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FOOD BALANCE SHEETS AND ASEAN FOOD SECURITY: PANEL DATA ANALYSIS

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Food Security
- has been a major concern since the First World War to meet the sufficient food supply for population needs

Food Balance Sheet
- Related to SUA – apart of FBS
- Related to FS – secure or unsecure

ASEAN
- most of the countries economy is driven by the agriculture sector
- Rapid growing of population

"food security exists when all people, at all time, have physical and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy lifestyle"_(FAO World Food Summit, 1996)

Introduction: DEFINITION OF FS – Four Pillars

Food availability	Physical and economic access to food
• Domestic production • Import capacity • Food stocks • Food aid	• Purchasing power • Income of population • Transport and market infrastructure
Stability of supply and access • Weather variability • Price fluctuations • Political factors • Economic factors	**Food Utilization** • Food safety • Hygiene and manufacturing practices applied in: primary agricultural production, harvesting and storage; food processing; transportation, retail, households • Diet quality and diversity: meeting needs in terms of energy, macro- and micronutrient

FBS is a statistical comprehensive framework which is a systematic statistics of food supply and utilization to measure the FS. Conceptually, food balance sheets measure the food supply of the population.

Introduction: DEFINITION OF FBS

Food Balance Sheet (FBS)

Supply (Tonnes)

    Production

  + Import

  + Opening stocks

  = Total supply

Utilization (Tonnes)

    Export

  + Seed

  + Feed

  + Losses

  + Processing

  + Closing Stocks
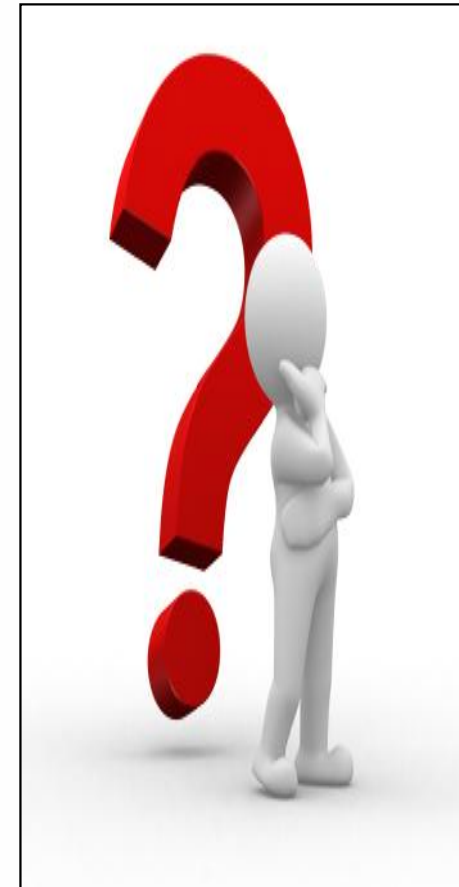
  + Food

  = Total utilization

Food Supply per caput

- Kg/Year

- Calories/day

- Protein/day

- Fat/day (gram)

Problem Statement

Over the years, ASEAN food security has always been a sensation issue to be discussed and debates among government, NGOs, researchers, and entrepreneurs. One of the issues that always concern is how to provide the amount of food to accommodate the rapidly growing of population especially in the next 30 years.

FOOD SECURITY IN ASEAN COUNTRIES

The amount of food supply is inadequate, obedient with the increase of population in ASEAN countries.

Embryonic structure of ASEANS' economies in agriculture sector.

The divergence of agricultural policies among the ASEAN countries.

to determine the economic variables such as food demand, export, import, seed, feed, waste, population and GDP as a major factor that influence the production level among ASEAN-8 countries and to examine the food security level.

Literature Review

AUTHOR/S & YEAR	CONTENT
Huang et al., (1999)	the main determinant for food demand are income growth and population growth
Verburg et al., (1999)	High population growth in Java give pressure to the agriculture land use change to other activity and caused decrease in paddy fields as well as production capacity.
Tiffen, (2003)	High GDP growth will pushed the countries become urbanized and have large industrial and service sector.

