CONCEPTUAL DESIGN OF AGRICULTURAL INFORMATION SYSTEM

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I. Introduction

Various economic and social activities in, so called, information age go on the axis named information. The information age can be defined as a time when society moves from the centralized, industrial age to an era where the acquisition and use of information become the keys to success.

In such a society, most industries concerned with the production and the marketing of goods are facing the increasing demands to change their production and circulation methods, since the timely and accurate information means the significant difference in making a profit or a loss in a particular transaction. In our society, also, the tendancy to put more value on the software and the added value of goods rather than the hardware oriented goods itself is increasing and this tendancy are changing the paradigm of our economic and social structure.

The agricultural sector is an not exception for such a mega-trend. The signals have come out already. The transitional problems related to production increase, marketing system, pricing policy, nonagricultural income, rural exodus have taken place in the agricultural sectors by the quantitative as well as the qualitative change of our agricultural environment. Analyzing the structure of these problems, we know that the causes and effects of problems are not independent but inter-related. In such a case, that is, the problem has a system structure, it is natural that the problem solving procedure should also have a system structure.

Therefore, what is most needed in solving the transitional problems is to secure the systematic management capabilities such as a scientific decision making and an accurate and objective recognition of the current agricultural situation and the expected role in our society. Accordingly, to develop the agricultural sector stationarily coping with the inner and outer changes, the security and practical use of the analytical methods is urgent and the collection and processing of the relevant information is an important step as

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a preceding task.

Based on this currents of the times, though MAFF* has been collecting the agricultural data, it is unsatisfactory in their practicality, applicability and precision. If, as it is now, the series of processes in collection, store, arrangement and distribution of data are not systemized and so the collected data is used only for the single purpose of the agricultural statistics, those data would lose the value as the agricultural information. If those data, through a proper processing, are not used as the primary input for the various decision making process such as analysis, diagnosis, forecast and planning, we could not exclude the possibility that those observed statistics which have the significant meaning as an indicator of the current agricultural environment would be the simple figures for the *ex post* management.

For example, in the pricing mechanism of the agricultural products, the producers rely only on the experience and guess in the planning and the choice of shipping date by the uncertainty of the future price. And as the competition between producers become more and more excessive, policy makers are facing with the difficulties in the agricultural resource allocation by the ignorance of the current situations. Under the present situation, the price trend is indirectly induced by only adjusting extemporaneously the quantity of production and supply, and it is usually far from the acceptable level to maintain proper level not to speak of the optimun. To set and maintain the price policy guranteed the production cost and the reasonable profit, the various relevant informations, such as demand and supply outlook, substitution effect of competative goods, price and income elasticity, influence of import and export policy, trend of consumption pattern and efficiency and mechanism of marketing system, should be analyzed and processed through the series of structured information systems to establish the composite index.

In brief, the most necessary thing to establish the optimal policy is the information system in which the uncertainty is minimized and the interrelationship between informations is clearly proved. On the whole, it is very hard to organize such an information system by simply gathering the non-processed source data. Furthermore, in recent years, the kind and quantity of agricultural information have increased so fast that agricultural policy makers have difficultes in obtaining these informations timely and, more over, it is nearly impossible to generate the new informations based on their own analytic and reasoning capability.

Therefore, in solving those previous mentioned problems fundamentally, it can be regarded as an important precondition to construct an effective information mangement system. Though the conception of total agricultural information system, which would be classified into the database system and the model base system, seems to be behind the right time, it is still a very

* MAFF : Ministry of Agriculture, Forest and Fishery

important and urgent task from a point of view in the size and environment of our agriculture and the informatic process of our society.

Ⅱ. The States and Problems of the Current Agricultural Information System

To set up the direction then to design and implement the effective agricultural information system, the states and performance of the current agricultural information system should be reviewed and diagnosed. Aiming this, the information resource management and information system structure in MAFF and its subordinate organizations would be reviewed in this chapter, especially stressing as follow ;

First, the flexibility and standardization for the agricultural database and model base in system development section. Second, the efficiency and expansibility of the hardware maintenance and network management in system maintenance section. Third, office automation, education, documentation, project management in system management section.

1. The State of Agricultural Information System.

A. The History and Development

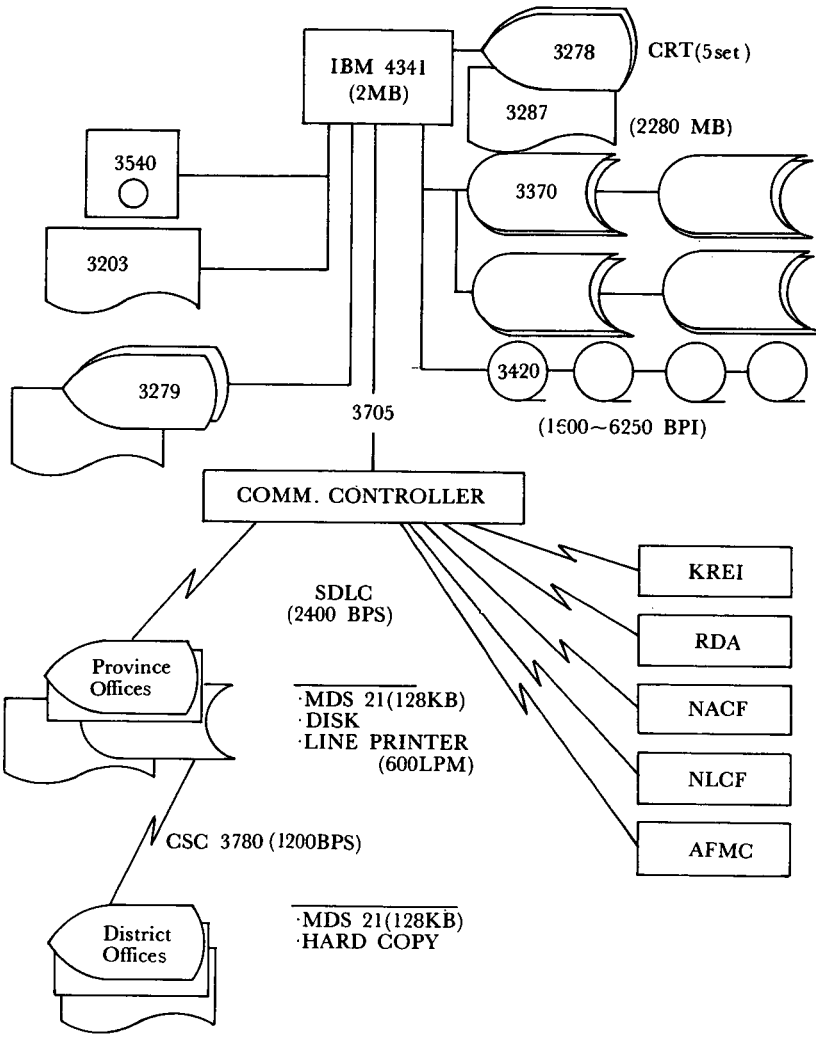
TABLE 1. **The History of Computer Network of MAFF.**

Year and Month	Event
1971. 1	Computerize the 1970 ag. census data processing with GCC computer.
1973. 3	Computerized the data processing of farm household economy survey and production cost survey
1974. 3	Lease key-punch machins
1979. 12	Lease host computer(IBM 370/125, 128KB), and set up information network(TTS) with 30 terminals (MDS21)
1980. 12	Lease additional 50 terminals(MDS21)
1981. 9	Lease additional 72 terminals(MDS21) (total 152 terminals)
1983. 1	Change the host computer to IBM 4341 K-10(2MB)
1984. 1	Connect with the relevant organizations(GCC, EPB, RDA, NACF, etc)
1984. 8	Expand on-line network system to provincial offices
1985. 8	Expanded on-line network system to country branch offices

B. Computer System.

Main computer is IBM 4341/K10 of which memory is 2MB. The communication method is SDLC between the center and province offices and is BSC between province offices and district offices shown as Fig. 1.

FIGURE 1. **Computer System**



C. Computerized Information Processing.

Information processing in MAFF is composed of three major applications such as statistics, marketing and food grain management.

First, statistical system is divided into economy subsystem and production subsystem. Their main objectives are to survey the production data of various crops and collect data of farm household economy. From the characteristic point of view, those processings are on-line batch oriented and, therefore, in the statistical information processing, the transition from the

accumulated but unstructured data files to D/B and the development of information retrieval and analysis system are urgent. The statistical information processing is composed as shown in Fig. 2 and the DFD(Data Flow Diagram) is shown in Fig. 3.

