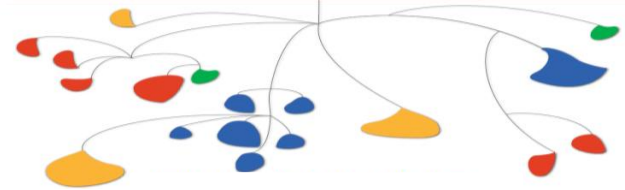


Modelling Feed Demand to monitor Sustainability

Bernhard Dalheimer

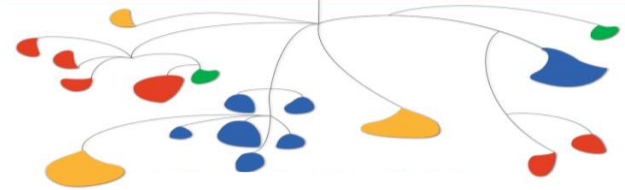
FAO Statistics

bernhard.dalheimer@fao.org



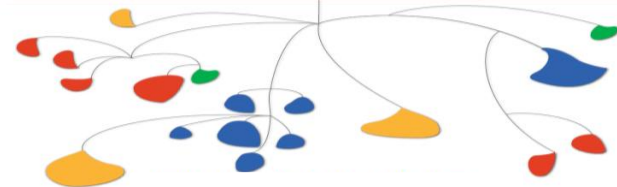
Presentation Outline

- Outline of the Model
- Results
- Validation

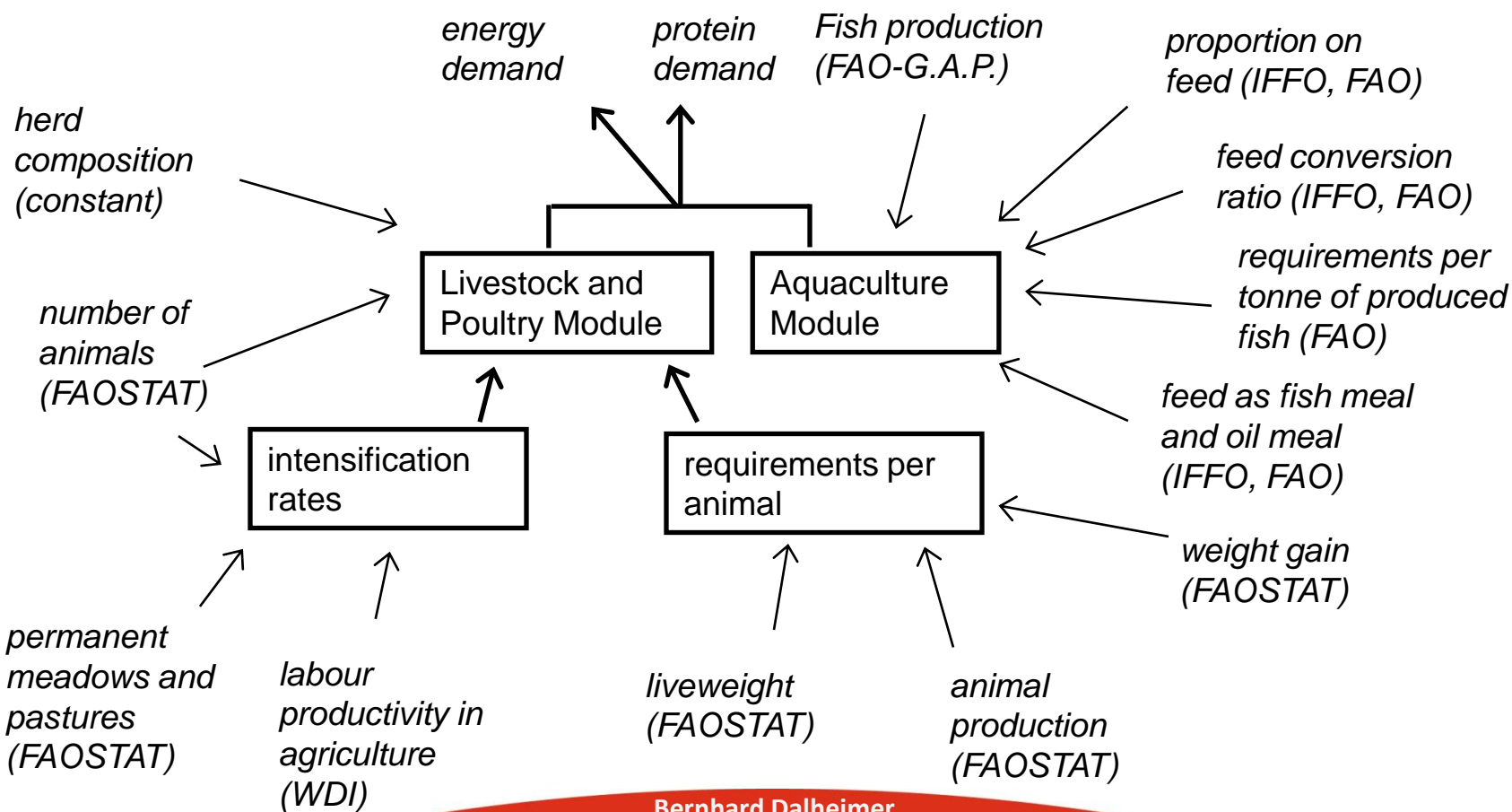


Motivation

- Increase accuracy in Feed Estimation
- Capture the dynamism in the livestock sector
- Increase opportunities for estimation of other uses (*e.g.* food, stocks, industrial utilization)



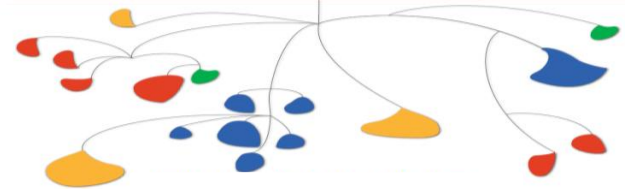
Outline of the Model



Bernhard Dalheimer

Modelling Feed Demand to Monitor Sustainability

Dairy Asia – Towards Sustainability, Bangkok, May 21, 2014, bernhard.dalheimer@fao.org

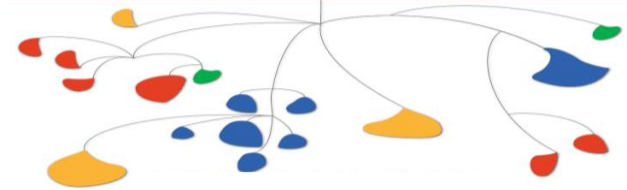


Outline of the Model

$$D^{Total} = D^{LS\&P} + D^{Aqua}$$

Livestock and
Poultry Module

Aquaculture
Module



Livestock and Poultry Module

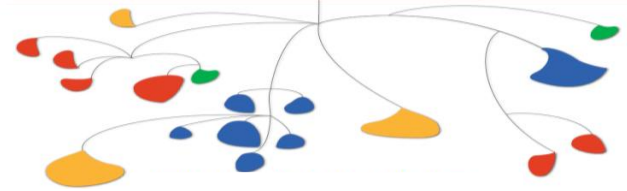
$$D_{c,t}^{LS\&P} = hr_0 \sum_i N_{i,c,t} S_{i,c,t} U_{i,c,t}$$

