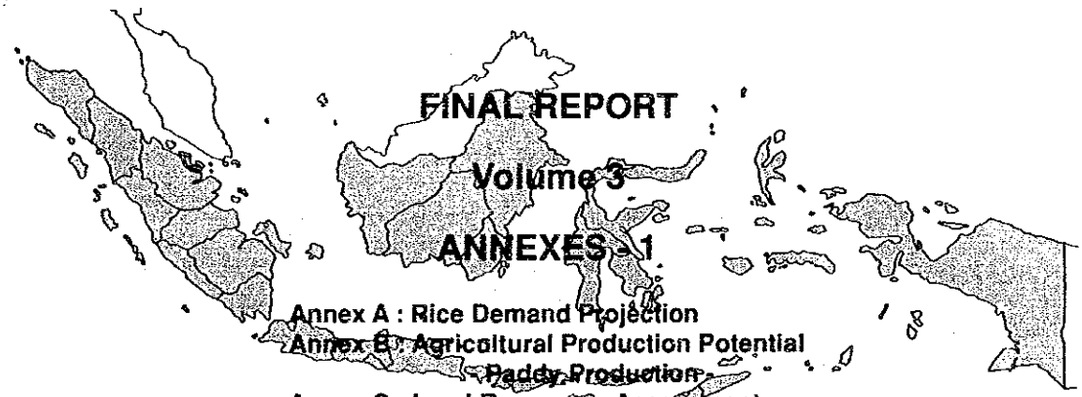
DIRECTORATE OF PLANNING AND PROGRAMMING, DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT MINISTRY OF PUBLIC WORKS

BUREAU OF WATER RESOURCES AND IRRIGATION BAPPENAS REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY JAPAN

THE STUDY FOR FORMULATION OF IRRIGATION DEVELOPMENT PROGRAM IN THE REPUBLIC OF INDONESIA



FINAL REPORT

Volume 3

ANNEXES - 1

Annex A : Rice Demand Projection
Annex B : Agricultural Production Potential
- Paddy Production -
Annex C : Land Resources Assessment
Annex D : Water Resources Assessment

November 1993

NIPPON KOEI CO., LTD.
TOKYO, JAPAN
IN ASSOCIATION WITH
JAPAN IRRIGATION AND RECLAMATION CONSULTANTS CO., LTD.

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Abbreviations

AMDAL	Environmental Impact Assessment
APBN	Anggaran Pendapatan dan Belanja Negara
APBD	Anggaran Pendapatan dan Belanja Daerah
BAPPEDA	Badan Perencanaan Pembangunan Daerah - Provincial Development and Planning Agency
BAPPENAS	Badan Perencanaan Pembangunan National - National Development and Planning Agency
BIMAS	Mass guideline for agricultural development
BPP	Bina Program Pengairan - Planning Division of Water Resources
BULOG	Badan Urusan Logistik - Agency for National Logistics Administration
CBS (BPS)	Central Bureau of Statistics (Biro Pusat Statistik)
DGWRD	Directorate General of Water Resources Dvelopment in MPW
DOI	Directorate of Irrigation
DPU	Provincial Public Works
EOM	Efficient Operation and Maintenance
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographical Information System
GOI	Goverment of Indonesia
IBRD	International Bank for Reconstruction and Development
JICA	Japan International Cooperation Agency
Kanwil	District Office of a Line Agency under Minister
KUD	Village cooperative
MOA	Ministry of Agiculture
MOF	Ministry of Forestry
MOH	Ministry of Home Affears
MPW	Ministry of Public Works
OECF	Overseas Economic Cooperation Fund, Japan
P3A	Water Users Association
Palawija	Secondary food crops (grown mainly in dry season)
PBME	Project Benefit Monitoring and Evaluation
PIK	Proyek Irigasi Kecil (Handing over small scheme)
PIR	Perkebunan Inti Rakyat (Nuclear Estate Schemes)
PJPT I	Pembangunan Jangka Panjang Tahap I
PJPT II	Pembangunan Jangka Panjang Tahap II
PRAS	Provincial Agricultural Services
PRIS	Provincial Irrigation Services
PU	Ministry of Public Works
Repelita	Rencana Pembangunan Lima Tahun - Five-Year Development Plan
RePPProt	Regional Physial Planning Program for Transmigration
SUSENAS	Survei Sosial Ekonomi Nasional (National Socio-economic Survey)
USAID	United States Agency for International Development

Annex A

Rice Demand Projection

ANNEX A

RICE DEMAND PROJECTION

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1. Introduction

Rice demand projection in FIDP study aims to build a **framework for long-term irrigation development planning**. The objective is to provide a target of total amount of rice to be supplied in the future. In principle the FIDP study pursues to present a direction towards how to manipulate the supply capacity. Demand projection is thus made independently of supply-demand equilibrium. The projection will show a required amount of rice on both national and provincial levels so that the sector investment plan can be an optimal one. Recommendation for strategy of rice production is to be made after development potential with cost-effectiveness will be clarified.

Considering that a development program must always be practicable, throughout the work for this demand projection, the consultants has tried to keep its **simplicity and maneuverability** in mind. Upon conditional change, either in supply side or demand side, the long-term program is expected to be revised by Indonesian government authority. Another aspect concerned in the course of this work was **consistency** with other models to be adopted in national economic planning. Existence of various contradictory projections would cause annoyance for planners.

2. Literature Overview

Several studies on future demand for rice have been made by various institutions and researchers so far. Before defining projection procedure and parameters to be used, methodologies of previous studies were overviewed. Brief summaries of them are as follows.

BAPPERTA Model

BAPPERTA agriculture sector model (Kesavan et al. 1992) intends to examine policy effects of the next five year development plan (Replita VI) with a simulation model up to the year 2000. The multi-commodity dynamic model contains both supply and demand functions of constant elasticity manner for each sub-sector. Dynamic income elasticities are applied only for the function of rice demand formula. The income elasticity was given as a linearly decreasing one from 0.20 in 1988 to 0.08 in 2000. Rice price, population growth, GDP growth are exogenously assumed, which implies demand projection part in the model has an

independent aspect. The model forecasts the per capita rice demand[1] will be at 153 kg/year and total demand at 38.57 million tons of milled rice or 56.73 million tons of rough rice equivalent at 2000. The model was developed by Winrock International, USA and Bureau of Agriculture anf Irrigation of BAPPENAS in 1992.

IWRD 1992

This study was performed as a part of "Planning of Integrated Water Resources Development (BTA-155)" for DGWRD of the Ministry of Public Works (Delft Hydraulics et al. 1992). Projections for both demand and supply of rice were made up to the year 2015. The study contains a detailed analysis of population forecast but less for per capita demand forecast. National average per capita consumption of milled rice is projected to decrease by 0.1% per year after 1995 in the most likely case. Given population increase rate at 1.4 % and 1.1% per annum for the periods 1990-2000 and 2000-2015, respectively, rice demand in 2000 and 2015 is estimated at 49.81 and 57.40 million tons in terms of rough rice.

IBRD 1991

This World Bank study titled "Agricultural Demand Projections for Indonesia (Magiera 1991)" is based on multi-national analysis of food demand tendency. The projection uses a declining income elasticity of rice from 0.13 during 1988-1995 to -0.11 during 2005-2010 in case of economic growth rate at 6% per annum. In other words, the per capita rice consumption is expected to meet the "saturation point" by the end of current century. Commodity price effect on consumption is not taken into account assuming that government price policy bars dramatic changes. Projected demand for rice consumed as food and feed is at 33.73 and 37.23 million tons or 49.60 and 54.75 million tons of rough rice equivalent for the years 2000 and 2010, respectively.

DGFCA-MOA 1988

This study presents a food balance sheet for major agricultural products up to the year 2000. In this projection, parameters are estimated through various regressions on population growth, private consumption expenditure and per capita consumption. In estimating income elasticity, a semi-log model was fitted at lower income stage and then linear model at higher stage. Rice demand amount at 2000 is estimated at 36.77 million tons, or 54.07 million tons of rough rice. The study was carried out by joint work group consisting of U.S. consultants and Indonesian staff

[1] Hereinafter "per capita demand/consumption" is defined as a residual devided by population after deducting feed and seed consumption and wastes from amount produced, imported and released from storage while "total demand" contains any kind of disappearance.

FAO 1991

The Food and Agriculture Organization of the United Nations also made its own rice demand projection as one chapter of a study on food grains demand in several Asian countries. Rice demand is separately forecasted for urban and rural population. With per year growth rates of 1.6% for population and 1.9 % for per capita private consumption expenditure, the study forecasts that total paddy demand in 2000 will be at 54.29 million tons.

Others

In addition to above studies, some other institutes has made Indonesian rice demand projections. These include works by Ellis (1988), Center for Agricultural and Rural Development of Iowa State University (1990) and Center for World Food Studies (1988).

3. Projection Methodology

In this study, total annual rice demand is forecasted at first by estimating per capita consumption in each year. "Consumption" here is given in terms of **disappearance base** rather than of "actual food consumption". To capture total demand amount from consumption side has become more difficult due to an increased "meals away from home" and processed food. The discrepancy between per capita consumption data from the Indonesian Socio-Economic Surveys (SUSENAS) and that of the Food Balance Sheet (BPS various years) may be explained by these factors. After multiplying this disappearance base consumption by population, feed and seed use and wastes are added to obtain total demand amount. **Per capita annual consumption** is calculated with a formula:

$$\ln Q_t = a + \eta_t \bullet \ln(PCE_t / POP_t) + \varepsilon \bullet \ln P_t$$
$$= a + \eta_t \bullet (\ln PCE_t - \ln POP_t) + \varepsilon \bullet \ln P_t$$

where, Q is per capita consumption, a is the intercept, PCE is total private consumption expenditure, POP is population, P is rice price, η is expenditure elasticity, ε is price elasticity and t represents year.

Cross price effect of other commodities on rice consumption is not built in because these elasticities are estimated to be very low or close to zero by various studies. Own price elasticity is assumed to be constant while expenditure elasticity assumed to change every year. Total expenditure is given as a function of GDP with constant private consumption expenditure elasticity at 1.12, following BPPERATA model assumption. Then $\ln PCE_t$ is defined as:

$$\ln PCE_t = b + 1.12 \bullet \ln GDP_t$$

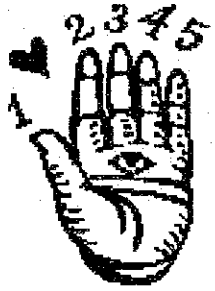
where b is the intercept.

Actual data of 1990 was used as the base of the calculation.

The projection of both population and rice demand is separately made for urban and rural fractions in each province aiming to reflect the difference in consumption taste. Provincial and urban-rural difference was captured with SUSENAS data since it is the only source available that presents segmented consumption data. Transformation to disappearance base was made using national level proportional difference ratio. Process of estimating provincial per capita food consumption of rice for the base year 1990 is shown in Table 2.

The effect of changing age composition is not counted in demand projection, although a change in demographic structure do affect the "effective growth rate" for food consumption[2]. This effect is expected to be negligible as compared to population increase itself.

4. Parameter Assumptions



All numbers used in this demand projection as parameter estimates are given in Table 1. The background and procedure in selecting and modifying these numbers are shown below:

Expenditure Elasticity

In this projection we adopt the same expenditure elasticity as used in BAPPERTA model up to the year 2000. BAPPERTA's expenditure elasticity of **about 0.2 at present** seems reasonable and consistent with the result of econometric analysis given in Appendix-1. For years later than 2000, elasticity was assumed to decrease in a decreasing rate. According to this elasticity forecast, the "saturation point" of per capita rice consumption would be around 2010 if income increases homogeneously between urban and rural.

According to Engel's law, the income elasticity[3] of demand for food is expected to decline as income level becomes higher. This phenomenon has already observed in most of

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[2] As ratio of economically active population which consume more food over total population increases, average per capita consumption is expected to be larger. Tabor and Heldley estimate that during the 1980s, the effect of age composition on calorie consumption was at 0.108% per annum (Magiera 1991).

[3] Hereinafter, the terms of "income elasticity" and "expenditure elasticity" will be used for the same meaning. In the following analysis responsiveness of consumption is discussed with respect to "total expenditure." Therefore "expenditure elasticity" is preferablly used.

rice consuming Asian countries. In several countries, elasticity is estimated to be negative (Ito et al. 1989, see Figure 2), which, in economics term, means that rice is an "inferior good." In Indonesia income elasticity is still estimated to be positive in any study, although generally it is believed to be shrinking over time. Figure 1 depicts per week consumption of cereals and tubers by expenditure class based on SUSENAS 1990 data. The cross section data implies that income elasticity has already turned to be negative for higher expenditure class. When national income increases, each income class may also shift upwards, and then deceleration of consumption would result. This can prove rationale of declining expenditure elasticity assumed in BAPPERTA model. As shown in Figure 2, the BAPPERTA and subsequent FIDP elasticities also have consistency with other studies.

The result of a multi-national econometric analysis by Ito et al. (1989) is depicted in Figure 2. The far higher income countries, namely, Japan and Taiwan aside, those with relatively lower income such as Malaysia and Thailand are concluded to have negative income elasticity at less than -0.4 by 1985 in the study. Thus, the elasticity for Indonesian rice in FIDP demand projection that is forecasted to decrease to be **-0.07 by 2020** seems rather moderate one or at least not an extreme.

Economic Growth

Growth of private consumption expenditure accompanied by national economic growth is a drive of changing per capita consumption demand. Setting scenario(s) of economic growth is as important as determining income elasticity parameter. The GDP growth rate in real term in next five year plans are targeted at 6.2% per annum for Repelita VI, 6.6% for Repelita VII, 7.1% for Repelita VIII, 7.8% for Repelita IX and 8.7% for Repelita X, respectively. Since our projection is separately made for urban and rural areas, real growth rate at **7%** for urban and at **4%** for rural, respectively, is used for projection up to 2000. After that, more accelerated economic growth at **9%** and **5%** is assumed. An alternative is prepared for the case of decelerated growth for urban and rural, at 6% and 4% during 1990 - 2000 and 7% and 4% during 2000 - 2020, respectively.

Population Growth

Population growth will be the main force of demand increase as income elasticity declines with income growth. All of overviewed projections include their own population forecasts. The annual increase rates used in aforementioned studies are around 1.5% before 2000 and 1%-1.2% after then. BAPPERTA model applies relatively higher growth rate that linearly decreases from 1.98% in 1988 to 1.76% in 2000. Two other studies exclusively for population projection by the United Nations (1989) and the

University if Indonesia (Antana and Arifin 1991) assume much lower growth rate at 1.34% (UN) and 1.43% (UI), and 0.85% (UN) and 0.66% (UI) respectively for periods of 1995-2000 and 2015-2020.

BAPPENAS, in consultation with CBS and the University of Indonesia, has recently set projected population to be used for a series of five year development plans, to avoid any discrepancy of basic figures among agencies. The population growth parameter in the FIDP study is also taken from it. Future population projected presents rather moderate numbers among those in other projections as shown in the following table. The difference at 2020 is less than 10 millions or 4% of total population estimates. A higher growth rate scenario that uses the same growth rate with that of the BAPPERTA model was prepared as an extreme alternative.

Comparison of Population Projection Results

Unit: million

Projection	1995	2000	2010	2015	2020
BAPPERTA Model 1992	200	218			
FIDP 1992 (Baseline)	195.3	210.4	238.9	251.5	262.4
(higher growth scenario)	197.5	216.0	251.0	266.7	281.1
University of Indonesia(UI) 1991	195.8	210.3	235.1	245.4	253.7
United Nations (UN) 1989	194.8	208.3	232.0	243.0	253.6
IWRD 1992	192.5	205.8		241.2	

Sources: Kesavan et al. 1992, Antana and Arifin 1991, United Nations 1989 and Delft Hydraulics et al. 1991, 1992.

Note: BAPPERTA model, UI 1991 and UN 1989 are made before 1990 census result is announced. All the three projection had already overestimated 1990 population by 3 million, 1.2 million and 1.3 million, respectively.

The FIDP projection forecasts population on provincial level. Until the year 2000, officially projected population is adopted in each province (CBS 1993). After year 2000, it is assumed that inter-provincial difference in population growth rates will hold proportionally. Provinces that had higher increase rate are assumed to show relatively high growth rate in future. In a long-run, this assumption could be violated, but it is hardly possible to predict such a relative change. The influence of transmigration is not separately treated since there are no indications of change in magnitude and direction of migration so far (Delft Hydraulics et al. 1991). The influence is thus already included in population growth rates of each province.

Urbanization

As one of the world fastest growing economies, Indonesia has been facing an accelerated urbanization. In fact the rate of urbanization at 30.9% shown in 1990 census exceeds an ex-ante estimate of 28.8% by the United Nation 1989. Before discussing this issue, the definition of "Urban Area" by BPS is revisited. BPS classifies desa's as urban based on three criteria (Delft Hydraulics et al. 1991):

- population density exceeds 5,000 persons per km^2;
- less than 25% of households are engaged primarily in agriculture;
- there are more than eight urban facilities including primary school, secondary school, cinema, hospital, clinic, bank, road accessible by 3 or 4 wheel vehicles, public electricity, and others.

Thus, it can happen often that an entire desa which was classified as rural before is classified as urban in next census, which makes it difficult to examine "urbanization."

Since the FIDP projection is made separately for urban and rural areas, assumption on urbanization is another key factor to be discussed. Estimated urbanization rate by BAPPENAS is applied for future urban-rural population ratios in the study.

Price Elasticity

Unlike the income elasticity, own price elasticity was given constant at **0**. Since paddy price has been controlled by the Government policy, drastic change in price would not be expected. It is therefore expected that the price fluctuation will not affect consumption of rice or will affect to a negligible extent.

Others

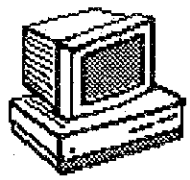
Other coefficients assumed in the projection model are of conversion factors used to transform food consumption amount into total demand amount. Conversion factors used in Food Balance Sheet by BPS shown below are employed in this projection.

- Milling rate from rough rice (*gabah kering giling*) to milled rice is 65% [4]
- Seed use is at 39.97 kg of rough rice for every ha of planted area
- Rough rice for feed consumption is at 2% of paddy production
- Wastes are at 5.4% before milling and 2.5% after milling

[4] Rice milling rate is presently agreed at 0.65 among Bureau for Logistics (BULOG), BPS and Agricultural University at Bogor (delft Hydraulics and et al. 1992). The rate used to be 0.68 until 1988 and then suddenly reduced to be 0.65.

When converting food demand for rice into total demand, a coefficient of 1.118 derived from 1990 actual data (for derivation, see Table 1) was applied to avoid using planted area as explanatory variable. Numbers above are fixed throughout the study period in this projection. In a long-run, these conversion factors would be changed due to improved technology and management. In modifying them, however, one have to be careful because a change in these factors will significantly alter the final demand estimates.

5. Projection Results



Calculation for rice demand projection was made with aforementioned methodology and assumed parameters. All the calculation process is in a spreadsheet file (see Appendix-2) so that parameter can be replaced easily. Results of projection are summarized below. Note that the results presented here are strictly under aforementioned assumptions. These have to be modified when new data becomes available or in case any situation change happens. Further model elaboration will also be acceptable. For the purpose of sensitivity analysis, projections under some alternative scenarios are carried out.

Population Projection

The population projection outcomes for baseline and higher growth rate scenarios are given in Table 3 for national level. Provincial level projections of total and urban-rural population are in Tables 4 and 5 but only for the baseline scenario. Figure 3 explicitly presents urban and rural population changes in Jawa and outer-Jawa regions up to the year 2020. Urban population is expected to catch up rural population and the urbanization rate will reach 50% before 2020.

Per Capita Consumption

Future per capita consumption (PCC) under the baseline parameter assumptions is given in Table 6 and drawn in Figure 4. While urban PCC will hit the peak in the middle of 1990s and then sluggishly decrease after then, rural PCC is expected to increase until the middle of 2010s. On the national average, starting from 147.1 kg/year in 1990, PCC will reach a peak at 154.1 kg/year in 2005 and then gradually decrease to be 147.3 kg/year[5].

