Rural Energy Development of Strategic Research in Beijing Area

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ABSTRACT

This paper presents a rural energy system dynamics (RESD) model in Beijing. The system covers a wide range of aspects, such as economy, energy, pollution, water, population, labour and farmland. RESD model contains 8 sectors: electric industry, coal industry, building material industry, other industry, the third occupation, capital, agricultural production and people's life, from which 788 variables were attained with 48 level equations. The present study puts forward 4 suggestions and how to realize the 4 suggestions to the development of this system.

Key Words: Rural Energy Economy Ecology Strategic Development Beijing

1. PURPOSES AND CLUE

Generally speaking, main purposes of energy strategic research are as follows:

(1)To clarify the present relationships between supply and demand of rural energy and its influences on the economic development and environment.

(2)To analyse and predict the directions & importances of rural economic development and its needs to energy and resources, and to design as more schemes as possible so as to more fully reveal its development potentialities and potential problems.

(3)To further analyse and evaluate the possibilities and reasonabilities of various developmental strategies, to select the best strategic target and to put forward the best suggestions so as to provide scientific basis for formulating the developmental plans, schemes and policies of rural energy.

According to the above, when we study developmental strategy of rural energy in Beijing, system view three must be noticed: Let energy, economy and ecological environment be as a system to be researched. From the system point of view, energy, economy and ecological environment is the sub-system of the whole national economic system. They exist close relations with each other. Generally speaking, the scale and structure of economic development depend on those of energy consumption and supply. Conversely, the scale and structure of energy supply and consumption condition those of economic development. So, there forms the cycle of conditioning & promoting each other. Simultaneously, with the increase of energy consumption & supply, there will lead to bad influences on the environment. In order to protect and improve the ecological environment, we must put in large amount of manpower, capital and material. As a result, it will influence energy exploitations & its uses and economic developmental speed & level thus form another cycle of feedback. From the relationship of energy, economy and environment's view (see figure 1), they exist promotion each other and also condition each other. Generally, one factor increases or decreases will result in another factor decreasing or increasing. Therefore, as to energy developmental strategic research, we must consider the relations among rural economy, rural ecological environment and rural energy that

can get scientific developmental strategy.

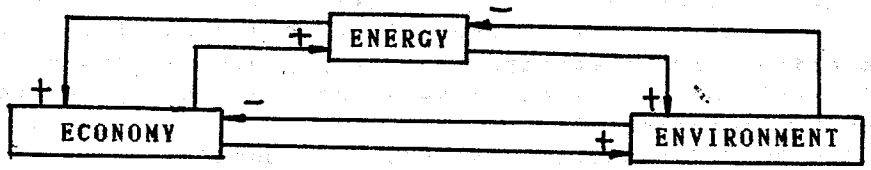

FIGURE1 RURAL ENERGY-ECONOMY-ECOLOGICAL ENVIRONMENT CAUSE-EFFECT RELATIONS

2.MAIN FACTORS & THEIR ANALYSES

According to the actual facts of Beijing, the following factors are considered and they are basic conditions which depend on the development of rural energy system in Beijing. These factors are environmental volume, population & labour resources, water resources, land resources, investment capability and market.

(1)ECONOMIC SCALE In recent years, Capital's rural economy has made great progress. In 1980, the total economic income was ¥2.78 billion, in 1985, is ¥8.83 billion. It increases by 2 times in 5 years, of which rural industry increases by 4 times. Because of the rapid development of rural industry, it results in much increase of energy consumption. From 1979 to 1985, coal consumption has increased by 0.5 times, fuel oil by 1.04 times and electricity by 1.05 times. As to its increased speed, it exceeded much more than those of the whole nation in the same periods so that aggravate tension of energy supply. Conversely, the shortage of energy supply conditions the development of rural economy. According to statistics, many factories do not work well, about 25% of which can not use of their productive capabilities. In recent years, rural industry meets with the contradiction of putting in more but producing lower and decreasing of economic benefits and many rural industry products are from the selling market to becoming buying market. Thus the products are unsalable and overstocking. These phenomena are closely related to the shortage of energy and raw materials and price system. And the development of agricultural production is confined by the area of cultivated land, water resources and energy. In the same way, the scale expansion of agricultural production, of course, will lead to increase of energy consumption. Therefore, the development of rural energy is closely connected with the development of rural economy. Thus, the scale and structure of rural industrial development is becoming an important part of the system of energy, economy and ecological environment.