Second, the objectives of marketing information processing are to moniter the variation of livestock price and marketing quantity and to distribute nationwide these informations. The characteristics of marketing information processing are the speed and the accuracy, therefore the on-line real-time processing network between the district offices and the computer

FIGURE 2. **The Composition of Statistical Information Processing**

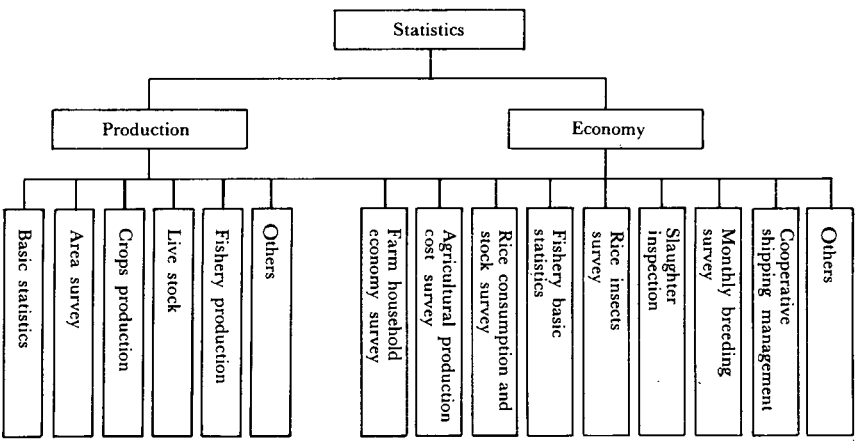
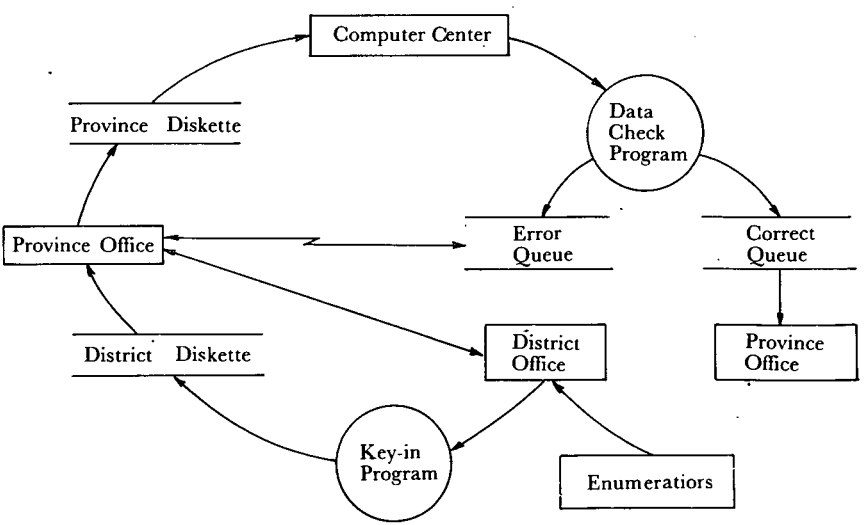


FIGURE 3. **DFD of Statistical Infromation Processing**



center is inevitable. The current composition of marketing information processing is shown in Fig. 4 and DFD is shown in Fig. 5.

FIGURE 4. **Composition of Marketing Information Processing**

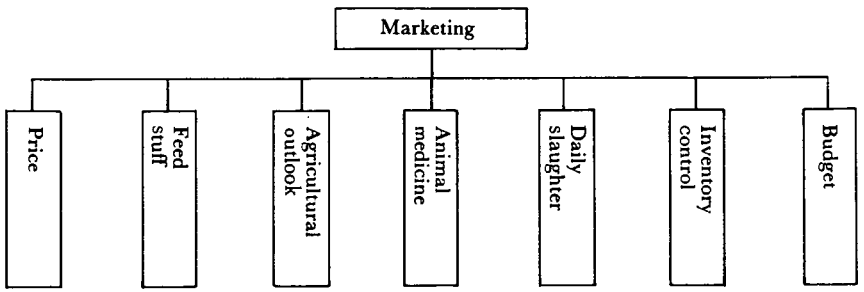
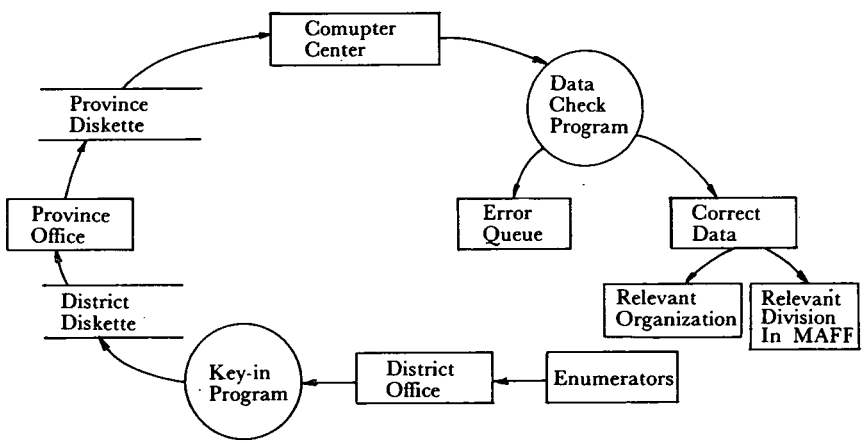


FIGURE 5. **DFD of Marketing Information Processing**



Third, food grain management of releasing, selling and purchasing subsystem have been computerized and are accounting and stock management subsystems are under development now. By its importance and quantity, the computerization of food grain management should have done much earlier. When a total grain management system is established and implemented, MAFF would enjoy the enormous direct economic benefit far more than the investment for the development. The composition of food grain management system is shown as Fig. 6 and DFD is shown as Fig. 7.

FIGURE 6. **Composition of Food Grain Management**

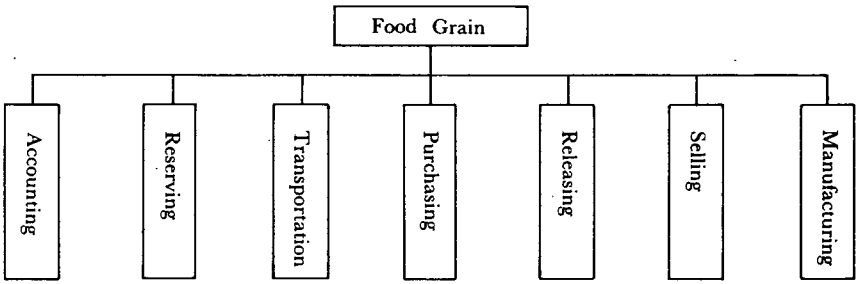
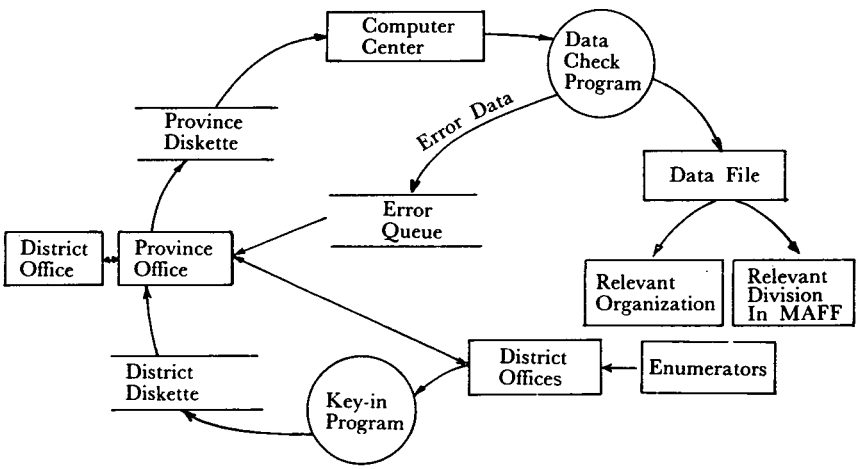