Literature Review

Literature Review

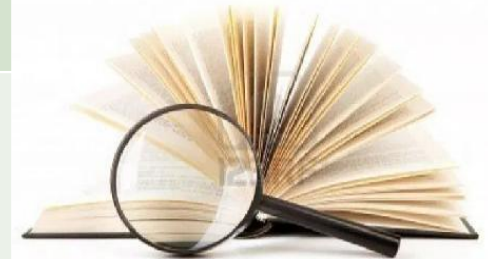| AUTHOR/S & YEAR	CONTENT
Thi Dien et al., 2009	the main determinant for food demand are income growth and population growth
Desker et al., 2013 **Thi Dien et al., 2009**	Farms size are getting smaller as a result of population growth. Thus, decline the area of food crops as well as food production and become the global issues.
Barrett & Lentz, (2009)	there is an ample food at the global level but in some poor countries still facing insufficient food.

Literature Review

AUTHOR/S & YEAR	CONTENT
Alonso-Carrera & Raurich (2010)	There is a connection between production level and the sectoral composition of GDP.
Washington & Kilmer, (2002),	import demand are depends on the market requirement either for final goods or as an input for production due to globalization
Desker et al., 2013	ASEAN region's population, Asia urban population and Asia's share of the global GDP, which will have a massive impact on the region's future food consumption patterns.

Literature Review

Literature Review

AUTHOR/S & YEAR	CONTENT
Fader et al., 2013	To increase the volume of domestic food production with water and land constraints also rapid population growth, food imports have to increase as well.
(Smith & Sulaiman, 2015).	changes in cultivation technique due to the increase of GDP have a significant positive impact on production and food security
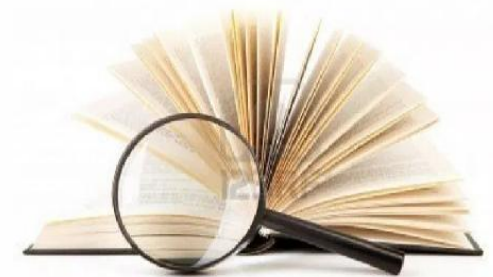
Literature Review

Methodology

❖ **Volumes of rice used to proxy total food production. The selection of rice is because it is the main staple food at ASEAN countries as well as the world's largest producer and exporter of rice.**

❖ **An empirical study using secondary data were obtained from several international agencies which is covered the ASEAN-8 countries.**

❖ **The annual rice FBS data from 1990 to 2012 were collected from FAOSTATS website published by Food and Agricultural Organization (FAO) and the rest (2013-2017) were taken from International Rice Research Institute (IRRI) website.**

❖ **Data for total GDP and population were obtained from the World Bank website.**

Methodology

Variables descriptions

Variables	Descriptions	Unit measurement
Production	Production refers to the total production of rice which is produced in the country.	thousand tons
Food	This comprises the amounts of rice that are available for human consumption. The result could be positive or negative relationship with the dependent variable which explains of the level of food security.	thousand tons
Export	This refers to the rice movements out of the country.	thousand tons
Seed	This comprises all amounts of the rice used for reproductive purposes whether domestically produced or imported	thousand tons

• Sources: Supply Utilization Accounts and Food Balance Sheets, FAO website, 2017

Continued...

Variables	Descriptions	Unit measurement
Feed	This comprises amounts of rice that are fed to livestock.	thousand tons
Import	This refers to the rice movements into the country.	thousand tons
Waste/losses	The losses of rice during storage and transportation.	thousand tons
Population	Refers to the total number of people that living in a geographic area that needs food to consume for life.	thousand people
Gross Domestic Product (GDP)	GDP is a measure of aggregate output produced in an economy.	At constant price per capita US$

Model Specification

The model can be described as follows:

Prod = f(F, X, M, FS, W, Pop, GDP)………………………………………..(1)