(2)ENVIRONMENT VOLUME Rural pollution is mainly from 3 aspects: firstly, it is from the waste material of the city; secondly, it is from the agricultural production itself. About 2/3 of the used amount of fertilizers and farm chemicals enter into environment; Finally, it is from the pollution of rural industry. According to 1984's investigation to the 11,974 rural enterprises in the whole city, 1,295 of which are polluted, accounted for 11% of the total. Among the 11% the enterprises, 2.3% of which are seriously polluted and 9.2% of which are moderately polluted. Apparently, the pollution of rural industry is not very serious. But, because rural enterprises are small-scale, disperse widely & are backward-technique and their the three wastes are discharged deliberately, the actual damages they brought are still serious. The rural ecological environment in Beijing is not good: In 1985, the coverage rate of forest is only 21.6%; Excessive felling of firewood

exceeds half of the reasonable supply by forest; Part of crop straw is used for cooking, heating, raw material of light industry and architecture, so only very small amount of crop straw returns to farmland. From now on, when construct rural energy, we must pay more attention to the improvement of rural ecological environment so that energy, economy and environment develop coordinately.

(3)POPULATION & LABOUR RESOURCES In 1985, the population of the city is 9.58 million, rural population accounts for 3.85 million. In 1980, the city's natural population increased rate was 0.926%, of which the rural rate was 1.021%. In 1985, the city's rate decreases to 0.693%, the rural rate is 0.647%. The extension of the city & construction of satellite towns made urban population increased thus the mechanical increased number of rural population did not exceed 4,000-5,000 everyyear. Therefore, the rural population did not increase very much. In 1978, the rural population was 3.826 million and in 1985, it rises to 3.854 million. The population increased only about 30,000 for 7 years. We suppose it possible that city's population is controlled within 4.2 million in the year of 2000. And this can make peasants' living standard improved steadily. In the whole system, the number of rural population depends on the number of labour, the consumption of energy and water in dailylife and the improvement of GNP per capita.

Labour force is the most active among productive forces. In 1985, the rural labour is 1.9 million, among which tens of thousand labour go to city to work and the labour is small surplus. In recent yeas, the high speed development of rural industry has attracted large amount of rural surplus labour: In 1980, the number of workers in rural enterprises was 310,000, which only accounted for 19.1% of the total labour; However, in 1985, the number of workers is 760,000, it accounts for 40.2% of the total labour. Considering the limited increase of labour, if rural industry continues to develop in high speed, it will result in shortage of labour. Especially, the high economic profits of rural industry attracts labour strongly. Thus it will lead to shortage & low quality of agricultural productive labour and influence agricultural production conversely. It shows that population and labour is a signi-

(4)WATER RESOURCES Beijing belongs to semi-drought & monsoon climate. The average rainfall is 626 mm and the total rainfall is about 10.5 billion cubic meters everyyear. In recent years continuous drought and the attenuation of Guanting reservoir storage make surface water declined sharply. And people have to exploit underground water. Before 1980, the supply of underground water is about half of the total supply, now it exceeds 2/3 and becomes the main water source of Beijing. Excessive exploitation of underground water makes the water level declined sharply and results in the water environment in bad quality. So the water has to limit to be exploited. Therefore, the shortage of water resources in Beijing is evident and cannot be solved in a short time. The policy of using water is to satisfy people's life firstly, to confine industry consumption and to cut down agricultural consumption. In the consumption of water in the countryside, most of which is used in agricultural production and only a small amount of which is used in rural enterprises. In a period a time, to increase water supply capacity is, except to build up a small number of reservoirs in mountain areas, mainly to intrduce water into Beijing from other provinces. But, in recent years, planting output is influenced by water resources to great extent. With the upgrading of people's living level, water consumption in peasants dailylife will also increase sharply. So it can be said that wa-

ter resources are more and more close to the development of rural economy, people's living level's upgrading, agricultural ecological environment and rural energy construction.

