ACCURATION OF INDONESIAN RICE SUPPLY AND DEMAND FORECASTING FOR FOOD AVAILABILITY

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Abstract

Accuration of forecasting is very usefull as a base for policy making in the future. This study aimed to test accuration of Indonesian rice supply and demand forecasting in 2015 which was made in 2006. Study was done on national scale used secondary data between 1970-2004 which was obtain from legitimate institution publication. Forecasting was done through these steps : (a) model equation arranging, (b) model identifying, (c) model estimating and parameter testing by two stage least square methode using SAS program analysis software, (d) model validation test, and (e) exogenous variable forecasting using exponential smoothing methode. Forecasting result was compared with official data in 2015 published by Center for Agriculture Data and Information System, Ministry of Agriculture Republik of Indonesia (2016). Accuration was based on % deviation between official source and forecasting result, the more deviation the more non accurate. The results were: (a) There was a big deviation (109.16%) between official source and forecasting calculation on Indonesian food avaiability in 2015. Based on official source, Indonesian rice supply was 44,710,528 tonnes, demand was 32,388,271 tonnes and availability was surplus 12,322,257 tonnes. The main cause of surplus was over estimate of harvested area.   On the contrary according to forecasting, supply was 40,894,521 tonnes, demand 42,023,699 tonnes, and Indonesian food availability was deficit 1,129,178 tonnes. The main cause of deficit was using of previous estimate of consumption/capita/year which was larger than official source so demand became larger too. None of these calculation was matching with actual condition; (b) Simulation using forecasting data which was calculated by official source way found out that food availability which more close to real condition, that domestic production plus 861,630 tonnes amount of imported rice could fulfil demand and without calculating national stock Indonesian food availability still surplus 1,164,574 tonnes in 2015.

Keywords: accuration, forecasting, supply, demand, food availability.

BACKGROUND

Food availability is a condition which food is available fulfilled by domestic production, national stock and import if two main sources could not meet a demand (Undang-Undang Republik Indonesia Nomor 18 Tentang Pangan Tahun 2012/Law of Republik of Indonesia Number 18 about Food, 2012). Main food of the most Indonesian people is rice, so food availability means rice availability. Food avaiability is difference between supply and demand. Rice supply is consist of domestic production, national stok and import minus export, while rice demand is consist of direct and indirect comsumption, seed, loss and waste, and others.

Since 1986 Indonesia has been being a rice net importer country which showed that domestic production could not fulfill demand. Effort for increasing production has been being done over and over, but demand has not fufill yet, so import is still needed. Importing rice should be determined exactly for assuring availability and protecting domestic producer. Lack of import would not meet demand, otherwise too much import would make over supply

which cause declining of price that could make farmer and producer loss, so determining exactly import need to know condition of supply and demand.

Process of production and import need time, so prediction is needed for making plan and policy which would be suitable in the future. Prediction of rice supply and demand in over the next view years must be based on certain forecasting methode. According to the forecasting will be found: (1) estimation of need and domestic production to predict import; (2) estimation of rice supply and demand as a base to make policy for better food availability condition.

This study was proposed to test accuration of Indonesian rice supply and demand in 2015 which was made in 2006 by Prayuginingsih (2007). Accuration was based on deviation between official source and forecasting, the more deviation the more non accurate. Official source was published by Pusdatin (Pusat Data dan Sistem Informasi Pertanian/ Center for Data and Agriculture Information System) Ministry of Agriculture, Republik of Indonesia.

METHODS

Study Field

Study field covered national scale for knowing and describing rice supply and demand behavior at domestic market. Domestic market was choosen because this study was focused on food availability at domestic field.

Method of Study

Study used descriptive and comparative method. Descriptive method was used made for making systematic description, factual and accurate about the facts. While comparative method was used for comparing some conditions.

Method for Collecting Data

This study used secondary data which was collected in 1970 – 2004 period from rice legitimate institution publication such as Ministry of Agriculture Republik of Indonesia, BPS (Badan Pusat Statistik/ Center for Statistic Agency), Perum Bulog (Logistic Affairs Company), Bank of Indonesia, IRRI , FAO dan PT Pusri (Fertilizer Producer) .

