World meat consumption patterns: an overview of the last fifty years (1961-2011).

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Introduction - 1

- Access to food determines the development of human societies and shapes dietary models (dietary quantities and patterns)
- 3 stages (Grigg, 1995 ; Popkin, 2006):
  - Subsistence economy
  - Dietary transition: quantitative growth in consumption of traditional foods
  - Nutritional transition: radical change in dietary structure
    - ✓ calorie saturation
    - ✓ more expensive foods such as meat, fruit and vegetables
- World Meat consumption: 23.1 kg /cap/year in 1961 → 42.20 kg /cap/year in 2011.
- Average levels of animal-based protein (ABP) consumption exceed needs in most developed countries.

Introduction - 2

- Some evidences of convergence in dietary models (↗ in ABP consumption)
  - High-income countries (Blandford, 1984; Gil, Gracia, & Perez y Perez, 1995; Herrmann & Röder, 1995)
  - Intermediate incomes (Regmi, Takeshima, & Unnevehr, 2008)
  - Emerging countries (Delgado, 2003; Speedy, 2003).
- Will emerging countries reach the same ABP consumption levels as developed countries?
  - Inflection point = income level beyond which ABP consumption falls off (Kuznets,1955).
    - ✓ calorie saturation
    - ✓ more expensive foods such as meat, fruit and vegetables
- Potential consequences may be incentives to change dietary practices:
  - Changes to nutritional recommendations (Reynolds et al., 2014)
  - Changes in consumers' behaviour: 'meatless days' / portion size (Dagevos & Voordouw, 2013; de Boer, Schosler, & Aiking, 2014).
  - Search for new sources of both plant and animal protein (Boland *et al.*, 2013; Verbeke *et al.*, 2014).

Introduction - 3

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Does global meat consumption follow an environmental Kuznets curve?

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150 countries for the period 1980–2009
Turning point for meat (bovine meat, pig meat and poultry) consumption for an high per capita income level (estimated at **US$36,400**)

2014

Curbing global meat consumption: Emerging evidence of a second nutrition transition

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120 countries for the period 1970–2007

The turning point lies between **US$32,000** and **US$55,000**.

Before: +1% GDP → +0.5% meat consumption
After: +1% GDP → -1.2% meat consumption

Objectives

- To revisit the increase in ABP consumption in conjunction with the growth in income in emerging or developing countries.
- Detailed analysis for the period 1961-2011:
  - World total protein and ABP consumption at the end of the period to identify the main trends.
  - Analysis of the evolution of ABP and meat-based protein (MBP) for the entire period.

Material & methods - 1

Data

- FAO food balance sheets for the period currently available (1961–2011)
- National per capita supply at a retail level :

  (national production + import + stocks)

  –

  (exports + feed + non-food usage + usage input for food + wastage + closing stocks).

- Per capita availability is calculated by dividing total availability by the country's population size
- Relevance:
  - Supply ≠ Consumption
  - Times series, useful for measuring changes and for highlighting differences between countries or geographical regions

Material & methods - 2

Data

FAO	World Bank
Calories (/cap/day)	Annual per capita Gross Domestic Product (GDP)
Protein intake (/cap/day)	Income group
Proportions of plant and animal protein intake	Population
Proportions of animal protein types	Urbanization rate (2005-2011)
Meat (including offals)	
Milk products	
Fish and Seafood products	
Others (mainly eggs)	