FIGURE 7. **DFD in Food Grain Information Processing**

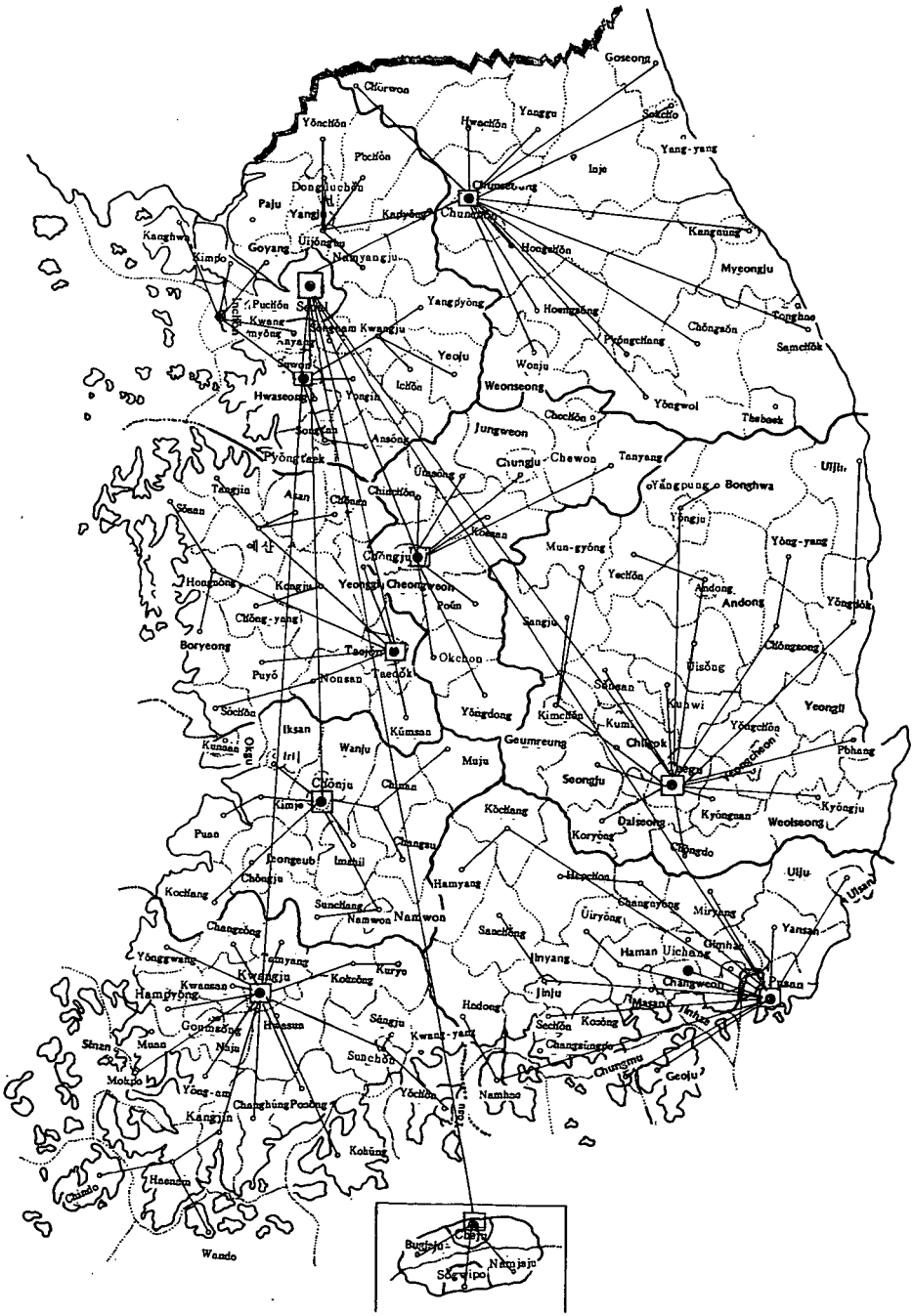


D. States of The Network Structure.

A network communication protocol between the host computer and the terminals in province office is SDLC(Synchronous Data Link Control), while a protocol between the province office and the district office is BSC(Binary Synchronous Control). Therefore, the structure of the network in MAFF is not on-line oriented but off-line oriented.

MAFF computer network are connected by the private circuits and transmission speed is 2400 BPS(Bytes Per Second) between the center and the province offices, and 1200 BPS between the province offices and the district offices. The composition of computer network in MAFF is shown in Fig. 8.

FIGURE 8. **The Composition of Computer Network of MAFF.**



2. Information Processing Structure in the Relevant Organization

MAFF and its relevant organizations have three major information networks such as agricultural administration network, finance network, research and extension network, which are representing marketing, environment and production.

First, the main objectives of agricultural administration network are the collection, processing, analysis and distribution of information and the

TABLE 2. **Kinds and Major Applications of the Computer System in the Subordinate Organizations**

Organization	Host System		Per-	Applications
	Maker and Series Name	Capa- city	sonnel	
Rural Delevolment Administration (RDA)	VAX11/785	6MB	10	Agricultural Experiment and Extension Services Technical Information General Administration
National Fisheries Administration (NFA)	MDS21–50	128KB	6	Fishery Information Management Resource Management
Forestry Administration (FA)	NEC100–85	512KB	2	Forestry Research Personnel Management Information Management
National Livestock Cooperative Federation (NLCF)	IBM4361 IBM5280	4 MB 512MB	40	Accounts Management Livestock Outlook Analysis General Management
National Agricultural Cooperative Federation (NACF)	UNISIS 1100/72H2 UNISIS 1100/62E2	3MB 1.5MB	170	Accounts Management Marketing Information Processing and Distribution General Management
Korea Rural Economic Institute (KREI)	MV7800	4MB	13	Economic Analysis and Forecasts General Research Public Opinion Survey
Agricultural Fishery Marketing Corporation (AFMC)	MDS21	256KB	20	Wholesale and Retail Price Analysis Marketing Trend Analysis General Management
Agricultural Development Corporation (ADC)	PRIME550	1.28MB	7	Design and Techinical Calculation Mathemathical Programminmg Structure Analysis

networks of MAFF, NFA, FA, AFMC, KREI, belong to this category. So far these organizations have been partially connecteed by a on-line network around MAFF.

Second, the finance networks are to process the transactions of the farmer's saving and credit accounts, and incidentally to process the farmer's marketing and economic information for their own purpose.
The networks of MAFF and NLCF which have their own host system belong to this category.

Third, the research and extension networks are to provide not only the computing power but also the technical and bibliographical information such as AGRIS. The system in this network has a close relationship with the production field and often needs microelectronic techniques rather than the information processing through computer network.

By definition, we would focus our interests and efforts to the agricultural information system mainly related with the system in the first category.

Ⅲ. Agricultural Information System Analysis

An analysis for the new information system is to review the environments based on the information collected through the states and structure surveys on the current information processing system and to define the objectives and the practical limitations for a new system. For this analysis, a set of forms to summarize the output have been designed.

1. Analysis of Current States.

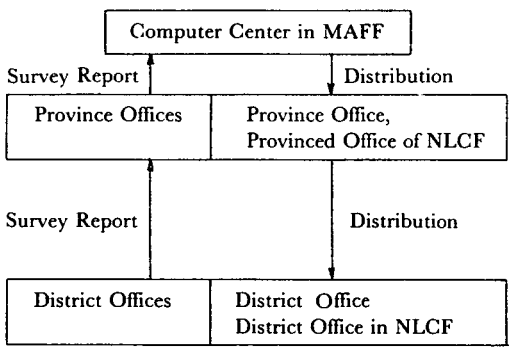
TABLE 3. **General Summary Table of Livestock Management Operations(Example)**

Division Name		The Livestock	Section Name		Large Livestock	
No.	Operation Name	Life Cycle	EDP/ Manual	Inner/ Outer	Destination	Sorce
1	Livestick Marketing Information	Everyday		Outer	District Offices Large Livestock Section	(Input)
2	Consumption Status Report of Milk and Milk Product	Every Month		Outer	District Offices Large Livestock Section	(Input)
3	Supply and Demand Adjustment, Price Trend Analysis	Everyday		Inner	Minister, Vice-Minister, Director-General	
4	Breeding Status Analysis	Every Quarter		Outer	Province Offices District Offices	(Output)

Major analytical tasks for the operations in MAFF through the selection of the pivoting operations which have a considerable potential for the computerization, are to establish the general summary table of operations to examine objectives, I/o information flow, decision making process, problems and possible improvements, and to provide those informations as a source in the design stage. Table 3 and Table 4 are simple examples of the general summary table of operations and the work sheet of one pivoting operation in livestock division.