The specification of equation 1 is drawn from the production function. We modify our original model in equation (1) for the variables so that all the variables in our new model (2) can show its impact to the production. Based on the production function, we finally specify the empirical model as follows:

$$Prod_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 X_{it} + \beta_3 FS_{it} + \beta_4 W_{it} + \beta_5 M_{it} + \beta_6 GDP_{it} + \beta_7 Pop_{it} + \mu_{ti} \ldots\ldots(2)$$

This model has modified with transformed the GDP variables into natural log as shown below (Eq. 3).

$$Prod_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 X_{it} + \beta_3 FS_{it} + \beta_4 W_{it} + \beta_5 M_{it} + \beta_6 lnGDPit + \beta_7 Pop_{it} + \mu_{ti} \ldots\ldots(3)$$

Where;

Prod	=	Food production
F	=	Food demand
X	=	Export
FS	=	Feed & Seed
W	=	Waste/losses
M	=	Import
Pop	=	Population
lnGDP	=	Gross Domestic Product Per Capita
β	=	the parameter for the explanatory variables
t	=	time series
i	=	denotes country
μ	=	error term

Methodology

Descriptive Statistics

Unit root test

Statistical Analysis

Co-integration Test

Diagnostic Test
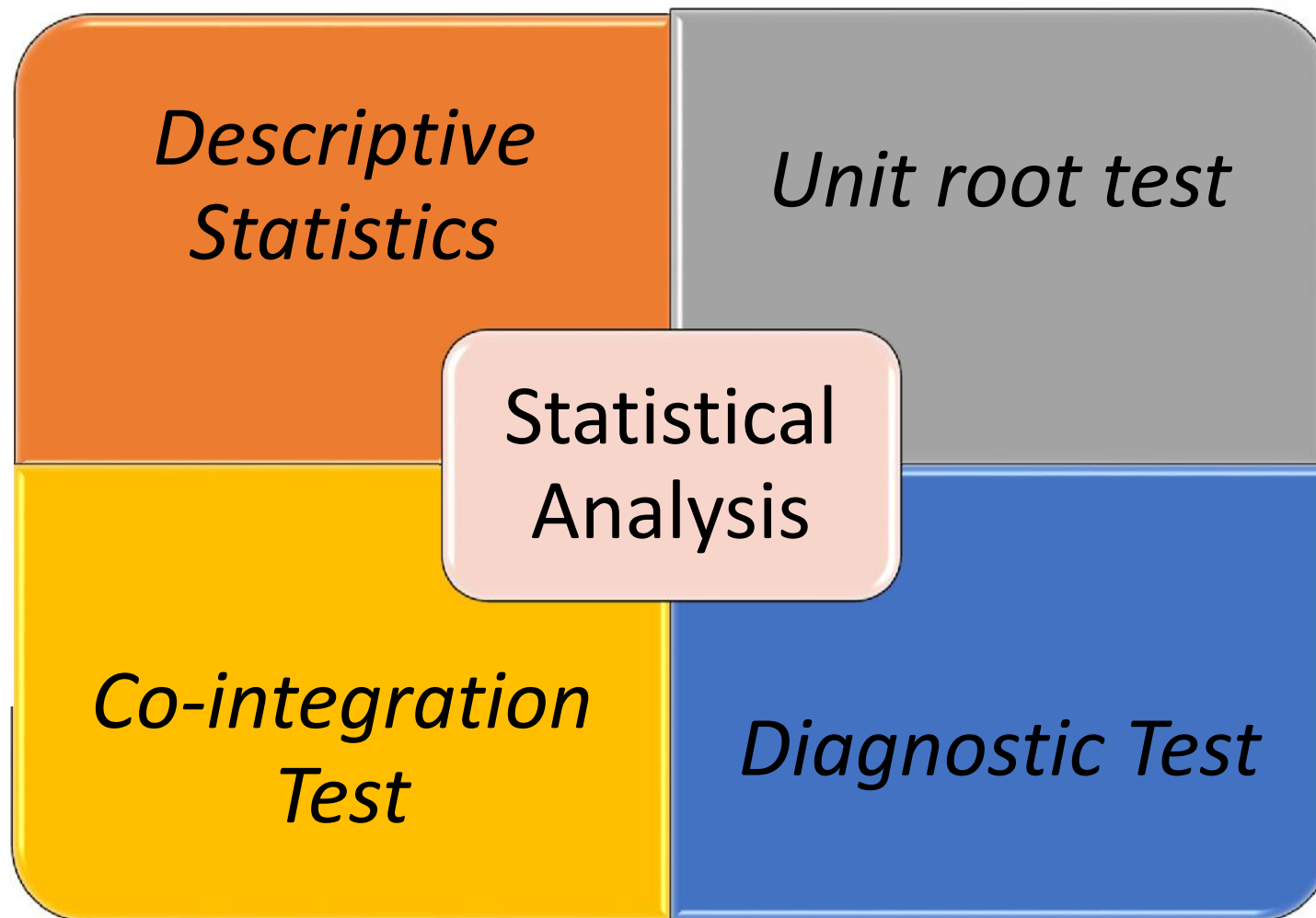
Findings and Analysis

Descriptive Statistics

Stat	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Food	8554.67	6540.55	36756.10	679.40	8622.81	1.5983	4.7791
Export	2986.56	32.75	19552.80	0.10	5229.43	1.6794	4.5235
