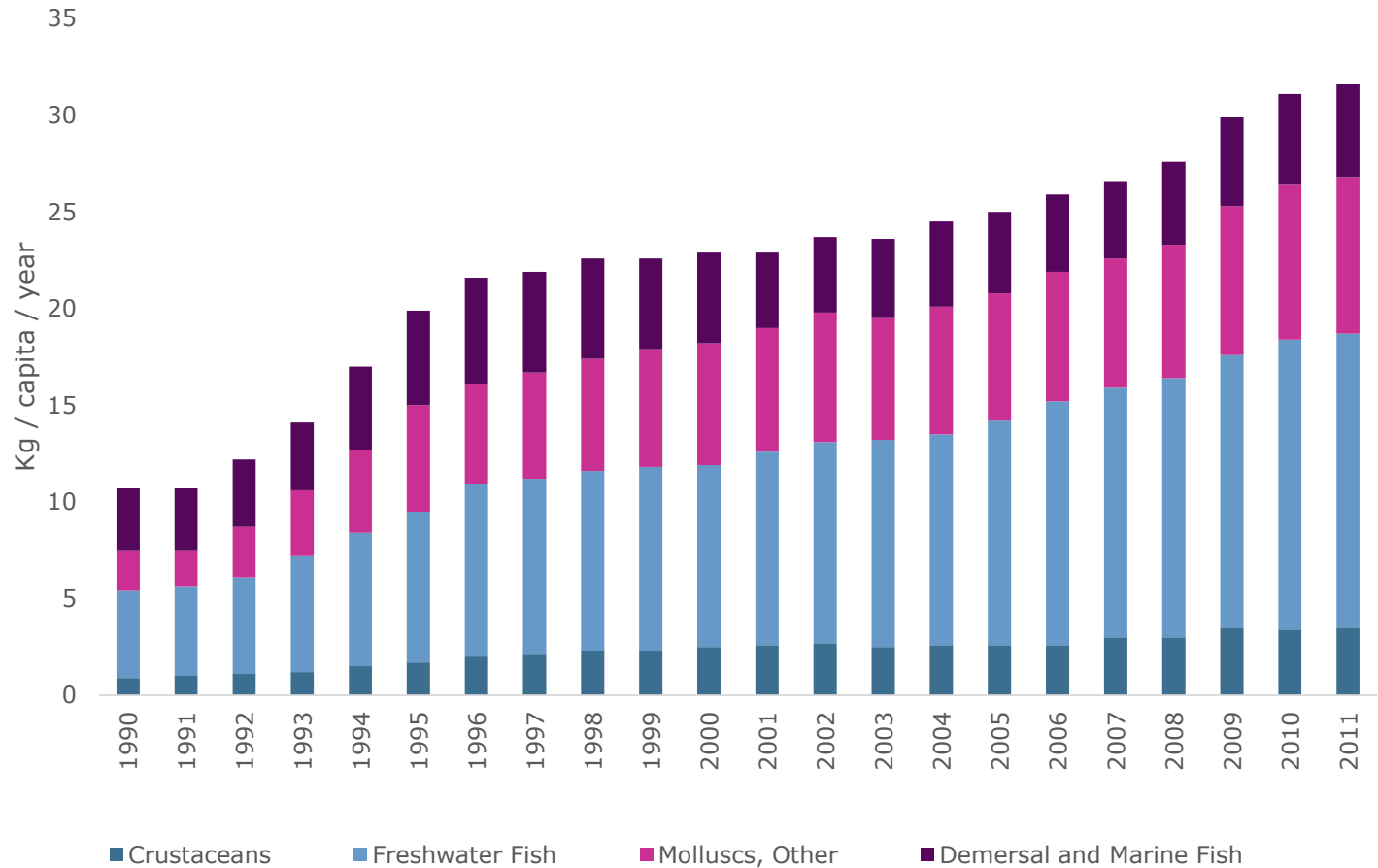
China seafood consumption per capita tripled in the last 30 years

- Seafood demand will continue to increase for some time, increasingly for high value species

- Seafood consumption per capita in kg:

US	23,7
EU 27	23,3
China	32,8
Malaysia	53,2
Japan	54,7
Hong Kong	>60

- China still consumes mostly low value carps (45%) and low value mussels (26%); this will gradually change

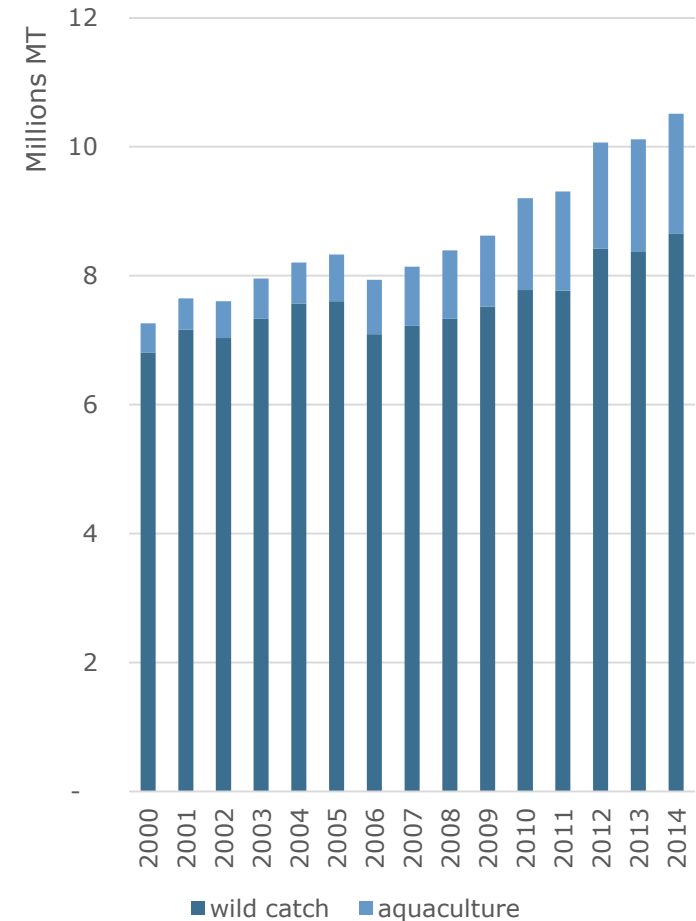
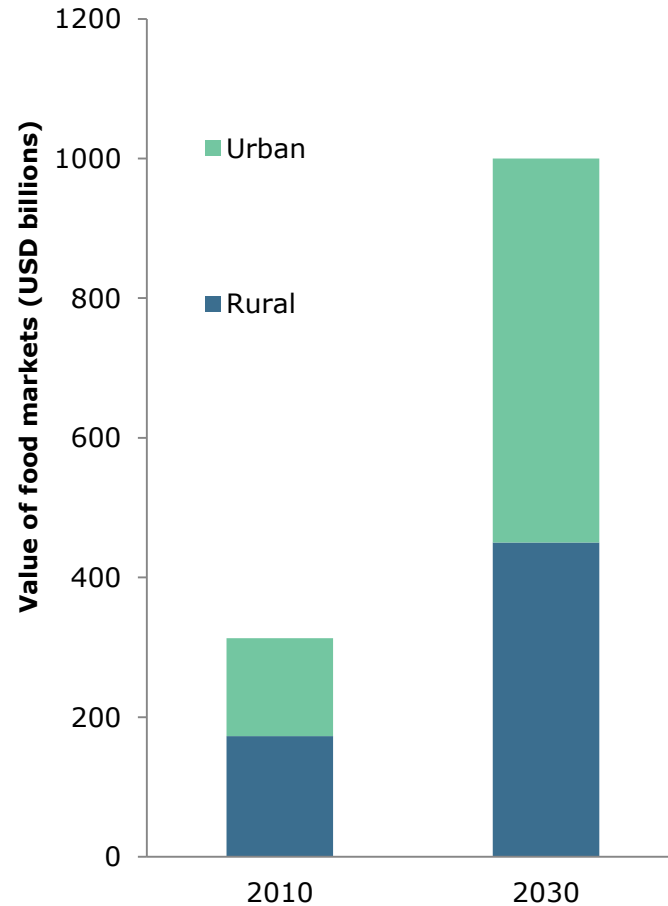