(5)LAND RESOURCES The total area of Beijing is 25.21 million mu, of which plain area is 9.85 million mu, accounts for 38%; Mountain area is 15.63 million mu, accounts for 62%. Present cultivated land is 6.3 million mu, forest land is 5.44 million mu and wasteland which can grow forest is 5.1 million mu. The reserve cultivated land in Beijing is limited and cannot become more farmland. Conversely, farlmand decreases at the speed of tens of thousand mu per year with the development of town construction and rural enterprises and the improvement of people's living houses in recent years. The restraint of farmland makes further development of planting limited. Thus it restrains the development of animal husbandry and fishery. In order to solve the short supply of foodstuffs, it is necessary to transport fodder at high cost from other provinces. It can be seen that farmland decides on the development of agricultural production. In future, we must control the cultivated land occupied by the state, collective and private, develop collectivization production, speed up to construct the suburban bases of foodstuffs, build up the vegetable bases mainly on near suburb & subsidiary on distant suburb, the bases of live pig and fowls & eggs mainly on grain produced plain, the milk bases mainly on state farms, the fruit bases mainly on near hills and sand plain, the fresh fish bases mainly on ponds and reservoirs and the raising bee bases etc., at the same time, make full use of land resources and develop forestry; grow trees on the 5.1 million mu wasteland and let limited land to be made better use of.

(6)INVESTMENT CAPABILITY Beijing is the Capital. So capital is rich relatively. In recent years, the investment to rural areas increased sharply, which has prospered rural economy, enlivened Capital market and has improved peasants life. In 1983, the total investment of the state & banks to rural areas was ¥520 million; rural enterprises accounted for ¥320 million; In 1984, the investment reached ¥1.25 billion, rural enterprises Accounted for ¥610 million; In 1985, the number exceeds ¥1.72 billion, rural enterprises accounts for ¥1.08 billion. How to use the capital and how to distribute it reasonably to rural enterprises, agricultural production, energy consumption & pollution control etc., is a significant factor which decides on whether the system of energy, economy and environment can develop coordinately.

(7)MARKET To face the specific environment, the market of agricultural products & foodstuffs is wide, but rural enterprises are not like so. At present, the rural enterprises are facing to rival with the state, collective and other provinces enterprises in data management, raw material supply, talented people requirement, products quality & price sales channel and promoting sales policies etc.. In future, how to develop Beijing? what are the important? what are the reasonable developmental speed and scale? To answer these questions should analyse & predict market demand situation.

In a word, the whole system is consisted of energy, economy, environment, population and labour, water, land, capital and market. Every factor coordinates each other and promotes each other. They exist close cause and effect relationships. In the following, I will use the principle & method of system dynamics to describe & simulate these relations in order to provide a convenient test tool & method for strategic development and to make strategic research build on scientific

bases.

3.RESD MODEL OF RURAL ENERGY SYSTEM'S DEVELOPMENT

(1)RESD (Rural Energy System Dynamics) Model's Cause-Effect Relations Diagram

It can be seen in figure 2, RESD model is consisted of a positive feedback (main loop) and six negative feedback loops.

A.positive feedback loop (main loop)

(a) as for rural industry:

rural industrial output→+ capital→+ rural industrial investment→+ rural industrial output

(b) as for agricultural production:

agricultural output→+ capital→+ agricultural investment→+ agricultural output

But, the development of rural industry & agriculture is confined by various factors:

B. negative feedback loops

(a) pollution confines:

rural industrial output→+ pollution→-rural industrial investment→+ rural industrial output