[5] Note that comparing the absolute values of per capita consumption from different sources has less meaning due to difference of assumptions for non-food uses and wastes among projections. If one applies larger waste ratio, a smaller per capita consumption estimates will result.

Total Demand Amount

Finally the amount of paddy needed to be supplied for Indonesian market was estimated after multiplying population and converting from food consumption to total demand base. The numbers are in the most right column of Table 6 and summarized as below:

Rice Demand Projection for Indonesia

Unit: million ton

Year	1990	1993	1998	2003	2008	2013	2018
Food Consumption in milled rice	26.46	28.30	31.19	33.77	35.97	37.60	38.50
Total Demand in rough rice	45.52	48.68	53.66	58.09	61.87	64.67	66.23

The projection result shows that by the year 2019 supply amount must be increased by about 21 million tons or 45% of the production in 1990. The demand trend is depicted in Figure 5. Tables 7 and 8 show provincial demand projection. The net increase in rice demand between 1990 and 2018 was divided into effect of increased PCC and that of increased population. It was found that 98.0% of demand increase during the period will be attributed to population increase and remaining 2.0% to PCC change during the period. Increased population is thus regarded as the vehicle of expanding rice demand.

Alternative Scenarios

Projections under four alternative scenarios as shown below are made to examine the sensitivity of projection to parameter changes.

1) Higher population growth scenario
   Use higher population growth rate which is the same as the one used in BAPPERTA model projection.
2) Lower income elasticity scenario
   Income elasticity will decrease faster in urban area to reach to -0.3 in 2020.
3) Decelerated economic growth scenario
   Annual growth rate of GDP in urban and rural areas will be lower with 6% and 4% during 1990 - 2000 and 7% and 4% after 2000 respectively.
5) Higher population growth & Lower economic growth scenario
   A mixture of scenarios 1) and 3). Simultaneous occurrence of them would produce the highest demand projection.

The simulation results are summarized below and drawn in Figure 6.

Rice Demand Projection for Indonesia

Unit: million ton, rough rice

Scenario	1993	1998	2003	2008	2013	2018
Baseline	48.68	53.66	58.09	61.87	64.67	66.23
1) Higher Population Growth	48.95	54.60	59.89	64.49	68.09	70.47
2) Lower Income Elasticity	48.68	53.66	58.07	61.73	64.15	64.80
3) Lower Economic Growth	48.66	53.63	58.10	61.96	64.87	66.59
4) 1) + 3)	48.93	54.58	59.91	64.59	68.29	70.85

Remarks: For per capita consumption change in each alternative, refer to Table 9 to Table 12.

Only the scenarios with higher population growth show significantly different projection results, while others derive only less than 2% difference from the baseline scenario by 2020. The forth scenario from which the lowest forecasts are expected derives 7.0% higher demand estimate than that of the baseline at 2018. As shown in Figure 6, four similar scenarios show almost saturated demand trend for the final five years of the projection period. This is due to the effect of decreased per capita consumption that compare to the effect of increased population.

6. Comparison with Other Studies

The projection result is compared with other previous studies referred to in literature overview in order to examine its adequacy. The comparison is given in Table 13. The FIDP projection shows moderate total demand as compared with other projections. The differences at the year 2000, which is the final year of three of five projections, lie mostly within the range of three million tons. Some has already under-estimated 1990 total demand, which implies if the base years were the same, the difference would be smaller. The comparison result supports that the FIDP projection presents a reasonable forecast.

As mentioned above, the accuracy of the demand projection highly depends on that of population projection. Applying this projection for irrigation planning would **require close monitoring on the change in population growth rate**. The part of population growth in the demand projection model needs to be calibrated **every five year** with data from **population censuses and inter-census surveys (SUPAS)**.

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Tables

Table 1 Parameter Assumptions for Rice Demand Projection

Year	1) Population & Urbanization a. Population Growth Rate				b. Rate of Urbanization	2) Per Capita Consumption of Rice a. Expenditure Elasticity					
	1. Baseline		*2. Higher*			*1. Baseline*			*2. Accelerated*		
						Total	Urban	Rural	Total	Urban	Rural
1990	1.73%		1.94%		30.91%	0.18	0.06	0.24	0.18	0.06	0.24
1991	1.70%		1.92%			0.17	0.05	0.23	0.17	0.05	0.23
1992	1.66%	Average	1.90%	Average		0.16	0.04	0.22	0.16	0.04	0.22
1993	1.63%	Growth Rate	1.88%	Growth Rate		0.15	0.03	0.21	0.15	0.03	0.21
1994	1.60%	1990-1995	1.86%	1990-1995	at 1995	0.14	0.02	0.20	0.14	0.02	0.20
1995	1.57%	1.66%	1.84%	1.90%	33.02%	0.13	0.01	0.19	0.13	0.01	0.19
1996	1.54%		1.82%			0.12	0.00	0.18	0.12	0.00	0.18
1997	1.51%	Average	1.80%	Average		0.11	-0.01	0.17	0.11	-0.01	0.17
1998	1.48%	Growth Rate	1.78%	Growth Rate		0.10	-0.02	0.16	0.10	-0.02	0.16
1999	1.45%	1995-2000	1.76%	1995-2000	at 2000	0.09	-0.03	0.15	0.09	-0.03	0.15
2000	1.42%	1.51%	1.71%	1.80%	36.34%	0.08	-0.04	0.14	0.08	-0.04	0.14
2001	1.39%		1.66%			0.07	-0.04	0.13	0.07	-0.04	0.13
2002	1.36%	Average	1.62%	Average		0.06	-0.04	0.12	0.06	-0.05	0.12
2003	1.33%	Growth Rate	1.57%	Growth Rate		0.05	-0.05	0.11	0.05	-0.05	0.11
2004	1.30%	2000-2005	1.53%	2000-2005	at 2005	0.05	-0.05	0.10	0.04	-0.06	0.10
2005	1.26%	1.36%	1.49%	1.62%	40.64%	0.04	-0.05	0.09	0.03	-0.07	0.09
2006	1.23%		1.44%			0.03	-0.05	0.08	0.02	-0.07	0.08
2007	1.20%	Average	1.40%	Average		0.02	-0.06	0.07	0.01	-0.08	0.07
2008	1.16%	Growth Rate	1.36%	Growth Rate		0.01	-0.06	0.06	0.00	-0.09	0.06
2009	1.13%	2005-2010	1.33%	2005-2010	at 2010	0.01	-0.06	0.05	-0.01	-0.10	0.05
2010	1.09%	1.20%	1.29%	1.40%	44.48%	0.00	-0.06	0.04	-0.02	-0.11	0.04
2011	1.06%		1.25%			-0.01	-0.07	0.03	-0.03	-0.12	0.03
2012	1.03%	Average	1.22%	Average		-0.02	-0.07	0.02	-0.04	-0.13	0.02
2013	0.99%	Growth Rate	1.18%	Growth Rate		-0.03	-0.07	0.01	-0.05	-0.15	0.01
2014	0.96%	2010-2015	1.15%	2010-2015	at 2015	-0.03	-0.08	0.00	-0.07	-0.16	0.00
2015	0.92%	1.03%	1.12%	1.22%	47.63%	-0.04	-0.08	-0.01	-0.08	-0.18	-0.01
2016	0.89%		1.09%			-0.05	-0.08	-0.02	-0.10	-0.20	-0.02
2017	0.86%	Average	1.06%	Average		-0.06	-0.09	-0.03	-0.11	-0.22	-0.03
2018	0.82%	Growth Rate	1.03%	Growth Rate		-0.06	-0.09	-0.04	-0.13	-0.25	-0.04
2019	0.79%	2015-2020	1.00%	2015-2020	at 2020	-0.07	-0.10	-0.05	-0.15	-0.27	-0.05
2020	0.75%	0.86%	0.97%	1.06%	51.22%	-0.08	-0.10	-0.06	-0.17	-0.30	-0.06

b. Economic Growth (GDP Growth)

1. Baseline

1990-2000
- Urban 7%
- Rural 4%

2000-2020
- Urban 9%
- Rural 5%

2. Slowered

1990-2000
- Urban 6%
- Rural 4%

2000-2020
- Urban 7%
- Rural 4%

c. Other Parameters

Own Price Elasticity: 0

Expenditure Elasticity w.r.t. GDP Growth: 1.120

Rice Milling Rate: 0.650

Calculation of Base Year Consumption (1990)

a. Producton: Paddy	(1,000 ton)	45,179
b. Feed Consumption (2% of a.)	(1,000 ton)	904
c. Seed Use (39.97 kg/ha, paddy)	(1,000 ton)	420
d. Waste (5.4% of a.)	(1,000 ton)	2,440
e. Net Import (Food Blance Sheet)	(1,000 ton)	46
f. Change in Stock (")	(1,000 ton)	-173
g. Available Rice	(1,000 ton)	27,139
h. Waste at milled rice (2.5% of g.)	(1,000 ton)	678
i. Food Consumption	(1,000 ton)	26,461
j. Per Capita Food Consumption	(kg/year)	147.14
Food Consumption to Total Demand:	(a*0.65+(e-f))/i:	1.118

Per Capita Consumption by		SUSENAS 1990		Adjusted to disappearance base
Urban	(kg/year)	112.00	⟶	139.13
Rural	(kg/year)	121.34	⟶	150.73

Table 2 Estimation of Per Capita Consumption by Province

1990 Adjusted National Consumption	
7,730,845	18,730,052

Calculation Process 1.:
Consumption in 1990

Code No.	Privince	SUSENAS 1990 Per Capita Consumption		Population Census 1990		Total Consumption From SUSENAS Data		Adjusted 1990 Total Consumption		Adjusted 1990 Per Capita Consumption	
		Urban (kg/year)	Rural (kg/year)	Urban (thousand)	Rural (thousand)	Urban (ton)	Rural (ton)	Urban (ton)	Rural (ton)	Urban (kg/year)	Rural (kg/year)
11	D.I Aceh	136.72	150.48	544	2,896	74,318	435,820	92,298	542,063	169.80	187.17
12	Sumatera Utara	116.85	144.44	3,665	6,660	428,220	961,995	531,823	1,196,507	145.12	179.65
13	Sumatera Barat	128.01	154.86	812	3,208	103,990	496,797	129,149	617,904	158.98	192.62
14	Riau	110.18	122.59	1,057	2,254	116,442	276,269	144,614	343,617	136.83	152.47
15	Jambi	120.40	152.05	437	1,598	52,646	242,963	65,384	302,191	149.53	189.11
16	Sumatera Selatan	110.13	132.60	1,864	4,502	205,243	596,934	254,899	742,452	136.77	164.92
17	Bengkulu	143.65	158.25	243	948	34,837	149,992	43,265	186,557	178.41	196.83
18	Lampung	127.07	127.59	754	5,304	95,818	676,763	119,001	841,742	157.82	158.70
31	D.K.I Jakarta	102.62	0.00	8,281	0	849,762	0	1,055,353	0	127.44	
32	Jawa Barat	119.88	146.26	12,098	22,960	1,450,220	3,358,216	1,801,085	4,176,869	148.88	181.92
33	Jawa Tengah	105.90	102.77	7,728	20,914	818,440	2,149,358	1,016,454	2,673,320	131.52	127.83
34	D.I Yokyakarta	97.98	89.43	1,298	1,624	127,213	145,226	157,991	180,628	121.68	111.22
35	Jawa Timur	102.20	95.00	8,980	23,742	917,786	2,255,545	1,139,835	2,805,393	126.93	118.16
51	Bali	126.50	140.42	738	2,052	93,296	288,182	115,868	358,433	157.10	174.65
52	Nusa Tenggara Barat	133.49	145.06	586	2,803	78,183	406,664	97,099	505,799	165.78	180.42
53	Nusa Tenggara Timur	119.25	86.45	374	2,911	44,630	251,694	55,428	313,051	148.10	107.53
54	Timor Timur	86.66	76.81	59	693	5,071	53,211	6,298	66,182	107.63	95.53
61	Kalimantan Barat	113.41	128.90	647	2,609	73,396	336,322	91,153	418,310	140.85	160.32
62	Kalimantan Tengah	122.74	143.45	247	1,161	30,378	166,556	37,727	207,158	152.44	178.41
63	Kalimantan Selatan	106.63	129.52	707	1,906	75,438	246,850	93,689	307,026	132.43	161.10
64	Kalimantan Timur	124.99	132.13	922	967	115,274	127,732	143,163	158,869	155.23	164.34
71	Sulawesi Utara	128.64	117.22	568	1,923	73,010	225,354	90,673	280,290	159.76	145.79
72	Sulawesi Tengah	130.04	125.20	284	1,439	36,995	180,171	45,945	224,092	161.51	155.71
73	Sulawesi Selatan	128.48	139.64	1,693	5,320	217,570	742,903	270,209	924,005	159.56	173.68
74	Sulawesi Tenggara	114.77	95.21	232	1,129	26,587	107,537	33,019	133,752	142.53	118.42
81	Maluku	104.08	67.16	355	1,511	36,972	101,449	45,917	126,180	129.26	83.53
82	Irian Jaya	109.45	63.88	394	1,229	43,082	78,520	53,505	97,661	135.93	79.45
	INDONESIA	112.00	121.34	55,567	124,263	6,224,816	15,059,023	7,730,845	18,730,052	139.13	150.73

Table 3 Population Projection Toward 2020

	Baseline		Higher Senario	
Year	Population (thousand)	Growth Rate (per cent)	Population (thousand)	Growth Rate (per cent)
1990	179,830	1.73%	179,830	1.96%
1991	182,941	1.70%	183,318	1.94%
1992	186,044	1.66%	186,838	1.92%
1993	189,136	1.63%	190,388	1.90%
1994	192,217	1.60%	193,967	1.88%
1995	195,282	1.57%	197,575	1.86%
1996	198,343	1.54%	201,211	1.84%
1997	201,389	1.51%	204,873	1.82%
1998	204,422	1.48%	208,560	1.80%
1999	207,440	1.45%	212,273	1.78%
2000	210,440	1.42%	216,009	1.76%
2001	213,425	1.39%	219,705	1.71%
2002	216,400	1.36%	223,359	1.66%
2003	219,351	1.33%	226,970	1.62%
2004	222,273	1.30%	230,538	1.57%
2005	225,158	1.26%	234,061	1.53%
2006	228,004	1.23%	237,538	1.49%
2007	230,809	1.20%	240,968	1.44%
2008	233,569	1.16%	244,350	1.40%
2009	236,283	1.13%	247,685	1.36%
2010	238,948	1.09%	250,971	1.33%
2011	241,563	1.06%	254,208	1.29%
2012	244,123	1.03%	257,395	1.25%
2013	246,628	0.99%	260,532	1.22%
2014	249,074	0.96%	263,619	1.18%
2015	251,461	0.92%	266,655	1.15%
2016	253,784	0.89%	269,641	1.12%
2017	256,043	0.86%	272,576	1.09%
2018	258,234	0.82%	275,460	1.06%
2019	260,357	0.79%	278,294	1.03%
2020	262,409	0.75%	281,077	1.00%

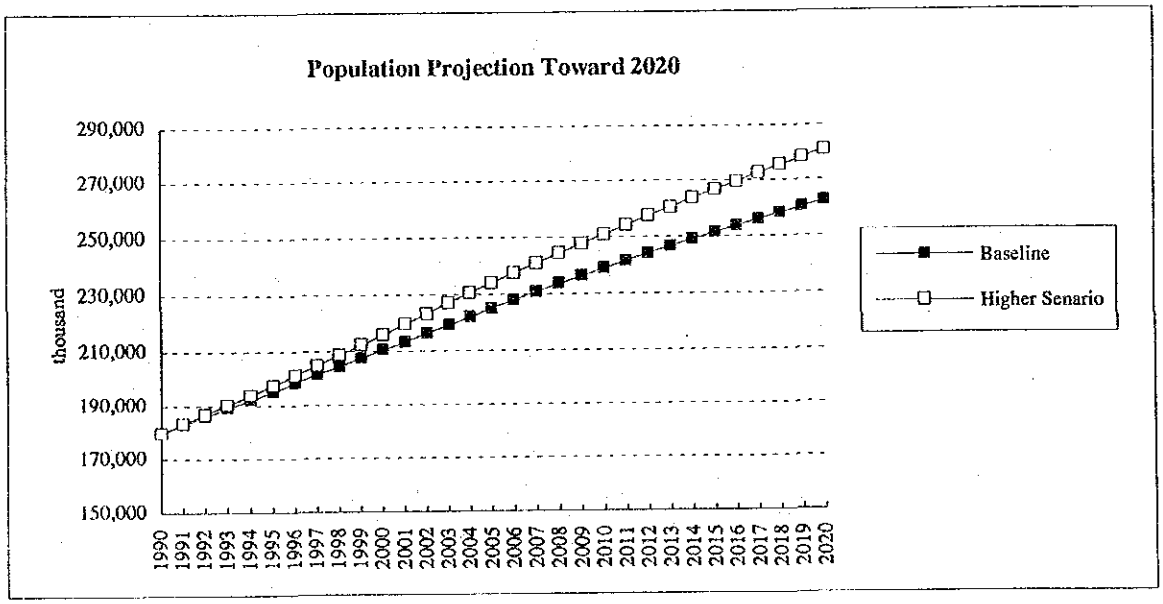


Table 4 Population Projection by Province

Unit: thousand

Code No.	Province	1990 (adjusted)	1993	1998	2003	2008	2013	2018
11	D.I Aceh	3,440	3,699	4,123	4,541	4,942	5,313	5,643
12	Sumatera Utara	10,325	10,857	11,636	12,372	13,054	13,663	14,192
13	Sumatera Barat	4,020	4,204	4,521	4,821	5,100	5,350	5,568
14	Riau	3,311	3,681	4,344	5,040	5,742	6,421	7,048
15	Jambi	2,035	2,246	2,619	3,006	3,393	3,763	4,102
16	Sumatera Selatan	6,366	6,910	7,798	8,687	9,551	10,356	11,079
17	Bengkulu	1,190	1,321	1,570	1,832	2,099	2,358	2,599
18	Lampung	6,058	6,529	7,237	7,933	8,597	9,208	9,751
31	D.K.I Jakarta	8,281	8,819	9,717	10,594	11,427	12,190	12,864
32	Jawa Barat	35,058	37,318	41,242	45,088	48,749	52,107	55,084
33	Jawa Tengah	28,642	29,297	30,252	31,103	31,858	32,508	33,057
34	D.I Yokyakarta	2,922	2,918	2,914	2,906	2,899	2,891	2,885
35	Jawa Timur	32,722	33,486	34,692	35,775	36,741	37,575	38,282
51	Bali	2,790	2,856	2,968	3,070	3,161	3,240	3,307
52	Nusa Tenggara Barat	3,389	3,562	3,816	4,057	4,279	4,478	4,651
53	Nusa Tenggara Timur	3,286	3,477	3,755	4,021	4,269	4,491	4,686
54	Timor Timur	751	812	891	968	1,041	1,107	1,166
61	Kalimantan Barat	3,256	3,506	3,898	4,285	4,656	4,997	5,301
62	Kalimantan Tengah	1,409	1,548	1,791	2,040	2,288	2,523	2,738
63	Kalimantan Selatan	2,613	2,789	3,086	3,378	3,656	3,911	4,137
64	Kalimantan Timur	1,889	2,148	2,637	3,171	3,729	4,285	4,812
71	Sulawesi Utara	2,490	2,588	2,759	2,919	3,066	3,197	3,310
72	Sulawesi Tengah	1,724	1,868	2,114	2,360	2,600	2,824	3,026
73	Sulawesi Selatan	7,014	7,365	7,929	8,465	8,963	9,410	9,800
74	Sulawesi Tenggara	1,361	1,505	1,746	1,994	2,241	2,476	2,692
81	Maluku	1,866	2,006	2,237	2,466	2,686	2,889	3,071
82	Irian Jaya	1,623	1,821	2,132	2,457	2,782	3,095	3,382
	Sumatera	36,745	39,448	43,847	48,234	52,478	56,432	59,983
	Jawa	107,625	111,837	118,816	125,466	131,675	137,272	142,173
	Bali, NTB, NTT &Timtim	10,216	10,706	11,431	12,116	12,750	13,317	13,810
	Kalimantan	9,167	9,991	11,412	12,874	14,328	15,716	16,989
	Sulawesi	12,588	13,326	14,547	15,738	16,870	17,907	18,827
	Maluku & Irian Jaya	3,489	3,826	4,369	4,923	5,468	5,984	6,453
	Jawa	107,625	111,837	118,816	125,466	131,675	137,272	142,173
	Off-Jawa	72,205	77,299	85,606	93,885	101,895	109,356	116,061
	INDONESIA	179,830	189,136	204,422	219,351	233,569	246,628	258,234