In Africa the supply side is by far the most important driver of consumption

Sub Saharan African booming value of food market

Food fish 25% of protein in key African countries

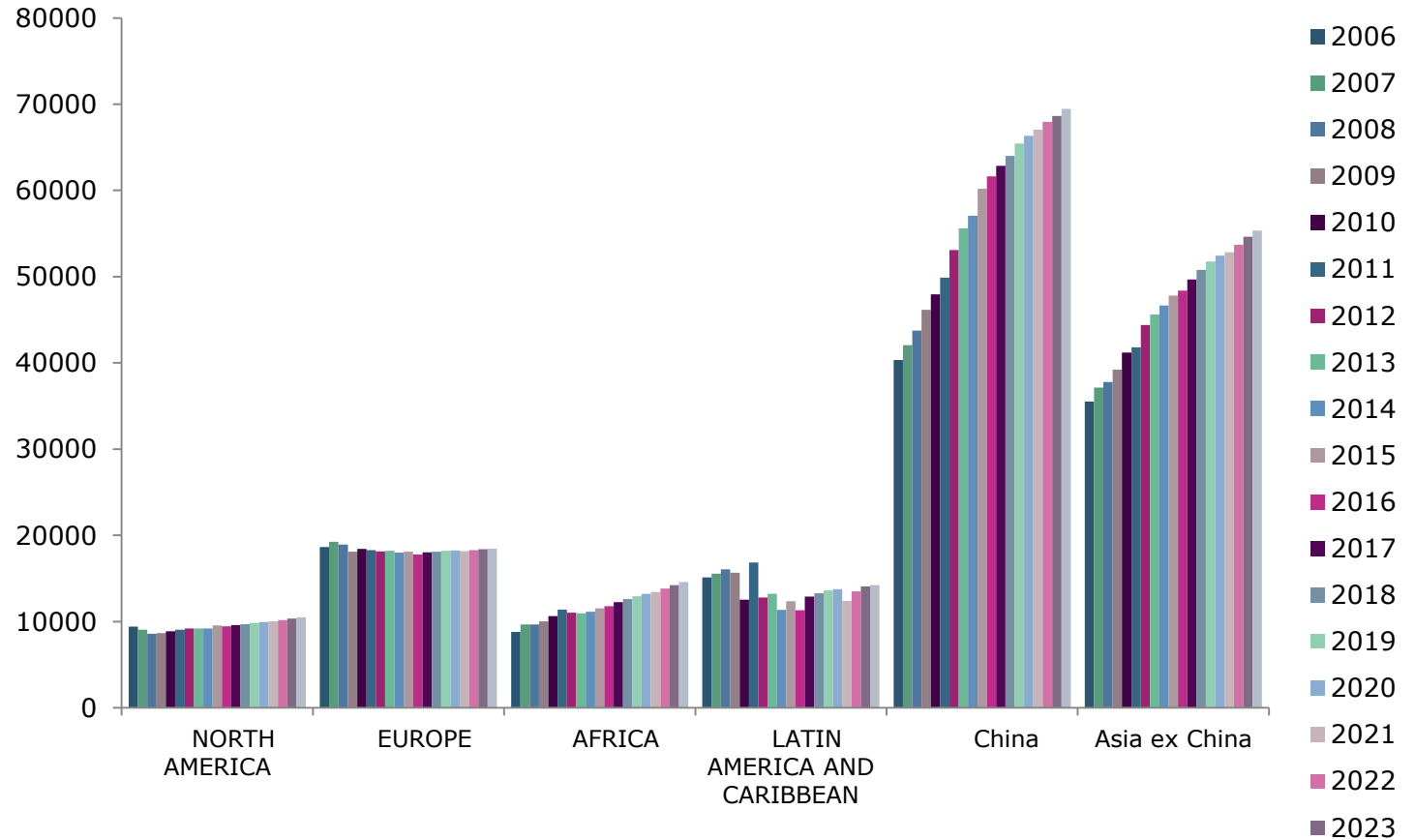
- **Although from a low base Africa has the fastest growing aquaculture industry world wide. It will likely over take Europe less then a decade**
- **Sub- Saharan GDP growth is only second to India**
- **Some areas of Africa such as Egypt, Nigeria and large part of Sub-Saharan Africa have excellent conditions for Aquaculture**
- **The supply side (existence of hatcheries, feed mills, knowledgeable workers etc.) are today the main constraint to growth of the sector**



OECD outlook: fish consumption and growth dominated by Asia and China

OECD outlook on the Fish consumption per region world wide (in MT)

- *Based on historical link of income and seafood consumption and future income growth expectations it is easy to see why Asia is key to future growth*
- *Asia and China dominates fish consumption and growth world wide*
- *Europe has near zero volume growth*
- *Growth of aquaculture could eventually increase seafood consumption growth in developed markets*



II

Supply – All cards on Aquaculture



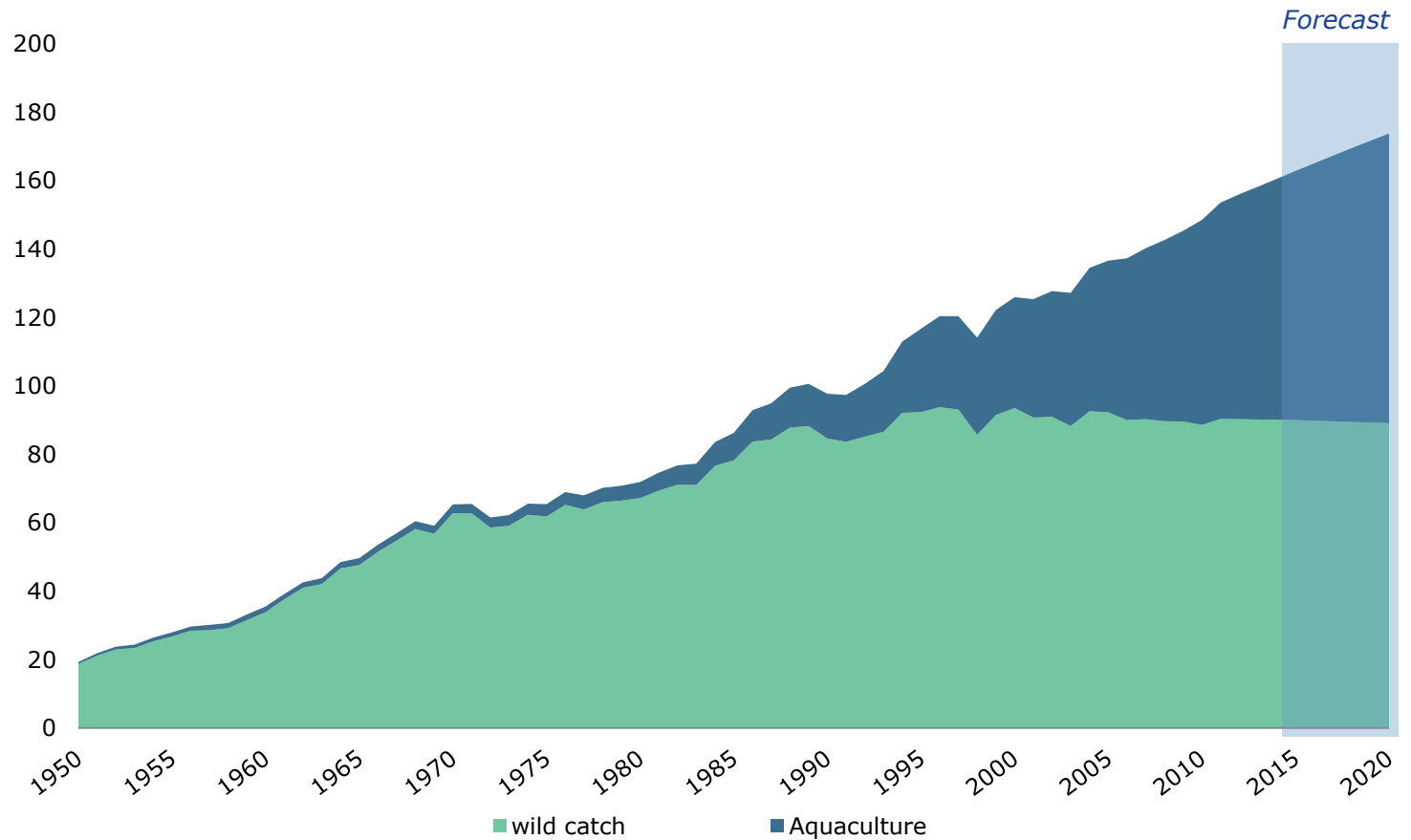
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Seafood supply: all growth needs to come from aquaculture