(b) farmland confines:*

farmland reducing rate→ farmland area→+ agricultural output

(c) energy confines:

rural industrial output

agricultural output→+ energy demand→+ contradiction of

rural industrial

energy supply & demand (supply less than demand)→- agricultural

investment rural industrial output

investment→+ agricultural output

(d) labour confines:

rural industrial output

agricultural output→+ labour demand→+ contradiction of

rural industrial

labour supply & demand (supply less than demand)→- agricultural

investment rural industrial output

investment →+ agricultural output

(e) water confines:

rural industrial output

agricultural output→+ water demand→+ contradiction of water

rural industrial

supply & demand (supply less than demand)→- agricultural

investment rural industrial output

investement→+ agricultural output

(f) market confines:

rural industrial output

agricultural output→+ market supply→+ contradiction of

rural industrial

market supply & demand (supply more than demand)→- agricultural

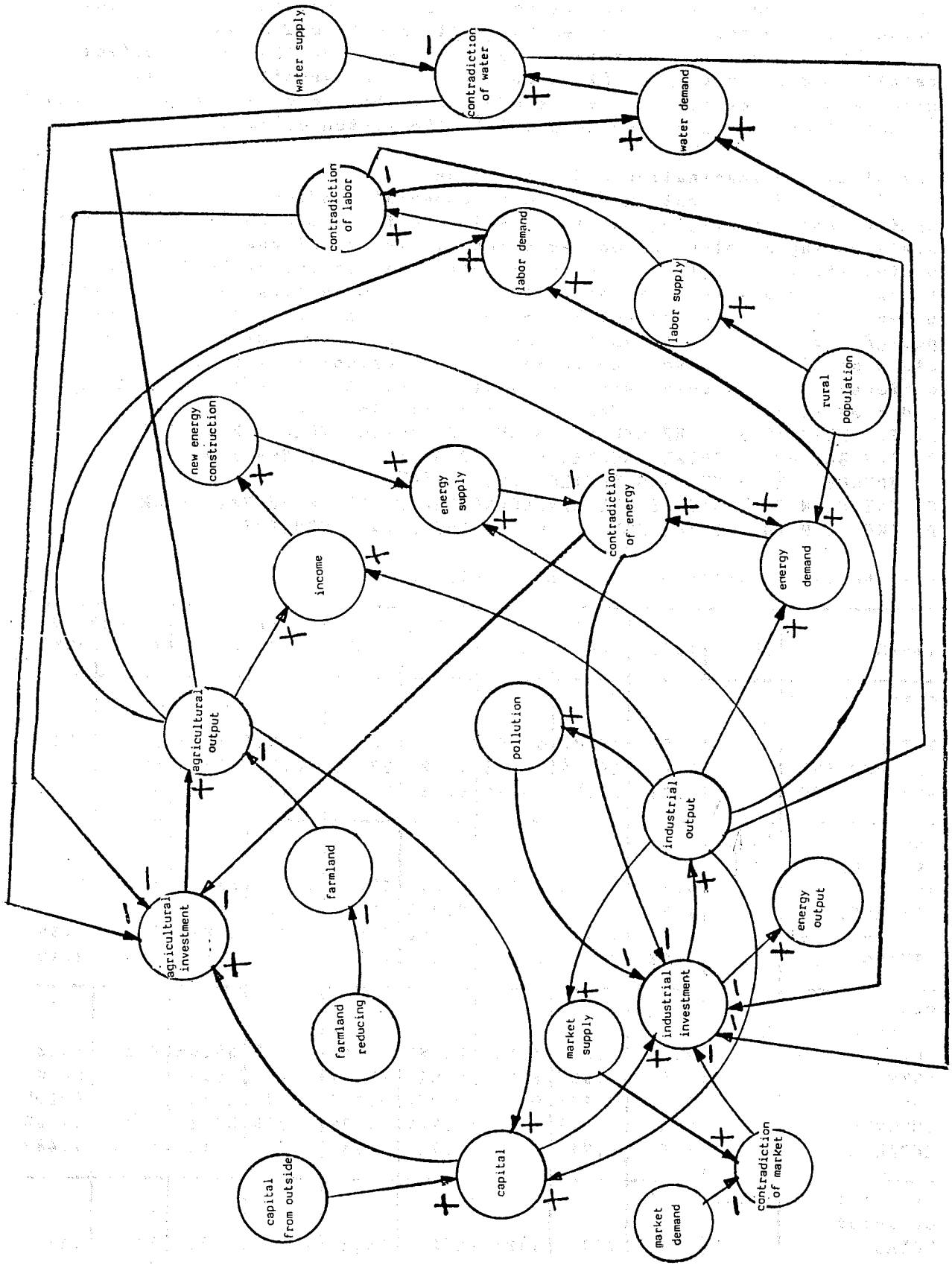

Figure2 The causal feedback loops diagram

investment → rural industrial output
investment → agricultural output
*NOTE: In fact, farmland reducing rate is more than zero. So, whether it increases or decreases will make farmland reduced.