Low income		Lower middle income			Upper middle income			High income: non OECD	High income: OECD	
Afghanistan	Nepal	Armenia	Moldova	Vanuatu	Albania	Fidji	Romania	Antigua and Barbuda	Australia	Netherlands
Bangladesh	Niger	Bolivia	Mongolia	Vietnam	Algeria	Gabon	Serbia	Barbados	Austria	New Zealand
Benin	Rwanda	Cabo Verde	Morocco	West Bank and Gaza	Angola	Grenada	South Africa	Bermuda	Belgium	Norway
Burkina Faso	Sierra Leone	Cameroon	Nicaragua	Zambia	Argentina	Hungary	St. Lucia	Croatia	Canada	Poland
Cambodia	Somalia	Djibouti	Nigeria		Azerbaijan	Iraq	St. Vincent and the Grenadines	Cyprus	Chile	Portugal
C. African Republic	Tajikistan	El Salvador	Pakistan		Belarus	Jamaica	Suriname	French Polynesia	Czech Republic	Slovak Republic
Chad	Tanzania	Georgia	Paraguay		Belize	Jordan	Thailand	Hong Kong SAR, China	Denmark	Slovenia
Ethiopia	Togo	Ghana	Philippines		Bosnia and Herzegovina	Kazakhstan	Tunisia	Kuwait	Estonia	Spain
Guinea	Uganda	Guatemala	Samoa		Botswana	Lebanon	Turkey	Latvia	Finland	Sweden
Guinea-Bissau	Zimbabwe	Guyana	Senegal		Brazil	Libya	Turkmenistan	Lithuania	France	Switzerland
Haiti		Honduras	Solomon Islands		Bulgaria	Malaysia		Macao SAR, China	Germany	United Kingdom
Kenya		India	Sri Lanka		China	Maldives		Malta	Greece	United States
Liberia		Indonesia	Sudan		Colombia	Mauritius		New Caledonia	Iceland	
Madagascar		Kiribati	Swaziland		Costa Rica	Mexico		Saudi Arabia	Ireland	
Malawi		Kyrgyz Republic	Syrian Arab Republic		Cuba	Montenegro		St. Kitts and Nevis	Israel	
Mali		Lao PDR	Timor-Leste		Dominica	Namibia		Trinidad and Tobago	Italy	
Mozambique		Lesotho	Ukraine		Dominican Republic	Panama		United Arab Emirates	Japan	
Myanmar		Mauritania	Uzbekistan		Ecuador	Peru		Uruguay	Luxembourg	

Material & methods - 3

Statistical analysis

- 183 countries (155 with full data for the period 1961–2011)
- 3 steps:
  - Analysis by WB income group
    - ✓ Average of the latest three years available (2009–2011 = 2011)
    - ✓ Simple regressions between one chosen indicator and per capita GDP (in natural log form)
    - ✓ Adjusted R-squared (R2) recorded
  - Change in calorie and protein intake (with plant/animal subgroups)
    - ✓ Between 1961-1963 (1961) and 2009-2011 (2011) / 155 countries (full data)
    - ✓ Simple regression with per capita GDP (in natural log form)
  - Analysis of Animal-Based-Protein (ABP) and meat protein intakes for a group of six countries
    - ✓ Between 1961-1963 (1961) and 2009-2011 (2011).

Results: Analysis by income group (2009-2011 = 2011)

Table 1: Calorie and protein intake by income level

Income Group	Low	Lower middle	Upper middle	High non OECD	High OECD	World
n	28	40	46	30	18	162
Population (billions)	0.69	2.31	2.25	0.06	0.99	6.88
Gross Domestic Product (USD)	566	2 025	6 685	26 919	41 190	9 430
Urbanization (% population)	30.1	45.4	61.5	68.7	77.8	52.0
Total calories (kcal/pers/d)	2 287	2 597	2 896	2 987	3 363	2 847
Protein (g/pers/d)	58	69	82	94	104	80
Animal protein (% total calories)	2.2	3.7	5.2	7.4	7.4	4.4
Animal protein (% total protein)	21.9	34.6	45.4	58.5	59.5	39.4
Meat protein (g/pers/d)	6	12	19	30	30	15

Results: Changes in protein consumption 1961-2011

Proportion of protein in calorie intake

- The proportion of protein in the calorie intake is stable between the two extremes of the period:
  - 1961: 10.7% (min=6.1, max=16.1)
  - 2011: 11.2% (min=6.6, max=15.7).
- This proportion is weakly correlated with per capita GDP, even if it rose slightly over the period (R2=0.12 in 1961 versus 0.35 in 2011).
- The share of plant protein in calorie intake falls (from 6.9% to 6.3%) to be replaced by Animal-Based Protein (ABP) intake (which rises from 3.8% to 4.9%):
  - Plant protein : weak negative correlation with GDP (R2=0.44 in 1961 versus 0.49 in 2011)
  - ABP : positive correlation with GDP (R2=0.5 in 1961 and 0.62 in 2011)