Total seafood supply

Millions tonnes

- *Unlike what some NGO's say wild catch is not on a declining trend*
- *Nevertheless it is clear that there won't be volume growth*
- *With 50% of the supply base aquaculture will contribute to 100% of the growth*

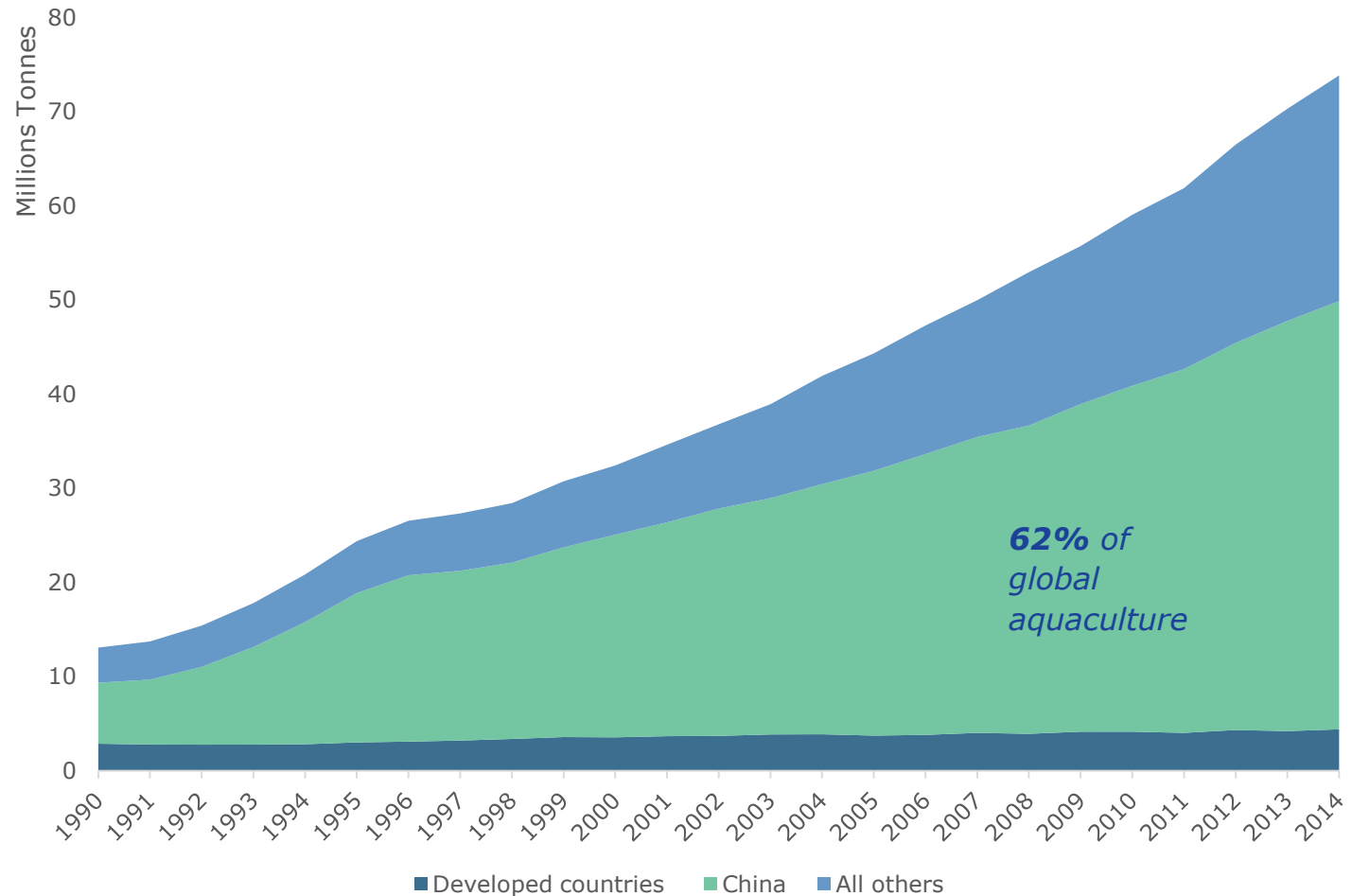


In supply volume terms Aquaculture is a developing country industry, and China dominates