TABLE 4. **Work Sheet of Pivoting Operation(Example).**

Division : Livestock — Section : Large Livestock

Opertion Name	Livestock Marketing Information	The Person in Charge: Lee Sang Su
Objections of Operation	By collecting and analizing the daily price and marketing status, the reliable policies for the supply-demand adjustments and the price stabilization are devised.	
		Remark
DFD		
Decision Making	–Based on the livestock demand and supply data and the price data, set up the policies on the price stability –Generate the leading indicators for the support of farmer's decision	
Problem	–Should eliminate the waste of time, budget and man power which used for the routine operations.	
Possible Improvement	–Introduce the computerized data processing system. –Formulate the decistion support model.	

2. Analysis of the Computerized Data Processing System

An analysis of the computerized system is to document all the systemized operations with the standardized forms. The output could be used in the design stage as a key indicators for the system integration and expansion. The system documentation has been proceeded by two parts as shown in Table 5.

The part of work status is for the general operational summary. The part of computerized processing status is to review the possibility of

standardization, which now differs in each operations. Total numbers of system documentation are about 100 files.

TABLE 5. **Table of Contents in System Documentation.**

Work Status	Computerized Processing Status
1. Purpose	1. Data Storage Status(File Structure,Volume)
2. History and Development	2. Survey Form
3. Objectives	3. File Layout
4. Personnel in Charge	4. Code System
5. Theoretical Basis	5. Process(DFD+DD+HIPO)
6. Operation Life Cycle	6. Program Status
7. References	7. Pre-Defined Output
8. Competent Division, Section	8. Relevant Information System
9. Others	9. Others

Ⅳ. Logical Design of Total Agricultural Information System.

Total agricultural information system is not merely gathering of many information systems which are operated individually but systematically interweaving to make one large information system which could cover the information demands from the famers decision making to the agricultural policy simulations which could be used to minimizing the uncertainty of agricultural environment.

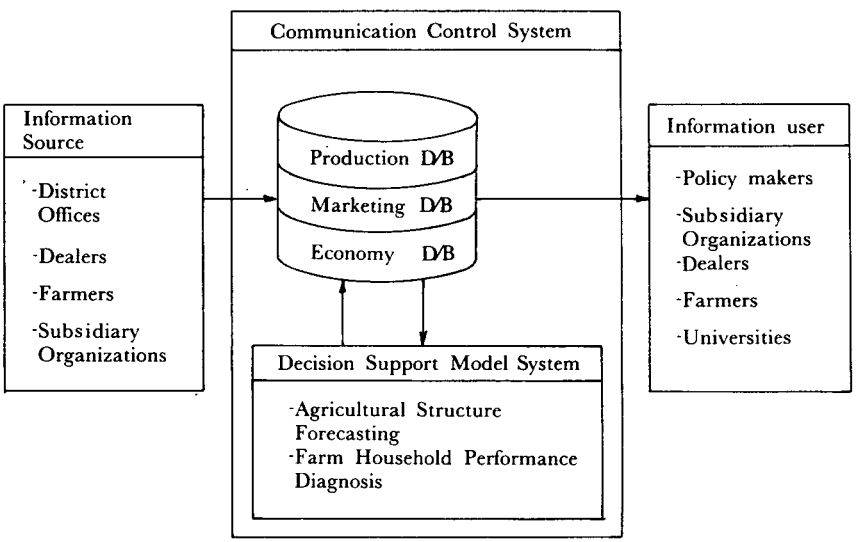
Almost all of the current agricultural data processing is to collect and distribute the surveyed data, therefore the figures of which have no meaning in other purposes, and decision supporting function of the information system is very poor. Therefore, the current agricultural information system could be characterized as in a data administration stage where the computer only replaced our hands, eyes and mouths, rather than in a information management stage where the computer replace our intelligence, accumulated experience and wisdom.

In the statistical information processing, annual data of farm housholds production and economy have been collected for years but seldom or never used as a key input of major policy making process. In the marketing information processing, the prices of 140 agricultural and fishery products are surveyed and distributed but are not connected to the related systems, which needs those information, such as production trend analysis system and shipping planning system. In the food grain managememt system, operations of selling, supply and demand reporting, demand forecasing are computerized. But it is nearly impossible to get the benefit from the computerization without a small but total system in which all the unit operations from production and demand forecasting to transportation, reserving and accounting are fully connected and systemized.

In each case and for all, deficiency in systemization is apparent and it is

because there has not been a systematic concept of total agricultural information system and a rational development strategy. Through the policy making process, to get the objective and correct information, to use the scientific decision techniques and to execute the timely and stable administrative operations, the fundamental transition from the simple mechanization to the systemization is inevitable. The proposed total agricultural information system, conceived by this background, is composed physically of the database management system, which collect, process and store all the relevant informations in the national level, the decision support model system, which produce the processed informations using D/B, and the communication control system, which circulate informations between inter or intra systems.

FIGURE 9. **Physical Composition of Total Agricultural Information System**



Meanwhile, total agricultural information system is largely divided into 3 information subsystems according to their informatic functions.

First, agricultural production subsystem is composed of 11 systems(fertilzer, blight and insect, feed stuff, seedling, science and technology, farm management, agricultural weather, land, water supply, yield, machinery).

Second, agricultural marketing subsystem is composed of 5 systems-(marketing, international trade, transportation, marketing control, collection, reserve and processing).

Third, agricultural economy subsystem is composed of 4 systems as shown in Fig. 10.