Herd adjustment factor \rightarrow $D_{c,t}^{LS\&P}$
 feed requirement of an animal unit \rightarrow hr_0
 number of animals \rightarrow $N_{i,c,t}$
 intensification rate \rightarrow $S_{i,c,t}$
 animal unit index \rightarrow $U_{i,c,t}$

i : animal species

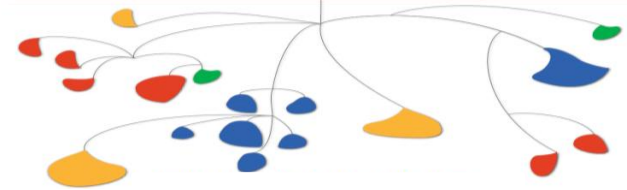
c : country

t : year



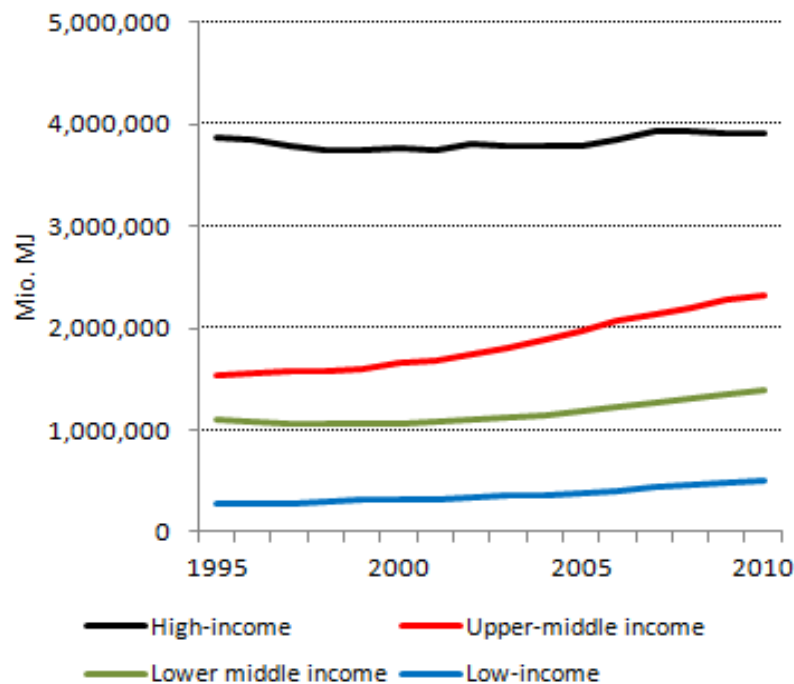
Results

- Time series for 225 countries from 1990 to 2011
- 4728 data points

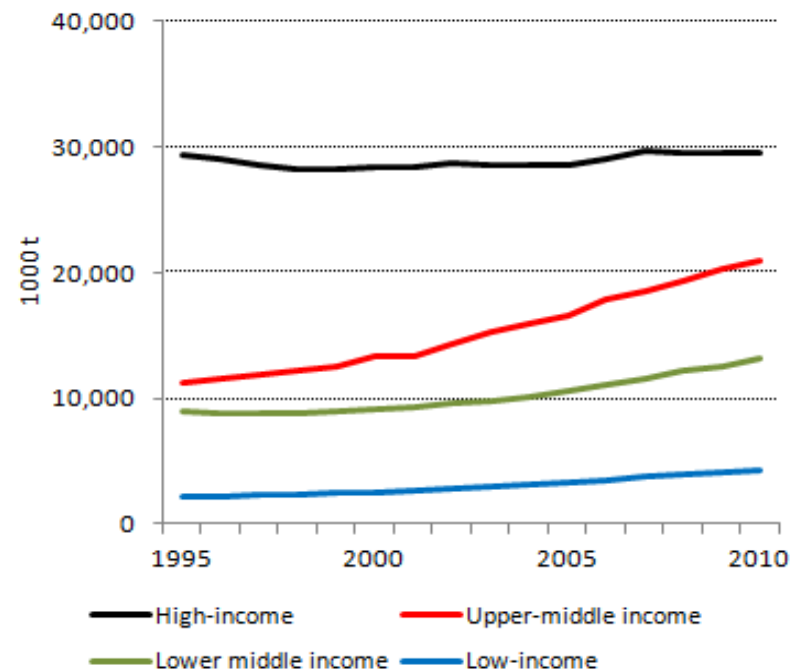


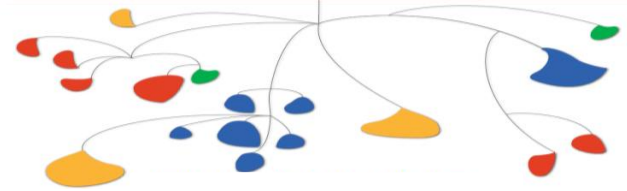
Calculated feed demand, by country group