Global aquaculture production is predominantly based in developing countries

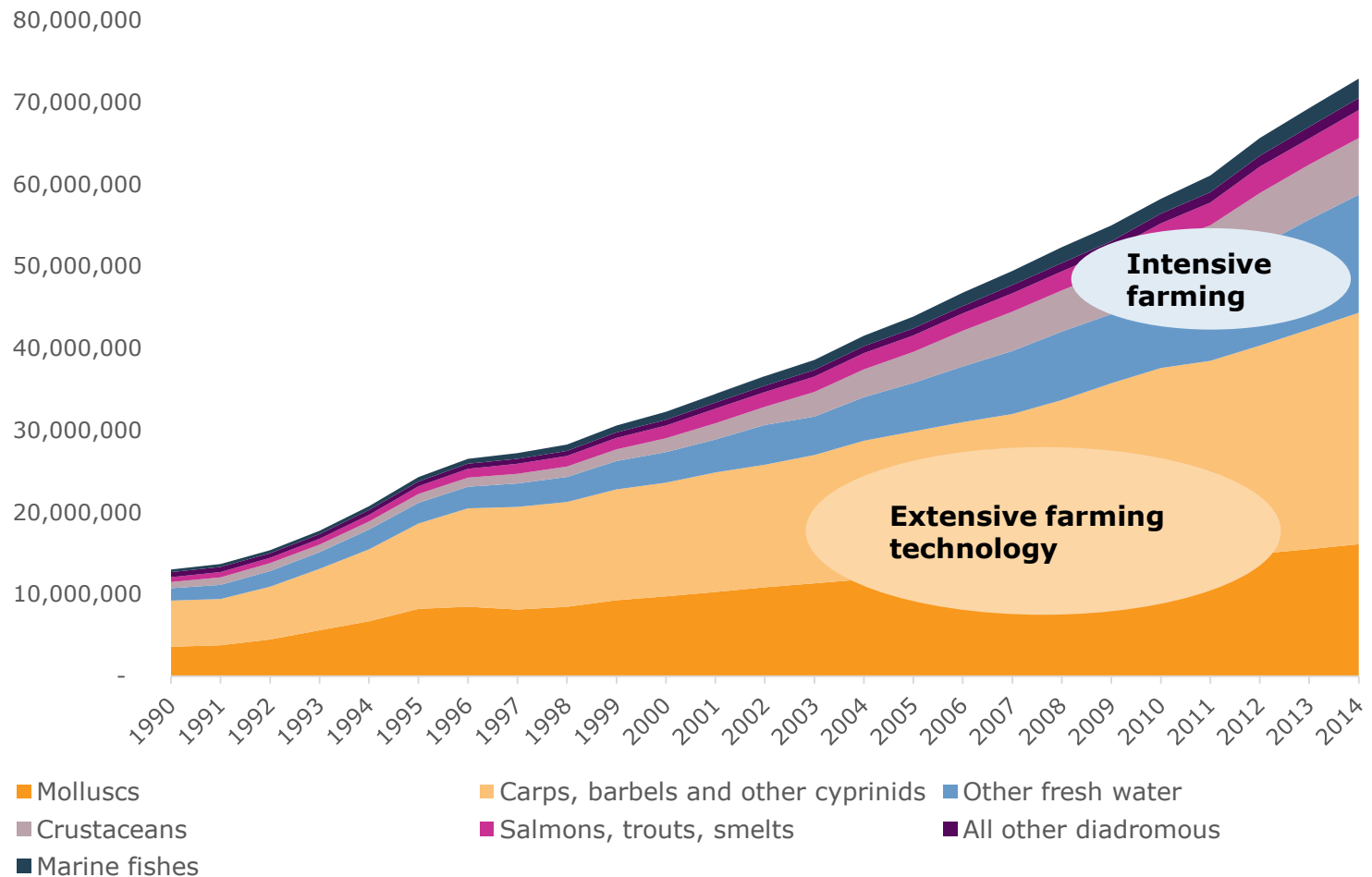
- **There is no other protein industry worldwide so skewed towards developing countries, Asia and China**
- **China is by far the largest producer. Its carp and mollusc industries perfectly suited for a country lacking grains**
- **Developed countries have had access to wild catch fish and low cost meat for decades. There was less need to develop an aquaculture industry**
- **Salmon is the only large aquaculture industry primarily based in developed countries - this industry represents less than 5% of total aquaculture**



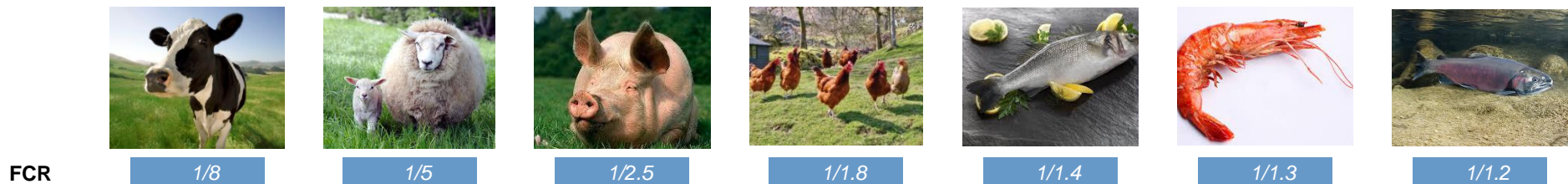
Moreover 2/3rd of aquaculture is based on extensive farming (loosely comparable to pasture farming on land)

Global aquaculture production (excluding aquatic plants) 1990 – 2014 per key species group

- **Nearly all Carp and Mollusk farming is based on extensive farming technology**
- **In terms of inputs and technology this can be compared to pasture farming on land**
- **Intensive farming - such as salmon, shrimp, tilapia in terms of land use and exposure to the environment compare to FREE RANGE Chicken or Pork production**
- **As LAND is the key input for extensive farming, Intensive aquaculture will be the future of the industry**



Compared to terrestrial protein farming the intensive aquaculture industry compares favorable



FCR (feed conversion rate) can be very low, even below 1

- *No gravity under water — no energy wasted when standing still;*
- *No need for a heavy bone structure and also mean high protein content*
- *Species are ectothermic — no energy used to heat the animal*
- *Very low fat needed for insulation – which uses a lot more feed to make then protein*
- *The industry is at an early stage with many innovations reducing the cost function*

III

Constraints in aquaculture: Biology versus Demand

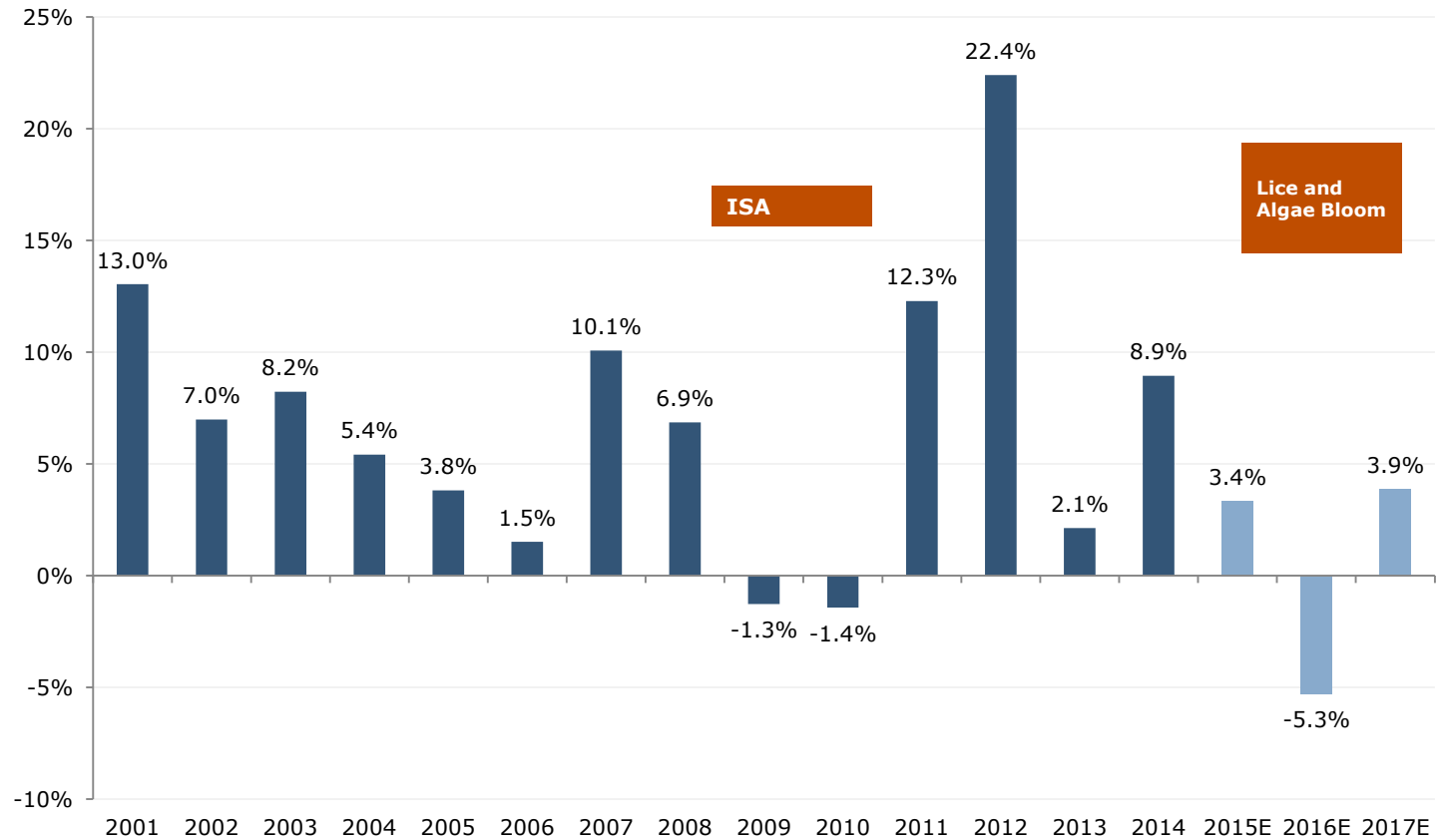


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Biological and Environmental supply constraints in the salmon industry