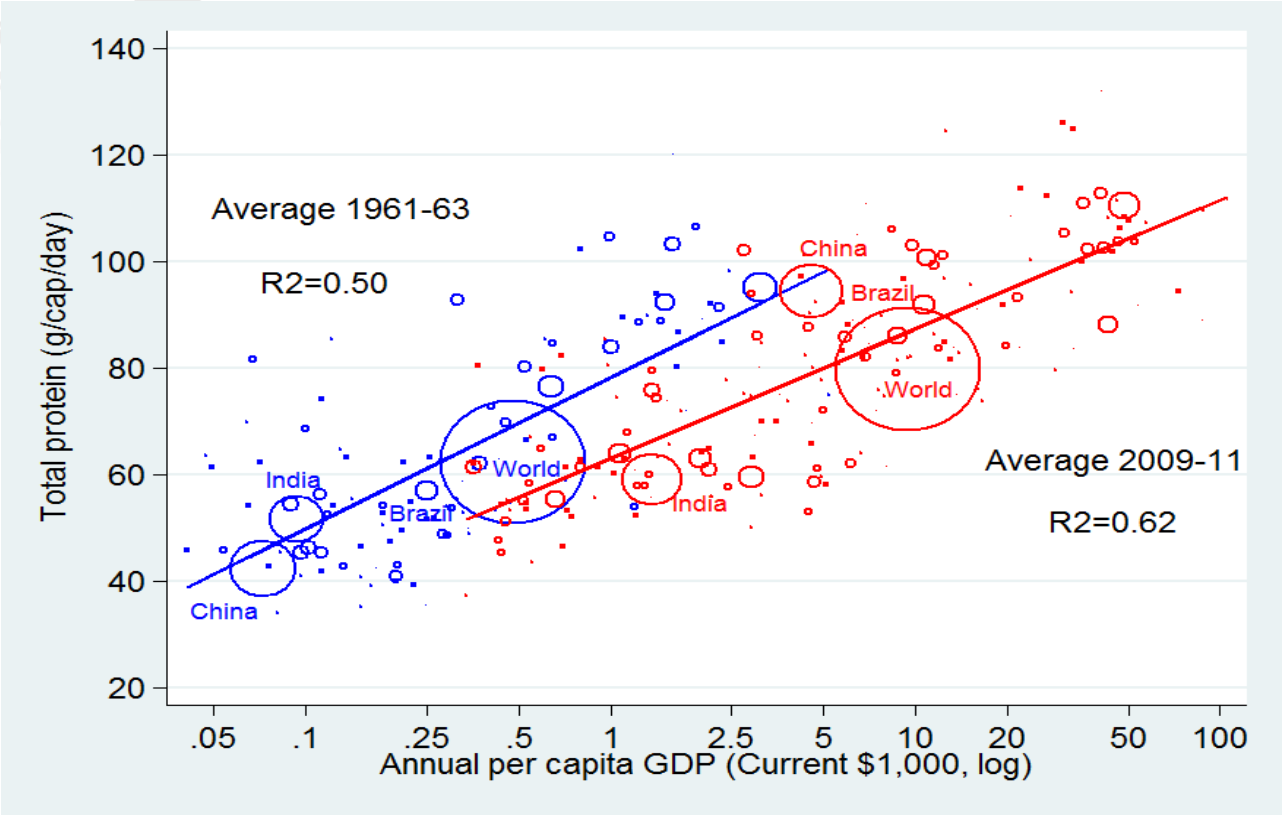
Results: Changes in protein consumption 1961-2011

Protein intake

	1961	2011	Evolution (%)
Total protein protein (g/pers/day)	61	80	+ 31
Plant protein	38	44	+ 16
ABP	23	36	+ 56
Share in total protein intake (%)			
Plant protein	62	55	- 7
ABP	38	45	+ 7

- Total protein intake levels remain highly variable depending on the countries and positively correlated with per capita GDP.