- Energy Demand



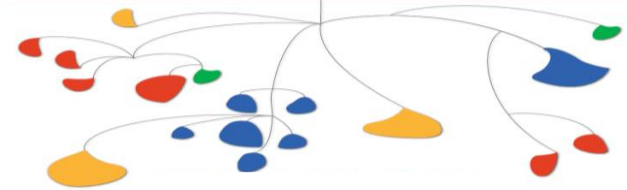
- Protein Demand



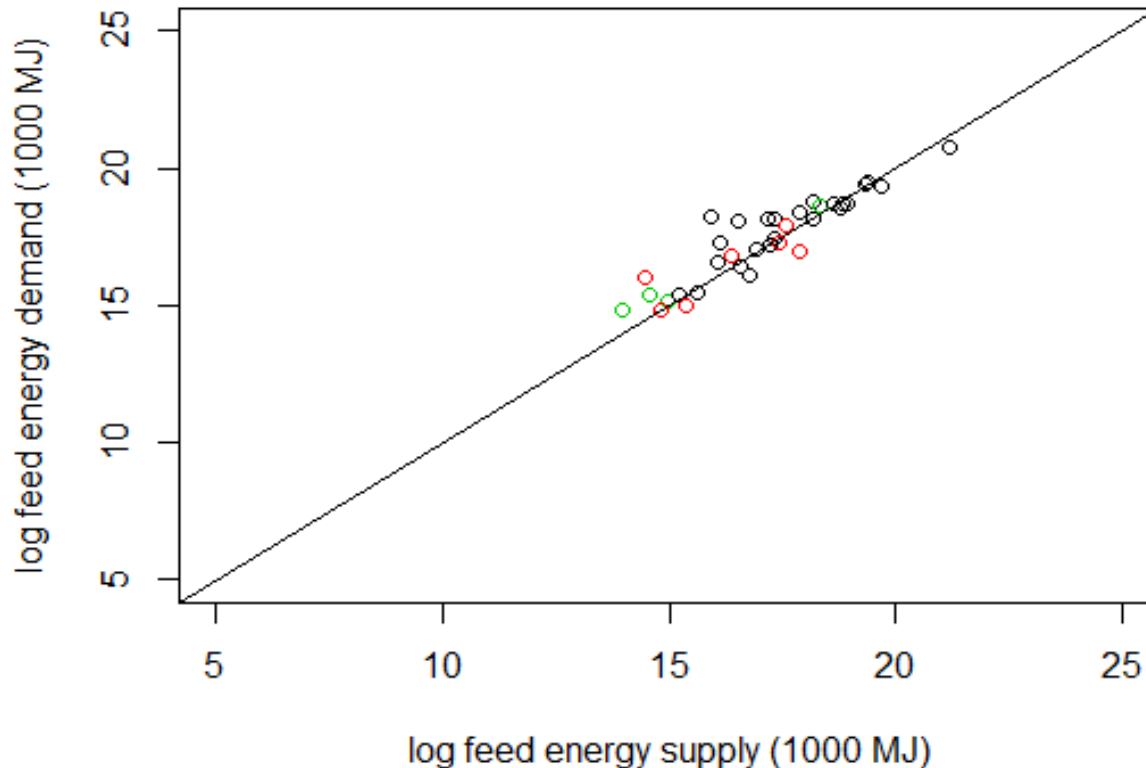


Validation

- Comparison with aggregated feed supply as recorded in FAOSTAT
- Quality check with AMIS country studies



Validation (1): Feed Energy Demand and Supply



N=36

corr=0.919

item coverage > 5

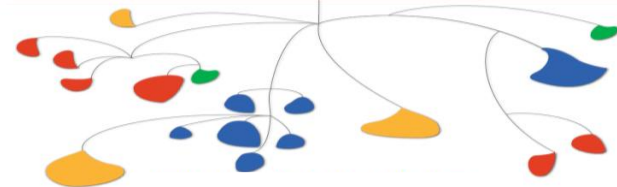
averages over the last 3 years with official or semi-official data

- high-income country
- lower-middle-income country
- upper-middle-income country
- low-income country

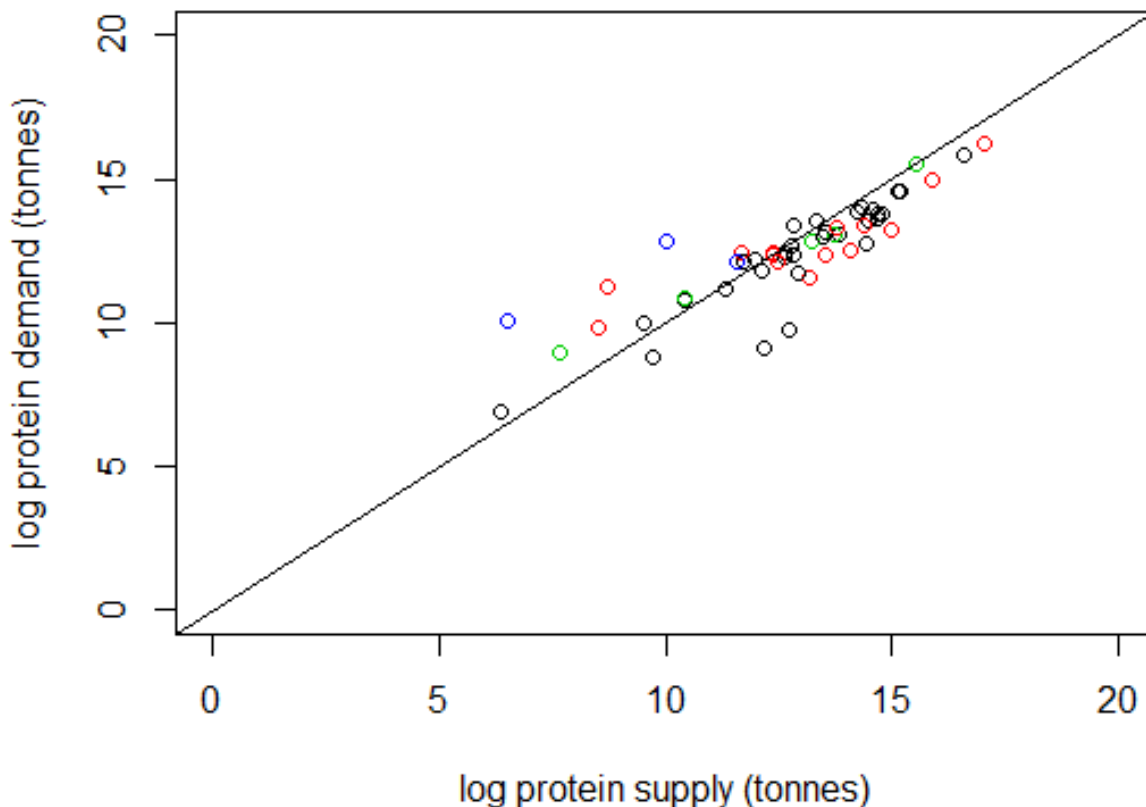
Bernhard Dalheimer

Modelling Feed Demand to Monitor Sustainability

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Validation (1): Feed Protein Demand and Supply



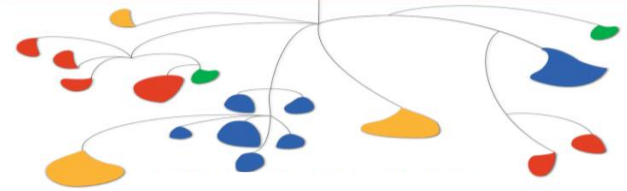
N=53

corr=0.873

item coverage > 5

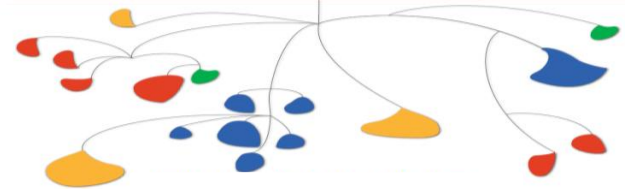
averages over the last 3 years with official or semi-official data

- high-income country
- upper-middle-income country
- lower-middle-income country
- low-income country