Feed&Seed	1672.11	734.20	9962.90	50.90	2111.03	2.0964	7.4243
Waste	1021.06	628.05	4003.90	37.70	1019.90	1.0422	2.9739
Import	835.98	276.60	6620.70	1.10	1272.69	2.1637	7.7171
Pop	67213.90	54734.02	261115.50	4258.47	65243.59	1.5570	4.6592
LnGDP	3.1782	3.1807	4.0426	2.2861	0.4350	0.0451	2.1620

Findings and Analysis

Correlation Matrix Analysis

Correlation Analysis	Food	Export	Feed& Seed	Waste	Import	Pop	LnGDP
Food	1.0000	0.0317	0.2222	0.9030	0.5200	0.9917	0.1996
Export	0.0317	1.0000	0.2109	0.3493	-0.2599	0.0164	0.2329
Feed&Seed	0.2222	0.2109	1.0000	0.2569	-0.1586	0.1897	-0.1738
Waste	0.9030	0.3493	0.2569	1.0000	0.3049	0.8699	0.1944
Import	0.5200	-0.2599	-0.1586	0.3049	1.0000	0.5621	0.3972
Pop	0.9917	0.0164	0.1897	0.8699	0.5621	1.0000	0.2656
LnGDP	0.1996	0.2329	-0.1738	0.1944	0.3972	0.2656	1.0000

Findings and Analysis

Analysis of Unit Root Test

Variable	ADF		PP	
	Without trend	With Trend	Without trend	With Trend
	LEVEL			
Prod	6.09 (0.99)	29.12 (0.02)***	3.89 (0.99)	32.76 (0.01)***
Food	5.59 (0.99)	16.31 (0.43)	5.90 (0.99)	16.32 (0.43)
Export	22.46 (0.13)	52.34 (0.00)***	22.24 (0.14)	45.38 (0.00)***
Import	26.18 (0.05)	41.98 (0.00)***	29.06 (0.02)	26.02 (0.05)***
Feed&Seed	6.61 (0.98)	32.74 (0.01)***	8.69 (0.93)	29.66 (0.02)***
Waste	2.92 (0.99)	15.73 (0.47)	1.75 (1.00)	11.64 (0.77)
Population	20.14 (0.21)	35.99 (0.00)***	37.08 (0.00)***	10.65 (0.83)