The above lists only main loops. Please, see the canse- effect relations diagram (figure 2) in detail. From cause-effect relations diagram, the flow diagram can be depicted, then to establish equations, to select coefficients and to simulate the system on computer.

(2) Strategic Imagination and Prediction

In order to estimate the developmental tendencies of rural energy & economy in Beijing and to reveal more fully & completely the possible coming problems & contradictions in the development so as to study the strategic policies which promote rural energy of Beijing to develop, it is necessary to predict the possible developmental directions & tendencies in the future. But prediction is not reality. It needs to design several plans to analyse and to compare. According to actual facts & needs of Beijing, the following developmental strategies will be different developmental ways of rural economy & energy in the future and need inquiring into. The several strategic plans are as follows:

A. THE PLAN TO PUT THE STRESS TO DEVELOP AGRICULTURE & FORESTRY
B. THE BALANCED DEVELOPMENTAL PLAN TO GIVE CONSIDERATION TO ENERGY , ECONOMY AND ENVIRONMENT
C. THE PLAN TO CONTINUE THE DEVELOPMENTAL MODEL IN RECENT YEARS
D. THE PLAN TO PUT THE STRESS TO DEVELOP RURAL INDUSTRY

(3) The main results of computer simulation

ITEMS	UNIT	1985	PLAN A		PLAN B		PLAN C		PLAN D	
			2000	2030	2000	2030	2000	2030	2000	2030
output value	BIL. ¥ RMB									
TOTAL		6.99	19.42	31.99	24	65	31.35	233.2	33.6	274.8
ENTERPRISES		5.03	10.78	18.33	19.3	57.59	26.5	223.9	29.2	268
AGRICULTURE		1.97	8.65	13.16	4.73	7.41	4.84	9.29	4.45	6.76
energy consumption	MIL.T (SCW)									
TOTAL		4.1	6.852	9.26	8.31	17.3	10.21	58.14	10.81	68.5
ENTERPRISES		1.95	3.049	4.318	5.232	13.4	7.103	53.85	7.787	64.
AGRICULTURE		0.43	1.77	2.6	1.003	1.515	1.025	1.895	0.95	1.39
LIVING		1.28	2.028	2.34	2.07	2.39	2.077	2.399	2.069	2.40
coal consumption	MIL.T									
TOTAL		3.46	2.941	4.942	6.057	14.48	8.019	55.66	8.82	66.8
ENTERP.		2.2	2.807	4.353	5.51	13.67	7.46	55.52	8.18	63.6
AGR.		0.06	0.134	0.2	0.076	0.115	0.077	0.144	0.072	0.105
IMPORTED		0.47	-1.77	3.452	1.347	12.99	3.309	54.17	4.107	65.35
RURAL MIENS		3.01	4.71	1.489	4.71	1.489	4.71	1.489	4.71	1.489
fuel oil consumption	THOUS T									
TOTAL		228	773	1184	653	1391	772	3779	787	4190