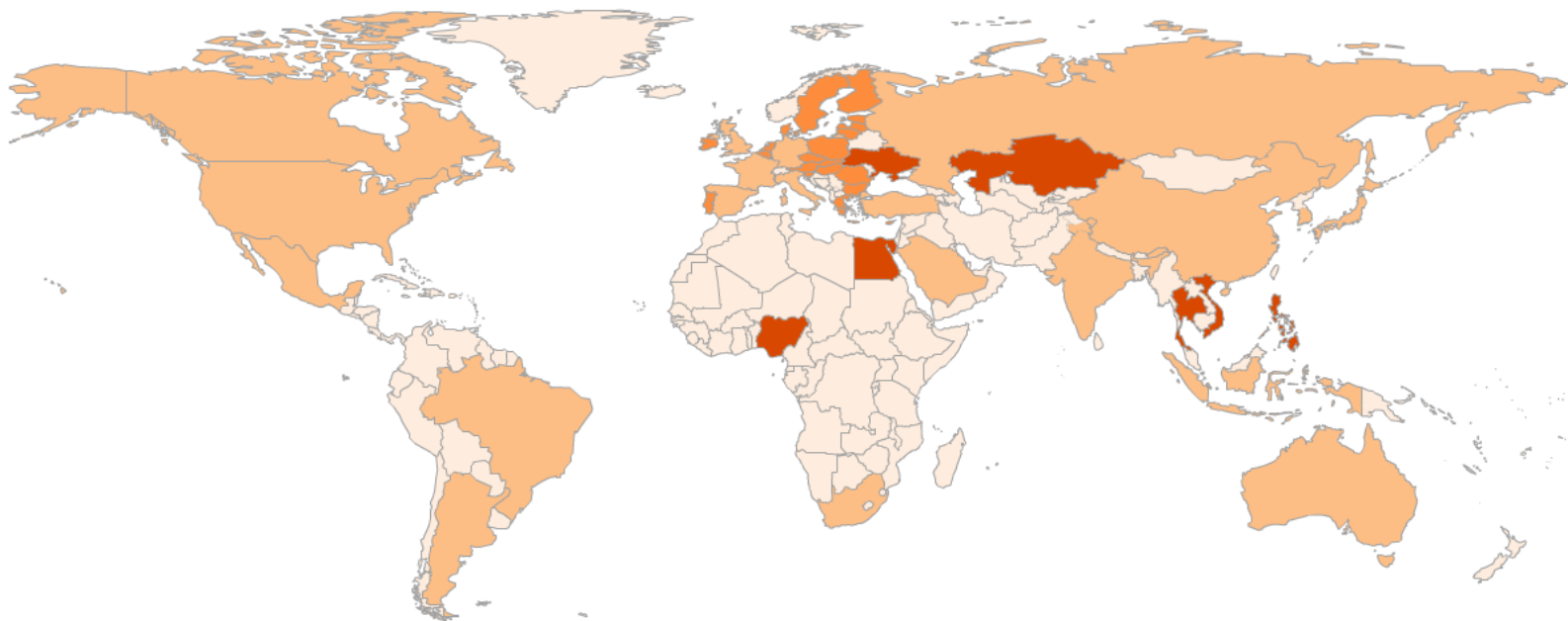





What is AMIS?

- A G20 initiative to increase food market transparency, reduce the likelihood of food price volatility
- Focus: production, utilization, stocks and trade
- Crops: wheat, maize, rice and soybeans
- Participants: G20 Members plus Spain and seven invited countries

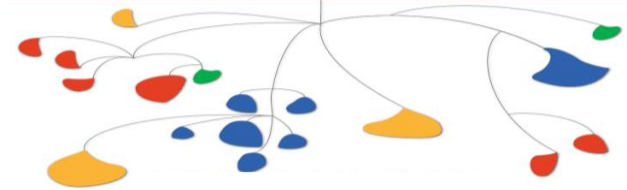


Global coverage



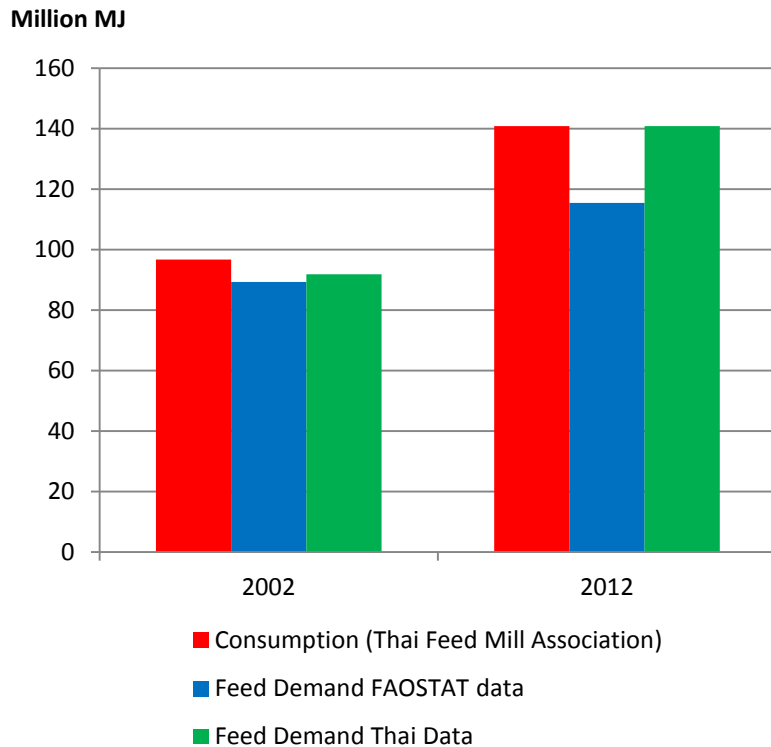
 G20 Members & Spain  Other EU Members*  Invited Countries

* Not participating in AMIS as individual countries, but collectively represented by the European Union