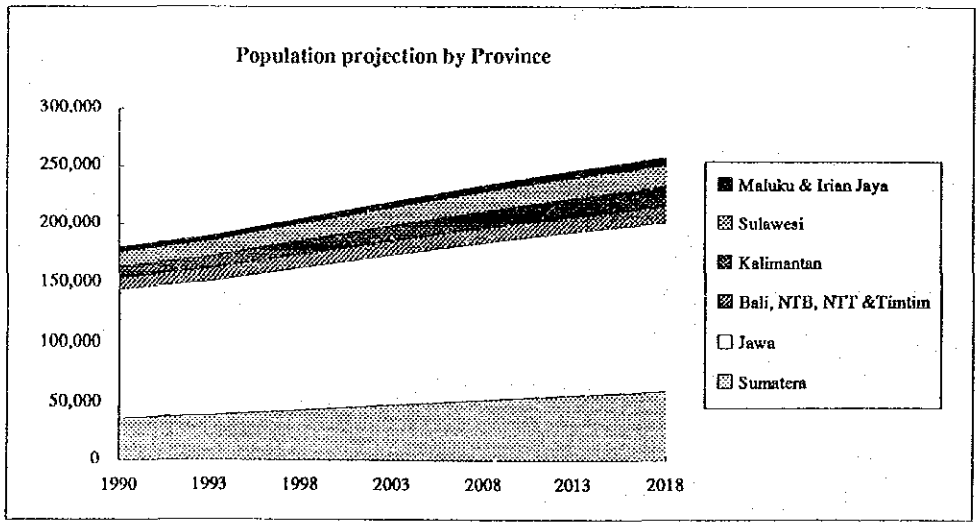


Table 5 Population Projection: Urban versus Rural

Unit: thousand

Code No.	Province	1990 (Census data)			1993			1998			2003			2008			2013			2018		
		Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
11	D.I Aceh	544	2,896	3,440	657	3,042	3,699	875	3,247	4,123	1,124	3,418	4,541	1,432	3,510	4,942	1,843	3,470	5,313	2,357	3,286	5,643
12	Sumatera Utara	3,665	6,660	10,325	4,114	6,742	10,857	4,832	6,803	11,636	5,467	6,905	12,372	6,149	6,905	13,054	7,010	6,653	13,663	7,978	6,215	14,192
13	Sumatera Barat	812	3,208	4,020	917	3,287	4,204	1,101	3,419	4,521	1,282	3,539	4,821	1,491	3,610	5,100	1,756	3,595	5,350	2,063	3,505	5,568
14	Riau	1,057	2,254	3,311	1,223	2,458	3,681	1,515	2,829	4,344	1,832	3,208	5,040	2,211	3,531	5,742	2,676	3,745	6,421	3,198	3,850	7,048
15	Jambi	437	1,598	2,035	519	1,728	2,246	670	1,949	2,619	837	2,169	3,006	1,039	2,354	3,393	1,294	2,469	3,763	1,594	2,508	4,102
16	Sumatera Selatan	1,864	4,502	6,366	2,074	4,835	6,910	2,398	5,399	7,798	2,722	5,966	8,687	3,102	6,448	9,551	3,564	6,792	10,356	4,063	7,016	11,079
17	Bengkulu	243	948	1,190	300	1,021	1,321	420	1,149	1,570	549	1,283	1,832	695	1,404	2,099	881	1,477	2,358	1,102	1,497	2,599
18	Lampung	754	5,304	6,058	837	5,692	6,529	958	6,279	7,237	1,060	6,873	7,933	1,167	7,430	8,597	1,298	7,910	9,208	1,434	8,316	9,751
31	D.K.I Jakarta	8,281	0	8,281	8,819	0	8,819	9,717	0	9,717	10,594	0	10,594	11,427	0	11,427	12,190	0	12,190	12,864	0	12,864
32	Jawa Barat	12,098	22,960	35,058	14,196	23,122	37,318	18,134	23,107	41,242	21,652	23,436	45,088	25,155	23,594	48,749	29,524	22,583	52,107	34,467	20,617	55,084
33	Jawa Tengah	7,728	20,914	28,642	8,521	20,776	29,297	9,797	20,455	30,252	10,933	20,169	31,103	12,214	19,645	31,858	13,890	18,618	32,508	15,832	17,226	33,057
34	D.I Yokyakarta	1,298	1,624	2,922	1,424	1,494	2,918	1,635	1,279	2,914	1,704	1,202	2,906	1,704	1,195	2,899	1,740	1,151	2,891	1,789	1,096	2,885
35	Jawa Timur	8,980	23,742	32,722	9,825	23,661	33,486	11,180	23,513	34,692	12,308	23,467	35,775	13,532	23,209	36,741	15,139	22,436	37,575	16,970	21,312	38,282
51	Bali	738	2,052	2,790	833	2,023	2,856	1,003	1,966	2,968	1,140	1,930	3,070	1,276	1,886	3,161	1,451	1,789	3,240	1,654	1,653	3,307
52	Nusa Tenggara Barat	586	2,803	3,389	648	2,914	3,562	743	3,074	3,816	829	3,228	4,057	926	3,353	4,279	1,049	3,430	4,478	1,185	3,466	4,651
53	Nusa Tenggara Timur	374	2,911	3,286	433	3,044	3,477	534	3,221	3,755	642	3,379	4,021	773	3,496	4,269	942	3,549	4,491	1,146	3,540	4,686
54	Timor Timur	59	693	751	67	745	812	78	812	891	89	879	968	101	940	1,041	115	992	1,107	131	1,035	1,166
61	Kalimantan Barat	647	2,609	3,256	728	2,778	3,506	856	3,042	3,898	995	3,291	4,285	1,167	3,488	4,656	1,383	3,614	4,997	1,629	3,672	5,301
62	Kalimantan Tengah	247	1,161	1,409	297	1,251	1,548	391	1,400	1,791	507	1,533	2,040	663	1,625	2,288	870	1,653	2,523	1,131	1,607	2,738
63	Kalimantan Selatan	707	1,906	2,613	793	1,996	2,789	937	2,150	3,086	1,083	2,295	3,378	1,258	2,398	3,656	1,475	2,436	3,911	1,720	2,417	4,137
64	Kalimantan Timur	922	967	1,889	1,086	1,062	2,148	1,387	1,250	2,637	1,718	1,453	3,171	2,112	1,616	3,729	2,593	1,692	4,285	3,129	1,683	4,812
71	Sulawesi Utara	568	1,923	2,490	632	1,957	2,588	741	2,018	2,759	846	2,073	2,919	966	2,100	3,066	1,119	2,078	3,197	1,295	2,015	3,310
72	Sulawesi Tengah	284	1,439	1,724	346	1,523	1,868	465	1,649	2,114	609	1,752	2,360	797	1,804	2,600	1,051	1,774	2,824	1,375	1,651	3,026
73	Sulawesi Selatan	1,693	5,320	7,014	1,874	5,491	7,365	2,163	5,766	7,929	2,410	6,055	8,465	2,675	6,290	8,963	3,004	6,406	9,410	3,368	6,432	9,800
74	Sulawesi Tenggara	232	1,129	1,361	284	1,221	1,505	384	1,362	1,746	502	1,492	1,994	654	1,587	2,241	855	1,622	2,476	1,105	1,586	2,692
81	Maluku	355	1,511	1,866	423	1,583	2,006	548	1,689	2,237	691	1,776	2,466	868	1,818	2,686	1,102	1,788	2,889	1,389	1,682	3,071
82	Irian Jaya	394	1,229	1,623	458	1,363	1,821	559	1,574	2,132	664	1,793	2,457	786	1,997	2,782	934	2,161	3,095	1,097	2,286	3,382
	Sumatera	9,375	27,370	36,745	10,643	28,806	39,448	12,772	31,075	43,847	14,873	33,361	48,234	17,286	35,193	52,478	20,322	36,110	56,432	23,789	36,193	59,983
	Jawa	38,385	69,240	107,625	42,784	69,052	111,837	50,462	68,354	118,816	57,191	68,275	125,466	64,031	67,643	131,675	72,483	64,789	137,272	81,922	60,251	142,173
	Bali, NTB, NTT &Timtim	1,756	8,460	10,216	1,981	8,726	10,706	2,358	9,073	11,431	2,700	9,416	12,116	3,075	9,675	12,750	3,557	9,759	13,317	4,116	9,693	13,810
	Kalimantan	2,524	6,643	9,167	2,904	7,087	9,991	3,570	7,842	11,412	4,303	8,571	12,874	5,200	9,128	14,328	6,321	9,395	15,716	7,609	9,380	16,989
	Sulawesi	2,777	9,811	12,588	3,135	10,192	13,326	3,752	10,795	14,547	4,366	11,372	15,738	5,089	11,781	16,870	6,028	11,879	17,907	7,143	11,685	18,827
	Maluku & Irian Jaya	749	2,740	3,489	880	2,946	3,826	1,107	3,263	4,369	1,354	3,569	4,923	1,654	3,814	5,468	2,035	3,949	5,984	2,486	3,967	6,453
	Jawa	38,385	69,240	107,625	42,784	69,052	111,837	50,462	68,354	118,816	57,191	68,275	125,466	64,031	67,643	131,675	72,483	64,789	137,272	81,922	60,251	142,173
	Off-Jawa	17,181	55,023	72,205	19,542	57,756	77,299	23,559	62,047	85,606	27,597	66,288	93,885	32,303	69,591	101,895	38,264	71,092	109,356	45,143	70,919	116,061
	INDONESIA	55,567	124,263	179,830	62,327	126,809	189,136	74,021	130,401	204,422	84,788	134,563	219,351	96,335	137,234	233,569	110,747	135,881	246,628	127,064	131,170	258,234
	Ratio over Population	30.9%	69.1%		33.0%	67.0%		36.2%	63.8%		38.7%	61.3%		41.2%	58.8%		44.9%	55.1%		49.2%	50.8%	

Table 6 Projection of Demand for Rice in Indonesia

Year	Per Capita Consumption (kg/year)			Population (1,000)		Food Demand (1,000 ton)				Total Demand
	Urban	Rural	Indonesia	Urban	Rural	Urban	Rural	Indonesia	(in Paddy)	
1990	139.13	150.73	147.14	55,567	124,263	7,731	18,730	26,461	40,709	45,516
1991	139.40	152.01	148.02	57,766	125,175	8,052	19,027	27,080	41,661	46,580
1992	139.62	153.25	148.85	60,020	126,024	8,380	19,314	27,693	42,605	47,636
1993	139.78	154.47	149.63	62,327	126,809	8,712	19,588	28,301	43,539	48,680
1994	139.90	155.63	150.35	64,571	127,645	9,034	19,865	28,899	44,460	49,710
1995	139.96	156.75	151.00	66,862	128,421	9,358	20,130	29,488	45,366	50,723
1996	139.96	157.83	151.60	69,202	129,141	9,686	20,382	30,068	46,258	51,720
1997	139.90	158.87	152.13	71,588	129,801	10,015	20,621	30,637	47,133	52,699
1998	139.78	159.87	152.59	74,021	130,401	10,346	20,847	31,193	47,989	53,656
1999	139.57	160.75	152.97	76,117	131,323	10,623	21,110	31,733	48,820	54,585
2000	139.28	161.58	153.29	78,241	132,199	10,898	21,361	32,258	49,628	55,488
2001	138.99	162.36	153.56	80,394	133,030	11,174	21,599	32,773	50,420	56,374
2002	138.68	163.10	153.78	82,578	133,821	11,452	21,826	33,277	51,196	57,241
2003	138.35	163.77	153.95	84,788	134,563	11,730	22,038	33,768	51,951	58,085
2004	138.00	164.40	154.06	87,059	135,214	12,014	22,230	34,244	52,683	58,904
2005	137.64	164.97	154.13	89,351	135,808	12,298	22,405	34,703	53,390	59,694
2006	137.26	165.49	154.14	91,662	136,343	12,582	22,563	35,144	54,068	60,453
2007	136.86	165.94	154.10	93,990	136,818	12,864	22,703	35,567	54,718	61,179
2008	136.44	166.33	154.00	96,335	137,234	13,144	22,826	35,969	55,338	61,872
2009	136.04	166.68	153.82	99,169	137,114	13,490	22,854	36,344	55,914	62,516
2010	135.61	166.95	153.57	102,030	136,919	13,836	22,859	36,695	56,454	63,120
2011	135.16	167.16	153.26	104,915	136,648	14,180	22,841	37,022	56,956	63,682
2012	134.68	167.28	152.88	107,821	136,302	14,522	22,801	37,323	57,419	64,199
2013	134.18	167.33	152.45	110,747	135,881	14,860	22,737	37,597	57,842	64,672
2014	133.68	167.30	151.91	113,978	135,096	15,237	22,601	37,838	58,212	65,086
2015	133.15	167.18	151.31	117,229	134,232	15,609	22,440	38,049	58,538	65,450
2016	132.59	166.97	150.65	120,496	133,288	15,977	22,255	38,232	58,818	65,763
2017	132.00	166.67	149.91	123,776	132,267	16,338	22,045	38,383	59,051	66,024
2018	131.37	166.28	149.11	127,064	131,170	16,693	21,811	38,504	59,237	66,232
2019	130.72	165.80	148.23	130,357	130,000	17,040	21,554	38,594	59,375	66,386
2020	130.02	165.22	147.29	133,650	128,758	17,377	21,274	38,651	59,463	66,485

Contribution to Demand Increase (1990-2019): **Per Capita Consumption=** **2.0%** **Population=** **98.0%**

Table 7 Rice Demand Projection for Food Consumption by Province

Unit: milled rice, thousand ton

Code No.	Province	1990	1993	1998	2003	2008	2013	2018
11	D.I Aceh	634	691	784	874	952	1,014	1,051
12	Sumatera Utara	1,728	1,841	1,999	2,128	2,228	2,283	2,290
13	Sumatera Barat	747	794	870	937	991	1,028	1,046
14	Riau	488	546	649	763	873	971	1,048
15	Jambi	368	408	480	558	631	694	742
16	Sumatera Selatan	997	1,092	1,247	1,410	1,558	1,683	1,776
17	Bengkulu	230	257	308	365	420	470	509
18	Lampung	961	1,048	1,183	1,323	1,452	1,565	1,653
31	D.K.I Jakarta	1,055	1,129	1,237	1,327	1,403	1,457	1,487
32	Jawa Barat	5,978	6,433	7,177	7,827	8,378	8,743	8,895
33	Jawa Tengah	3,690	3,857	4,087	4,232	4,327	4,364	4,335
34	D.I Yokyakarta	339	347	356	354	350	343	333
35	Jawa Timur	3,945	4,127	4,386	4,562	4,685	4,751	4,747
51	Bali	474	495	526	546	559	563	558
52	Nusa Tenggara Barat	603	644	705	761	808	845	867
53	Nusa Tenggara Timur	368	398	442	484	521	553	576
54	Timor Timur	72	79	89	99	108	115	121
61	Kalimantan Barat	509	555	627	700	765	818	856
62	Kalimantan Tengah	245	271	317	366	412	449	476
63	Kalimantan Selatan	401	433	486	537	581	616	637
64	Kalimantan Timur	302	345	424	514	605	688	757
71	Sulawesi Utara	371	393	430	460	485	504	514
72	Sulawesi Tengah	270	297	342	389	431	467	492
73	Sulawesi Selatan	1,194	1,274	1,398	1,511	1,606	1,678	1,722
74	Sulawesi Tenggara	167	187	221	258	294	327	355
81	Maluku	172	189	218	247	275	301	324
82	Irian Jaya	151	171	203	238	273	307	337
	Sumatera	6,153	6,676	7,520	8,357	9,105	9,707	10,114
	Jawa	15,007	15,893	17,243	18,302	19,142	19,658	19,797
	Bali, NTB, NTT &Timtim	1,518	1,616	1,762	1,889	1,996	2,076	2,122
	Kalimantan	1,457	1,603	1,854	2,117	2,362	2,572	2,726
	Sulawesi	2,002	2,151	2,391	2,618	2,816	2,976	3,083
	Maluku & Irian Jaya	323	361	422	486	548	608	660
	Jawa	15,007	15,893	17,243	18,302	19,142	19,658	19,797
	Off-Jawa	11,454	12,407	13,950	15,467	16,828	17,939	18,707
	INDONESIA	26,461	28,301	31,193	33,768	35,969	37,597	38,504

Table 8 Demand Projection for Paddy by Province

Unit: rough rice, thousand ton

Code No.	Province	1990	1993	1998	2003	2008	2013	2018
11	D.I Aceh	1,091	1,189	1,349	1,503	1,638	1,744	1,808
12	Sumatera Utara	2,973	3,166	3,439	3,661	3,832	3,927	3,939
13	Sumatera Barat	1,285	1,365	1,497	1,612	1,705	1,769	1,798
14	Riau	840	939	1,116	1,312	1,501	1,670	1,803
15	Jambi	632	702	825	959	1,086	1,194	1,276
16	Sumatera Selatan	1,716	1,879	2,146	2,425	2,680	2,895	3,055
17	Bengkulu	395	442	530	627	722	808	875
18	Lampung	1,653	1,802	2,034	2,275	2,497	2,691	2,843
31	D.K.I Jakarta	1,815	1,941	2,127	2,283	2,413	2,507	2,558
32	Jawa Barat	10,283	11,066	12,345	13,463	14,411	15,040	15,300
33	Jawa Tengah	6,347	6,635	7,030	7,280	7,442	7,506	7,456
34	D.I Yokyakarta	582	597	613	609	602	590	574
35	Jawa Timur	6,786	7,099	7,545	7,847	8,059	8,171	8,166
51	Bali	816	852	905	939	962	969	959
52	Nusa Tenggara Barat	1,037	1,108	1,213	1,309	1,390	1,453	1,492
53	Nusa Tenggara Timur	634	684	760	832	896	950	991
54	Timor Timur	125	136	153	170	185	198	208
61	Kalimantan Barat	876	954	1,078	1,203	1,315	1,408	1,473
62	Kalimantan Tengah	421	466	546	630	708	773	819
63	Kalimantan Selatan	689	744	836	924	1,000	1,059	1,096
64	Kalimantan Timur	520	593	730	885	1,040	1,184	1,303
71	Sulawesi Utara	638	677	739	791	835	867	884
72	Sulawesi Tengah	464	510	589	668	741	802	847
73	Sulawesi Selatan	2,054	2,191	2,405	2,599	2,763	2,887	2,962
74	Sulawesi Tenggara	287	321	380	444	506	563	611
81	Maluku	296	326	376	425	473	518	557
82	Irian Jaya	260	295	350	410	470	528	579
	Sumatera	10,585	11,484	12,936	14,374	15,661	16,698	17,397
	Jawa	25,814	27,338	29,660	31,481	32,926	33,814	34,054
	Bali, NTB, NTT &Timtim	2,611	2,780	3,032	3,250	3,433	3,570	3,651
	Kalimantan	2,506	2,758	3,189	3,642	4,064	4,424	4,690
	Sulawesi	3,444	3,700	4,114	4,503	4,844	5,119	5,304
	Maluku & Irian Jaya	556	620	725	835	943	1,046	1,136
	Jawa	25,814	27,338	29,660	31,481	32,926	33,814	34,054
	Off-Jawa	19,702	21,342	23,996	26,604	28,945	30,858	32,178
	INDONESIA	45,516	48,680	53,656	58,085	61,872	64,672	66,232