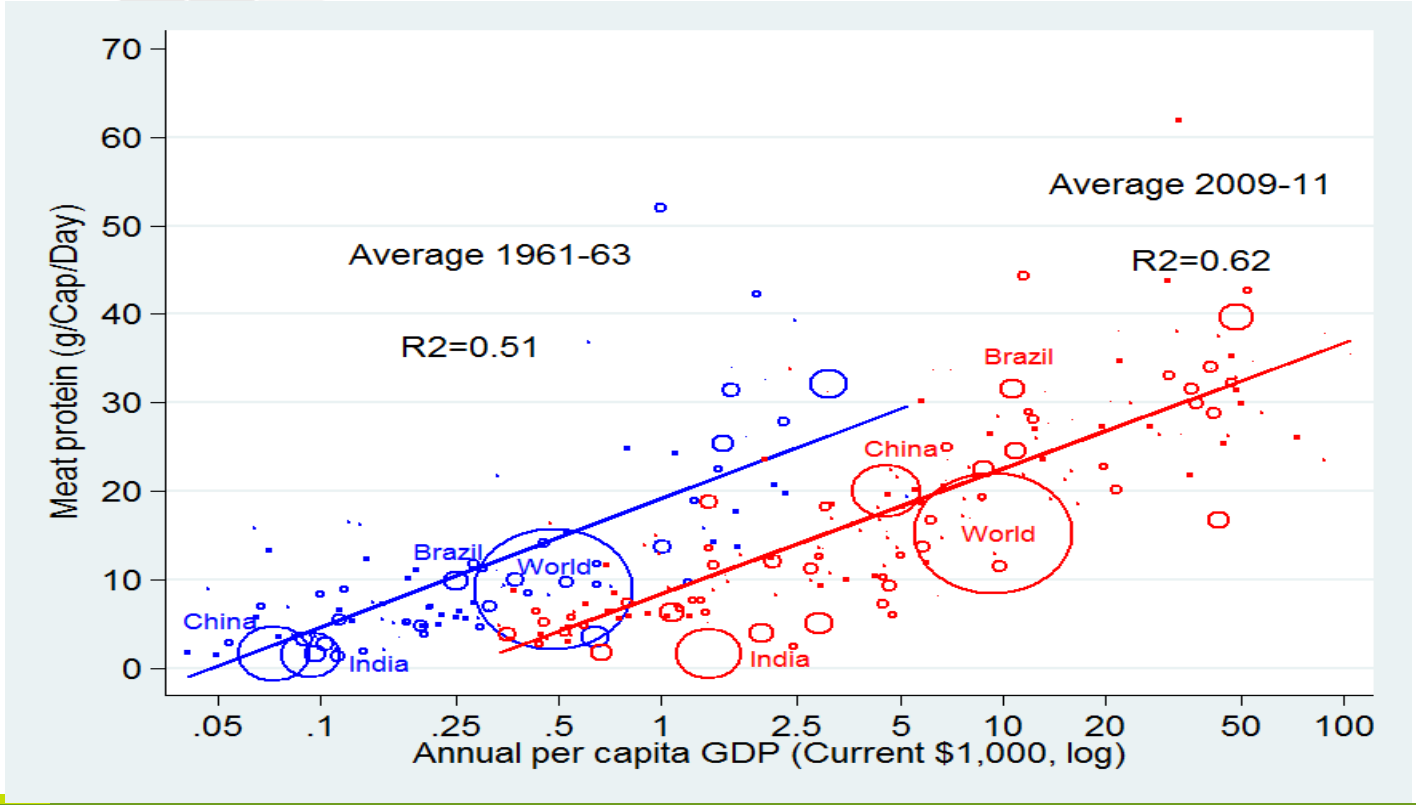
Change in total protein intake versus per capita Gross Domestic Product (GDP)



Changes in meat protein consumption

- Consumption of meat protein rose worldwide from 9 to 15 g per person per day between 1961 and 2011
- Trend is observed in all geographical zones defined by the FAO:
  - Strongest rises in absolute value (> 15 g/person/d) for Polynesia, Southern Europe and Eastern Asia
- Intake levels remain very different:
  - for geographical zones (2011):
    - ✓ Min=2.9 g/person/day for Southern Asia
    - ✓ Max=39.9 g/person/day for Oceania
  - between countries, with few major trends for protein from meat consumption:
    - Positive correlation with annual per capita GDP
    - Positive correlation with urbanization (R2=0.40)
    - Level in 1961 is a poor predictor of meat consumption in 2011 (R2=0.05)

Change in protein from meat versus per capita Gross Domestic Product (GDP)