Fig 10. **Functional Composition of To Agriculture Information System**

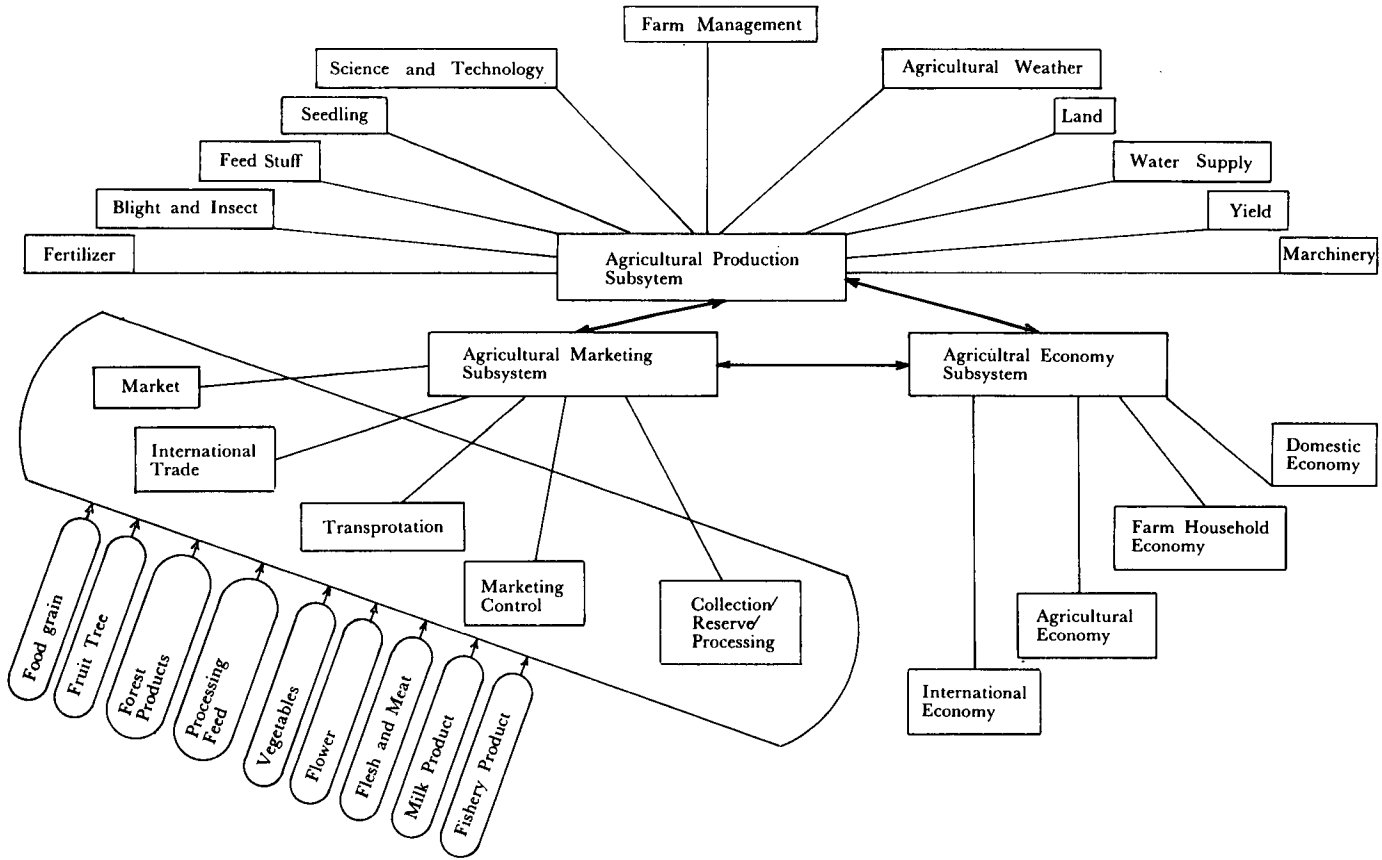
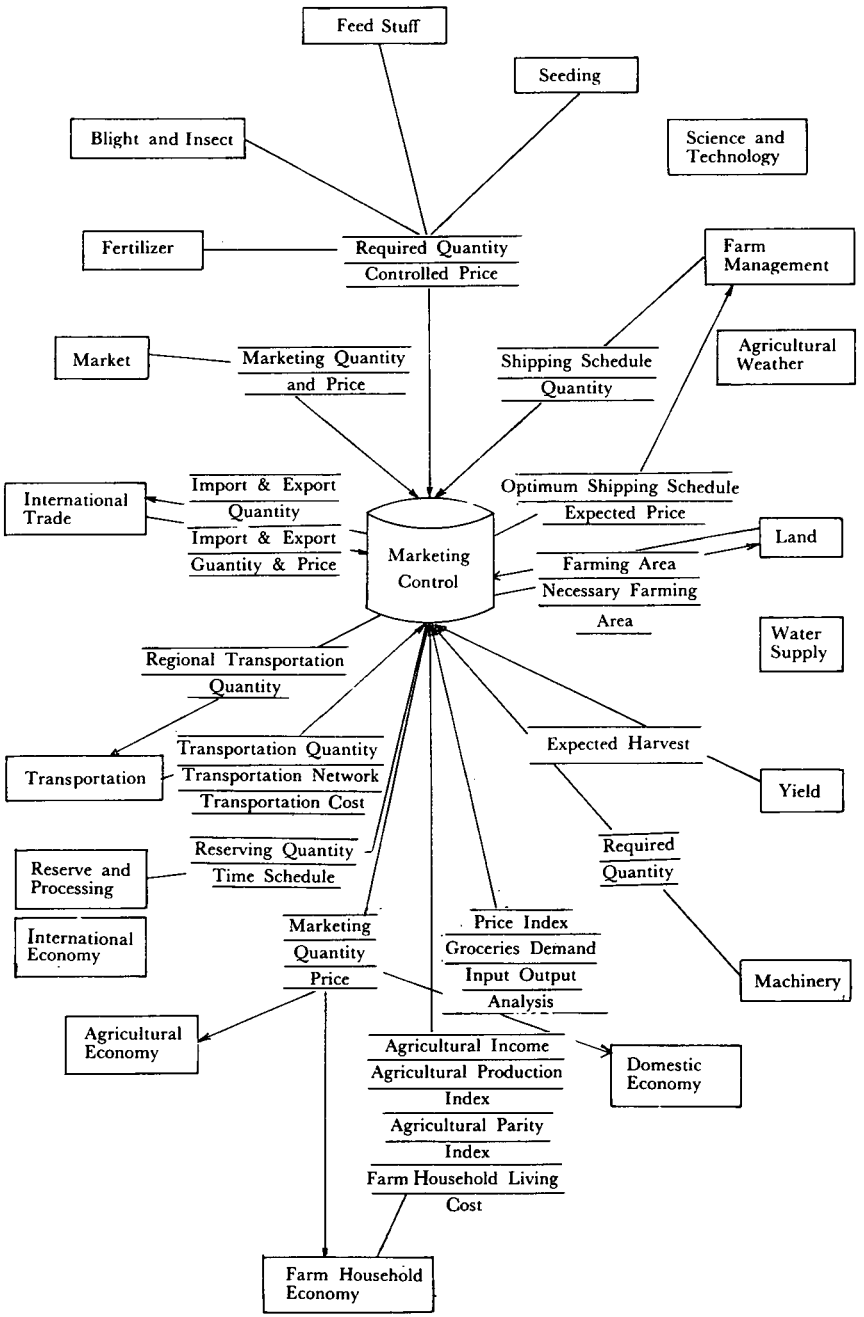


FIGURE 11. **Information Processing Scenario for Marketing Control System**



2. Information Processing Scenario and D/B Composition

For the design of the 2nd stage information system, 20 functional information processing scenarios have been established based on the output of the system analysis. This scenario has a complex structure and would play an important role as an infra-structure in later developments. The numbers and kinds of decision support models, the size of databases and the methods of communications have been proposed by this designed scenrios in the conceptual design process. The organizational relationship between these systems would be accentuated in the 2nd stage of system design. For example, the scenario for the agricultural marketing control system can be briefly summarized as Fig. 11.

An information processing cycle in the agricultural marketing control system starts with determining the production scale by receiving informations of price index from the domestic economy system, the informations of agricultural production index, main grocery consumption and agricultural contribution ratio from the agricultural economy system, informations of regional characteristics and regional production trend from the farm household economy system.

Once the agricultural production scale is determined, then it is connected to the land system to calculate necessary farming area. In the land system, a national farming structure is determined considering the technical indexes such as regional weather and soil composition. Once farming area for each crop is determined, this information is keyed in the land system back.

Now, to derive the regional requirements of agricultural materials by crop and time, this system is connected to the fertilizer system, the feed stuff system, the seedling system, the agricultural machinery system and the blight and insect system. Then in each system, the production and price of the materials are surprised.

Also, the information of insufficient or surplus amounts which is estimated by considering farming area and the food requirments is transfered to the international trade system, where used as a basic input of import and export operations.

When crop cultivation begins, the marketing control system receives the information of expected harvest from the yield system and establishes a demand and supply policy and therewith modify and supplement indexes for the subsequent information processing.

When it becomes harvest time, the marketing control system receives the shipping schedule from the farm management system and by the pre-determined demand and supply control plan, determines shipping date, quantity, market and the expected price and makes a purchasing plans for some government controlled items.

Once shipping starts, the marketing control system receives the marketing information of quantity and price on the real time basis and adjusts the

TABLE 6. **Volume and Variety of Information.**

Flow	Characteristics	Processing Method
C–Collect D–Distribute	C–String G–Graph N–Numeric V–Voice	B–Batch R–Real Time

17. Marketing Control System

Information Name	Flow	District				Province				National			
		Volume	Cycle	Char.	Proce.	Volume	Cycle	Char.	Proce.	Volume	Cycle	Char.	Proce.
Demands(Region, Crop)	–									26MB	1/Mon.	N	OB
Expected Shipping Quantity	C	26MB	1/Mon.	N	OB								
Farming Area	C	22MB	4/Year	N	OB								
Machine Requirements	–									2MB	4/Year	N	B
Price Index	–									5MB	1/Mon.	N	B
Food Demand	–									5MB	1/Mon.	N	B
Industrial Index	–									5MB	1/Mon.	N	B
Reserving Capacity	C	93MB	1/Mon.	N	OB								
Warehousing Status	C	93MB	1/mon.	N	OB								
Transportation Quantity	C	93MB	365/Y.	N	R								
Transportation Network	C	93MB	365/Y.	N	R								
Transportation Cost	C	93MB	365/Y.	N	R								
International Trade	–									5MB	1/Mon.	N	R
Marketing Price, Quantity	C	5MB	Occas.	N	R								
Agricultural income	C	12MB	1/Mon.	N	OB								
Production Index	–									5MB	Occas.	N	B
Parity Index	–									5MB	Occas.	N	B
Agricultural Contribution	–									5MB	Occas.	N	B
Shipping Time,Expected Price	–									5MB	Occas.	N	R
Required Farming Area	–	22MB	4/Year	N	OB					22MB	Occas.	N	OB
Marketing Price,Quantity	D									5MB	365/Y.	N	R
Reserving Capacity	D									93MB	Occas.	N	R
Time Schedule	–									7MB	Occas.	N	R
Regional Transportation Requirements	–									93MB	1/Mon.	N	OB
Imports, Exports Requirements	–									5MB	1/Mon.	N	OB
Price Forecasting	–									4MB	1/Mon.	N	OB

major control parameters such as transportation quantity, transportation network, buying and selling quantity to balance the national marketing network.