YOY change in global Atlantic salmon supply and forecast (%)

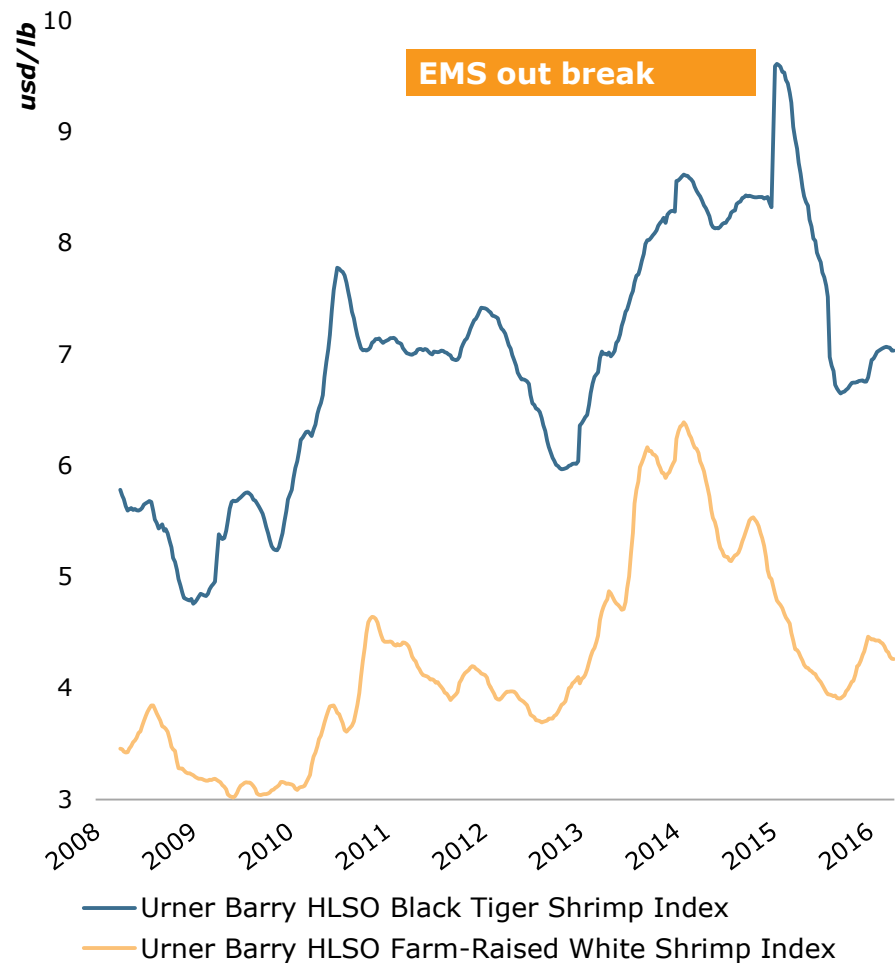
- **Even before the algae bloom, Chile was expected to experience contracting production from H2 2016 onwards**
- **The estimate is that over 100Kt fish has been lost in Chile due to algae – when measured at harvest weight**
- **This comes only a few months after the news of the issues with lice resistance in Norway where Norwegian production was reduced by some 70Kt**
- **Both events have a major impact on 2016 production and some impact on 2017 production**