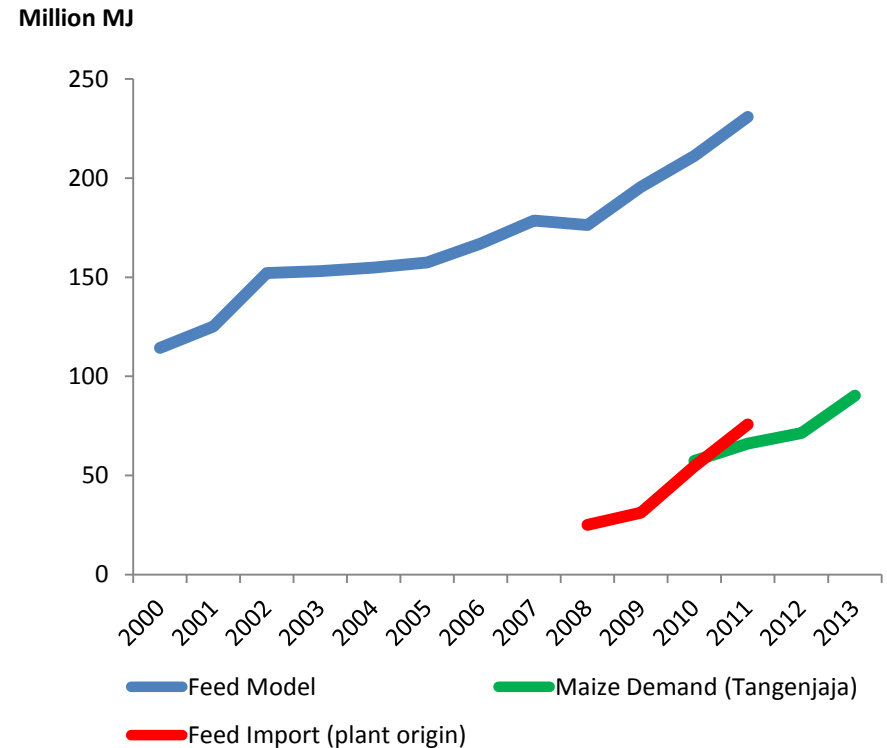


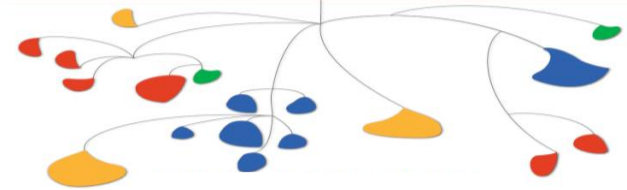
Validation (2): AMIS country Cases

- Thailand



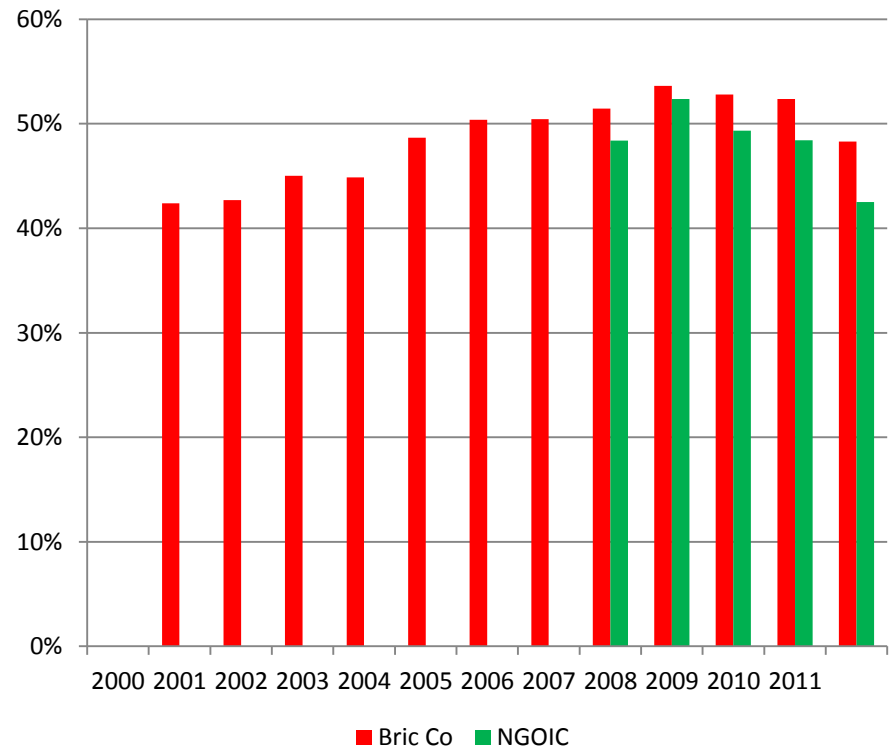
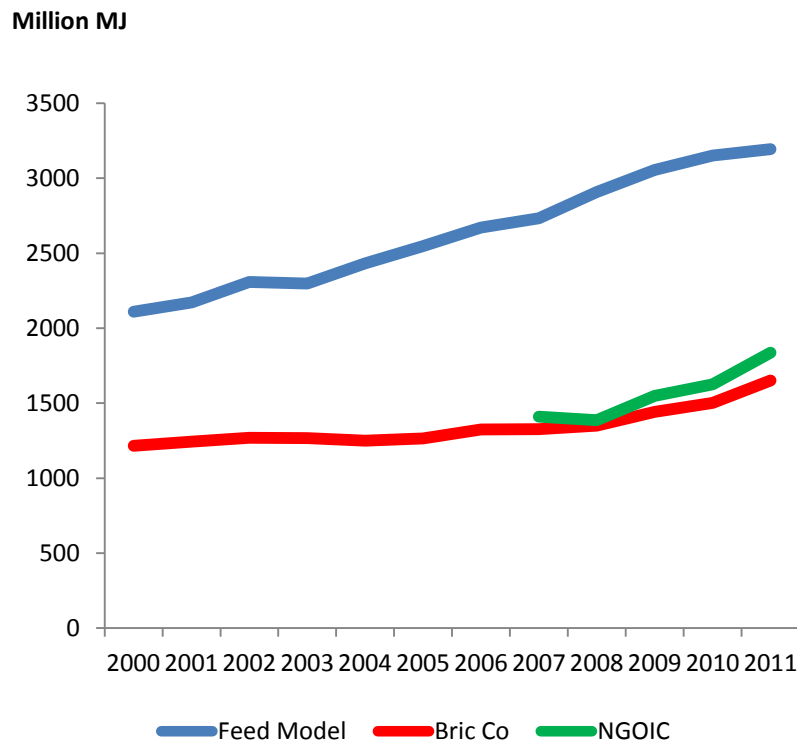
- Indonesia