All the information whether they are by product informations or the processed informations during the cycle are sent to the economy subsystems in the summarized forms, then used as inputs of the various analyses and evaluations of agricultural policies.

Though the information processing scenario of the agricultural marketing control system is briefly explained in previous paragraph, the actual information processing structure between subsystems is massive and complex. Major sorts of informations which would be stored in the marketing control database are shown in Table 6. The volume of information generated from one information processing cycle of the agricultural marketing control system has been estimated such that for 20 input informations would be about 600MB and for 10 output informations about 250MB (IMB is about 1 million characters).

The information processing method in the marketing control system would be mainly the on-line real-time processing.

As a summary, 20 database and their major input and output informations are shown in Table 7.

3. Composition of Decision Support Model System

The decision support model system is composed of about 100 models which process the stored informations in the previously mentioned 20 D/B's and customize for the operations of diagosis, analysis, forecasting and planning (Table 8). As an example, the farm management planning model would be explained. The farm management planning model could generate the optimum farming structure at national, regional or farmer's level.

Fig. 12 shows the general scheme of the model and reads as follows :

First, farmer keys in the lot address and his first intention of crop composition, then this model connects and receives internally the land register information from the land D/B, analyzes the soil properties *via* the science and technical D/B, and processes them with the average weather condition from the weather D/B to determine the most profitable crop and seeds.

By iteratively simulating all the available land and considering the consumption pattern and price trends, the model eventually would give the globally optimum farming structure. Once determined crop and area, the model determines the required agricultural materials(fertilizer, agri-medicine, machinery) and the farming schedule and also gives the shipping policy and the expected income.

4. Standadization

One of the most important subject in the information system design is

TABLE 7. **D/B System and Major Informations**

No.	D/B Name	I/O	Major Informations
1	Fertilizer D/B	I	Unit Fertilizer Requirements, Fertilizer Demands
		O	Fertilizer Requirements by Crop, Time, Fertilizer Demands and Supply Plans, Regional Demands Forecasts
2	Blight and Insect D/B	I	Disaster Status Agricultural Medicine Used Purchasing Cost and Quantity Animal and Plant Disinfection Status
		O	Optimum Agrimedicine Requirements Disaster Forecasting Disaster Diagnosis Agrimedicine Demand and Supply Plans
3	Feed Stuff D/B	I	Unit Feed Stuff Requirements, Feed Stuff Purchasing Quantity and Price Livestock Breeding Status Feed Stuff Production Status
		O	Optimum Feeding Quantity Feed Stuff Demands Forecasts Feed Stuff Demand and Supply Plans
4	Seeding D/B	I	Unit Sowing Quantity Seeding Purchasing Quantity and Price
		O	Seeding Productivity, Optimum seeding Seeding Demand and Supply Plans
5	Science and Technology D/B	I/O	Breeding Techinique, Processing Techinique, AGRIS Counter-Disaster Technique
6	Farm Mangement D/B	I	Material Cost Production Cost Farming Area
		O	Optimum Farming Schedule, Expected Income Farm Management Diagnosis
7	Agricultural Weather D/B	I	Agricultural Weather
		O	Agricultural Weather Forecasting
8	Land D/B	I	Soil Property, Fertility Farming Area Land Change and Arrangement Scheduled Development Plan
		O	Land Productivity Optimum Farming Structure
9	Water Supply D/B	I	Water Supply Status
		O	Water Supply Plans
10	Yield D/B	I	Farming Area Weather
		O	Expected Yields(Crop, Vegetable, Fruit, Livestock, Fishery)
11	Agricultural Machinery D/B	I	Machine Maintenance System Machine Possession Status
		O	Machine Productivity Machine Efficiency Machine Requirements

TABLE 7. **(Continued)**

No	D/B Name	I/O	Major Informations
12	Domestic Economy D/B	I/O	Population, Price Trend Economic and Social Development Plan GNP, Industrial Production Food Balancing Sheet, Population Migration, Wages
13	Agricultural Economy D/B	I	Agricultural Structure
		O	Agricultural Contribution Farm Household Producion Cost Agricultural Production Cost Agricultural Parity Index
14	Farm Household Economy D/B	I/O	Regional Index(Finance, Industrial Activity, National Condition) Land Utilization, Factory Condition of Location, Medicare Status, Educational Environment, Road/Transportation/Communication, Water Supply and Drainage
15	International Economy D/B	I/O	Farming Area, Population, Income, Agricultural Production, Food Balancing Sheet, International Marketing Quantity and Price
16	Collection/ Reserving Processing D/B	I	Reserving Quantity, Regional Transportation Requirements
		O	Warehousing Plans
17	Marketing Control D/B	I	Regional Demands, Marketing Price and Quantity
		O	Shipping Time and Expected Price, Marketing Quantity and Price, Network Balancing Plans
18	Transporta–tion D/B	I	Regional Transportation Network. Demands, Unit Cost
		O	Network Structure, Network Status
19	International Trade D/B	I	Import and Export Requirements
		O	Country, Quantity, Price, Transportation
20	Marketing D/B	I/O	(Farm, Wholesale, Retail) Price, Expected Price, Production Cost, Shipping Quantity

standardization. This is because the agricultural information system incorporates the information processing of not only MAFF but the major subsidiary organizations. Thus, kinds of protocols should be established to maintain the compatability between organizations, techniques, operations and resources.

As it is now, the individual system development and the introduction of computer equipments in each organization's own style would be the serious obstacle to the free communication and share of the cumulated agricultural experience between organizations. Therefore, to establish small but efficient information system in the long-run, standardization should be considered before the detail system design begins about main computer, communication network, software(language, package, DBMS, operating system), multi-function office automation equipments, organization and other resources. As an

example about the necessity of standardization, the crop code used in MAFF is shown in Table 9.

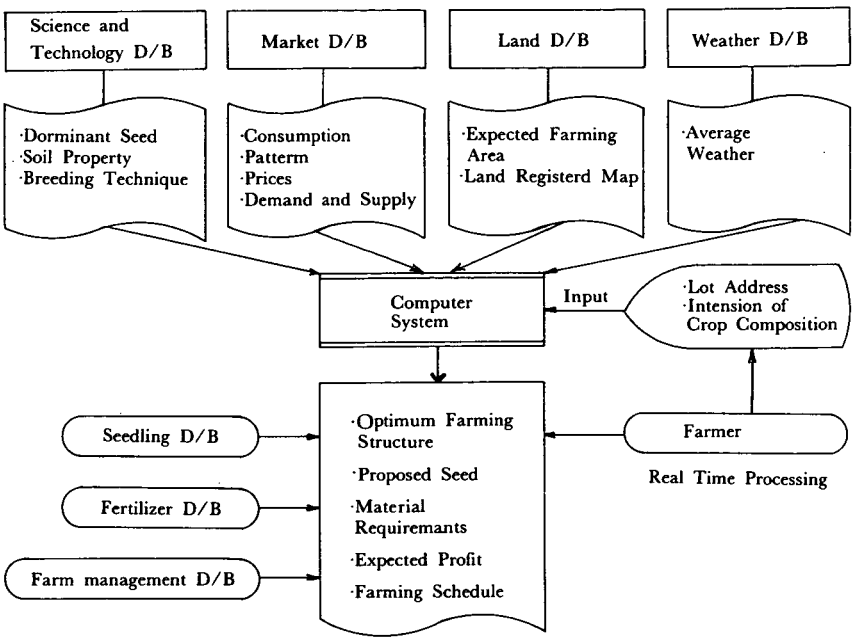
TABLE 8. **Composition of Decision Support Model System**