Note: Total Demand Base

Table 9 Projection of Demand for Rice in Indonesia
Higher Population Growth Scenario

Year	Per Capita Consumption (kg/year)			Population (1,000)		Food Demand (1,000 ton)				Total Demand
	Urban	Rural	Indonesia	Urban	Rural	Urban	Rural	Indonesia	(in Paddy)	
1990	139.13	150.73	147.14	55,567	124,263	7,731	18,730	26,461	40,709	45,516
1991	139.38	151.93	147.97	57,885	125,433	8,068	19,058	27,126	41,732	46,660
1992	139.59	153.11	148.75	60,276	126,562	8,414	19,378	27,792	42,756	47,805
1993	139.75	154.25	149.47	62,739	127,649	8,768	19,690	28,458	43,781	48,950
1994	139.86	155.33	150.13	65,159	128,808	9,113	20,008	29,121	44,801	50,092
1995	139.91	156.37	150.74	67,647	129,928	9,465	20,317	29,782	45,819	51,229
1996	139.91	157.38	151.29	70,202	131,008	9,822	20,618	30,440	46,831	52,361
1997	139.86	158.34	151.77	72,826	132,046	10,185	20,908	31,094	47,836	53,485
1998	139.74	159.26	152.19	75,519	133,041	10,553	21,188	31,742	48,833	54,599
1999	139.54	160.07	152.54	77,890	134,383	10,869	21,511	32,380	49,815	55,697
2000	139.28	160.83	152.82	80,311	135,697	11,186	21,825	33,010	50,785	56,782
2001	139.00	161.55	153.06	82,759	136,945	11,504	22,124	33,628	51,735	57,843
2002	138.70	162.23	153.25	85,234	138,125	11,822	22,408	34,231	52,662	58,881
2003	138.39	162.86	153.40	87,733	139,238	12,141	22,677	34,818	53,567	59,892
2004	138.06	163.45	153.51	90,295	140,243	12,467	22,923	35,389	54,445	60,874
2005	137.72	163.99	153.56	92,882	141,178	12,792	23,151	35,943	55,297	61,826
2006	137.35	164.47	153.57	95,493	142,045	13,116	23,362	36,478	56,121	62,747
2007	136.97	164.89	153.52	98,126	142,842	13,440	23,554	36,994	56,914	63,634
2008	136.56	165.26	153.43	100,780	143,571	13,763	23,727	37,490	57,676	64,486
2009	136.18	165.59	153.25	103,952	143,733	14,156	23,801	37,957	58,395	65,291
2010	135.77	165.86	153.01	107,161	143,810	14,549	23,852	38,401	59,078	66,054
2011	135.33	166.05	152.71	110,404	143,803	14,942	23,879	38,820	59,723	66,775
2012	134.88	166.17	152.35	113,681	143,714	15,333	23,881	39,214	60,329	67,453
2013	134.39	166.22	151.93	116,988	143,544	15,723	23,859	39,582	60,895	68,086
2014	133.91	166.18	151.42	120,632	142,987	16,154	23,762	39,916	61,410	68,661
2015	133.40	166.07	150.84	124,311	142,344	16,583	23,639	40,222	61,881	69,187
2016	132.86	165.87	150.20	128,024	141,617	17,010	23,490	40,500	62,307	69,665
2017	132.29	165.59	149.49	131,768	140,808	17,432	23,316	40,748	62,689	70,091
2018	131.69	165.21	148.72	135,540	139,920	17,850	23,117	40,966	63,025	70,467
2019	131.06	164.75	147.88	139,338	138,955	18,262	22,893	41,155	63,315	70,791
2020	130.39	164.20	146.98	143,159	137,917	18,667	22,646	41,313	63,558	71,063

Contribution to Demand Increase (1990-2019): Per Capita Consumption= 1.2 % Population= 98.8 %

Table 10 Projection of Demand for Rice in Indonesia
Lower Income Elasticity Scenario

Year	Per Capita Consumption (kg/year)			Population (1,000)		Food Demand (1,000 ton)				Total
	Urban	Rural	Indonesia	Urban	Rural	Urban	Rural	Indonesia	(in Paddy)	Demand
1990	139.13	150.73	147.14	55,567	124,263	7,731	18,730	26,461	40,709	45,516
1991	139.40	152.01	148.02	57,766	125,175	8,052	19,027	27,080	41,661	46,580
1992	139.62	153.25	148.85	60,020	126,024	8,380	19,314	27,693	42,605	47,636
1993	139.78	154.47	149.63	62,327	126,809	8,712	19,588	28,301	43,539	48,680
1994	139.90	155.63	150.35	64,571	127,645	9,034	19,865	28,899	44,460	49,710
1995	139.96	156.75	151.00	66,862	128,421	9,358	20,130	29,488	45,366	50,723
1996	139.96	157.83	151.60	69,202	129,141	9,686	20,382	30,068	46,258	51,720
1997	139.90	158.87	152.13	71,588	129,801	10,015	20,621	30,637	47,133	52,699
1998	139.78	159.87	152.59	74,021	130,401	10,346	20,847	31,193	47,989	53,656
1999	139.57	160.75	152.97	76,117	131,323	10,623	21,110	31,733	48,820	54,585
2000	139.28	161.58	153.29	78,241	132,199	10,898	21,361	32,258	49,628	55,488
2001	138.97	162.36	153.55	80,394	133,030	11,172	21,599	32,772	50,418	56,371
2002	138.62	163.10	153.76	82,578	133,821	11,447	21,826	33,273	51,189	57,233
2003	138.24	163.77	153.90	84,788	134,563	11,721	22,038	33,759	51,937	58,069
2004	137.81	164.40	153.99	87,059	135,214	11,997	22,230	34,227	52,657	58,875
2005	137.33	164.97	154.01	89,351	135,808	12,271	22,405	34,676	53,347	59,646
2006	136.81	165.49	153.96	91,662	136,343	12,540	22,563	35,103	54,004	60,381
2007	136.22	165.94	153.84	93,990	136,818	12,803	22,703	35,507	54,625	61,075
2008	135.57	166.33	153.64	96,335	137,234	13,060	22,826	35,885	55,208	61,727
2009	134.91	166.68	153.34	99,169	137,114	13,379	22,854	36,232	55,742	62,324
2010	134.18	166.95	152.96	102,030	136,919	13,690	22,859	36,549	56,229	62,868
2011	133.36	167.16	152.48	104,915	136,648	13,992	22,841	36,833	56,666	63,357
2012	132.46	167.28	151.90	107,821	136,302	14,282	22,801	37,082	57,050	63,786
2013	131.45	167.33	151.22	110,747	135,881	14,558	22,737	37,295	57,376	64,151
2014	130.39	167.30	150.41	113,978	135,096	14,861	22,601	37,463	57,635	64,440
2015	129.21	167.18	149.48	117,229	134,232	15,147	22,440	37,587	57,827	64,655
2016	127.90	166.97	148.42	120,496	133,288	15,412	22,255	37,666	57,948	64,791
2017	126.45	166.67	147.23	123,776	132,267	15,651	22,045	37,696	57,994	64,842
2018	124.84	166.28	145.89	127,064	131,170	15,863	21,811	37,674	57,960	64,804
2019	123.06	165.80	144.40	130,357	130,000	16,042	21,554	37,596	57,840	64,670
2020	121.10	165.22	142.75	133,650	128,758	16,185	21,274	37,459	57,629	64,434

Contribution to Demand Increase (1990-2019): Per Capita Consumption= -5.4% Population= 105.4%

Table 11 Projection of Demand for Rice in Indonesia
Slowered Economic Growth Scenario

Year	Per Capita Consumption (kg/year)			Population (1,000)		Food Demand (1,000 ton)				Total Demand
	Urban	Rural	Indonesia	Urban	Rural	Urban	Rural	Indonesia	(in Paddy)	
1990	139.13	150.73	147.14	55,567	124,263	7,731	18,730	26,461	40,709	45,516
1991	139.32	152.01	148.00	57,766	125,175	8,048	19,027	27,075	41,654	46,573
1992	139.48	153.25	148.81	60,020	126,024	8,371	19,314	27,685	42,592	47,621
1993	139.60	154.47	149.57	62,327	126,809	8,701	19,588	28,289	43,521	48,660
1994	139.68	155.63	150.27	64,571	127,645	9,020	19,865	28,885	44,438	49,685
1995	139.73	156.75	150.92	66,862	128,421	9,342	20,130	29,472	45,342	50,696
1996	139.73	157.83	151.51	69,202	129,141	9,669	20,382	30,052	46,233	51,693
1997	139.68	158.87	152.05	71,588	129,801	10,000	20,621	30,621	47,109	52,672
1998	139.59	159.87	152.52	74,021	130,401	10,333	20,847	31,179	47,968	53,632
1999	139.43	160.75	152.92	76,117	131,323	10,613	21,110	31,722	48,804	54,566
2000	139.21	161.58	153.26	78,241	132,199	10,892	21,361	32,252	49,619	55,478
2001	138.98	162.36	153.55	80,394	133,030	11,173	21,599	32,772	50,419	56,372
2002	138.73	163.10	153.80	82,578	133,821	11,456	21,826	33,282	51,203	57,249
2003	138.47	163.77	154.00	84,788	134,563	11,741	22,038	33,779	51,968	58,104
2004	138.21	164.40	154.14	87,059	135,214	12,032	22,230	34,262	52,710	58,934
2005	137.92	164.97	154.24	89,351	135,808	12,323	22,405	34,728	53,428	59,737
2006	137.62	165.49	154.28	91,662	136,343	12,615	22,563	35,177	54,119	60,509
2007	137.30	165.94	154.28	93,990	136,818	12,905	22,703	35,609	54,782	61,251
2008	136.97	166.33	154.22	96,335	137,234	13,195	22,826	36,021	55,416	61,960
2009	136.66	166.68	154.08	99,169	137,114	13,552	22,854	36,406	56,009	62,622
2010	136.33	166.95	153.87	102,030	136,919	13,909	22,859	36,768	56,566	63,246
2011	135.97	167.16	153.61	104,915	136,648	14,266	22,841	37,107	57,088	63,829
2012	135.60	167.28	153.29	107,821	136,302	14,621	22,801	37,422	57,572	64,370
2013	135.21	167.33	152.91	110,747	135,881	14,974	22,737	37,711	58,017	64,867
2014	134.82	167.30	152.43	113,978	135,096	15,366	22,601	37,967	58,411	65,308
2015	134.40	167.18	151.90	117,229	134,232	15,756	22,440	38,196	58,763	65,702
2016	133.96	166.97	151.30	120,496	133,288	16,142	22,255	38,397	59,072	66,047
2017	133.50	166.67	150.63	123,776	132,267	16,524	22,045	38,569	59,336	66,342
2018	133.00	166.28	149.91	127,064	131,170	16,900	21,811	38,711	59,555	66,587
2019	132.48	165.80	149.11	130,357	130,000	17,269	21,554	38,823	59,728	66,780
2020	131.92	165.22	148.26	133,650	128,758	17,631	21,274	38,905	59,854	66,921

Contribution to Demand Increase (1990-2019): Per Capita Consumption= 3.5 % Population= 96.5 %

Table 12 Projection of Demand for Rice in Indonesia
Higher Population and Slowered Economic Growth Scenario

Year	Per Capita Consumption (kg/year)			Population (1,000)		Food Demand (1,000 ton)				Total Demand
	Urban	Rural	Indonesia	Urban	Rural	Urban	Rural	Indonesia	(in Paddy)	
1990	139.13	150.73	147.14	55,567	124,263	7,731	18,730	26,461	40,709	45,516
1991	139.30	151.93	147.95	57,885	125,433	8,064	19,058	27,121	41,725	46,652
1992	139.45	153.11	148.70	60,276	126,562	8,405	19,378	27,783	42,743	47,791
1993	139.56	154.25	149.41	62,739	127,649	8,756	19,690	28,446	43,763	48,930
1994	139.64	155.33	150.06	65,159	128,808	9,099	20,008	29,107	44,780	50,067
1995	139.68	156.37	150.66	67,647	129,928	9,449	20,317	29,766	45,794	51,202
1996	139.68	157.38	151.20	70,202	131,008	9,806	20,618	30,424	46,806	52,332
1997	139.64	158.34	151.69	72,826	132,046	10,169	20,908	31,078	47,812	53,458
1998	139.55	159.26	152.13	75,519	133,041	10,539	21,188	31,727	48,811	54,575
1999	139.40	160.07	152.49	77,890	134,383	10,858	21,511	32,369	49,798	55,678
2000	139.20	160.83	152.79	80,311	135,697	11,179	21,825	33,004	50,775	56,771
2001	138.99	161.55	153.05	82,759	136,945	11,503	22,124	33,627	51,733	57,842
2002	138.76	162.23	153.28	85,234	138,125	11,827	22,408	34,235	52,670	58,889
2003	138.52	162.86	153.45	87,733	139,238	12,153	22,677	34,829	53,584	59,911
2004	138.27	163.45	153.59	90,295	140,243	12,485	22,923	35,408	54,473	60,905
2005	138.00	163.99	153.67	92,882	141,178	12,818	23,151	35,969	55,337	61,871
2006	137.71	164.47	153.71	95,493	142,045	13,151	23,362	36,513	56,173	62,806
2007	137.41	164.89	153.70	98,126	142,842	13,484	23,554	37,038	56,981	63,709
2008	137.09	165.26	153.64	100,780	143,571	13,816	23,727	37,543	57,759	64,579
2009	136.80	165.59	153.51	103,952	143,733	14,221	23,801	38,022	58,495	65,402
2010	136.48	165.86	153.32	107,161	143,810	14,626	23,852	38,478	59,196	66,186
2011	136.15	166.05	153.06	110,404	143,803	15,032	23,879	38,910	59,862	66,930
2012	135.80	166.17	152.76	113,681	143,714	15,437	23,881	39,319	60,490	67,633
2013	135.42	166.22	152.39	116,988	143,544	15,843	23,859	39,702	61,080	68,292
2014	135.05	166.18	151.94	120,632	142,987	16,291	23,762	40,054	61,621	68,897
2015	134.66	166.07	151.43	124,311	142,344	16,739	23,639	40,378	62,120	69,456
2016	134.24	165.87	150.85	128,024	141,617	17,186	23,490	40,676	62,578	69,967
2017	133.79	165.59	150.22	131,768	140,808	17,630	23,316	40,946	62,993	70,431
2018	133.32	165.21	149.52	135,540	139,920	18,071	23,117	41,187	63,365	70,847
2019	132.82	164.75	148.77	139,338	138,955	18,507	22,893	41,401	63,693	71,214
2020	132.30	164.20	147.95	143,159	137,917	18,939	22,646	41,586	63,978	71,532

Contribution to Demand Increase (1990-2019): Per Capita Consumption= 2.5% Population= 97.5%

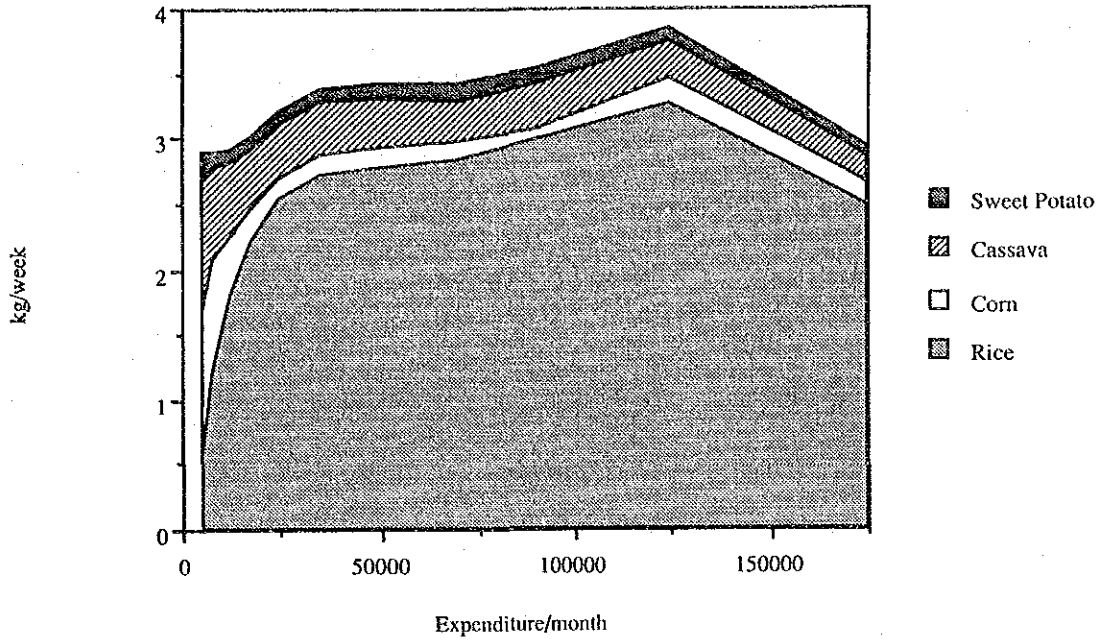
Table 13 Comparison of Projections of Indonesian Rice Demand

Study	Case	Projection Period	Assumptions: Population Growth Rate (% per annum)	Assumptions: Income/Expenditure Growth Rate (% per annum)	Assumptions: Expenditure Elasticity	Demand Projection: 1990	1995	2000	2010	2015
							(million ton of rough rice))			
BAPPERTA Model	Baseline	1988-2000	1.98% - 1.76%	6.5% (-1992) 5.0% (1993-)	0.20 - 0.08	45.17	51.12	56.73		
	High Rice Price	"	"	"	"		50.67	55.36		
	Fertilizer Subsidy	"	"	"	"		51.19	55.87		
	HIgh Rice Yield	"	"	"	"		51.33	56.51		
IWRD 1992		1990-2015	1.4% (- 2000)	-	-	44.96	46.78	49.81		57.40
		"	1.1% (2000 -)	-	-					
IBRD 1991	6% GDP growth	1988-2010	1.9% - 1.2%	6.0%	0.14 - -0.11		51.24 (47.44)	56.04 (51.88)	61.86 (57.27)	**
DGFCA-MOA 1988		1986-2000	2.17% - 1.88%	2.25% - 0.93%*	0.7 - 0.17	43.72	48.89	54.08		
FAO 1991	Neutral	1985-2000	1.6%	1.90%*	Urban 0.05			54.29		
	Urban-Biased	"	1.6%	Urban 2.21% Rural 1.55%	Rural 0.33			53.43		
	Rural Biased	"	1.6%	Urban 1.56% Rural 2.23%				55.12		
FIDP 1993	Baseline	1990-2020	1.73% - 0.75%	Urban 9.0% - 7.0%	0.06 - -0.10	45.52	50.72	55.49	63.12	65.45
				Rural 5.0% - 4.0%	0.24 - -0.06	(actual)				
	High Population	"	1.94% - 0.97%	"	"	45.52	51.23	56.78	66.05	69.19

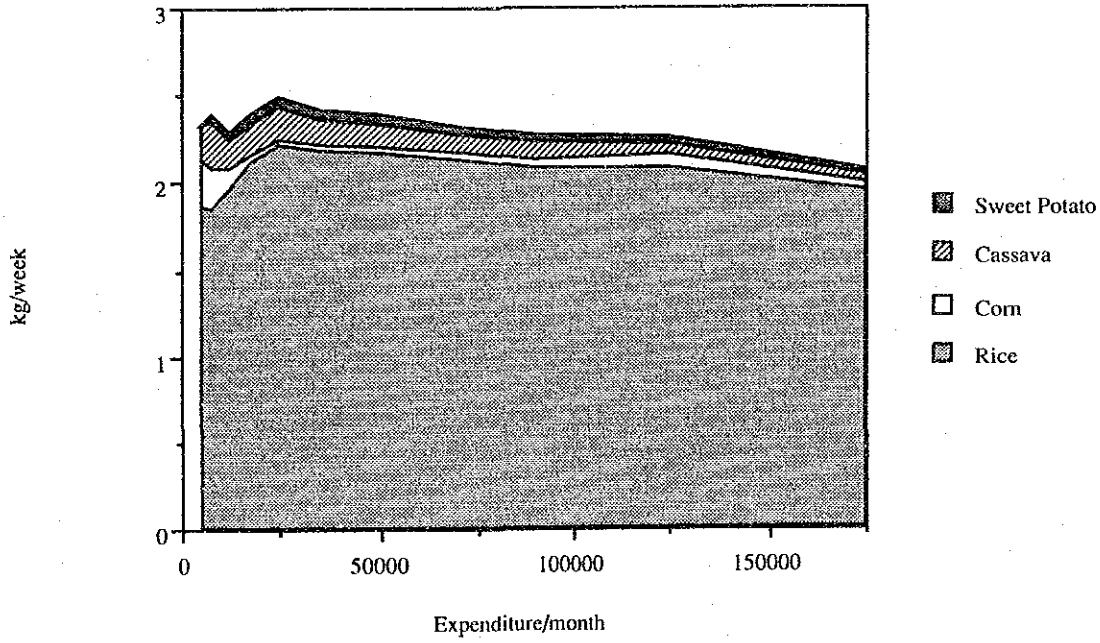
Notes: Studies with plural sets of assumptions are represented by of midium or most likely case.
* Income growth rates in FAO 1991 and DGFCA-MOA 1988 are on per capita basis.
** Numbers reported (in parenthesis) are of food and feed consumption only. 8% of wastes and seed use is added for comparison.