Method for Analizing Data

Here were some steps for forecasting Indonesian rice supply and demand at domestic market :

1. **Arranging model equation :**
   a. **Indonesian Rice Demand at Domestic Market**

   IRD $= a_0 + a_1 POP + a_{2H}A$

   Explaination:
   IRD $=$ Indonesia Rice Demand (tonne)
   POP $=$ Population (person)
   HA $=$ Harvested Area (ha)
   Expected coefficient
   a_1 dan $a_2 > 0$

   b. **Harvested Area**

   HA $= b_0 + b_1 PFP + b_2 LPPD + b_3 LROD + b_4 LHA$

   Explaination:
   HA $=$ Harvested area (ha)
   PFP $=$ Paddy floor price (Rp/kg)
   LPFP $=$ PFP last year (Rp/kg)
   PROD $=$ produktivity (tonne/ha)

LPROD   = PROD last year (tonne/ha)
LHA   = HA last year (ha)
Expected Coefficient
b_1 , b_2 , b_3, $b_4 > 0$

c. Produktivity

$PROD = c_o + c_1 PFUr + c_2 PFSP + c_3 LPFP + c_4 LPROD$

Explainnation:

PFUr   = Price of urea fertilizer (Rp/kg)
PFSP   = Price of TSP fertilizer (Rp/kg)

Expected coefficient

c_1 dan $c_2 < 0$
c_3 dan $c_4 > 0$

d. Imported Rice

$QIMP = d_o + d_1 IRD + d_2 QSTOCK + d_3 B + d_4 C + d_5 TIMP$

Explainantion:

B   = Ratio of self sufficiency (%)
C   = Ratio of PIR and PIMB
QSTOCK   = early year stock at BULOG warehouse(tonne)
TIMP   = tariff of imported rice (Rp/kg)

Expected coefficient

d_1, d_2, d_4 dan $d_5 > 0$
$d_3 < 0$

e. Price of Imported Rice

$PIMP = e_o + e_1 ER + e_2 WPR + e_3 LPBIMP$

Explaination:

PIMP   = Price of Imported Rice
ER   = Exchange Rate Rupiah on US dolar
WPR   = World Price of Rice ($)
LPIMP   = Harga beras impor tahun lalu

Expected coefficient

e_1, e_2 dan $c_3 > 0$

f. Price of Rice at Domestic Market

$PRI = f_o + f_1 PPI + f_2 IRD + f_3 IRS + f_4 TIMP + f_5 LPRI$

Explaination:

PRI   = Price of Rice (Rp/kg)
PPI   = Price of Paddy (Rp/kg)
IRS   = Indonesian Rice Supply (tonne)
LPRI   = Price of Rice last year (Rp/kg)

Expected coefficient

f_1, f_2 , f_4 and $f_5 > 0$
$f_3 < 0$

g. Price of Paddy at Domestic Market

$PPI = g_0 + g_1 PRI + g_2 PFP + g_3 LPPI$

Expected coefficient

g_1 , g_2 , and $g_3 > 0$

h. Indonesian Rice Supply at Domestic Market :

$IRS = QDRP + QIMP + QSTOCK - QBEXP$

Explaination:

QDRP   = Domestic Rice Production (tonne)
QEXP   = Exported Rice(tonne)

i. Domestic Rice Production

$DRP = k * DPP$

K   = rendemen of rice

$$= 0,632 \quad \text{(Hariyati, 2003; Mulyana, 2004; Puspoyo,2004;)}$$

DPP   = domestic paddy production

              = harvested area x productivity

              = HA * PROD

i. Foof Availability

FA   = IRS –IRD

2. Model Identification

Model identification was needed because if a equation (or a whole model) was *under identified*, non of econometric technique could be done for estimating all parameter.

Equation was identified if amount of variable which did not include in a equation but include in another equations, at least equal with amount of equation wich was exist in model (equation system) minus 1 (one) , or formulated by Koutsoyiannis in Hariyati (2003) such as : $(K – M) > (G – 1)$. Explanation :

K = amount of total variables in model (endogen and predetermined}

M = amount of variable (endogen and eksogen) in identified equation

G = amount of total equations (amount of total endogen variable)

Criteria of decision making :

If $(K – M) < (G – 1)$, equation was *under identified*

If $(K – M) = (G – 1)$, equation was *exactly identified*

If $(K – M) > (G – 1)$, equaition was *over identified*

3. Model Estimation and Parameter Test

Estimating model was done by Two Stage Leasrt Square analysis methode   using SAS analysis progarm software. Effects of variables in model was tested by evaluating R^2. Compability model or effect of aggregate independent variable on dependent variable was judged by F test, while to know effect of each independent variable on dependent variable was used t- test

4. Test of Validation Model

Validation test was needed to know did the predicted model had good ability to forecast by tracing some values such as: Mean Percent Error (MPE), Root Mean Square Percent Error (RMSPE), coeffisient U-Theil and decomposition of coeffisient U-Theil to be biased (U^M), varian proportion (U^S) and covarian propotion (U^C).