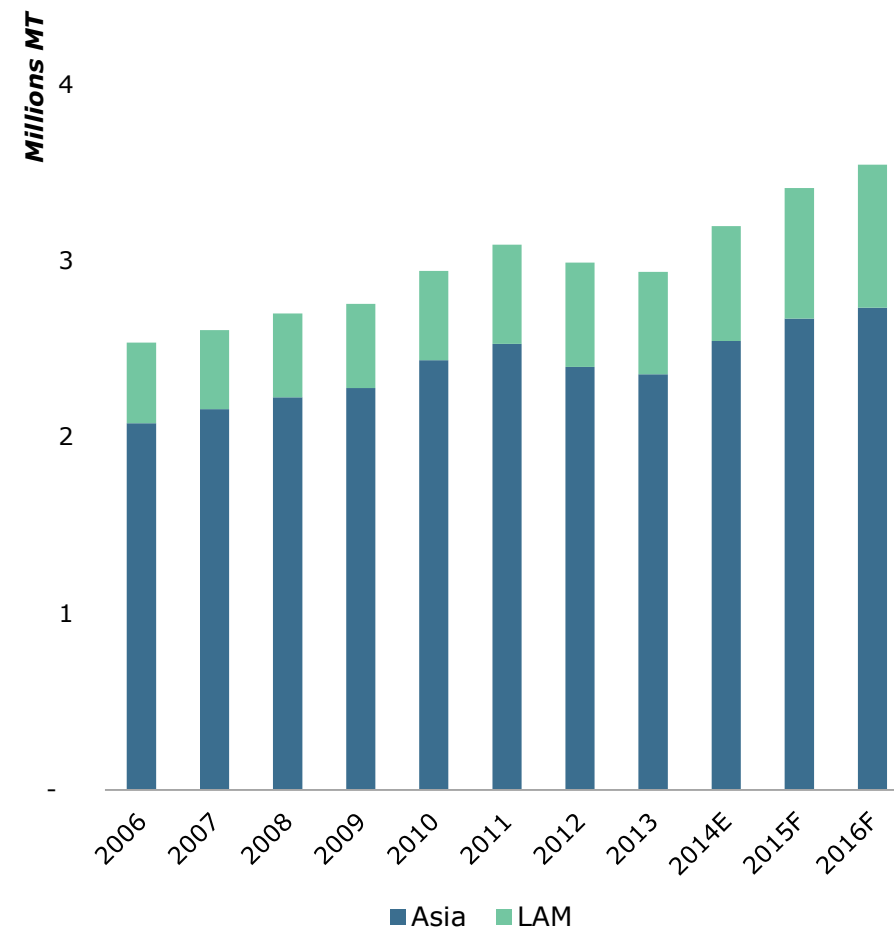


A very similar picture in the shrimp industry

Estimate on the global marine shrimp aquaculture (Vannamei and Monodon)¹



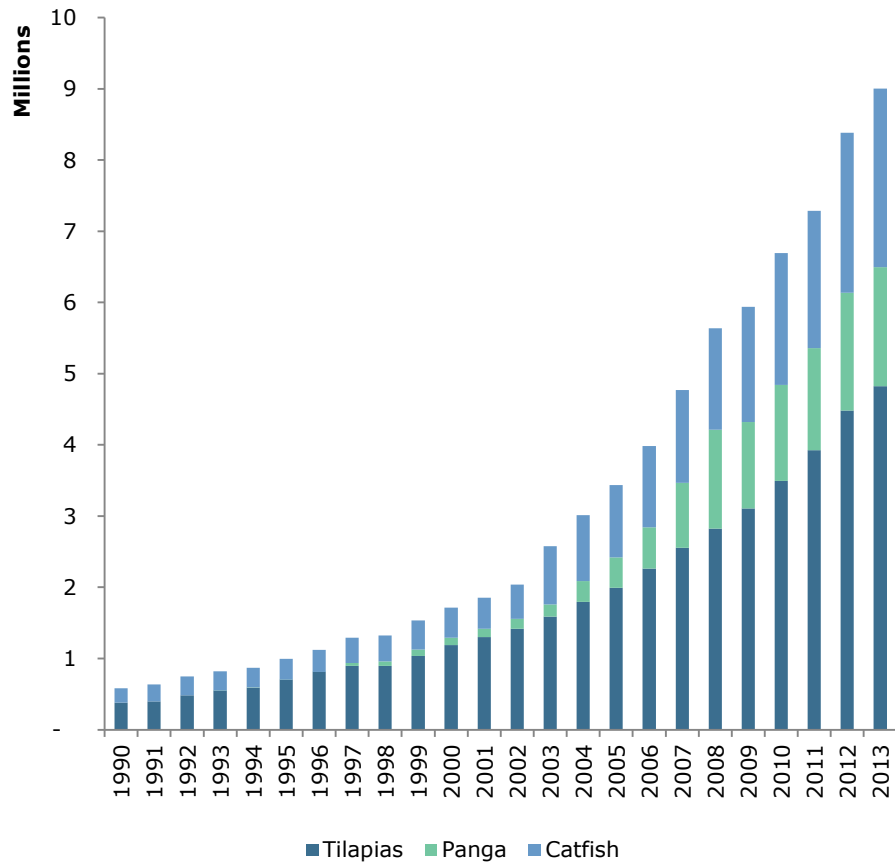
Price development of white and black tiger shrimps in the US



Rabobank, Food and Agriculture Organization, Uerner Barry (2014)
Note 1: Chinese production includes freshwater vannamei farming. *M. Rosenbergii* is not included
Note 2: FAO figures for 2012 has been adjusted due to suspected over reporting

In the case of Tilapia and Pangasius market development is the bottle neck

Aquaculture of selected fresh water species



Price development of Tilapia and Pangasius in the US



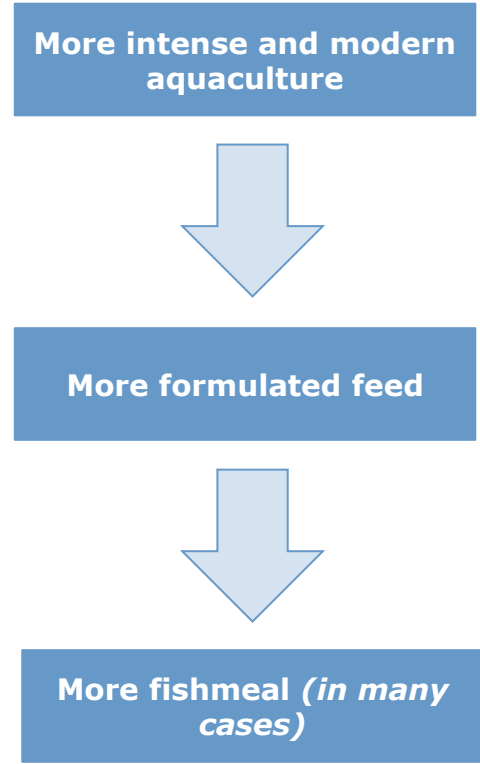
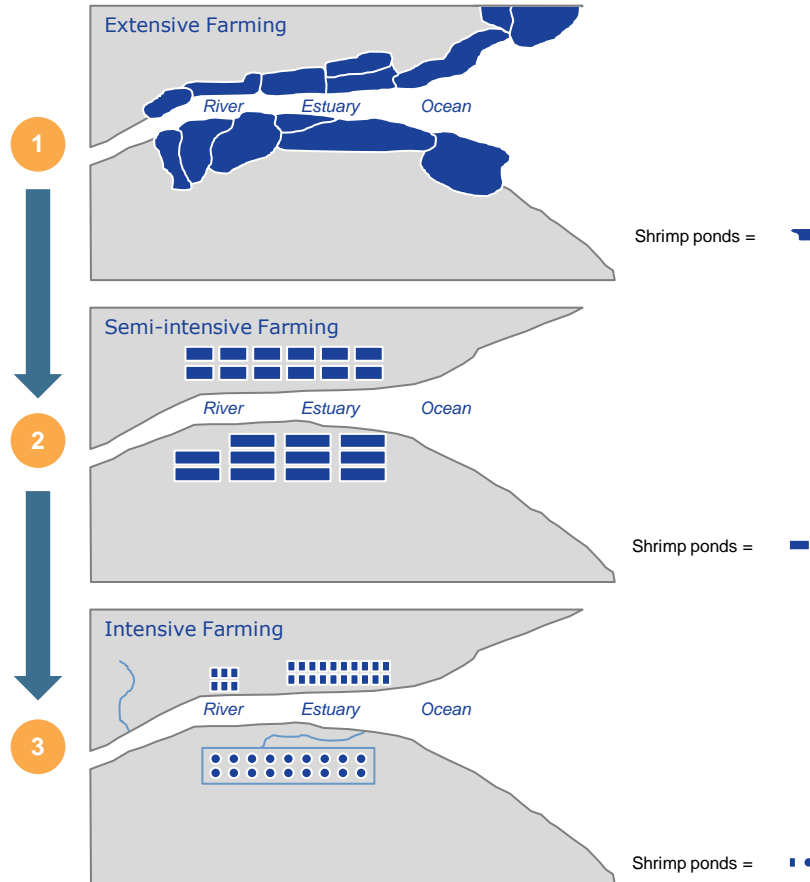
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Constraints in available land/water will cause intensification of aquaculture and consequent feed demand

Comment

Shrimp farm design evolution, an example of an industry switching to higher level of farming intensity

- **Shrimp, Tilapia, and even the Carp species are farmed in an increasingly more intensive way**
- **More intensity means more feed as here is less options for the animals to find feed in the environment**
- **So even with a very low fishmeal content it still means more demand for fishmeal**
- **In some cases as a strategic ingredient to accelerate farming process**