Figures

Rural 1990



Urban 1990



Source: BPS 1991a (SUSENAS 1990)Note: Expenditure classes are represented by middle value of expenditure range.

Figure 1 Cereals and Tuber Consumption byExpenditure Class in 1990

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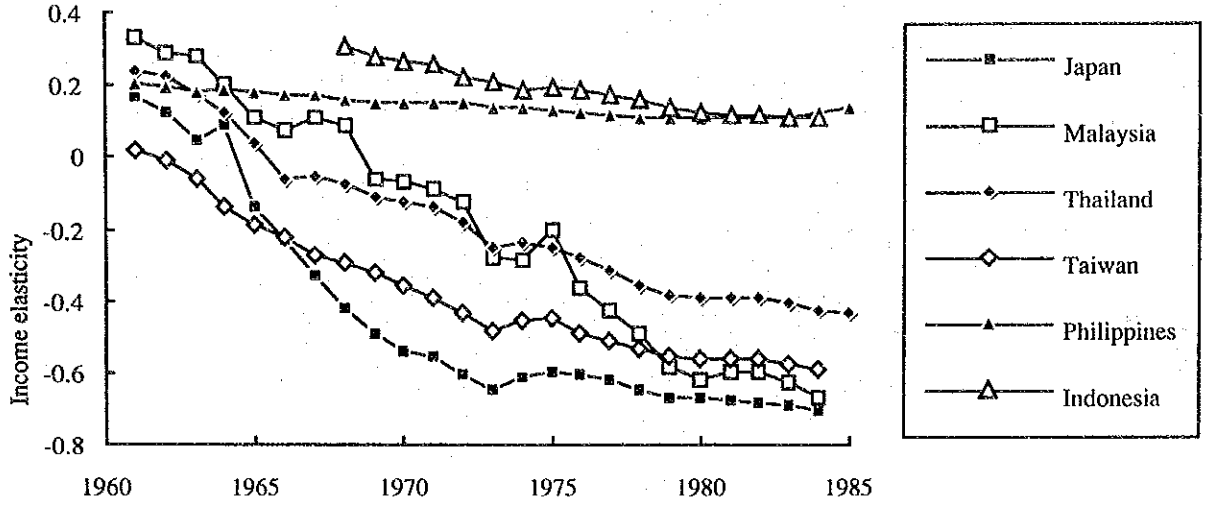
Income Elasticities of Rice in Asian Countries Estimated by Ito et al.



Income Elasticity Estimates/Forecasts

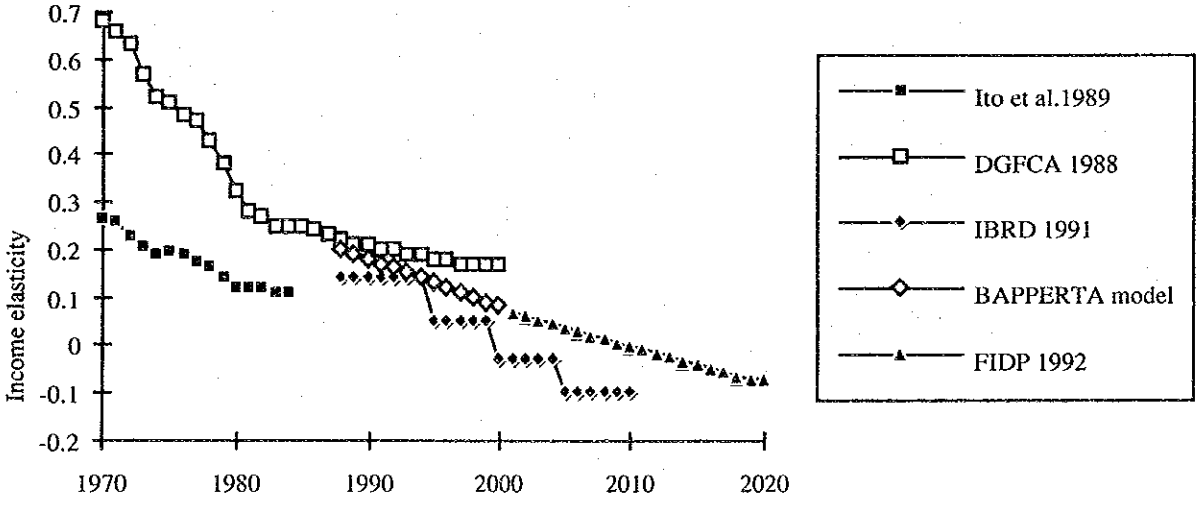


Figure 2 Estimations for Income Elasticities

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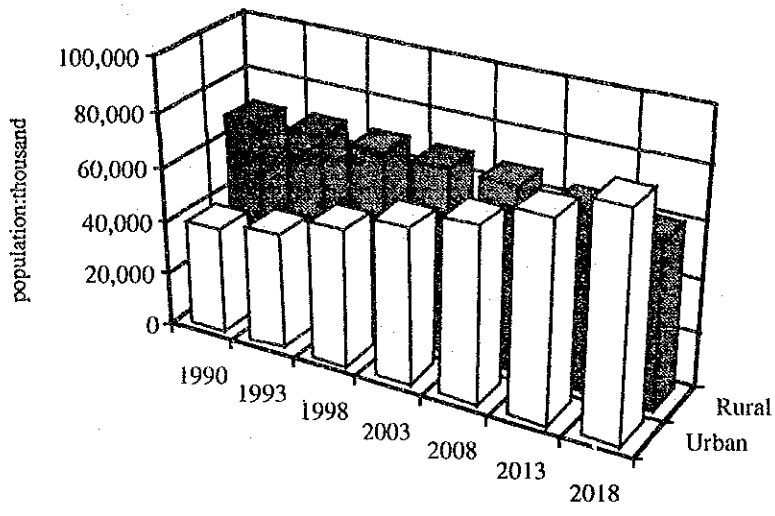
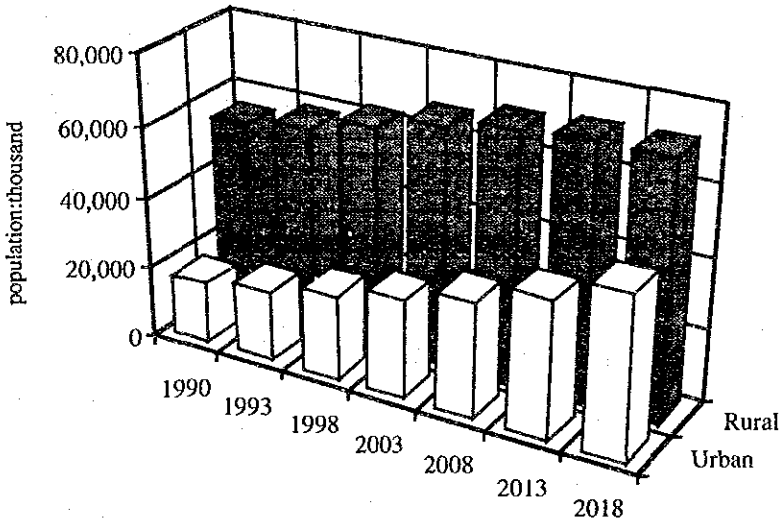
Jawa



Off-Jawa



Indonesia

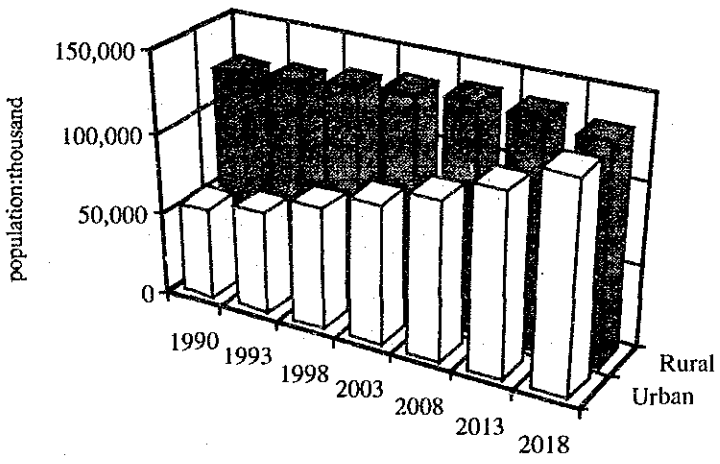


Figure 3 Population Projection
Urban versus Rural

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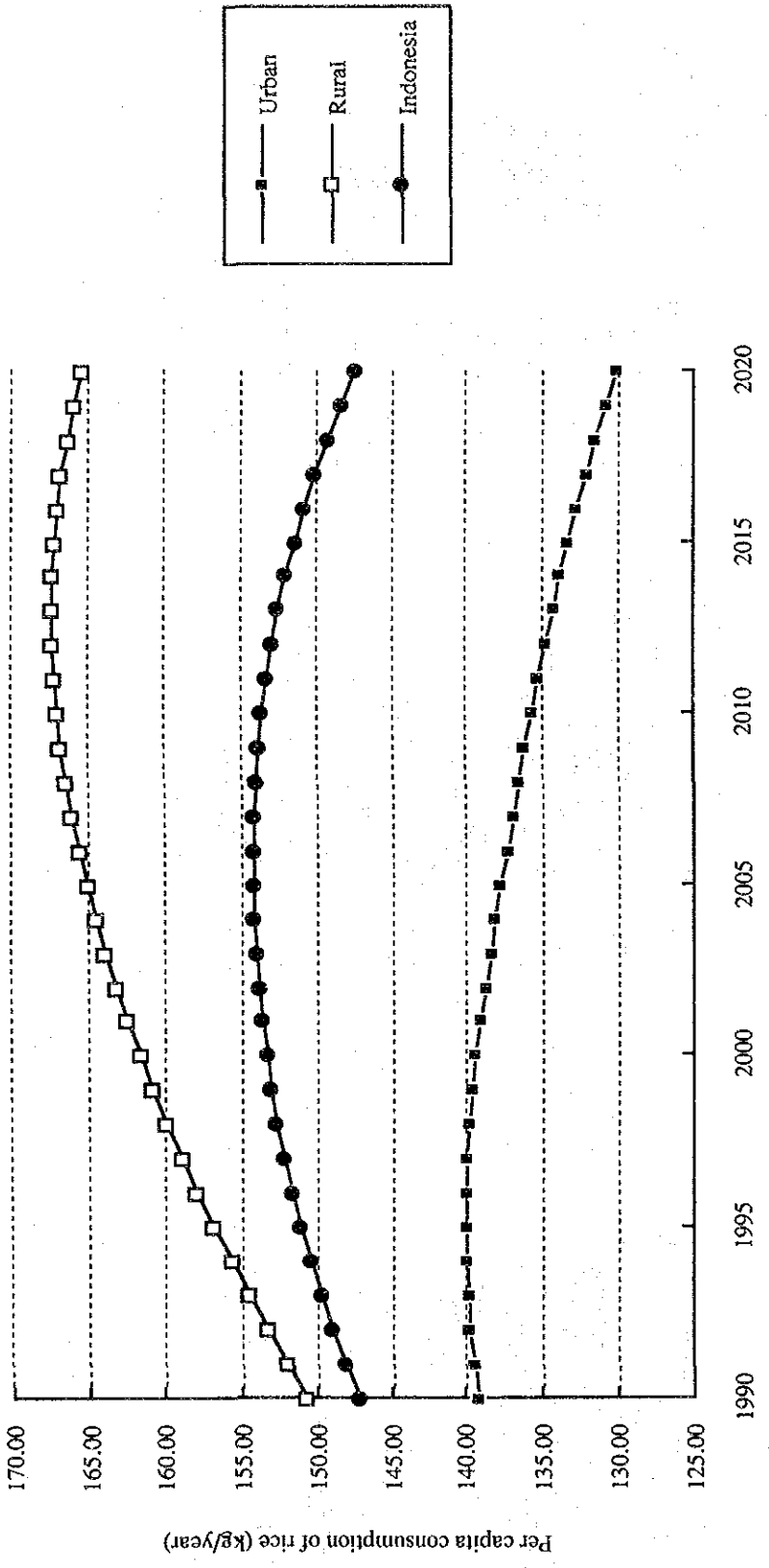

Figure 4 Projection of Per Capita Consumption of Rice up to 2020

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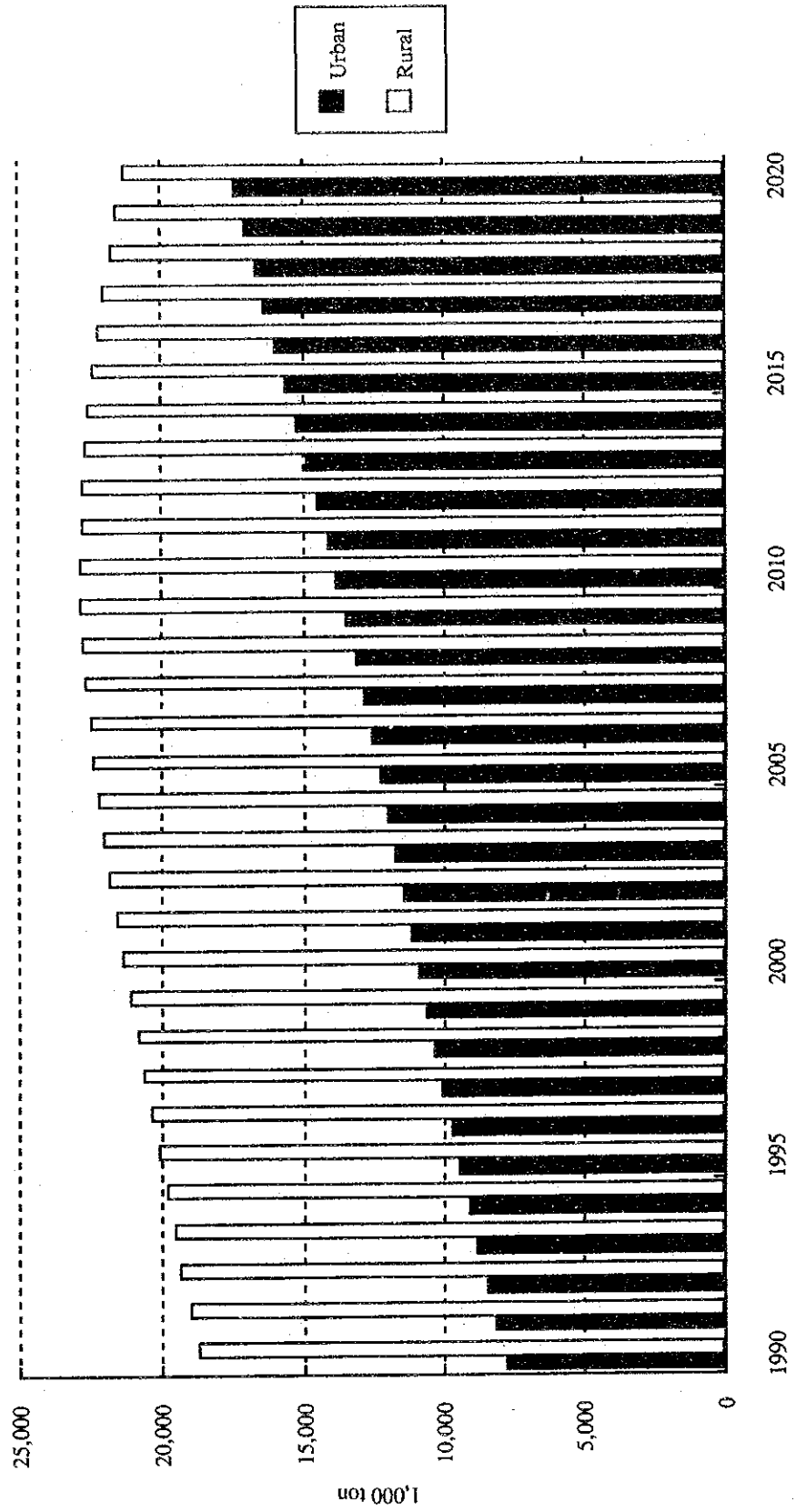

Figure 5 Food Consumption Demand for Rice up to 2020

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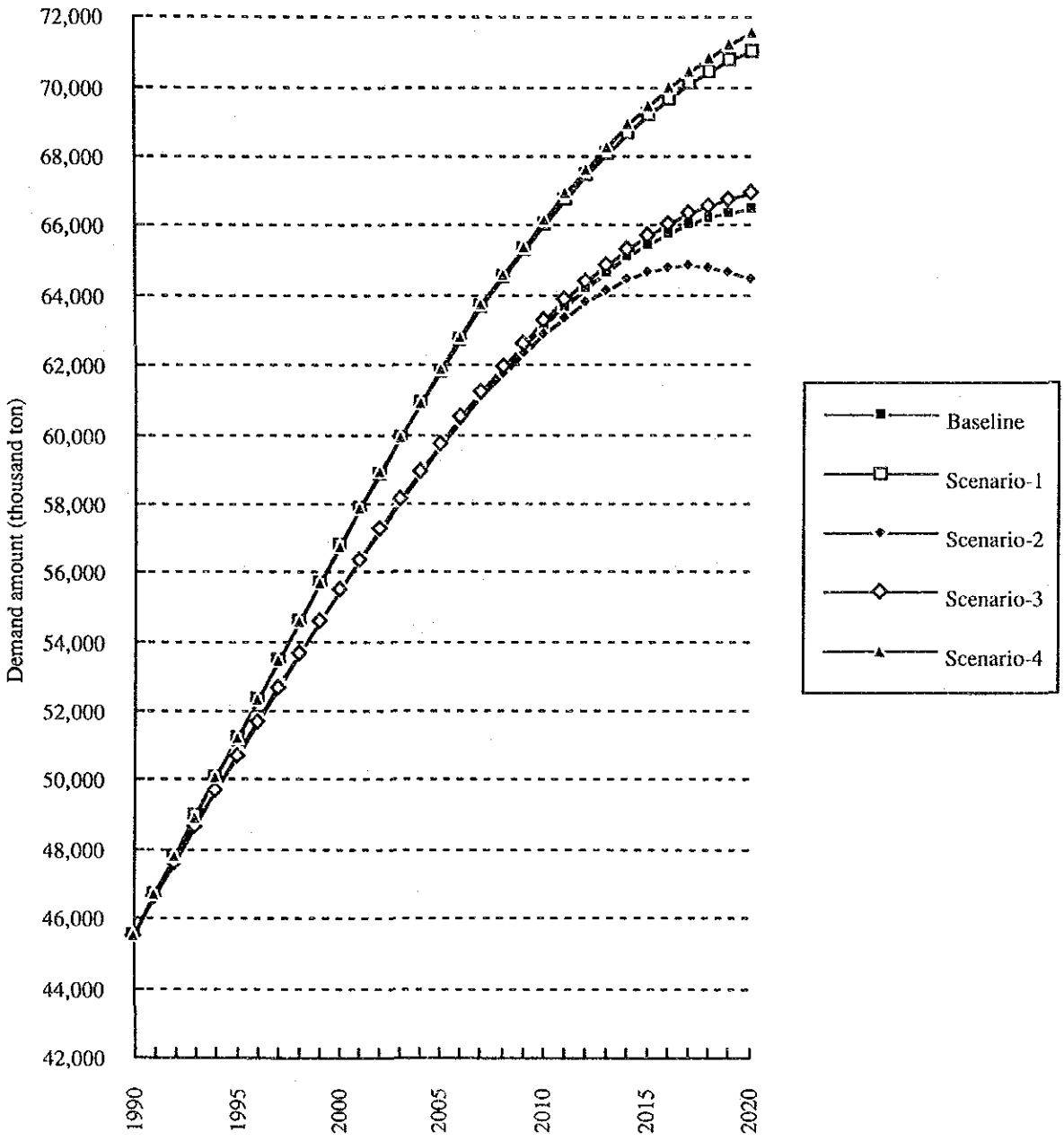

Figure 6 Paddy Demand Projection under Alternative Scenarios

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Appendix-1

An Econometric Analysis of Rice Consumption

Appendix-1 An Econometric Analysis of Rice Consumption

A.1.1 Objectives

Elasticity of demand with respect to income and price change is among the key factors that affect consumption of food commodities. The FIDP rice demand projection applies both income and own price elasticities as parameters in its consumption function. The study basically follows the results of previous studies of food demand structure and those adopted in the BAPPERTA agriculture sector model in assuming these parameters.