Decision making criteria:

a. Fewer MPE and RMSPE meaned better predicted model , because forecasting result closed to actual condition

b. U^M dan U^S showed good ability to forecast if closed to 0, because bias and varian were small

c. U^C showed good ability to forecast if close to 1

5. Forecasting

Exsogenous variables in 2005 - 2020 period were forecasted by using exponential smoothing method and combined with constant trend , linear trend and quadratic trend mode

6. Accuration of Forecasting

Accuration of forecasting was based on deviation between data from official source and forecasting .

$$\text{Deviation} = \frac{\text{Official source - forecasting}}{\text{Official source}} \times 100 \%$$

RESULT AND DISCUSSION

Indonesian supply and demand based on Pusdatin (2016) showed that there was surplus of food availability in 2015, but on the contrary based on forecasting which was made in 2006 showed that there was deficit. It meaned that there was so big deviation of food avaibility between official source and forecasting (Table 1).

Supply Side

According to offcial source, Indonesian rice supply was 44,710,528 tonnes while forecasting was lower (40,894,521 tonnes). There was only a few deviation (8.53%) of rice supply between official and forecasting data, but there was a substantial defference. Supply based on official source consist of domestic production, import and eksport of rice. Domestic rice production was equal with yield minus loss and waste, feed, seed and any need for industry and then was converted into rice by 62,74% rendemen.

Based on forecasting data, supply consist of paddy which was converted into rice by 63,2% rendemen plus national stock and so big forecasting import (until 2,835,460.00 tonnes) minus export, but there was no calculation of loss and waste, feed, seed or even industry. Forecasting national stock was 2,835,460 tonnes which was close to commonly stock about 1,5 until 2 million tonnes per year (Sawit, 2004), but import was very far from actual data (861,630 tonnes). Paddy was produced from more narrow harvested area and lower productivity compared with official source.

Table 1. Camparison Indonesian Rice Supply and Demand in 2015 between Official Source and Forecasting.

Official Data		Forecasting		Deviation (%)
Supply Component		**Supply Component**		
Harvested area (ha)	14,116,638.00	Harvested area (ha)	11,637,550.00	17.56
Productivity (tonne/ha)	5.34	Productivity (tonne/ha)	4.90	8.26
Yield tonne paddy)	75,369,964.00	Yield (tonne paddy)	57,023,995.00	24.37
Loss and waste (5.40%)	4,071,436.00	National Stock (tonne)	2,111,844.00	
Feed (0.44%)	331,747.00			
Seed (0.90%)	678,573,00			
Other industry (0.56%)	422,223.00			
Net Paddy (tonne)	69,892,985.00			
Rice (62.74% net paddy)	43,850,859.00	Rice (63.2% net paddy)	36,039,165.00	17.81
Import (tonne)	861,630.00	Import (tonne)	2,835,460.00	
Export (tonne)	1,961.00	Export (tonne)	91,948.00	
Supply (tonne)	**44,710,528.00**	**Supply**	**40,894,521.00**	**8.53**
Demad Component				
Population (person)	247,572,000.00	Population (person)	255,363,000.00	-3.15
Consumption (kg/cap/year)	124.89	Harvested Area (ha)	11,637,550.00	
Food (tonne)	30,919,267.00			
Feed (0.17% Rice)	74,546,00			
Loss and Waste (2.5% Rice)	1,096,271.00			
Other industry (0.68% Rice)	298,186.00			
Demand (tonne)	**32,388,271.00**	**Demand (tonne)**	**42,023,699.00**	**-29.75**
Food Availability (surplus)	**12,322,257.00**	**Food Availability (deficit)**	**1,129,178**	**109.16**

Source : Pusdatin (2016) and Processed secondary data (2006)

Demand Side

Based on official source, Indonesian rice demand was 32,388,271 tonnes, consist of direct and indirect consumption of total population minus loss and waste, feed, and industry. Population was 147,572,00 person, and consumption/capita/year was 124,89 kg which had been settled since 2015 based on calculation of SUSENAS 2010 (Sensus Ekonomi Nasional/National Economic Census). Before 2015 consumption/capita/year was settled more than 130 kg (Pusdatin, 2016).

Based on forecasting, Indonesian rice demand was affected by population and harvested area which need seed. Population was forecasted 255,363,000 person and consumption/capita/year settled bigger than 130 kg, so the demand was 42,023,699 tonnes, much bigger than official source and deviation was 29.75%. Actually, predicted population closed to population projection published by BPS (Badan Pusat Statistik/ Center of Statistic Agency) that was 255,461,700 person while actual data from SUSENAS 2015 was 254,9 million (BPS in Hidayatullah, 2017).

Food Availability

Food avaibility was resulted from supply minus demand, so Indonesian food availability in 2015 based on official source was surplus 12,322,257 tonnes while based on forecasting was deficit 1,129,178 tonnes, that's why the deviation was very-very big (109,16%).