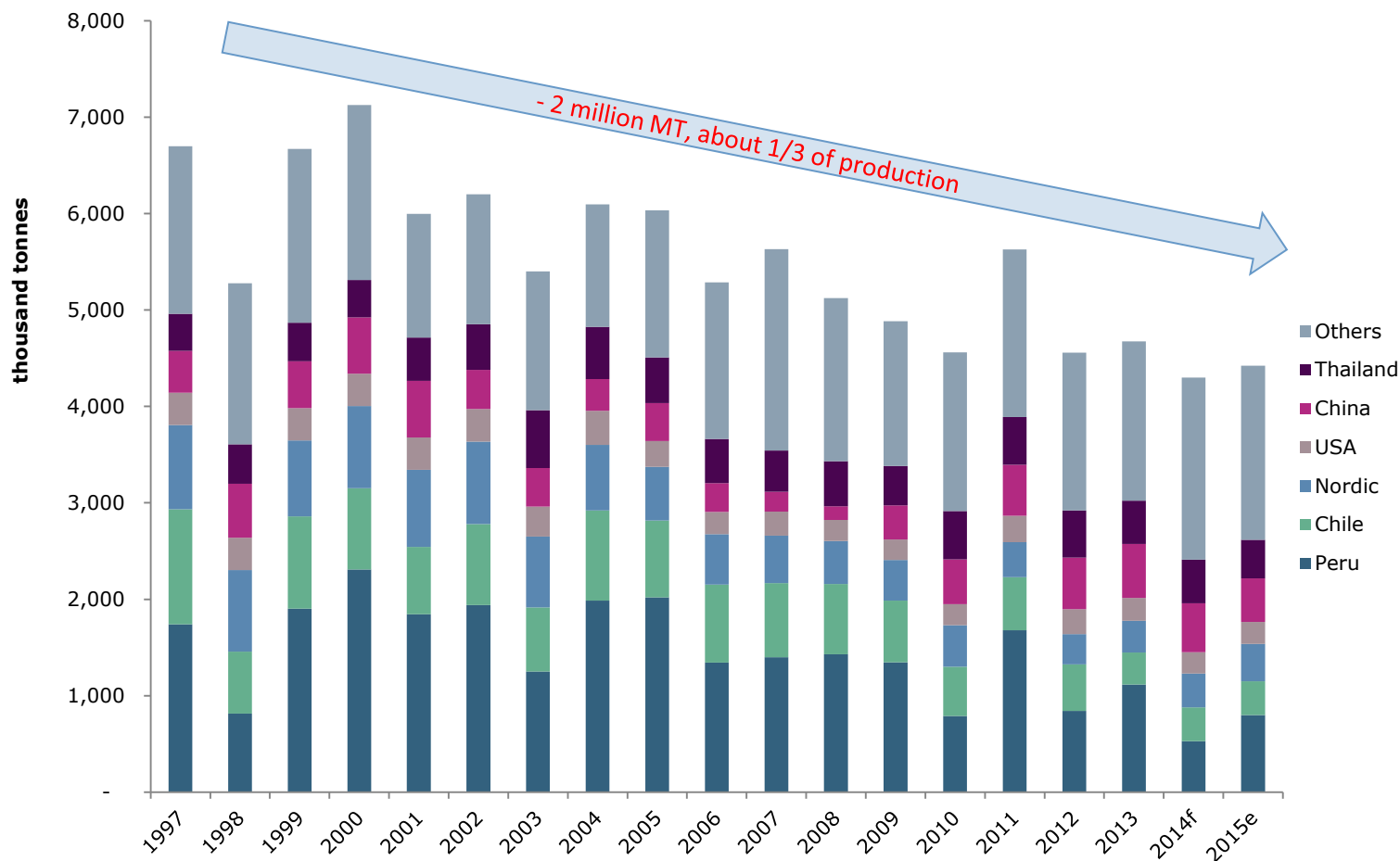
Supply of fishmeal may continue to decline, already down some 20% in past 15 years

Global supply of fish meal

- **Since 1997 fishmeal production has declined over 2 million tonnes approximately 20%**

WHY:

- **Lower catch of small pelagics. Unsustainable harvesting in the past?**
- **Climate change?**
- **Direct human consumption of pelagics**
- **According to FAO over 1.5 million tonnes of fish meal (above 35%) is now made out of trimmings, a relevant source**
- **Trimmings are increasingly used for human consumption and pet food**

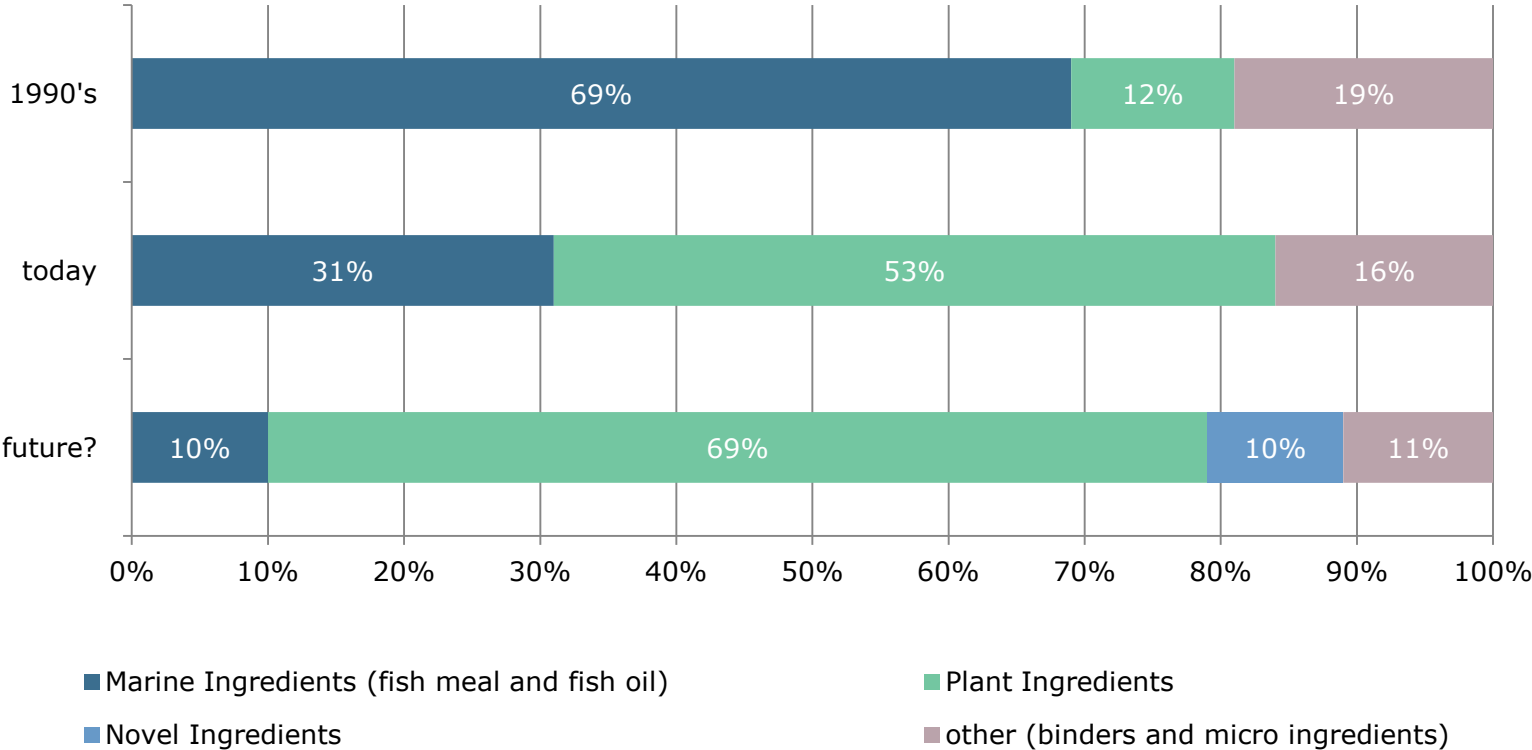


Aqua feed producers have done a great job in reducing fishmeal, it will be increasingly challenging to lower the inclusion further