ENTERP.		89	178	314	316	883	428	3143	469	3725
AGR.		139	595	871	337	508	344	636	318	465
electricity consumption	BIL. KWH									
TOTAL		1.29	3.79	5.54	3.86	8.61	4.71	28.33	4.92	32.9
ENTERP.		0.67	1.33	2.06	2.3	6.39	3.12	25.67	3.43	30.85
AGR.		0.46	2.06	3.03	1.17	1.75	1.19	2.21	1.1	1.61
LIVING		0.16	0.39	0.45	0.39	0.45	0.39	0.45	0.39	0.45
RURAL POWER PLANTS'OUTPUT	BIL. KWH	0	0.19	0.3	0.46	1.16	0.71	5.53	0.79	6.78
IMPORTED ELECTR.	BIL. KWH	1.28	3.59	5.24	3.4	7.45	4	22.8	4.13	26.14
labour	THOUS									
TOTAL DEMAND		1763	2004	1189	2344	2364	2376	8202	3174	9656
TOTAL SUPPLY		1900	2178	2515	2178	2515	2178	2515	2178	2515
ENTERP.DEMAND		741	937	670	1674	2029	2298	7812	2527	9341
AGR. DEMAND		1021	1067	519	670	335	678	390	647	315
water consumption	BIL. CUB.M									
TOTAL		2.28	2.75	3.94	2.57	3.29	2.62	4.72	2.61	4.8
ENTERP.		0.04	0.08	0.13	0.14	0.41	0.19	1.67	0.21	2
AGR.		2.17	2.44	3.54	2.2	2.61	2.2	2.81	2.17	2.53
LIVING		0.07	0.23	0.27	0.23	0.27	0.23	0.27	0.23	0.27
DIACHARED WASTE GASES	BIL.N CUB.M /YEAR	29.1	12.6	15.9	14.55	32	31.6	163.5	36.4	261.8
ACCUMULATED WASTE SOLIDS	THOUS T	598	1194	3535	1820	3689	2667	24570	3290	28570
ACCUMULATED WASTE WATER	BIL. CUB.M	0.023	0.13	0.24	0.17	0.4	0.24	4.65	0.27	5.61
CROP STRAW CONS.	THOU.T (SCW)	490	865	484	580	401	580	422	573	348
FIREWOOD CONS.	THOU.T (SCW)	320	1190	1202	870	973	878	984	798	966
NUMBER OF BIOGAS PIT	THOUS	50	142	226	151	383	167	1098	173	1250
AREA OF SOLAR HEATERS	THOUS SQ.M	12	519	738	587	1398	688	4619	725	5340
AREA OF SOLAR HOUSES	THOUS SQ.M	6	1653	3768	1749	5982	1982	15660	2006	17700
EFFICIENCY LIVING ENERGY CONS.	%	16.5	23.9	23.9	23	23	23.4	23.4	23.4	23.4
FIREWOOD FOREST AREA	MIL. MU	0.2	1.966	1.966	1.41	1.55	1.42	1.57	1.264	1.533
COVERAGE RATE OF FOREST	%	21.6	62.6	63.3	48	53.8	48.3	54.2	45	53.3
PEASANTS' INCOME	¥ PER CAPITA	679	1719	2452	2127	4984	2774	17878	2976	21064

GRAIN OUTPUT	KG PER CAPITA	568	1581	1521	1061	1272	1061	1333	1048	1219
ECONOMIC CROP OUTPUT	KG PER CAPITA	11.3	22.8	31.8	14.7	18.7	1.51	22.8	14.1	17.2
VEGETABLE OUTPUT	KG PER CAPITA	598	905	1179	669	743.5	680.5	909.7	684.6	678.3
FRUIT OUTPUT	KG PER CAPITA	49	286.4	494.8	160	241	165	306.4	141.4	253.8
FISH OUTPUT	KG PER CAPITA	4.2	42.9	133	22.6	62.2	23.3	85.1	20.5	53.9
ANIMAL HUSBANDRY OUTPUT	¥ PER CAPITA	172	1139	1555	512	723	532	1007.8	460	625
RURAL POPULATION	MIL.	3.854	4.23	4.88	4.23	4.88	4.23	4.88	4.23	4.88
unit output energy cons.	T(SCW)/ THOU.¥									
TOTAL		0.34	0.25	0.22	0.26	0.23	0.26	0.24	0.26	0.24
ENTERP.		0.38	0.28	0.23	0.27	0.23	0.27	0.24	0.27	0.24
INDUSTRY		0.47	0.36	0.3	0.35	0.3	0.35	0.3	0.35	0.3
BUILDING MATERIAL INDUSTRY		1.6	1.5	1.4	1.46	1.35	1.43	1.29	1.43	1.28
OTHER INDUSTRY		0.13	0.115	0.11	0.11	0.1	0.1	0.095	0.1	0.095
AGR.		0.22	0.205	0.198	0.212	0.204	0.212	0.204	0.213	0.205
LIVING CONS. PER CAPITA	T (SCW)	0.448	0.48	0.48	0.49	0.49	0.49	0.49	0.49	0.49
OUTPUT RATIO OF ENTERP. TO TOTATAL	%	71.9	55.5	58.9	80.3	88.6	84.6	96	86.8	97.5
LABOUR DEMAND RATIO OF ENTERP. TO TOTAL	%	42	46.8	56.4	71.4	85.8	77.2	95.6	79.6	96.7
ENERGY CONS.RATIO OF ENTERP. TO TOTAL	%	47.5	44.5	46.6	63	77.4	69.6	92.6	72.1	94.5
ENERGY CONS.RATIO OF AGR. TO TOTAL	%	10.4	25.9	28.1	12.1	8.8	10	3.3	8.8	2
WATER CONS.RATIO OF ENTERP. TO TOTAL	%	1.7	2.9	3.3	5.4	12.5	7.2	35.3	8	41.7
WATER CONS.RATIO OF AGR. TO TOTAL	%	95.3	88.7	89.9	85.5	79.4	83.9	59	83.1	52.3