No	System	Major Models
1	Fertilizer System	Optimum Fertilization Model Fertilizer Demand and Supply Analysis Model
2	Blight and Insect System	Agrimedicine Demand and Supply Analysis Model Disaster Forecasting Model
3	Feed and Stuff System	Optimum Feeding Model Demand Supply Analysis Model
4	Seedling System	Seedling Demand and Supply Analysis Model
5	Science and Technology System	Technical Information Processing Model
6	Farm Management System	Farmhouse Management Model
7	Agricultural Weather System	Agricultural Weather Forecasting Model
8	Land System	Farming Structure Model
9	Water Supply System	Agricultural Water Supply Management Model
10	Yields System	Production Forecasting Model Production Analysis Model
11	Machinery System	Machine Requirements Forecasting Model Agricultural Machine Productivity Analysis Model
12	Domestic Economy System	Population Migration Analysis Model Input Output Analsis Model
13	Agricultural Economy System	Food Demand Forecasting Model
14	Farm Household Economy System	Regional Characteristics Analysis Model Structure Analysis Model
15	Internaltional Economy System	International Agricultural Trend Analysis Model
16	Collection/ Reserving and Processing System	Inventory Control Model
17	Marketing Control System	Price Forecasting Model Demand and Supply Analysis Model
18	Transportation System	Network Management Model
19	International Trade System	Internaltional Price Analysis Model
20	Market System	Price Analysis Model

TABLE 9. **Crop Code System**

Crop Code in Production Systems	Crop Code in Marketing Systems	Crop Code in Economic Systems
Sweet Potato a123 15105	Sweet Potato 15100–15104	Sweet Potato 022
Spring Potato a123 15211	Potato 15200–15201	Potato 023

FIGURE 12. **General Scheme of the Farm Management Planning Model**



V. Physical Design of AIS.

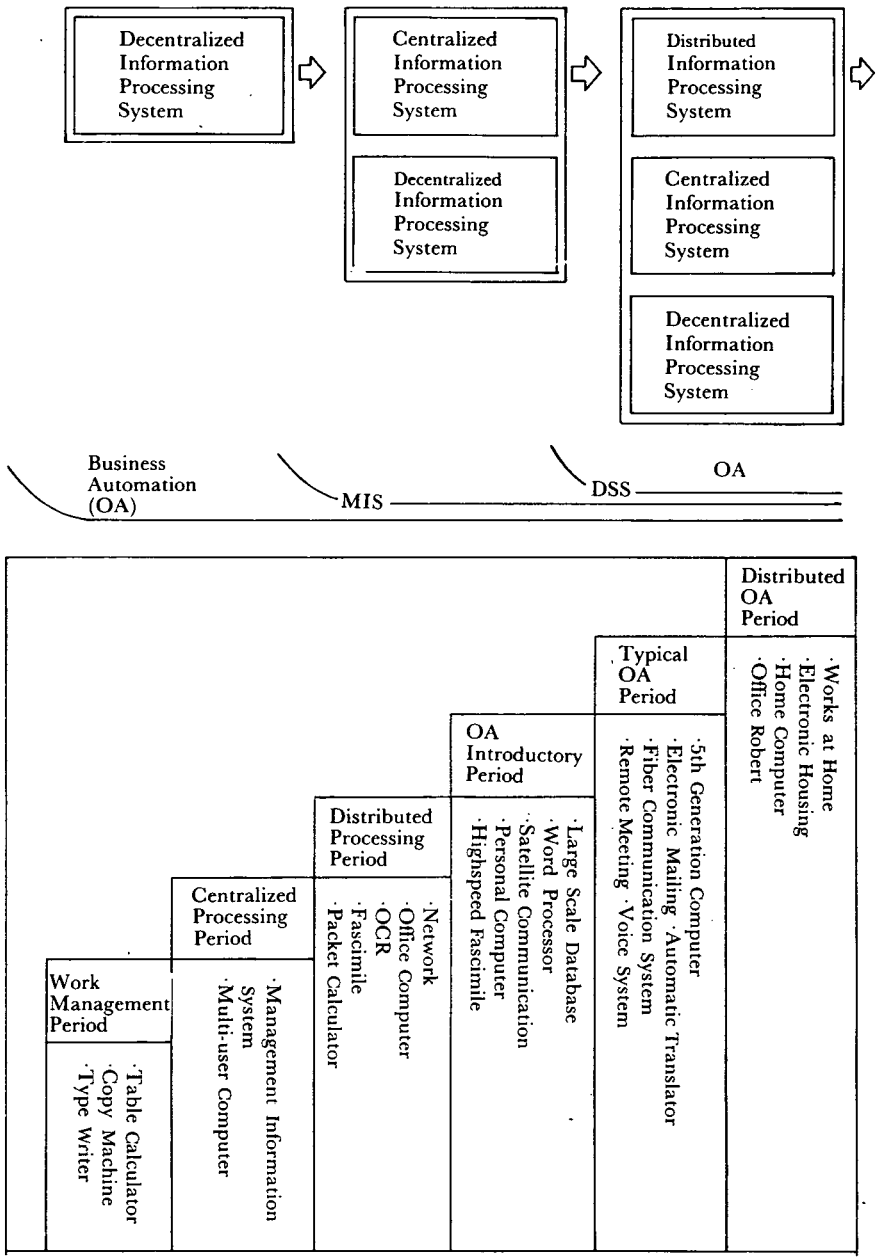
1. Shape of AIS

Generally an information processing system starts from a decentralized system with micro or mini computer, moves to the centralization information processing system with multi-users and large computer, then the user oriented distributed information processing system (Fig. 13).

The agricultural information system could be regarded to follow the same trend of system development. Currently the information processing in MAFF system is mainly the centralized type. This is justified since the collection and the distribution are its only processing. But in a near future, when almost all operations are processed using the inter-organizational informations, the information processing demands will be increased and concentrated rapidly. To alleviate the system's burden, AIS needs to follow three development stages as follows :

1st stage ; The 1st stage is to fix and improve the current centralized information processing system. In this stage, AIS would expand its on-line network on the national scale and establish functional subsystems. This

FIGURE 13. **Development of Information Processing System**



network would cover all the district offices, and the province offices, which would be composed of 200 terminals.

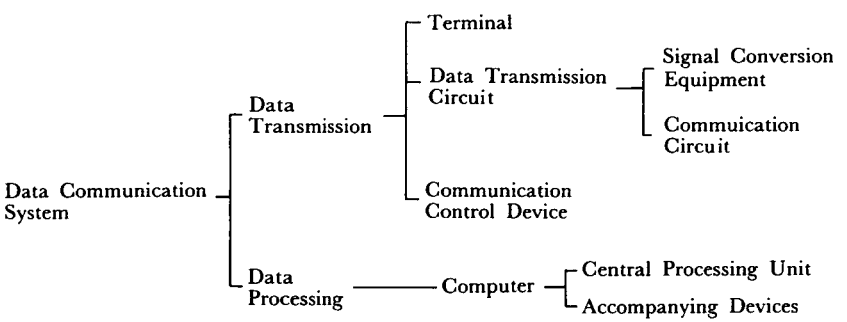
2nd stage ; During this stage the network would extend to connect NACF, NLCF, AFMC, KREI, RDA, NFA, FA. It would establish the hierarchical distributed systems to enable the regional information processing and show the general shape of the fundamental structure of AIS by absorbing the networks of the subsidiary organizations. By this stage, almost all routine and fomal decision processes would be operated by AIS.

3rd stage ; The 3rd stage would be the completion stage to connect AIS to the national computer network. In this stage, through AIS network, much of the local administrative informations would be supported, and AIS network would be the back-bone of the national network by its quality and quantity.

2. Data Communication

Data communication can be defined as to connect the main host, its accomplishing I/O devices and other equipments to the communication circuit then to sent, receive, or process informations by this circuit. Data communication combines data transmission and processing for special purpose organically, then constitutes the new system as shown in Fig. 14. As in the previous sections, where database, information processing scenario, and decision support model system were discussed, in this section the AIS'

FIGURE 14. **Composition of Data Communication System**



Division	Information Source	Data Transmission Equipment	Information Sink
Composition	Computer — FEP (DTE)	DCE — DCE (DSU)	TERMINAL (DTE)

development strategy in aspect of data transmission, especially communication circuit, circuit composition status and protocol would be discussed.

The current data transactions are mainly numeric batch processing, however the mixed mode real time transaction of character, graph, and voice informations would be the standard as the variety of operations are absorbed into AIS. The characteristics of AIS data is to have a relatively long length and massive volume, therefore, communication length is long and this would not be changed for the time being. The frequency of data transaction is much lower than the bank on-line system or the air line reservation system and the response time constraint is not severe except for some special applications.