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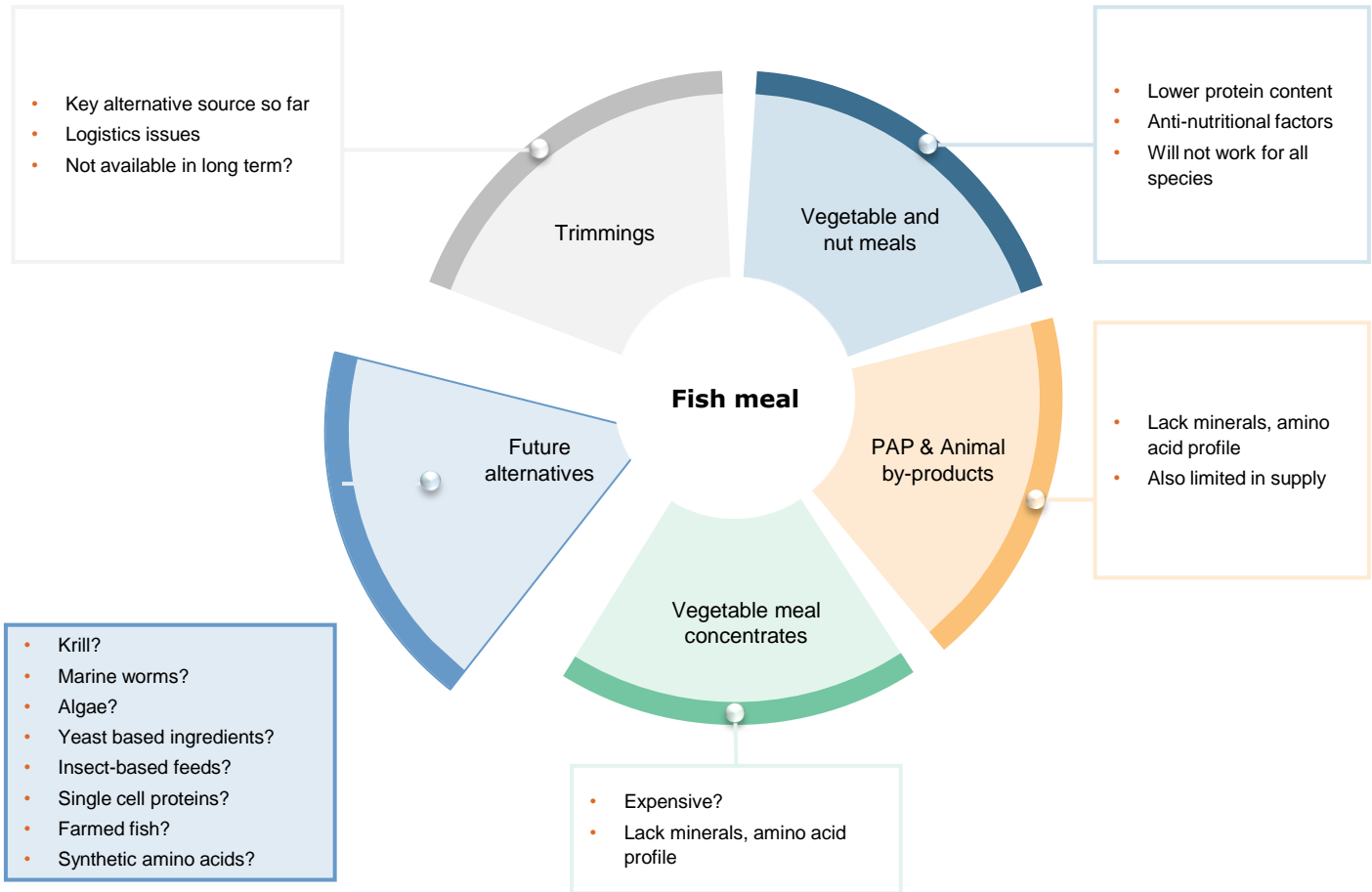
Salmon feed formula evolution



Source: EWOS 2015

Finding scalable alternatives is crucial

- **Veg. meals and PAP are available and cost efficient but lack certain properties to fully replace FM**
- **There is a long list of future options – non of which are currently available significant volume**



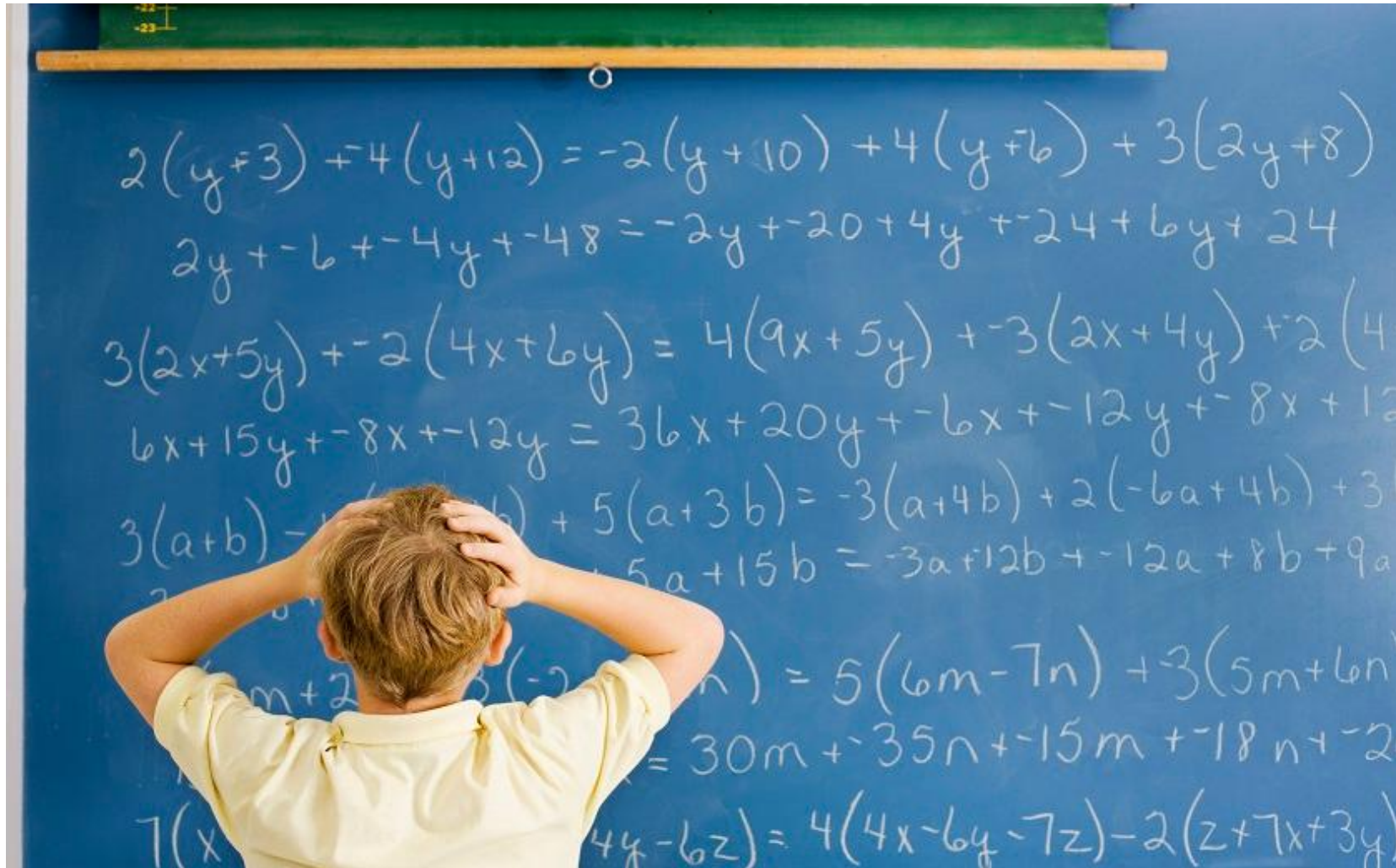
IV

Our view: growth in aquaculture will be enabled by unrivalled innovation



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Seafood has a more complex demand function than the other proteins and is highly influenced by local availability



Global seafood consumption going forward: two expectations

1. Global seafood demand growth depends on Asia and particularly China

The most rapidly expanding middle class in the world also has the highest preference for seafood consumption

2. Value growth will be key

Assuming change in species and higher level of processed products the value of seafood consumption is likely to grow much faster than volume



Key driver for growth: innovation by the entire value chain - from genetics up to new farming technologies



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Farming of new species



New Genetics



New Feed formulas



Farmed insects as raw material source



Single cell organisms as a feed source



New farming technologies