NOTE: 1.BASE YEAR IS 1985; ALL PRICE IS THAT OF 1980;
2.HEATING VALUE OF 1KG SCW(STANDARD COAL WEIGHT)=7,000KCAL;
3.IF INPORTED COAL IS MINUS, IT MEANS OUTPUT OF SMALL MINES IS MORE THAN TOTAL COAL CONS; 1HA=15MU;
4.ENERGY CONS. INCLUDES AGR., ENTERP., AND LIVING CONS.. ENTERP. IS SUB-DIVIDED INTO ELECTR., COAL, BUILDING-MATERIAL & OTHER INDUSTRY AND THIRD OCCUPATION.

4.CONCLUSIONS & POLICIES

How to develop rural economy of Beijing? What are the developmental directions & importances? what are the reasonable developmental

speed & scale? These are the questions which the developmental strategic research of rural energy will answer firstly.

According to the predictions & analyses of the four developmental plans, I recommend the second plan, whose output is not low, economic benefits are better, contradiction of energy supply & demand is not great and relations of water and labour supply & demand are basically balanced and which benefits to adjust the agricultural environment. Especially, the plan is close to the rural construction aims which are included in the total planning of Beijing and it has the skill to serve the Capital, to make peasants rich and to build the city which has good environment and ecology.

In order to guarantee to carry out the above plans, especially, the second plan and to promote the rural economy of Beijing to develop continuously, steadily and healthily, the following problems must be solved well:

1.TO INCREASE COMMODITY ENERGY SUPPLY GRADUALLY AND TO MAKE IT IN THE ECONOMIC DEVELOPMENTAL PLANNING OF THE WHOLE CITY
2. IT IS EXTREMELY URGENT TO DEVELOP ELECTRIC CONSTRUCTION
3. TO STRESS THE ESSENTIALS ON USING FUEL OIL ECONOMICALLY & REASONABLY
4. TO SOLVE THE SHORTAGE OF WATER RESOURCES AS SOON AS POSSIBLE
5. TO MAKE FULL USE OF THE LOCAL RESOURCES AND TO UPGRADE SELFSUPPLY CAPABILITY OF LIVING ENERGY CONSUMPTION
6. TO SAVE RURAL ENERGY AND TO PUT THE STRESS ON RURAL INDUSTRY
7. THE REASONABLE CIRCULATION OF RURAL CONSUMPTION CAPITAL IS ONE OF THE KEY FACTORS WHICH GUARANTEES THE BALANCE OF ENERGY SUPPLY & DEMAND
8. TO STRENGTHEN THE AGRICULTURAL CIRCULATION ITSELF AND TO DEVELOP ECOLOGICAL AGRICULTURE
9. TO PAY ATTENTION TO THE PROTECTION OF AGRICULTURAL ECOLOGICAL ENVIRONMENT
10. TO AMPLIFY MANAGEMENT ORGANIZATION AND TO FULLY UTILIZE POLICIES AND SCIENCE & TECHNOLOGY

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