An econometric analysis to be presented in this appendix aims to justify the parameter estimates by examining the most recent consumption data available. To estimate the difference in income elasticity between urban and fractions is another focus of the analysis because the projection applies a process of segregation for these two groups. After the pioneering work by Timmer and Alderman (1979), several studies have been made for assessing parameters for food consumption using the cross-sectional data from the Indonesian Socio-Economic Surveys (SUSENAS) of various years. The estimation results are to be compared with those of the previous studies for the purpose of viewing over time changes.

A.1.2 Methodology

Specification

A single commodity equation in which the consumption amount of rice is given as a function of per capita income and rice price is used in the analysis. The general form of consumption function is:

$$Q_i = f(Y_i, P_{ij}, H_i, T_i)$$

where, Q_i is quantity of rice consumption by household i; Y_i, the income for household i; P_{ij}, the price of commodity j which household i faces; H_i, household size and Ti, household tastes which may be represented by variables of education region or ethnic groups.

Effect of other commodity price on rice consumption is not included considering the results of precursor studies that mostly present nearly zero elasticity estimates. Variable H_i is empirically not investigated since available data (SUSENAS) is already in the form of per capita terms. Difference between urban and rural segments are the only effects specified in

the analysis. Income variable is substituted by "total expenditure," which implies that the elasticity to be obtained will be an "expenditure elasticity" rather than an "income elasticity." These two elasticities coincide as far as an assumption of constant consumption propensity holds. A specific functional form fitted is of log-linear type from which constant elasticities can be derived. The model equation is:

$$\ln Q_i = \beta_0 + \beta_1 \ln TX_i + \beta_2 \ln P_i + u_i$$

where, TX is total expenditure and u is residual term.

The ordinary least square (OLS) was used as regression estimator.

Data Analyzed

Data from the SUSENAS at 1990 was used in the analysis. SUSENAS gives the only data which contains food consumption by different expenditure class, province and urban-rural segment. Aggregated provincial data segregated into expenditure classes and urban-rural areas are used in fitting above model. Weekly per capita consumption amounts separately given for domestic, high quality, imported and glutinous rices and rice flour were summed up to use as the consumption variable. Middle values of monthly per capita expenditure ranges are assumed to represent the expenditure class. The average retail prices of rice at provincial capital in 1990 was representatively used for the price variable.

In addition to a strictly cross sectional analysis, pooled time series and cross section data from SUSENAS 1984, 1987, 1990 were analyzed but only for national level. Expenditure amounts in current price were converted to 1990 price level by using Private Consumption Expenditure (PCE) deflators. Average retail prices at Jakarta in respective years were used for price variable after conversion to constant term.

A.1.3 Regression Results

Cross Section Analysis

Estimated parameters of the fitted equation are shown in Table A.1.1. All the derived coefficients show signs consistent with theory. The t-ratios show coefficients are significantly different from zero at 5 % α level for variable lnTX in three regressions. As for variable lnP, the t-test significance levels are at 5.5%, 13.1% and 1.0% for urban, rural and pooled urban-rural segments, respectively. Although the adjusted coefficients of determination ($\bar{R}^2$) are rather low at 0.240, 0.329 and 0.263, an analysis of variance (ANOVA) F-test rejects the

null hypothesis H_0: $\beta_1=\beta_2=0$ at less than 0.1% α level. Since our main interest is in elasticity estimation, we can retain the model as far as the overall significance of the regression and significance of coefficients are proved.

Table A.1.1 Regression Results: Cross Section Data

Coefficient	Urban	Rural	Pooled
b_0 (estimate for β_0)	4.523	3.095	4.087
b_1 (estimate for β_1)	0.127	0.320	0.228
(t-ratio)	(8.565)**	(11.177)**	(13.262)**
b_2 (estimate for β_2)	-0.860	-0.948	-0.961
(t-ratio)	(2.801)	(1.516)	(2.6041)**
$\overline{R}^2$	0.240	0.329	0.263
ANOVA F-value	40.240**	64.465**	91.931**
Sum of Square Error	10.270	49.020	64.218

Note: * Significant at 5% level of type I error
** Significant at 1% level of type I error

An alternative model omitted price variable was fitted and the resulted $\overline{R}^2$ values are 0.219, 0.326 and 0.256 for three cases respectively. These $\overline{R}^2$ values are lower than those with price variables and then price variable is finally retained. The derived own price elasticities are much larger than expected level and those estimated by various studies. Simplification in valuing price variable may cause these unreliable estimates and relatively small t-ratios. Estimates for expenditure elasticity by alternative model, on the other hand, are almost identical at 0.126, 0.321 and 0.229.

Pooled Time Series and Cross Section Analysis

The regression result using combined three SUSENAS of 1984, 1987 and 1990 is shown in Table A.1.2. $\overline{R}^2$s show better goodness of fit than the cross section analysis. Coefficients of expenditure variable are all significant and signs are as expected. On the other hand, coefficients for price variable are not significant for urban segment and pooled one and, in addition, the sign of estimated coefficient for urban segment is inconsistent with theory. Estimates of expenditure elasticity are slightly smaller than those obtained by cross section analysis. This might be explained by the difference between strict cross section analysis and pooled time series cross section analysis. Adding time series data would lessen long-run characteristic of estimates from cross sectional data.

Table A.1.2 Regression Results: Pooled Cross Section Time Series Data

Coefficient	Urban	Rural	Pooled
b_0 (estimate for β_0)	-0.750	-1.125	-0.938
b_1 (estimate for β_1)	0.111	0.350	0.231
(t-ratio)	(4.027)**	(8.046)**	(7.707)**
b_2 (estimate for β_2)	0.539	-0.292	-0.119
(t-ratio)	(0.744)	(2.552)*	(1.514)
$\bar{R}^2$	0.380	0.663	0.477
ANOVA F-value	10.916**	32.453**	30.655**
Sum of Square Error	0.810	2.022	4.012

Note: * Significant at 5% level of type I error
** Significant at 1% level of type I error

Urban-Rural Difference

The difference of regression between urban and rural fractions are tested by the Chow test. The F values are calculated as: for cross section analysis,

$$F = \frac{\{64.22 - (10.27 + 49.02)\}/2}{(10.27 + 49.02)/(250 + 260 - 4)} = 21.04 > F_{2,500,.05} \cong 3.0$$

and for pooled analysis,

$$F = \frac{\{4.01 - (0.81 + 2.02)\}/2}{(0.81 + 2.02)/(33 + 33 - 4)} = 12.91 > F_{2,62,.05} \cong 3.2$$

The null hypothesis that the regressions for urban and rural data are the same can be rejected. Therefore, we can conclude that there exists a difference in patterns of rice consumption between urban and rural areas.

A.1.4 Comparison with Other Studies

Comparison of estimates for income elasticity with those from previous studies is summarized in Table A.1.3. Only those from cross sectional data are given in the table since all of other studies compared are of cross section analysis which use various year's SUSENAS data. All estimates represent long-run change parameters that "refer to long-run responses expected after several years of adjustment to new income (Timmer and Alderman 1979)." and thus over-estimatation would result if used in estimating short-run effects. Taking this into consideration, the income elasticity used in BAPPERTA model and the FIDP demand projection at 0.06. 0.24 and 0.18 for urban, rural and overall areas seem to be reasonable ones. This elasticity setting also keeps consistency with the results of other

studies. Urban-rural difference in income elasticities are found in all study results. Mostly elasticity in urban area is valued at less than half of that in rural area.

Table A.1.3 Estimates of Income Elasticities for Urban and Rural Fractions

Study		Urban	Rural	Data Analyzed
Timmer and Alderman 1979		0.265	0.581	SUSENAS 1976
	Low income class	0.997	1.168	
	Low-Mid income class	0.759	0.924	
	High-Mid income class	0.533	0.704	
	High income class	0.070	0.364	
Dixson 1982		0.194	0.56	SUSENAS 1976
IFPRI-CAER 1987	(low income)	0.25	0.50	SUSENAS 1981
	(mid income)	0.10	0.15	
	(high income)	0.05	0.05	
FAO 1987		0.05	0.33	SUSENAS 1987
FIDP 1992		0.13	0.32	SUSENAS 1990

Sources: Each study and Tabor 1992a.

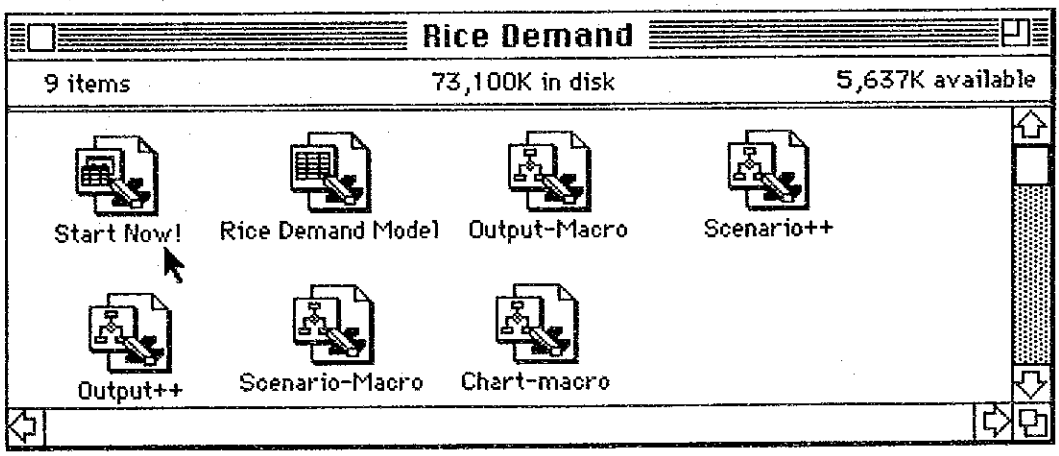
Appendix-2

Handling Manual of Rice Demand Projection Model

Appendix-2 Handling Manual of Rice Demand Projection Model

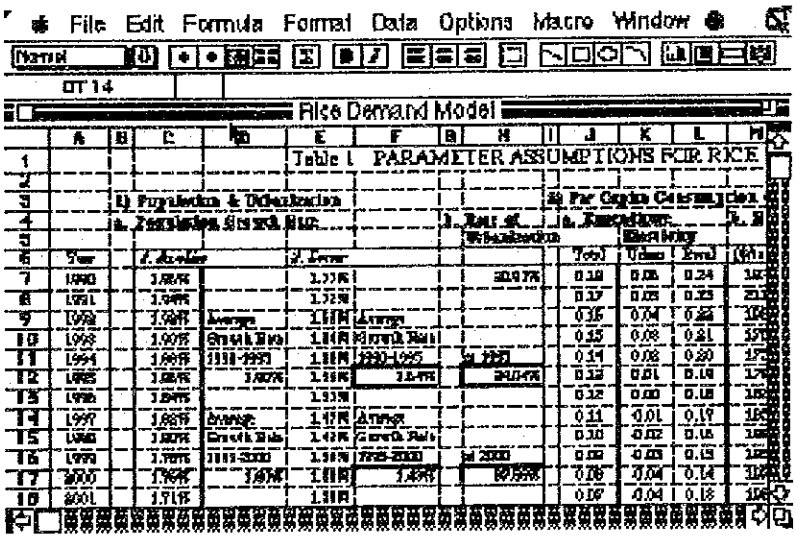
A.2.1 Start Now

This appendix gives an instruction to handle the FIDP rice demand projection model. Although containing a number of tables, the structure of spreadsheet is not so complicated one. Using macro commands makes it easy to get output tables and to do simulation for alternative scenarios. The spreadsheet file is made with **Microsoft Excel version 4.0**. The file can be transformed into **Lotus** but Excel macros are not usable in it. The file name is **"Rice Demand Model."** When starting your work click the file **"Start Now!"** then the file and all macros will be opened simultaneously. Click "No" if asked "Update reference to unopened documents?"

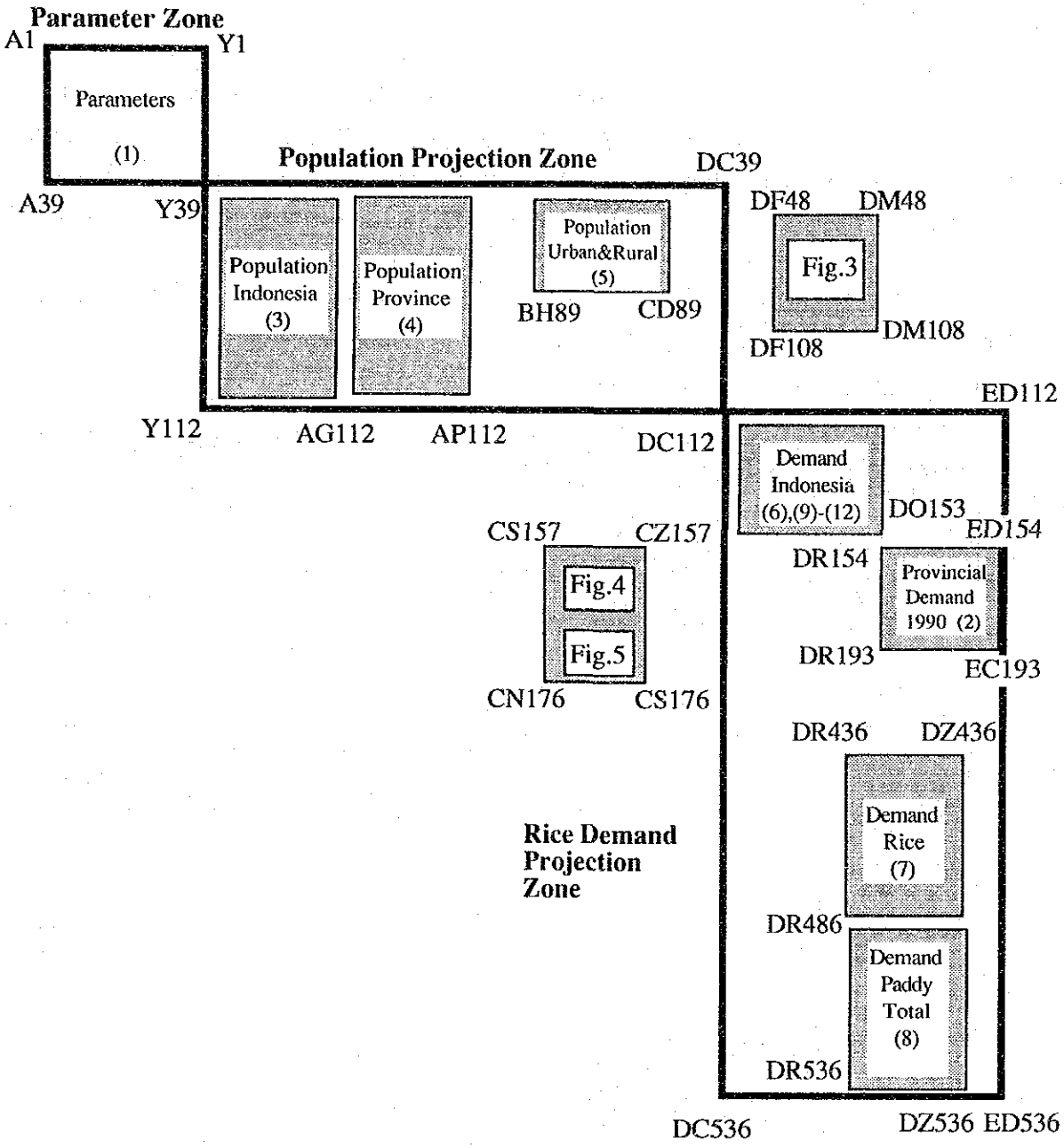


A.2.2 Spreadsheet Layout

Once you opened it, everything necessary is on the screen. You can see the screen like this



The layout of the spreadsheet is as shown below.



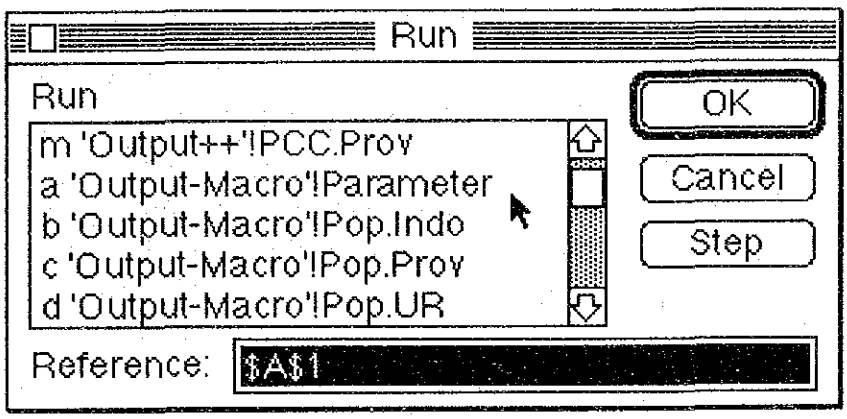
Address in the spreadsheet is expressed by letters (column) and numbers (row) like "A39" or "CZ157." Shaded area shows a table of projection outcome and the number in parenthesis in it is the table number in the paper. For example, (1) represents Table 1. Three figures out of six in the paper are also seen in the file.

When it is necessary to replace some of the parameter assumptions, you can just replace the numbers in bolded boxes. Use re-calculation command "⌘=" then the

spreadsheet will automatically re-calculate all the projection process. Unless the projection formula itself has changed, you do not have to correct any cells in other zones.

A.2.3 Macros

To obtain projection outputs and to do alternative scenario projections, you can use macro commands. Choose "Macro" from the pull down menu above the screen and select "Run." The following menu screen appears. If you choose one macro command and click "OK", the range of output table is set in the print area and print preview is on the screen in case of output macros, or calculation with alternative parameter is made in case of scenario macros.



List of all macros are as follows:

Macro File	Command	Operation
Scenario-Macro	Baseline	Baseline scenario
	High.Pop	Higher population growth scenario
	Low IE	Lower income elasticity after 2000 scenario
	Low.GDP	Decelerated GDP growth scenario
	H.PopxL.GDP	Mixture of High Pop and Low GDP
Output-Macro	Parameter	Parameter table (Table 1)
	Pop.Indo	Population projection:Indonesia (Table 3)
	Pop.Prov	Population projection by province (Table 4)
	Pop.UR	Population projection by urban and rural(Table 5)
	RD.Indo	Rice demand projection: Indonesia (Table 6, Table 9-12 for alternatives)
	RD.Prov	Rice demand projection by province (Table 7,8)
Output++	PCC.Prov	Provincial Per Capita Consumption (Table 2)

Output macros derives print preview screen. Since Excel macros cannot operate printer setup options, you need to setup the reduction percentage and paper orientation (vertical or horizontal). Use the following setups.