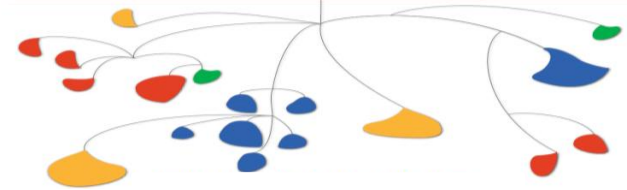




AMIS Country Case : China

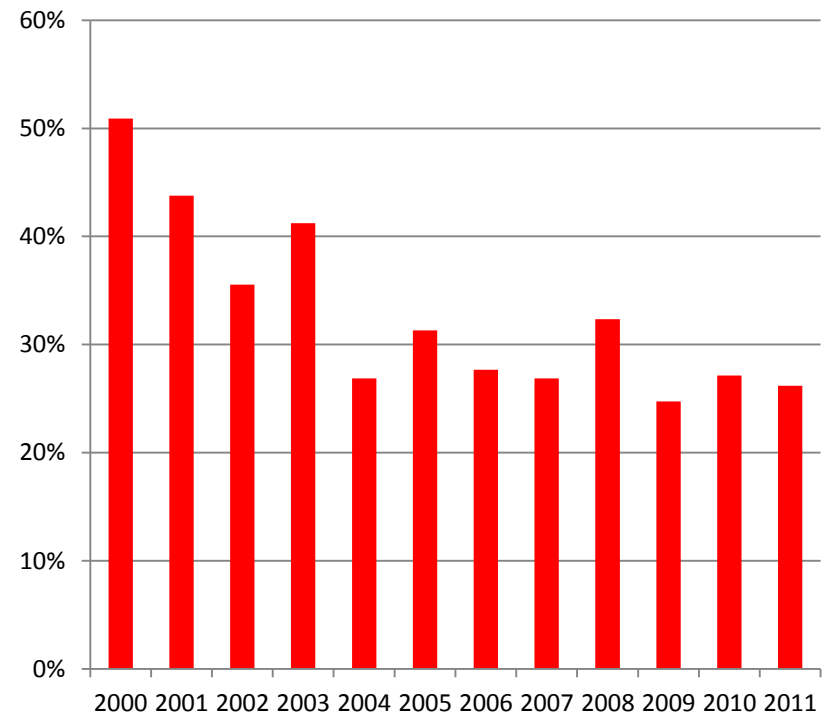
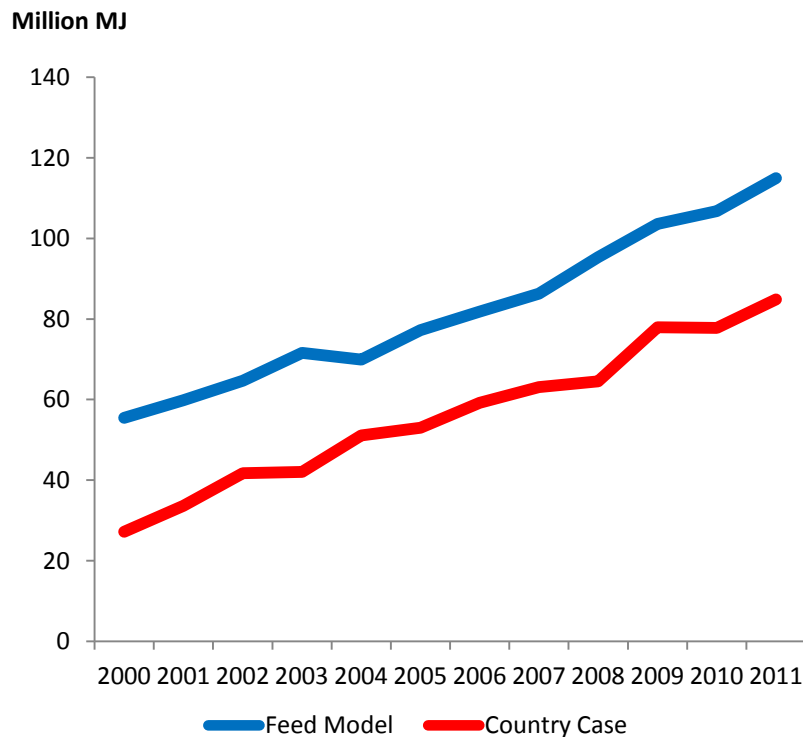
Feed Demand Model vs. two model results for estimated feed consumption of AMIS key commodities

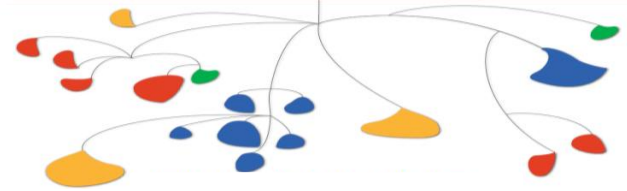




AMIS Country Case : Viet Nam

Feed Demand Model vs. estimated feed consumption of AMIS key commodities using Multi-Sector Dynamic Partial Equilibrium Model (Nguyen Ngoc Que, 2012)

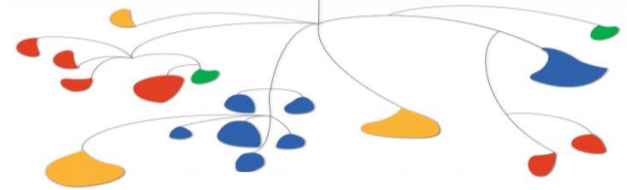




Way forward

- Harvesting, scrutinising and validating all relevant data, parameters and coefficients
- Exploiting data sources (*e.g.* arrangements for regular data exchange with data suppliers)
- Model re-specification / re-estimation to capture above
- Initiate further country studies (*e.g.* South Africa)
- Compilation of cereal balance sheets with improved estimates of livestock (energy) feed

=> improved statistics on global food availability and sustainability in feeding



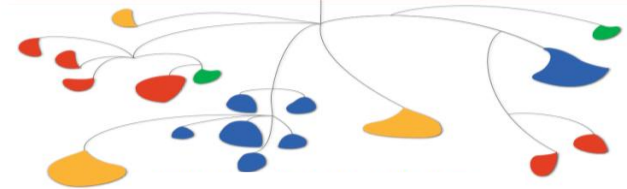
Thank you for your Attention!

For further information, please contact:

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Onno.Hoffmeister@fao.org

Adam.Prakash@fao.org



Annex 1-1: Calibrating Equations

Cattle:

$$\log s_{1Rt} = -1.89 + 0.22 \log LSD_{1Rt} - 0.18 D_R^{CSA} + 1.27 D_R^{OECD} + 1.69 D_R^{EE/CIS} + 0.004 t$$

(0.012) (0.007) (0.017) (0.017) (0.017) (0.001)

N=12 (6 groups), R²=0.9996

Sheep and goats:

$$\log s_{2Rt} = -1.99 + 0.32 \log LSD_{2Rt} - 0.25 D_R^{SSA} + 0.55 D_R^{OECD} + 1.52 D_R^{EE/CIS}$$

(0.028) (0.034) (0.057) (0.054) (0.053)

N=12 (6 groups), R²=0.992

Pigs:

$$\log s_{3Rt} = -2.55 + 0.23 \log LP_{Rt} - 0.56 D_R^{SSA} - 0.55 D_R^{WA/NA}$$

(0.482) (0.056) (0.137) (0.054)

N=12 (6 groups), R²=0.918

Poultry:

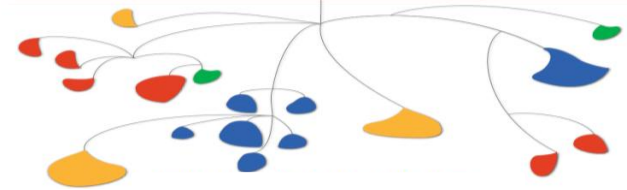
$$\log s_{4Rt} = -2.30 + 0.24 \log LP_{Rt} - 0.39 D_R^{SSA} - 0.23 D_R^{WA/NA}$$

(0.321) (0.038) (0.091) (0.076)