Differences among countries remain important

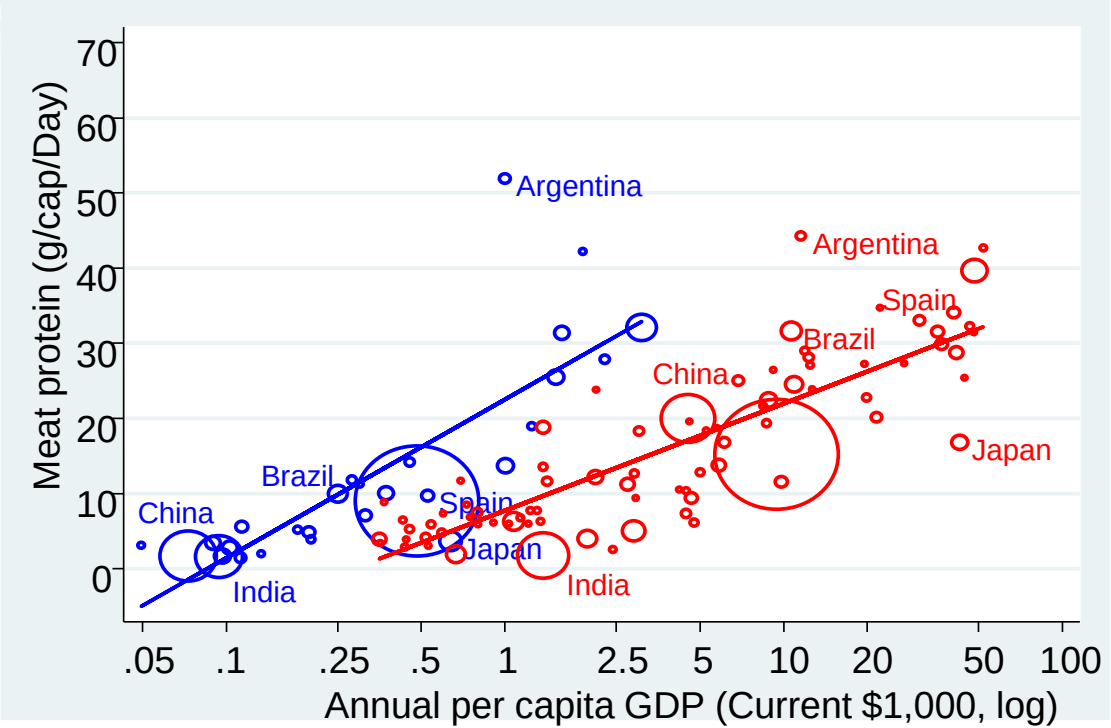
- Although variations in meat protein consumption are closely related to increases in GDP, the effects are not of the same magnitude for all countries.
- This situation can be explained by:
  - very different initial intake levels,
  - differentiated progression during the study period,
  - the relative place of meat in protein intake in each of these countries.
- Illustration for 6 countries : Argentina, Brazil, China, India, Japan, Spain

Changes in Animal Based Protein (and meat) consumption in six countries

	Argentina	Brazil	China	India	Japan	Spain
Animal protein (g/pers/day)						
1961	65.9	18.0	4.2	6.1	26.1	28.1
2011	64.1	49.0	37.2	11.9	48.7	65.8
Major animal protein source* (% of total animal proteins)						
1961	M (79)	M (55)	M (41)	Mi (63)	F (63)	M (35)
2011	M (69)	M (64)	M (53)	Mi (64)	F (38)	M (50)
Meat protein (g/pers/day)						
1961	51.9	10.0	1.7	1.7	3.7	9.8
2011	44.3	31.6	20.0	1.8	16.9	33.1
Overall variation of annual per capita GDP (Current US$1,000)	10.5	10.4	44.7	12.8	42.3	30.2

*: M=Meat ; Mi=Milk ; F=Fish & Seafood products

Change in protein from meat versus per capita Gross Domestic Product (GDP) 6 countries