Table	Reduction	Orientation
Parameter table (Table 1)	85%	Horizontal
Provincial Per Capita Consumption 1990 (Table 2)	80%	Horizontal
Population projection:Indonesia (Table 3)	80%	Vertical
Population projection by province (Table 4)	75%	Vertical
Population projection by urban and rural(Table 5)	60%	Horizontal
Rice demand projection: Indonesia (Table 6, Table 9-12)	80%	Horizontal
Rice demand projection by province (Table 7,8)	65%	Vertical

A.2.3 Modification with Newly Available Data

Population

Demand projection is expected to be revised when involved data become newly available. **Population** data from population census (every ten year) and inter-census (SUPAS, mid-year between censuses) are those to be used in revising. Population data coming to be available is SUPAS 1995. Modification process is as follows:

Once new population data become available, ex ante forecast must be replaced with real numbers. First, replace the **population growth rate** in the parameter zone (address: C7 - C37). For example, if 1995 inter-census gives a growth rate of 1.7% per annum, replace all numbers for 1991-1995, i.e., 1.94%, 1.92%,1.90%, 1.88% and 1.86% with it. Then when urban-rural segregation is available, input the rate of urban population into parameter boxes of corresponding year. Provincial population are in AJ50 - AP76 and urbanization rates in CE50 - CP76. Replace forecasts with real numbers. Recalculation is made with the key command "⌘=".

Per Capita Consumption

Additional amendment for per capita rice consumption data requires a little bit more complicated procedure. We need to revise New data will be available from SUSENAS with an interval of three years. The one coming next will be of 1993. New SUSENAS results are published by BPS in a book titled "Pengeluaran Untuk Konsumi Penduduk Indonesia." The statistics include national level par capita consumption of rice but not provincial level one. Only calorie consumption of aggregated "cereals" is in published statistics. Data for provincial average of consumed rice volume is kept by the **Village, Household and Environment Division of BPS**. The weekly consumption data is converted into annual one by multiplying 365/7. Those from SUSENAS 1990 are in the table of provincial per capita consumption located in address "**DT164 - DU192.**" Replace 1990 data with newly obtained annual consumption. Next action is:

1) for SUSENAS 1993

You need to correct the area DV204 - DW235. The formula in the cells DV204 and DW204 are:

DV204 =EB164*(1+(((1+$R$9)^5-1)*$U$12-(DT204/DV164-1))*$K$10)

DW204 =EC164*(1+(((1+$R$10)^5-1)*$U$12-(DU204/DW164-1))*$L$10)

Replace above formula with:

DV204 =EB164*(1+(((1+$R$9)^2-1)*$U$12-(DT204/DV164^(2/5)-1))*$K$10)

DW204 =EC164*(1+(((1+$R$10)^2-1)*$U$12-(DU204/DW164^(2/5)-1))*$L$10)

Then copy DV204 and DW204 to all the area DV205 - DW235

2) for SUSENAS 1996

Assuming that 1995 population has already been replaced with SUPAS data, first replace DV164 and DW164 where formulas "=BJ50" and "=BK50" in them by "=BK50" and "BL50", respectively. Copy the two cells to DV165 - DW190. Then cells DO244 and DP244 with formulas:

DO244: =DU204*(1+(((1+$T$9)^5-1)*$W$12-(DM244/DM204-1))*$K$15+$W$8*($M$17/$M$12-1)); and

DP244: =DV204*(1+(((1+$T$10)^5-1)*$W$12-(DN244/DN204-1))*$L$15+$W$8*($M$17/$M$12-1))

will be replaced with:

DO244: =DU164*(1+(((1+$T$9)^5-1)*$W$12-((DM244/DM204)^(4/5)-1))*$K$15+$W$8*($M$17/$M$13-1)); and

DP244: =DV164*(1+(((1+$T$10)^5-1)*$W$12-((DN244/DN204)^(4/5)-1))*$L$15+$W$8*($M$17/$M$13-1))

Then copy DP244 and DP244 to all the area DO245 - DP270

Again recalculation is made with the command key "⌘=". Note that after this manipulation outputs for the past years will lose their consistency. Just ignore these numbers.

Others

If new forecast of population, urbanization and GDP growth rate will be announced by an authorized institute such as BPS or BAPPENAS, these numbers will substitute for those in parameter zone.

Annex B

Agricultural Production Potential
- Paddy Production -

ANNEX B

AGRICULTURAL DEVELOPMENT POTENTIAL
- PADDY PRODUCTION -

Contents

Tables

Figures

Text

1. Introduction

Agricultural study within the framework of the FIDP study aims to estimate future potential for increasing crop production, especially paddy production, since water requirement of paddy accounts for larger part of water resources and it also relates to irrigation development. The agricultural study is, therefore, confined to food crops sub-sector. Although livestock and fishery sub-sector need water for production, the demand projection is rather difficult since development of these sub-sectors almost depend upon private sectors. Only some specific areas/regions may require significant volume of water for such sub-sectors.

In order to estimate future production increase, past trend in paddy production was firstly analyzed based on the existing statistics provided mainly by CBS. Factors determining production including, harvested area, cropping intensity, yield were analyzed by province and constraints to future production increase were examined. Based on the analysis, trend growth projection of paddy production was made. At the same time, provinces were categorized into three groups according to their potential, and direction of efforts to increase production was indicated.

During the study, basic data on irrigation development and paddy production are collected separately by different agencies, (MPW and CBS, respectively), which makes the analysis on the effect of irrigation development on paddy production rather difficult. Systematic approach on data arrangement and analysis should be established as soon as possible by concerned agencies.

2. Present Agriculture Situation

2.1 Agricultural Land Use

The area of the arable land in Indonesia is about 33 million ha that accounts for about 17 % of the total land area. The arable land can be classified into three categories, i.e. lowland for paddy plant, arable upland for annual upland crops and that for perennial estate (tree) crops. The area of lowland paddy field is about 8.2 million ha or 26% of total arable land and mainly used for paddy cultivation. The area of paddy field is the largest in Jawa followed by Sumatera and Kalimantan, while a limited area in Maluku and Irian Jaya.

The arable upland for annual upland crops accounts for about 13 million ha or 40% of the total arable land. A larger part of arable upland is used for the cultivation of palawija crop and upland paddy, and the area for vegetables and annual estate crops are limited to less than one million hectares, respectively. The area of arable upland is the largest in Sumatera, followed by Jawa and Kalimantan. The area for perennial estate crops is about 11 million ha or 30% of the arable land and mainly distributed in Sumatera, Jawa and Kalimantan (refer to Table 1.1).

The harvested area of major crops by island groups is summarized below.

Agricultural Land Use and Harvested Area of Major Crops as of 1989

Province/Island	Field Area ('000 ha)			Harvested Area ('000 ha)					
	Lowland	Upland	Estate	Lowland paddy	Upland paddy	Palawija	Vegetables	Annual Estate	Perennial Estate
Sumatera	2,257	4,352	5,987	2,141	421	1,131	180	75	4,829
Jawa	3,446	3,136	665	5,099	350	4,029	476	510	1,751
Bali & Nusa Tenggara	442	1,020	393	491	77	753	55	24	707
Kalimantan	1,282	2,226	2,199	640	240	129	34	9	1,675
Sulawesi	831	1,529	1,646	991	59	635	59	33	1,143
Maluku & Irian Jaya	12	955	856	14	11	75	11	0	330
Indonesia	8,271	13,217	11,746	9,360	1,156	6,752	815	651	9,834

Source: Agricultural Survey Land Area by Utilization for Jawa 1989, CBS
Agricultural Survey Land Area by Utilization for Outer Jawa 1989, CBS
Statistik Perkebunan Indonesia, Directorate General of Estate Crops, MOA(1989)
Statistical Year Book of Indonesia 1990;, CBS

Those of selected vegetables and estate crops are also shown in Tables 1.2 and 1.3. There is a big difference in the harvested area of those crops among the islands and among the provinces. The vegetable area is mainly distributed near the big town, reflecting the demand and marketability. On the other hand, the area of estate crops distributed in particular area where the climate and soil characteristics are favourable for these crops.

2.2 Past Trend of Change in Production of Paddy and Palawija Crops

2.2.1 Changes in the Harvested Area of Paddy and Palawija Crops

Changes in the harvested area of paddy and palawija crops by province and Island from 1980 to 1991 were analyzed by correlation analysis method. The results are shown in Tables 2.1 to 2.8, and summarized as follows:

Past Changes in Harvested Area of Paddy and Palawija Crops (1980-1991)

Province/Island	Lowland paddy		Upland paddy		Maize		Cassava	
	b*1	r*2	b*1	r*2	b*1	r*2	b*1	r*2
Sumatera	56.3	0.994	-5.9	-0.635	28.9	0.967	12.7	0.825
Jawa	42.5	0.722	9.3	0.826	5.2	0.067^{n}	-18.8	-0.828
Bali & Nusa Tenggara	4.8	0.887	-2.8	-0.768	-0.4	-0.078^{n}	-2.4	-0.654
Kalimantan	7.8	0.822	2.2	0.407^{n}	1.7	0.826	1.3	0.717
Sulawesi	30.3	0.939	-5.3	-0.973	-3.5	-0.254^{n}	1.1	0.473^{n}
Maluku & Irian Jaya	1.4	0.856	-1.5	-0.833	-0.2	-0.214	0.2	0.055^{n}
Indonesia	143.1	0.935	-4.2	-0.381^{n}	31.6	0.327^{n}	-3.6	0.264^{n}

Province/Island	Sweet Potatoes		Soyabeans		Groundnuts		Green grammes	
	b*1	r*2	b*1	r*2	b*1	r*2	b*1	r*2
Sumatera	1.0	0.833	33.3	0.950	4.5	0.918	2.8	0.925
Jawa	-2.2	-0.780	16.1	0.653	5.8	0.685	4.7	0.571^{n}
Bali & Nusa Tenggara	-1.2	-0.871	9.8	0.961	1.2	0.773	0.4	0.348^{n}
Kalimantan	0.3	0.756	1.2	0.876	1.4	0.955	0.2	0.840
Sulawesi	0.2	0.191^{n}	7.4	0.897	1.9	0.523^{n}	-0.1	-0.029^{n}
Maluku & Irian Jaya	-3.6	-0.801	0.5	0.741	0.2	0.599	0.2	0.634^{n}
Indonesia	-3.5	-0.758	68.2	0.907	14.9	0.887	8.3	0.710

Note: *1: 'b' value means an average annual increase of harvested area ('000 ha); *2 value 'r' means correlation coefficient; n: statistically not significant

Source: JICA-FIDP team calculation based on Agricultural Survey Production of Cereals in Indonesia (1980 - 1991), CBS

An average annual increase of the harvested area of lowland paddy in Indonesia is estimated at the rate of 143 thousand ha or 1.4%. The highest increasing rate in the harvested area of lowland paddy is found in Sumatera and Jawa at the rate of 56.3 and 42.5 thousand ha per year respectively, followed by Sulawesi with 30.3 thousand ha per year. In almost all the provinces, the harvested area of lowland paddy has increased, however, no change in the harvested area of lowland paddy is observed in Jambi, Yogyakarta, Kalimantan Barat and

Kalimantan Timur and it has decreased in DKI Jakarta. A high increasing rate of lowland paddy area is observed in Jawa Barat, Jawa Tengah Jawa Timur, Sumatera Utara, Lampung and Sulawesi Selatan. The harvested area is presented by the product of the field area and cropping intensity. The breakdown and analysis of the increase in the harvested area will be stated later.

The harvested area of upland paddy in Indonesia has not changed statistically, however, it shows a decreasing tendency. Only in Jawa, the harvested area of upland paddy has increased with an average annual increasing rate of 9.3 thousand ha per year. On the other hand, the harvested area of upland paddy has decreased in Sumatera, Bali and Nusa Tenggara, Sulawesi and Maluku and Irian Jaya at the annual rate of 5.9 thousand ha 2.8 thousand ha, 5.3 thousand ha and 1.5 thousand ha, respectively. The harvested area of upland paddy has significantly decreased in Sumatera, however, it has increased only in Jambi and Sumatera Barat at a rate of 2.7 and 0.5 thousand ha per year. An increasing tendency in the harvested area of upland paddy is observed in Kalimantan, but statistically not significant.

The harvested area of maize in Indonesia shows an increasing tendency although statistically no significant. In Sumatera and Kalimantan, the harvested area of maize has significantly increased with an average annual increasing rate of 28.9 thousand ha and 1.7 thousand ha, respectively. The changes in the harvested area of maize is statistically not significant in Jawa, Sulawesi, Bali and Nusa Tenggara and Maluku and Irian Jaya, although a decreasing tendency in the harvested area of maize for Sulawesi, Bali and Nusa Tenggara and Maluku and Irian Jaya, and an increasing tendency in Jawa have been observed. In these islands, the harvested area of maize has increased only in Jawa Barat, Sulawesi Utara and Irian Jaya with an average annual increasing rate of 5.3, 3.9 and 0.2 thousand ha, for Jawa Barat, Sulawesi Utara and Irian Jaya, respectively.

The harvested area of cassava in Indonesia shows a decreasing tendency but statistically not significant. On the other hand, that of sweet potatoes has significantly decreased with an average annual decreasing rate of 5.5 thousand ha. The harvested area of root crops, cassava and sweet potatoes, has significantly increased in Sumatera and Kalimantan with the average annual increasing rate of 12.7 thousand ha and 1.5 thousand ha for cassava, and 1.0 thousand ha and 0.3 thousand ha for sweet potatoes, respectively. On the other hand, the harvested area of root crops has significantly decreased in Jawa and Bali and Nusa Tenggara with the annual decreasing rate of 18.8 and 2.4 thousand ha for cassava and 2.2 and 1.2 thousand ha for sweet potatoes, respectively. In Sulawesi, there is no significant change in the harvested area of root crops, but an increasing tendency is observed. In Maluku and Irian Jaya, the

harvested area of sweet potatoes has significantly decreased with an average annual decreasing rate of 3.6 thousand ha, but there is no change in the harvested area of cassava.

The harvested area of pulses, soya beans, groundnuts and green grammes, has significantly increased in recent twelve years. The annual increasing rates of harvested area of pulses in Indonesia are 68.2 thousand ha for soya beans, 14.9 thousand ha for groundnuts and 9.8 thousand ha for green grammes, respectively. The harvested area of soya beans has significantly increased in all the islands and the average annual increasing rates are 33.3 thousand ha for Sumatera, 16.1 thousand ha for Jawa, 9.8 thousand ha for Bali and Nusa Tenggara, 1.2 thousand ha for Kalimantan, 7.4 thousand ha for Sulawesi, and 0.5 thousand ha for Maluku and Irian Jaya, respectively.

The harvested area of groundnuts has significantly increased in almost all the Islands. The average annual increasing rates are 4.5 thousand ha for Sumatera, 5.8 thousand ha for Jawa, 1.2 thousand ha for Bali and Nusa Tenggara, 1.2 thousand ha for Kalimantan and 0.2 thousand ha for Maluku and Irian Jaya, respectively. There is no significant change in the harvested area of groundnuts for Sulawesi , but increasing tendency.

The harvested area of green grammes has significantly increased in Sumatera, Kalimantan and Maluku and Irian Jaya with the yearly increasing rate of 2.8, 0.2 and 0.2 thousand ha, respectively. An increasing tendency in the harvested area of green grammes is found for Jawa, Bali and Nusa Tenggara, but not significant.

2.2.2 Change in Yield and Production of Paddy and Palawija Crops

Changes in the yield and production of paddy and palawija crops are also shown in Tables 2.1 to 2.8 and summarized as below:

Past Changes in Yield of Paddy and Palawija Crops (1980-1991)

Province/Island	Lowland paddy		Upland paddy		Maize		Cassava	
	b*1	r*2	b*1	r*2	b*1	r*2	b*1	r*2
Sumatera	0.069	0.974	0.057	0.960	0.084	0.979	0.210	0.904
Jawa	0.103	0.959	0.077	0.978	0.076	0.988	0.310	0.969
Bali & Nusa Tenggara	0.077	0.966	0.067	0.947	0.065	0.982	0.248	0.936
Kalimantan	0.028	0.952	0.039	0.968	0.044	0.853	0.175	0.789
Sulawesi	0.082	0.894	0.038	0.898	0.040	0.965	0.281	0.939
Maluku & Irian Jaya	0.058	0.922	0.074	0.962	0.041	0.790	0.330	0.950
Indonesia	0.082	0.954	0.062	0.989	0.069	0.989	0.284	0.969

Province/Island	Sweet Potatoes		Soyabeans		Groundnuts		Green grammes	
	b*1	r*2	b*1	r*2	b*1	r*2	b*1	r*2
Sumatera	0.060	0.634	0.022	0.855	0.012	0.534[n]	0.008	0.547[n]
Jawa	0.327	0.973	0.036	0.941	0.011	0.770	0.030	0.985
Bali & Nusa Tenggara	0.135	0.968	0.023	0.725	0.004	0.244[n]	0.012	0.560[n]
Kalimantan	0.162	0.786	0.035	0.932	-0.003	-0.161[n]	0.013	0.903
Sulawesi	0.054	0.473[n]	0.042	0.970	-0.012	-0.459[n]	0.026	0.918
Maluku & Irian Jaya	0.180	0.605	0.034	0.843	0.040	0.910	0.032	0.793
Indonesia	0.203	0.983	0.029	0.944	0.008	0.677	0.025	0.969

Note: *1: 'b' value means average annual increase of yield (ton/ha); *2 value 'r' means correlation coefficient; n: statistically non-significant

Source: JICA-FIDP team calculation based on Agricultural Survey Production of Cereals in Indonesia 1980-1991, CBS.

The yield of lowland paddy has statistically increased in Indonesia with an average annual increasing rate of 82 kg per ha or 1.6%. It has also increased in all the Islands and almost all the provinces with some exception. Only in Nusa Tenggara Timur and Kalimantan Tengah, there is no change in paddy yield. The highest average annual increasing rate in lowland paddy yield is found in Jawa, at the rate of 103 kg per ha followed by Sulawesi, Bali and Nusa Tenggara, and Sumatera at the rate of 82, 77 and 70 kg per ha, respectively. The lowest average annual increasing rate is observed in Kalimantan, at the rate of 29 kg per ha. There is a big difference in the average annual increasing rate of paddy yield among the islands and among the provinces. The increase of paddy yield can be attained by the improvement of cultural practice, use of high yielding varieties and good irrigation facilities.

The yield of upland paddy has significantly increased in Indonesia, with an average annual increasing rate of 62 kg per ha or 2.2%. It has also increased in all the islands and almost all the provinces with one exception, Sulawesi Utara. The highest average annual increasing rate in paddy yield is found in Jawa, at the rate of 77 kg per ha, followed by Maluku and Irian Jaya, Bali and Nusa Tenggara, and Sumatera, at the rate of 74, 67 and 57 kg per ha. The lower annual increasing rate in upland paddy yield is observed in Kalimantan and Sulawesi, at the rate of 39 and 38 kg per ha. The difference in the average annual increasing rate of upland paddy yield among the Islands is very small compared with that in lowland paddy. This suggests that there is much less difference in the cultural practice of upland paddy, upland paddy varieties and environment of upland paddy cultivation among the island groups compared with the case of lowland paddy cultivation.

The yield of maize in Indonesia has also increased year by year. An average annual increasing rate in the yield of maize in Indonesia is 67 kg per ha. It has also increased in all

the Islands and almost all the provinces with two exceptions, Kalimantan Barat and Irian Jaya. The highest average annual increase in yield of maize is found in Sumatera, at the rate of 84 kg per ha, followed by Jawa (76 kg per ha) and Bali and Nusa Tenggara (65 kg per ha). The lowest average annual increase rate in yield is in Sulawesi and Maluku and Irian Jaya with 40 kg per ha.