According to some experts (Anjak, 2015; Ariani, 2015; Erwidodo and Pribadi, 2014) food surplus in Indonesia was doubted, because it did not match with actual condition. Surplus 12 million was a big amount, about six times compared with national stock. If it was true it didn't make sense for importing rice over and over every year. As a comparison, Thailand and Vietnam as rice net importir continously in the world just had surplus 10,447 and 6,499 million tonnes in 2010 (Diu, 2014).

The main cause of big surplus was overestimate harvested area. Those experts guess that harvested area which was published by BPS and Pusdatin was wider than real condition. Actually wet land in Java had been decreasing year to year for another using such as residence, office, industry etc while forming at out of Java was lack. According to Malian (2004) harvested area in 2003 was 11,46 million ha, growth harvested area rate in 1997-2003 was about 0,51% per year. Based on this statement, it guess that harvested area in 2020 will grow 10% and become 12,49 million ha, so harvested area in 2015 must be more narrow. Furthermore Malian (2004) said that produktivity in 2003 was 4,48 tonnes/ha. Assumptioning the condition as same as condition before moneter crisis, growth productivity rate was equal with 1990-1996 period that was 0,44%, so productivity in 2020 was predicted 4,84 tonnes/ha. This prediction is almost same as Maulana said (2004) that in 1995-2001 periode, wet land in Indonesia had negative growth rate because of land function changing from agriculture to non agriculture using. Negative growth rate of wet land could cause decreasing of paddy production. Pusdatin (2014) also showed that in 2009-2013 of wet land in Indonesia had negatif growth rate (-0,25%).

It could be made simulation about Indonesian food avaibility in this way: data about harvested area, productivity and population used forecasting data in 2006, while consumption/capita/year and component of supply and demand used official source way. Result of simulation was showed in Table 2.

Based on result of simulation in Table 2, Indonesian rice supply was 34,175,970 tonnes and demand was 33,011,396 tonnes, so food avaibility in 2015 was surplus 1,164,574 tonnes without calculating national stock. Surplus 1,164,574 tonnes relatively was not big enough for national scale like Indonesia which has big population, but food available will be saver by adding national stock. This simulation seemed more reasonable and fit to actual condition that Indonesian rice demand could be fulfilled by domestic production plus national stock and 861,630 tonnes of imported rice in 2015.

Table 2. Simulation of Indonesian Rice Supply and Demand Using Official and Forecasting Data in 2015

Variables		Total (ton)
Supply		
Harvested area[**]	(ha)	11,637,550.00
Productivity[**]	(tonne/ha)	4.90
Yield[**]	(tonne paddy)	57,023,995.00
Loss and waste [*]	(5.40%)	3,079,296.00
Feed [*]	(0.44%)	250,906.00
Seed [*]	(0.90%)	513,216.00
Other industry[*]	(0.56%)	322,528.00
Net Paddy [*]	(ton)	52,858,050.00
Rice[*]	(62.74% net paddy)	33,406,288.00
Import [*]	(ton)	861,630.00
Export[*]	(ton)	1,961.00
Supply	**(ton)**	**34,175,970.00**
Demad Component		
Population [* *]	(person)	255,363,000.00
Consumption[*]	(kg/capita/year)	124.89
Food [*]	(ton)	31,892,285.00
Feed [*]	(0.17% Rice)	56,791,00
Loss and Waste [*]	(2.5% Rice)	835,157.00
Other industry [*]	(0.68% Rice)	227,163.00
Demand	**(ton)**	**33,011,396.00**
Food Availability (surplus)		**1,164,574.00**

Source: [*] Pusdatin (2016) and   [**] Processed secondary data (2006)

CONCLUSION

There was a big deviation (109.16%) between official source and forecasting calculation on Indonesian food avaiability in 2015. Based on official source, Indonesian rice supply was 44,710,528 tonnes, demand was 32,388,271 tonnes and availability was surplus 12,322,257 tonnes. The main cause of surplus was over estimate of harvested area.   On the contrary according to forecasting Indonesian food availability was deficit 1,129,178 tonnes because supply was 40,894,521 tonnes and demand 42,023,699 tonnes. The main cause of deficit was using of previous estimate of consumption/capita/year which was larger than official source so demand became larger too. None of these calculation was matching with actual condition.

Simulation using forecasting data which was calculated by official source way found out that food availability was more close to real condition, that domestic production plus 861,630 tonnes amount of imported rice could fulfil demand and without calculating national stock Indonesian food availability still surplus 1,164,574 tonnes in 2015.

Suggestion

Data of paddy harvested area in Indonesia need to revise so that appropriate with actual condition.

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