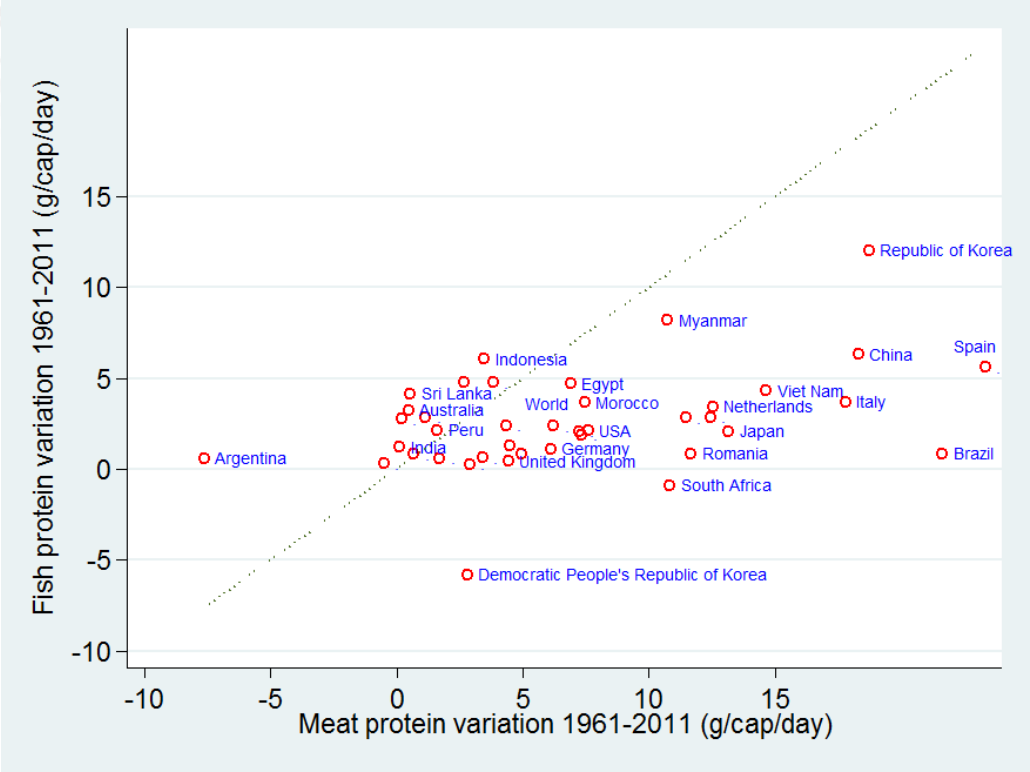


Changes meat protein consumption and variation in per capita income

	Argentina	Brazil	China	India	Japan	Spain
Overall variation of annual per capita GDP (Current US$1,000)	10.5	10.4	44.7	12.8	42.3	30.2
Share of the overall annual per capita GDP variation (%)						
P1*	11.8	14.2	2.2	9.0	17.3	13.0
P2	57.8	18.6	6.9	11.0	73.2	30.7
P3	30.4	67.2	90.1	80.0	9.5	56.3
Variation of meat protein (g/pers/day)						
P1	2.3	3.2	2.3	- .1	6.7	14.8
P2	- 9.6	8.6	7.4	.2	5.0	11.1
P3	- .3	9.8	8.6	.0	1.5	- 2.5
Overall	-7.6	21.6	18.3	.1	13.2	23.3

*: P1: 1961–1977 P2: 1977–1993 P3: 1993–2011 Overall: 1961–2011

Variation in meat and fish protein consumption
(countries > 10 million inh. in 2011)



Discussion: Dynamics of ABP consumption and income

- In 2011, the share of calories provided by ABP varied by a ratio of about 1 to 3 between the lowest and the highest-income countries.
- We confirm a close correlation (R2=0.91) between the calorie intake and annual per capita GDP (Gerbens-Leenes *et* al., 2010 ; Popp, Lotze-Campen, & Bodirsky, 2010).
- ABP intake has risen per person per day worldwide but the situation observed in 2011 also reveals large variations in intake between high- and low-income countries:
  - ABP = 21.9% of total protein intake in the low-income (*vs* 60% in the high-income)
  - Meat protein = 6g/person/day vs 30g/person/day
- Meat proteins are the major contributors worldwide to the increase in ABP.
  - The growth in meat protein consumption has not occurred to the detriment of other protein sources (such as fish) but contributes to a rise in overall ABP consumption.
  - We confirm the positive correlation between meat protein consumption and per capita income (Kearney, 2010) and rate of urbanization.

Discussion: Dynamics of ABP consumption and country

- Approaches by large geographical region or by income group are relevant to identify the main trends in dietary patterns.
- Nevertheless, they must be supplemented by studies at finer geographical levels.
- Cultural and religious factors are important to explain differences in dietary patterns (Grigg, 1995).
  - Ex: meat protein consumption in Asia (Nam *et al.*, 2010)
  - Catholic vs Protestant countries in Europe (de Boer *et al.*, 2006)
  - Ethnic groups in USA (Wang *et al.*, 2010 ; Daniel *et al.*, 2011).

Conclusion

- In the space of a few decades, dietary structure of many emerging and developing countries has changed radically.
  - Changes have occurred at a far faster rate than in developed countries in the twentieth century.
- The increase in animal protein consumption is a marker of the nutritional transition.
  - It is largely related to growing consumption of meat protein.
- The trend is expected to continue for the next ten years at an average rate of 1.6% per year:
  - Essentially in developing countries (OECD-FAO, 2014)
  - Increase of per capita income, continuing urbanisation and demographic growth (OECD-FAO, 2014 ; Msangi & Rosengrant, 2011)
  - Changes in dietary offer, distribution circuits and development of international trade.
- 'Westernisation' of diet takes various forms that affect the dissemination of the model.
- The prospect of generalisation of ABP consumption raises the question of its sustainability and invites us to explore the influence of new determinants of dietary behaviour.

Thank you for your attention