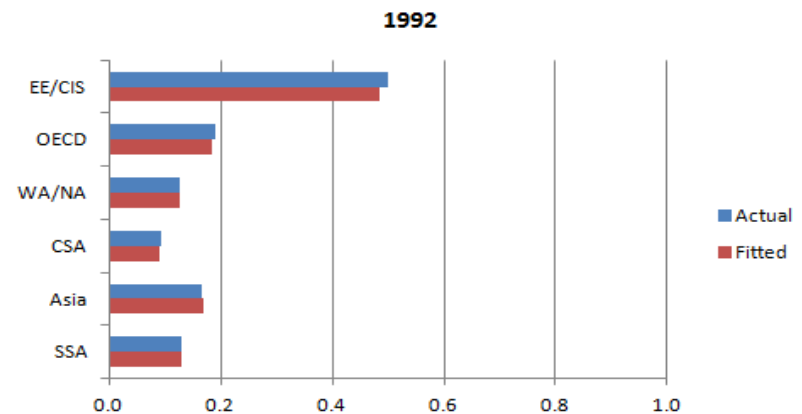
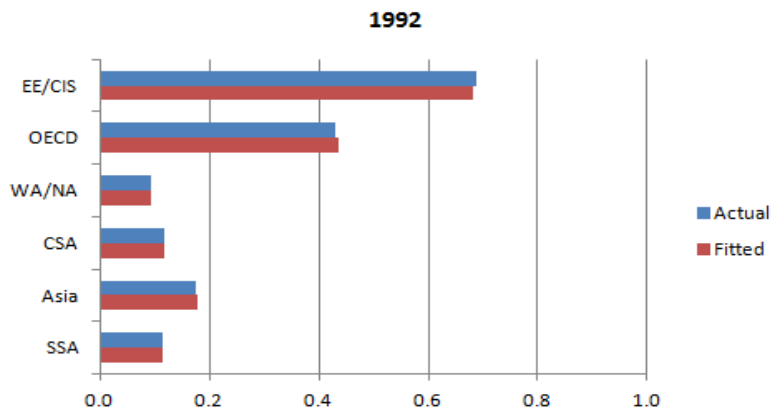
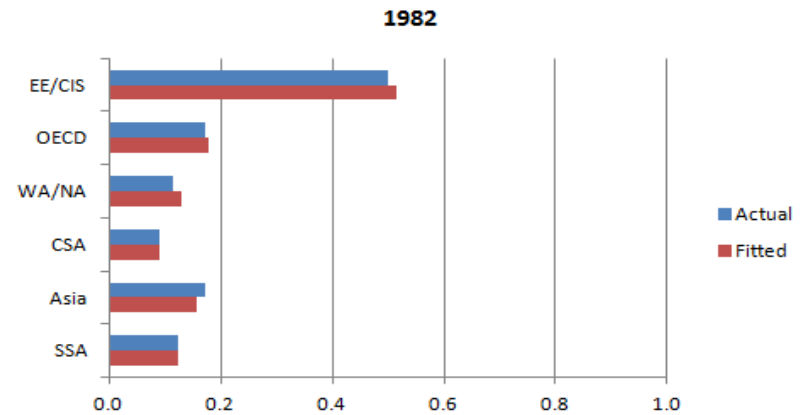
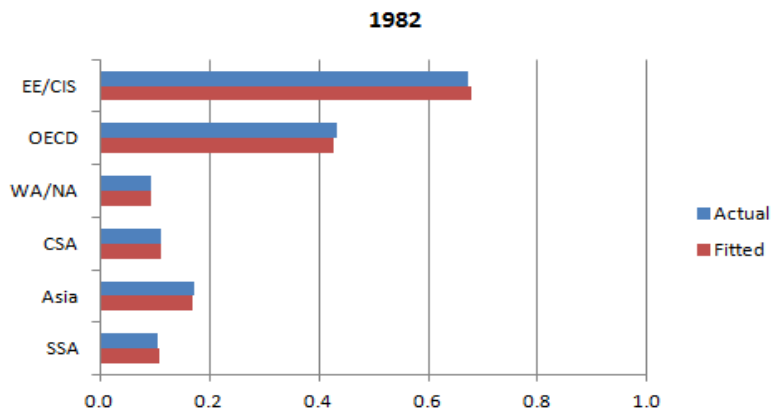
N=12 (6 groups), R²=0.940

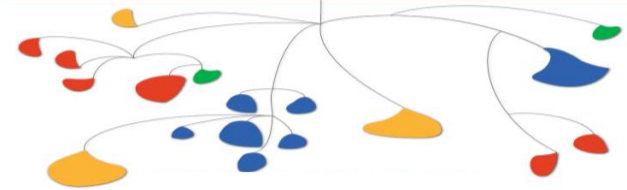
Coefficients estimated with OLS. Standard errors in parentheses.

No uncontrolled fixed effects or time trend. Residuals uncorrelated across equations.



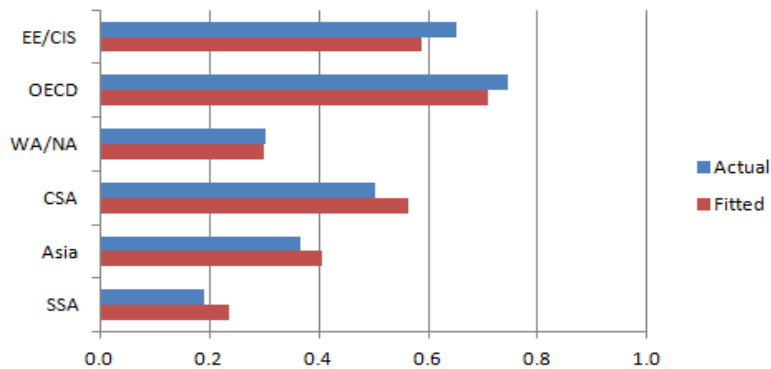
Annex 1-2: Actual and Fitted IRs



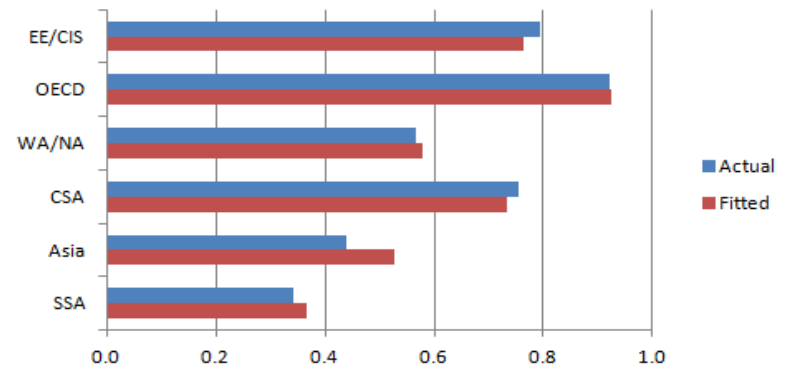


Annex 1-2: Actual and Fitted IRs (continued)