The yield of root crops, cassava and sweet potatoes, has significantly increased year by year. An average annual increasing rate in the yield of root crops in Indonesia is 284 and 203 kg per ha for cassava and sweet potatoes, respectively. The yield of cassava has significantly increased in all the Islands and almost all the provinces except two provinces, Kalimantan Barat and Kalimantan Tengah. The highest average annual increasing rate is found in Maluku and Irian Jaya, and Jawa, at the rate of 330 and 310 kg per ha and the lowest in Kalimantan, 175 kg per ha. The yield of sweet potatoes has significantly increased in Jawa, Kalimantan, Bali and Nusa Tenggara, and Sumatera, at the average annual increasing rate of 327, 161, 135 and 60 kg per ha, respectively. An increasing tendency in the yield of sweet potatoes is observed in Sulawesi, but statistically not significant.

The yield of pulses, soya beans groundnuts and green grammes in Indonesia, has significantly increased at an average annual increasing rate of 27 kg per ha for soya beans, 8 kg per ha for groundnuts and 29 kg per ha for green grammes, respectively. The yield of soya beans has increased in all the islands and almost all the provinces with some exceptions. The highest average annual increasing rate in soya beans yield is found in Sulawesi, at the rate of 42 kg per ha, and followed by Jawa (36 kg per ha) and Kalimantan (35 kg per ha). Lower average annual increasing rates are found in Bali and Nusa Tenggara and Sumatera at a rate of 23 and 22 kg per ha, respectively. There are no big differences in the average annual increasing rate of soya beans yield among the islands and among the provinces where the average annual increasing rate of soya beans yield is statistically significant. The yield of groundnuts has significantly increased in Jawa and Maluku and Irian Jaya with an average annual increasing rate of 11.3 and 40 kg per ha, respectively. In other islands, there is found no significant change in the yield of groundnuts, although an increasing tendency of groundnuts yield is observed in Sumatera and Bali and Nusa Tenggara and a decreasing tendency in Kalimantan and Sulawesi. The average annual increasing rate of green grammes is significantly observed in Jawa, Kalimantan, Sulawesi and Maluku and Irian Jaya at the rate of 30,.12, 26 and 32 kg per ha, respectively. In Sumatera and Bali and Nusa Tenggara, there is no statistical change in green grammes yield is observed, although an increasing tendency of green grammes yield is found.

The historical change in production is also shown in Tables 2.1 to 2.8 and summarized as below:

Past Changes in Production of Paddy and Palawija Crops (1980-1991)

Province/Island	Lowland paddy		Upland paddy		Maize		Cassava	
	b*1	r*2	b*1	r*2	b*1	r*2	b*1	r*2
Sumatera	334.9	0.995	12.9	0.631	72.1	0.977	187.5	0.868
Jawa	693.9	0.961	42.7	0.941	146.4	0.722	61.1	0.418^{n}
Bali & Nusa Tenggara	54.8	0.957	1.6	0.347^{n}	18.8	0.918	7.4	0.228^{n}
Kalimantan	37.5	0.937	13.0	0.874	2.7	0.934	21.8	0.779
Sulawesi	181.2	0.975	-5.4	-0.885	11.4	0.461^{n}	33.2	0.866
Maluku & Irian Jaya	3.9	0.856	-1.0	-0.613	-0.5	-0.342^{n}	8.4	0.220^{n}
Indonesia	1,306.1	0.980	64.0	0.939	251.9	0.841	319.4	0.802

Province/Island	Sweet Potatoes		Soyabeans		Groundnuts		Green grammes	
	b*1	r*2	b*1	r*2	b*1	r*2	b*1	r*2
Sumatera	10.7	0.846	33.9	0.944	5.2	0.905	2.5	0.907
Jawa	13.3	0.668	39.4	0.881	10.1	0.780	7.8	0.846
Bali & Nusa Tenggara	-6.2	-0.731	11.9	0.950	1.3	0.689	0.8	0.570^{n}
Kalimantan	3.8	0.901	1.2	0.915	1.3	0.919	0.2	0.894
Sulawesi	2.6	0.367^{n}	9.5	0.913	1.2	0.289^{n}	1.4	0.468^{n}
Maluku & Irian Jaya	-22.4	-0.688	0.6	0.768	0.4	0.863	0.3	0.765
Indonesia	1.8	0.046^{n}	96.6	0.941	18.9	0.890	12.9	0.892

Note: *1: 'b' value means average annual increase of production (1,000 ton); *2 value 'r' means correlation coefficient; n: statistically not significant

Source: JICA-FIDP team calculation based on Agricultural Survey Production of Cereals in Indonesia 1980-1991, CBS.

The amount of production of lowland paddy in Indonesia has increased significantly with an average annual increasing rate of 1.3 million tons. It has also increased in all the islands and almost all the provinces except three provinces, DKI Jakarta, Kalimantan Barat and Kalimantan Timur. In DKI Jakarta, the lowland paddy production has significantly decreased at an annual rate of 1.8 thousand ton, may be due to area loss by land conversion. In Kalimantan Barat and Kalimantan Timur, the production of lowland paddy shows an increasing tendency, but statistically not significant. The highest average annual increasing rate is found in Jawa with a rate of 693 thousand ton, followed by Sumatera (335 thousand ton annually). On the other hand, the lowest average annual increasing rate is observed in Kalimantan and Maluku and Irian Jaya with 38 thousand ton and 4 thousand ton, respectively.

The amount of production is presented by the product of harvested area and yield. Break down of the increase of production of lowland paddy will be discussed later.

The amount of upland paddy production in Indonesia has significantly increased at an average annual increasing rate of 64 thousand ton. An average annual increasing rate in upland paddy production is statistically significant in Sumatera, Jawa and Kalimantan with a rate of 13, 43 and 13 thousand ton respectively. In Sumatera, an average annual increasing rate of upland paddy production is significantly found in three provinces, Sumatera Barat (1.7 thousand ton) , Jambi (6 thousand ton) and Lampung (5 thousand ton), on the other hand, an average annual decreasing rate only in Sumatera Utara (3.2 thousand ton). There is found no statistical change in upland paddy production in other provinces. In Jawa, the production of upland paddy has significantly increased in all the provinces except DKI Jakarta, with an annual rate of 4 to 19 thousand ton. As for Kalimantan, it has also significantly increased in all the provinces except Kalimantan Selatan, at an annual rate of 2 to 6 thousand ton. On the other hand, an average annual decreasing rate of the production is noted in Sulawesi and Maluku and Irian Jaya at a rate of 5 and 1 thousand ton, respectively. In Sulawesi, the amount of upland paddy production is significantly decreased in almost all the provinces except Sulawesi Utara where the upland paddy production seems to be not changed.

The contribution of yield to the change in upland paddy production is much more than that of harvested area. The increase of upland paddy production is largely owing to the increase of yield, while the decrease of the production is mainly due to the decrease in harvested area. The rate of average annual change in upland paddy production is less than one-twentieth of that of lowland paddy.

An average annual increasing rate in maize production is statistically significant in Indonesia with a rate of 252 thousand ton. It is also statistically significant for Sumatera (72 thousand ton), Jawa (146 thousand ton), Bali and Nusa Tenggara (19 thousand ton) and Kalimantan (3 thousand ton). In these islands, it is also found statistically significant for almost all the provinces with some exception. At provincial level, the highest annual increasing rate in maize production is observed in Jawa Timur (84 thousand ton) and followed by Lampung (43 thousand ton), Jawa Barat (18 thousand ton), Sumatera Utara (16 thousand ton) and Nusa Tenggara Timur (15 thousand ton). An increasing tendency of maize production is observed in Sulawesi and Maluku and Irian Jaya, but not significant. In Sulawesi, the amount of maize production has significantly increased only in Sulawesi Utara (10 thousand ton annually).

An increase in maize production is largely supported by the expansion of harvested area in Sumatera and Kalimantan. On the other hand, the contribution of increasing of yield to

maize production is observed to be higher than that of expansion of harvested area in Jawa, Sulawesi and Bali and Nusa Tenggara.

The production of cassava has significantly increased in Indonesia, at an annual rate of 319 thousand ton. An average annual increasing rate in cassava production is also statistically significant for Sumatera (188 thousand ton), Kalimantan (22 thousand ton) and Sulawesi (33 thousand ton). In these islands, it is also statistically significant for almost all the provinces with some exception. It is not significant for Jawa, Bali and Nusa Tenggara, and Maluku and Irian Jaya. In Jawa, the production of cassava has significantly increased only in Jawa Tengah (60 thousand ton annually). In Provincial level, the highest average annual increasing rate is found in Lampung with the rate of 106 thousand ton , followed by Jawa Tengah (60 thousand ton), Sulawesi Selatan (27 thousand ton) and Sumatera Selatan (26 thousand ton). In Sumatera and Kalimantan, the effect of the expansion of harvested area on the increase of cassava production is much larger than that of yield increase in production. On the other hand, the contribution of the increase of yield to the production is much higher than that of the increase of harvested area in Sulawesi.

The change in sweet potatoes production shows an increasing tendency in Indonesia, but not significant. However, an average annual increasing rate of sweet potatoes production is observed to be significant for Sumatera (11 thousand ton), Jawa (15 thousand ton) and Kalimantan (4 thousand ton). On the other hand, a sweet potatoes production has significantly decreased in Maluku and Irian Jaya, at a rate of 22 thousand ton. There is observed no statistical change in Sulawesi, but an increasing tendency.

The increase in sweet potatoes production is supported by the yield increment in Jawa, however, the contribution of expansion of harvested area to the increase of production is much larger than that of yield increase to production in Sumatera and Kalimantan.

A soya beans production in Indonesia has significantly increased with an average annual increasing rate of 97 thousand ton. It is also observed in all the islands and almost all the provinces except DKI Jakarta. An average annual increasing rate of soya beans production is 34 thousand ton for Sumatera, 39 thousand ton for Jawa, 12 thousand ton for Bali and Nusa Tenggara, 1 thousand ton for Kalimantan, 10 thousand ton for Sulawesi and 6 hundred ton for Maluku and Irian Jaya, respectively. At provincial level, the highest annual increasing rate of soya beans production is found in Jawa Timur, at a rate of 16 thousand ton, followed by DI Aceh (15 thousand ton), Jawa Tengah (12 thousand ton) and Lampung (10 thousand ton). The contribution of expansion of harvested area to the production of soya beans is much larger than that of yield increase to production in all the islands.

The production of groundnuts has significantly increased in Indonesia with an average annual increasing rate of 19 thousand ton. It has also increased in almost all the islands except Sulawesi. An average annual increasing rate of groundnuts production is 5 thousand ton for Sumatera, 10 thousand ton for Jawa, 1.3 thousand ton for Bali and Nusa Tenggara, 1.3 thousand ton for Kalimantan and 0.4 thousand ton for Maluku and Irian Jaya, respectively. While an increasing tendency is observed for Sulawesi, but not significant. The contribution of expansion of harvested area to groundnuts production is much higher than that of yield increase to production in all the islands except Sulawesi.

A significant average annual increasing rate in the amount of production of green grammes is noted in Indonesia at a rate of 13 thousand tons, and it is also noted in almost all the islands except Bali and Nusa Tenggara and Sulawesi. An average annual increasing rate is 2.5 thousand ton for Sumatera, 7.8 thousand ton for Jawa, 0.2 thousand ton for Kalimantan and 0.3 thousand ton for Maluku and Irian Jaya. An increasing tendency of green grammes production is observed in Bali and Nusa Tenggara and Sulawesi, but statistically not significant. The increase of the production is mainly supported by increase of harvested area in Sumatera and Kalimantan. There is no big difference in contribution to production between of increase of yield and harvested area in other Islands..

2.3 Production of Crops Other than Lowland Paddy

The amount of production of paddy and palawija crops in 1989, 1990 and 1991 are shown in Tables 2.9 to 2.11, that of vegetables, fruits and estate crop in 1989 are shown in Tables 2.12 to 2.14, and summarized as below:

Production of paddy, palawija, vegetables, fruits and estate crops

unit: 000 ton

	Upland Paddy	Maize	Cassava	Sweet Potatoes	Soya Beans	Ground Nuts	Green Grammes	Vegetables	Fruits	Estate Crops
Sumatera	858	791	3,619	365	280	88	41	1,068	678	3,990
Jawa	840	4,235	10,437	1,010	795	416	146	3,026	3,384	2,948
Bali & Nusa Tenggara	142	589	1,408	302	155	42	33	219	401	233
Kalimantan	398	43	507	91	13	17	3	85	186	496
Sulawesi	101	618	217	202	62	52	41	160	489	721
Maluku & Irian Jaya	16	17	163	254	9	4	3	23	38	221
Indonesia	2,354	6,193	17,113	2,224	1,315	620	267	4,581	5,176	8,609

Source: Production of cereals in Indonesia 1989, CBS, Production of vegetables in Indonesia 1990, CBS Production of fruits in Indonesia 1990, CBS, Statistics Perkubunan Indonesia, Directorate General of Estate Crops, MOA (1989)

The production of upland paddy in Indonesia is about 2.4 million tons and is still increasing. Major upland paddy area is in Sumatera and Jawa followed by Kalimantan, in which about 90 % of total is produced. The amount of production of upland paddy is very low compared with that of lowland paddy that is about 42 million tons.

The amount of maize production in Indonesia is about 6.2 million tons. The maize production centre is in Jawa that accounts for 67% of total production or 4.0 million tons. Production of maize in outside of Jawa is very low, for example, in Sumatera, the second maize production area, only 0.8 million tons or 12.7% of total production.

The amount of cassava production is 17 million tons. Major cassava areas are in Jawa and Lampung in Sumatera. Sixty percent of total production is produced in Jawa followed by Sumatera (21% of total or 3.6 million tons) and Bali and Nusa Tenggara (8% of total or 1.4 million tons). The amount of sweet potatoes production is 2.2 million tons, 60% of which or one million tons is produced in Jawa.

Total production of soya beans is 1.3 million tons and increasing rapidly. Major soya beans production area is Jawa, 0.8 million tons, followed by Sumatera and Bali and Nusa Tenggara (0.28 and 0.16 million tons, respectively).

The amount of production of groundnuts and green grammes are about 620 and 270 thousand ton, respectively. Major production area is in Jawa where more than 60% of total production of these pulses are produced.

Many kinds of tropical and temperate vegetables are cropped in Indonesia with a total production of 4.6 million tons. Major vegetable production area is Jawa, followed by Sumatera. Sixty-seven percent of total or 3 million tons of vegetables is produced in Jawa and 23% or 1 million tons in Sumatera. Vegetable production in other Islands is very limited. Amount of vegetable production reflects the demands and marketability. Total fruits production in Indonesia is 5.2 million tons and the situation of fruits production is resembled to that of vegetables.

3. Environment of Paddy Production

3.1 Area of Lowland Paddy Field by Irrigation Type and Ecosystem

There is very little difference in the land utilization by upland crops among the field condition, however, there is a big difference in the land utilization by lowland paddy plant by different water regime, especially water supply system.

The low land paddy field is classified into three categories by water regime i e, irrigated, rainfed and swamp areas/other area which includes temporary fallow field. In Indonesia, the irrigated field is classified by irrigation facility into three types, technical, semi technical and simple, and by management system into two types, managed by government and managed by farmers themselves. The area of lowland paddy field by water regime and type of irrigation is shown in Tables 18 to 20 and summarized as follows.

Area of Lowland Paddy Area by Water Regime and Type of Irrigation as of 1991

unit: 000 ha

Province/Island	Irrigated lowland				Rainfed	Others	Total
	Technical	Semi technical	Simple	Sub-total			
Sumatera	167.9	228.0	514.2	910.1	606.5	702.6	2,219.3
Jawa	1425.8	438.7	681.6	2,546.1	847.5	26.0	3,419.5
Bali & Nusa Tenggara	45.9	170.6	91.0	307.5	70.8	30.0	408.3
Kalimantan	12.5	13.4	114.1	139.9	369.1	793.4	1,302.4
Sulawesi	183.1	99.2	246.3	528.6	271.1	65.7	865.5
Maluku & Irian Jaya	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Indonesia	1835.1	950.0	1647.1	4432.2	2165.1	1617.7	8,215.0

Source: Agricultural Survey Land Area by Utilization in Jawa 1991, CBS
Agricultural Survey Land Area by Utilization for Outside of Jawa 1991, CBS

The total lowland paddy field area is 8.2 million ha as of 1991. The largest paddy area is found in Jawa with 3.4 million ha or 42% of total lowland area, followed by Sumatera, 2.2 million ha or 27% of total, and Kalimantan, 1.3 million ha or 16% of total area, respectively. Irrigated paddy field area is 4.4 million ha, accounting for 54% of total lowland paddy area. Jawa has the largest irrigated area, 2.5 million ha or 57% of total, followed by Sumatera, 0.91 million ha or 21% of the total and Sulawesi, 0.53 million ha or 12% of total irrigated paddy field, respectively. Within the irrigation area, technical irrigation scheme is concentrated in Jawa in which shares almost 78% of total technical irrigation field. The area ratio of irrigated field to total lowland paddy field is the highest in Jawa and Bali and Nusa Tenggara with more than 75%, followed by Sulawesi (61%) and Sumatera (41%) while the lowest in Kalimantan with 11%..

The area of rainfed lowland paddy field is 2.2 million ha, 27% of total paddy field. Jawa shares 848 thousand ha or 39% of total rainfed paddy field, followed by Sumatera (607 thousand ha or 28% of the total area) and Kalimantan (370 thousand ha or 17% of total rainfed paddy field). Other areas, including tidal and fresh water swamp field, polder temporary fallow field etc, are 20% and 1.1 million ha, respectively. They are mainly distributed in Sumatera and Kalimantan, and very limited in other Islands.

Here are two information on the area of irrigated paddy field by the type of irrigation by province, compiled by CBS and MPW. There is a big difference in the area of each type of irrigation in each province between two information as shown in Table 3.4. The difference in the area of each irrigation type between the two Institutions may be due to following reasons. The MPW compiled this information by using only their own project areas and excluding non MPW (village) irrigation area. The second one may be due that the terminology used by MPW is something different from that used by CBS (refer to Table 3.5). Systematic data arrangement and analysis should be established as soon as possible by concerned agencies.

The change of area of paddy field by different irrigation type as well as water regime is shown in Table 3.6 and summarized below:

Changes in area of lowland by type of irrigation (000 ha)

	Technical		Semi technical		Simple		Sub total	
	1983	1991	1983	1991	1983	1991	1983	1991
Sumatera	133.9	167.9	164.6	228.6	534.5	514.2	833.0	910.1
Jawa	1,341.2	1,425.8	473.8	438.7	679.9	681.6	2,494.9	2,546.1
B & NT	56.2	45.9	131.7	170.8	102.6	91.0	290.5	307.5
Kalimantan	9.9	12.5	8.8	13.4	138.8	114.1	157.5	139.9
Sulawesi	110.4	185.1	75.0	99.2	226.4	226.4	411.8	528.6
M & IJ	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Indonesia	1,651.7	1,835.1	853.9	950.0	1,682.1	1,647.1	4,187.7	4,432.2.

	Rainfed		Tidal swamp		Inland swamp and others		Total	
	1983	1991	1983	1991	1983	1991	1983	1991
Sumatera	533.0	606.6	243.3	216.1	370.3	486.5	1,979.7	2,219.3
Jawa	911.4	847.5	3.4	0.5	22.4	25.5	3,432.1	3,419.5
B & NT	73.5	70.8	0	0.0	2.7	30.0	366.7	408.3
Kalimantan	393.9	369.1	233.8	283.2	87.1	510.1	872.4	1,302.4
Sulawesi	321.4	271.1	5.7	1.8	7.2	63.9	746.1	865.5
M & IJ	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Indonesia	2,233.2	2,165.1	486.2	501.7	489.7	1,116.0	7,397.0	8,215.0

Source: Agricultural Survey Land Area by Utilization in, Jawa 1983, 1991 CBS
Agricultural Survey Land Area by Utilization for Outside of Jawa 1983, 1991 CBS