Results of Unit root test ADF and PP

GDP	0.32 (1.00)	3.77 (0.99)	0.24 (1.00)	4.41 (0.99)
Difference				
ΔProd	130.56 (0.00)***	137.29 (0.00)***	174.44 (0.00)***	273.36 (0.00)***
ΔFood	105.21 (0.00)***	68.17 (0.00)***	125.51 (0.00)***	109.17 (0.00)***
ΔExport	155.35 (0.00)***	383.418 0.0000	155.905 (0.00)***	681.138 (0.00)***
ΔImport	119.07 (0.00)***	110.66 (0.00)***	167.03 (0.00)***	325.32 (0.00)***
ΔFeed&Seed	137.85 (0.00)***	113.23 (0.00)***	152.59 (0.00)***	454.07 (0.00)***
ΔWaste	132.35 (0.00)***	111.47 (0.00)***	139.03 (0.00)***	132.97 (0.00)
ΔPopulation	18.32 (0.30) 75.46 (0.00)***	20.55 (0.19) 81.79 (0.00)***	11.90 (0.75) 32.94 (0.01)***	3.83 (0.99) 24.69 (0.07)***

Findings and Analysis

Hausman Test Results

Variable	Pooled Model	Fixed Effects Model	Random Effects Model
F	0.98* (5.48)	0.68 (3.99)	0.98(7.62)
X	0.74* (20.82)	0.32(5.43)	0.74 (28.97)
FS	1.94 (33.20)	1.68 (14.17)	1.94 (46.19)
W	7.53 (15.70)	10.43 (19.73)	7.53(21.85)
M	-0.72 (-5.70)	-0.29 (-2.95)	-0.72 (-7.93)
lnGDP	-650.16 (-1.87)	-1170.69(-1.31)	-650.16 (-2.60)
POP	0.09 (4.51)	0.06 (2.05)	0.09 (6.28)
R^2	0.99	0.96	0.96
Hausman test			X^2 (7) = 201.78 [0.000]
Countries included	888		
Total observation	216	216	216

Estimation results ASEAN-8 countries using seemingly unrelated regression (SUR)

	Variables	Food	Export	Feed &Seed	Waste	Import	Population	lnGDP
Production	Cambodia	2226.6 (5.2)***	483.7 (1.1)	264.9 (1.0)	555.9 (6.6)***	35.58 (0.2)	12486.0 (4.8)***	-1.82 (-43.2)***
	Indonesia	26716.8 (59.4)***	-511.4 (-1.1)	1695.1 (6.1)***	2452.17 (28.05)***	2485.0 (11.2)***	208237.4 (75.0)***	0.68 (15.0)***
	Laos	-1108.6 (-2.47)***	-502.6 (-1.1)	-0.2 (-0.0)	-423.65 (-4.85)***	-68.89 (-0.31)	-7262.2 (-2.6)***	0.18 (4.0)***
	Malaysia	-26.55 (-0.1)	-507.4 (-1.1)	-194.2 (-0.7)	-426.94 -4.88***	1200.9 (5.4)***	11785.1 (4.3)***	1.14 (25.4)***
	Myanmar	4214.3 (9.4)***	544.4 (1.2)	5712.8 (20.4)***	-42.69 (-0.49)	-101.3 (-0.5)	34277 (12.4)***	-0.03 (-0.7)
	Philippines	7038.1 (15.6)***	-512.4 (-1.1)	323.6 (1.2)	99.16 (1.13)	2015.6 (9.0)***	69880.8 (25.2)***	0.53 (11.8)***
	Thailand	5271.6 (11.7)***	13341.5 (28.1)***	1586.5 (5.7)***	802.53 (9.18)***	180.0 (0.8)	50905.6 (18.3)***	0.88 (19.5)***
	Viet Nam	9927.4 (22.1)***	7935.9 (16.7)***	2225.5 (7.9)***	1566.72 (17.92)***	86.4 (0.4)	67199.3 (24.2)***	0.22 (4.9)***

Conclusions & Recommendations

❖ All variables play a role as determinants to the total rice production (domestic food production) in measuring food security level in ASEAN-8 countries.

❖ Positive relationships between independent variables (population and GDP) and dependent variable (rice production) clearly indicates that ASEAN-8 countries are still in food security situation.

❖ ASEAN-8 countries are still able to produce rice more than the needs of their population.

❖ Information from FBS is needed by every ASEAN country as a fast track to monitor and coordinate regional food security policies (Database, 2015). With this FBS, information on food supply and demand can be monitored locally or globally.

THANK YOU