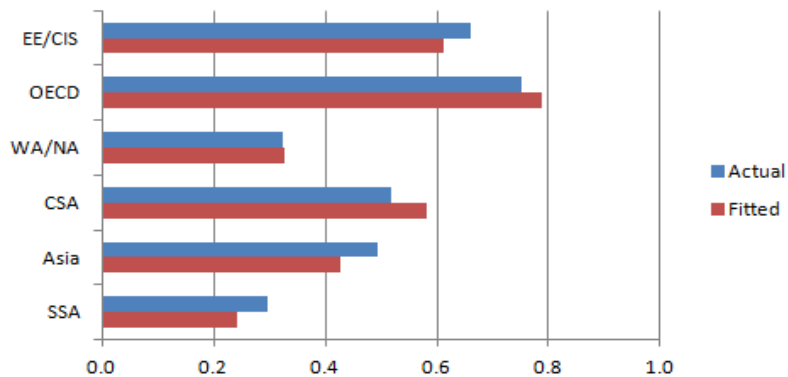
Pigs
1982



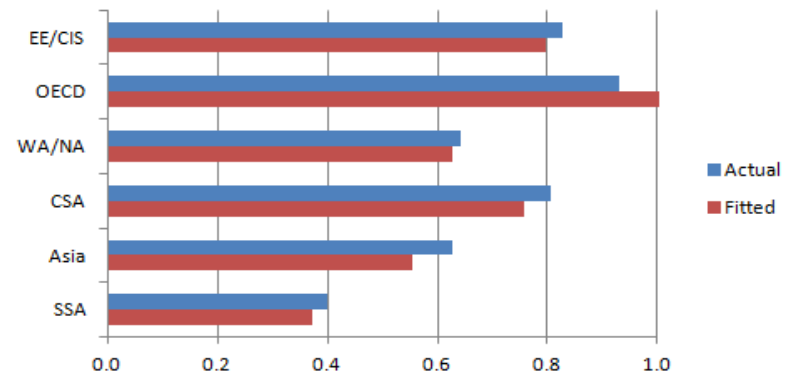
Poultry
1982

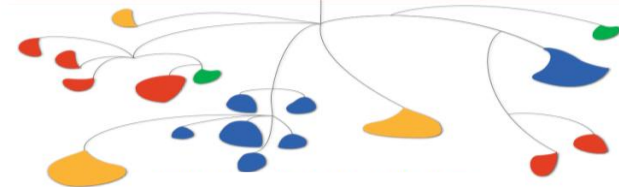


1992



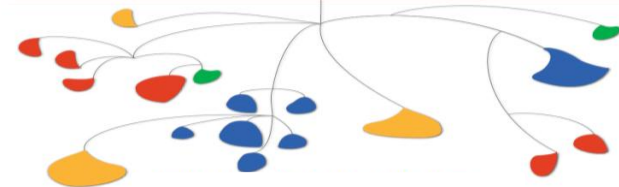
1992





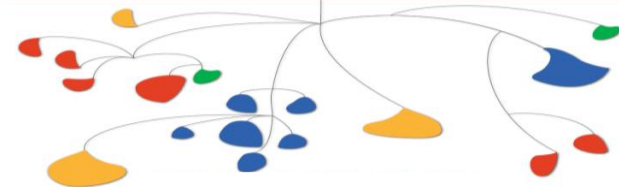
Annex 2-1: Parameter Values: China

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Intensification rate:												
Cattle	13%	14%	14%	14%	14%	14%	15%	15%	15%	15%	15%	15%
Small Ruminants	16%	16%	16%	16%	17%	17%	17%	17%	17%	17%	17%	17%
Pigs	71%	71%	72%	72%	73%	74%	75%	76%	77%	77%	78%	79%
Poultry	88%	88%	88%	89%	90%	90%	91%	91%	92%	92%	92%	93%
Feed requirements (Energy), expressed in terms of expected base unit consumption of 35,600 MJME per year												
Cattle	0.42	0.43	0.43	0.44	0.44	0.44	0.45	0.46	0.45	0.45	0.44	0.46
Sheep	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Goat	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05
Pigs	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17
Chicken	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Duck	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Geese	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03



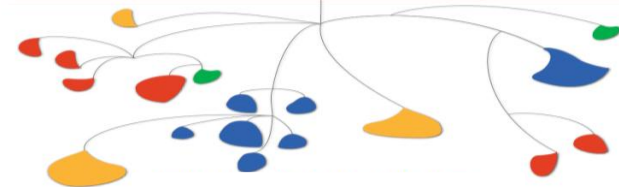
Annex 2-2: Parameter Values Viet Nam

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Intensification rate:												
Cattle	35%	35%	35%	36%	37%	38%	40%	40%	40%	40%	39%	39%
Small Ruminants	16%	17%	17%	18%	20%	21%	22%	23%	22%	21%	21%	21%
Pigs	41%	42%	42%	43%	43%	44%	45%	45%	46%	46%	47%	47%
Poultry	51%	52%	53%	53%	54%	55%	56%	57%	58%	58%	59%	59%
Feed requirements (Energy), expressed in terms of expected base unit consumption of 35,600 MJME per year												
Cattle	0.42	0.45	0.47	0.47	0.47	0.48	0.45	0.43	0.45	0.46	0.46	0.47
Goats	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Pigs	0.16	0.17	0.16	0.16	0.15	0.16	0.17	0.17	0.17	0.17	0.17	0.17
Chickens	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ducks	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01



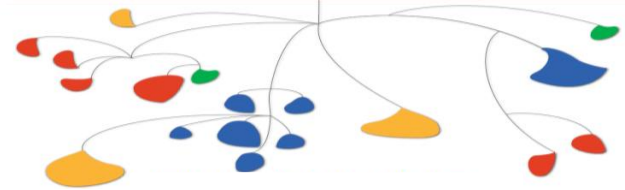
Annex 2-3: Parameter Values: Thailand

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Intensification rate:												
Cattle	34%	34%	35%	35%	36%	36%	37%	38%	38%	38%	38%	38%
Small Ruminants	11%	12%	12%	12%	13%	14%	14%	15%	14%	14%	14%	15%
Pigs	53%	54%	54%	57%	56%	56%	57%	57%	58%	59%	59%	60%
Poultry	67%	68%	68%	71%	71%	70%	72%	72%	73%	74%	73%	75%
Feed requirements (Energy), expressed in terms of expected base unit consumption of 35,600 MJME per year												
Cattle	0.80	0.66	0.70	0.74	0.72	0.66	0.63	0.65	0.70	0.69	0.62	0.65
Sheep	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Goat	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Pigs	0.49	0.35	0.54	0.61	0.52	0.51	0.44	0.42	0.35	0.31	0.31	0.31
Chicken	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Duck	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Geese	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02



Annex 2-4: Parameter Values Indonesia

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Intensification rate:												
Cattle	21%	21%	21%	21%	21%	21%	22%	22%	22%	23%	23%	24%
Small Ruminants	20%	20%	21%	21%	21%	21%	21%	22%	22%	22%	22%	23%
Pigs	48%	49%	50%	51%	51%	52%	53%	53%	54%	55%	56%	56%
Poultry	61%	62%	63%	64%	64%	65%	66%	67%	68%	69%	70%	71%
Feed requirements (Energy), expressed in terms of expected base unit consumption of 35,600 MJME per year												
Cattle	0.50	0.48	0.46	0.51	0.61	0.52	0.58	0.55	0.55	0.55	0.57	0.58
Sheep	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Goat	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Pigs	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Chicken	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Duck	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Geese	0.50	0.48	0.46	0.51	0.61	0.52	0.58	0.55	0.55	0.55	0.57	0.58



Annex 3: Animal Units

$$u_{i,c,t} = \frac{r_{i,c,t}}{r_0}$$

$r = f(\text{weight, weight gain, reproduction, milk, temperature adjustment})$

Sources:

- Livestock Development Planning System by the Animal Production and Health Division of FAO (LDPS2)
- National Research Council of the Academy of Sciences of the United States (NRC)