The proposed development strategy for the data communication can be read as follow ;

1st stage ; The network in the 1st stage would be structured by direct connection between center and regional offices as it is now. Since the number of terminals would be big enough, the shape of circuit composition would be the central branch circuits type, connecting several district offices with MUX's by considering centralized data and circuit management and response time(Fig. 15).

2nd stage ; The communication control processor at every province office would be introduced partly for the distributed processing and for the economy and efficiency of the circuit composition. For the communication between the center and the province offices, the high speed digital leased line would be used.

3rd stage ; The shape of AIS communication network would be like the wideband local area network. In this stage, AIS would be able to incoporate any kind of computer network, any type of data transaction constituting virtually one information network.

3. Data Base System

Recently the kinds of agricultural information and their quantity inceases rapidly. By now, books on the statistics exceed 100. Thus it is very difficult for users to obtain all these books and it costs considerable time to search the necessary items in these books. That is one of reasons why AIS should construct the on-line database system which collects, arranges, processes and analyzes the various agricultural or relevant informations and offers the accurate information rapidly at user's demand.

Major functions of database are, first, editing and storing function, second, processing and analyzing function to process and analyze raw data third, editing and printing function to communicate easily with users, fourth, information retrieval function. Data base system's development strategy is shown in Fig. 16 and reads as follows ;

FIGURE 15. **1st Stage Network Structure Plan**

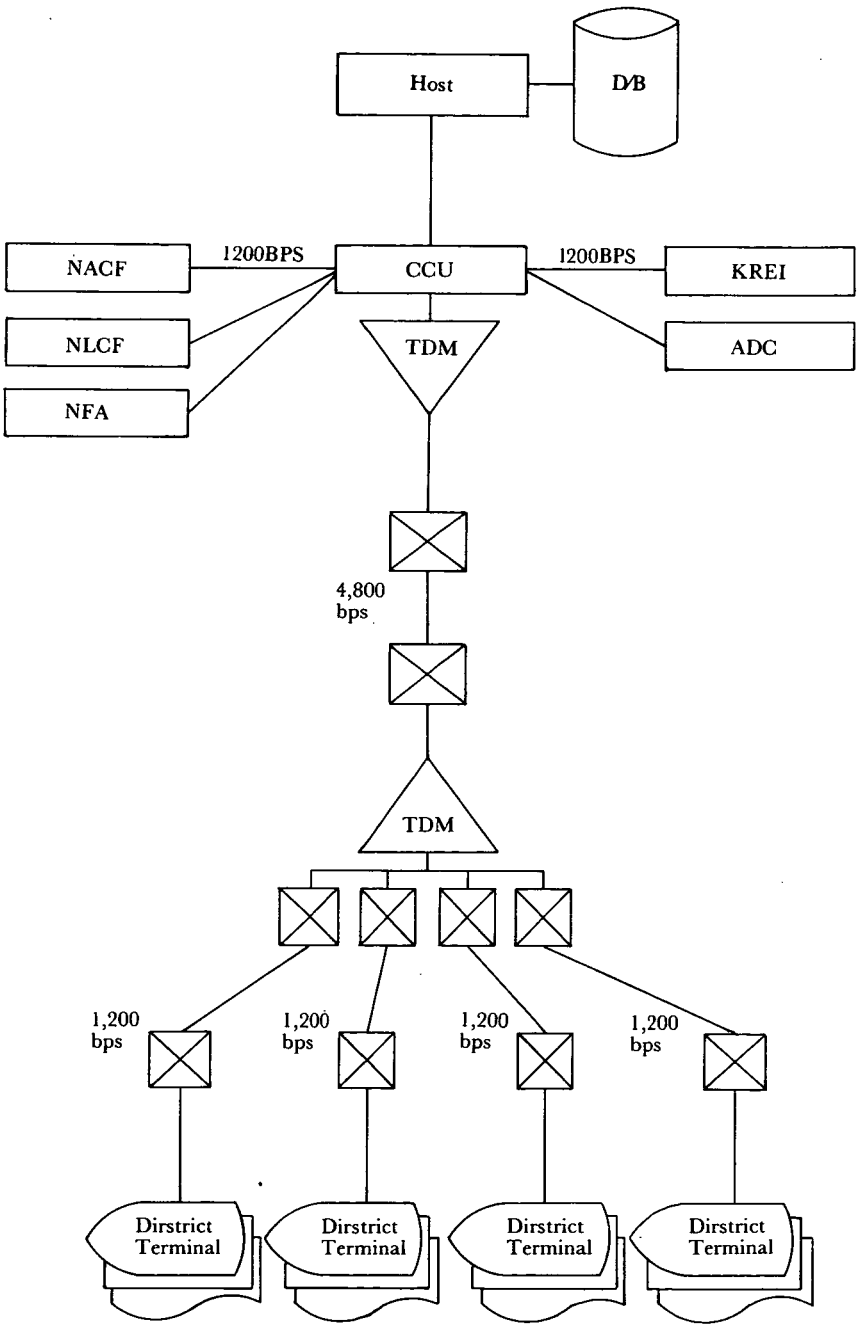
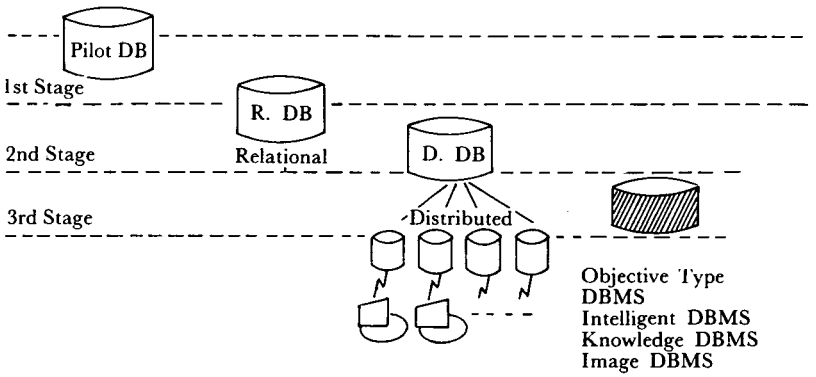


FIGURE 16. **Developement Strategy for Database System**



1st stage ; Here is the stage to develop the pilot D/B and test DBMS. In this stage, AIS would proceed the tasks of standardization and accomplish the prerequisites for the expansion.

2nd stage ; It would be the beginning stage to construct the relational and distributed database system preparing for the enforcement of local self-government and local administration. It would be the important tasks in this stage to fix the data maintenance system especially for the security. For the development of the systematic information index and directory, it would be necessary to analyze and organize the relationship between the information function and the regional characteristics.

3rd stage ; In this stage, AIS would manage and operate the efficient distributed database system keeping the compatibility with other central, local and subsidiary organizations.

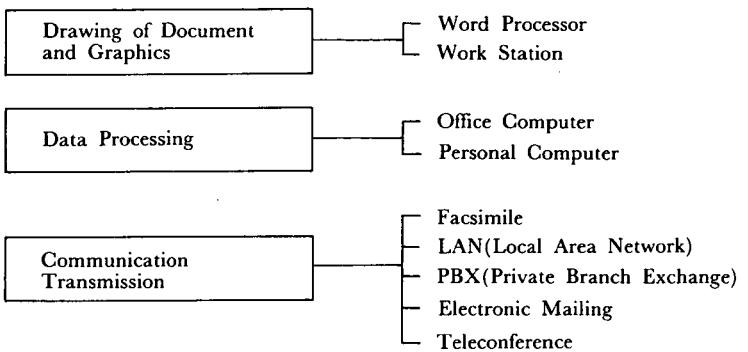
4. Office Automation System

OA, in a broad sense, is an enhancement of office productivity. The classification of OA machines according to the functions of office works is shown in Fig 17. As the number of agricultural organization increases, the limit has been already exposed in some special types of data processing (document, graphic, remote sensing). Also, as AIS grows, the compatability between the information processing and the administrative organizations should be maintained not only for their productivity but for the public confidence. Therefore, the OA has been regared as one of the AIS subsystems.

The proposed development strategy is as follows ;

1st stage(Point OA) ; In this stage, the necessity and feasibility of OA would be recognized and the various OA machines such as PC, facsimile,

FIGURE 17. **Classfication of OA Machines**



multi-function copy machine would be introduced over all organizations.

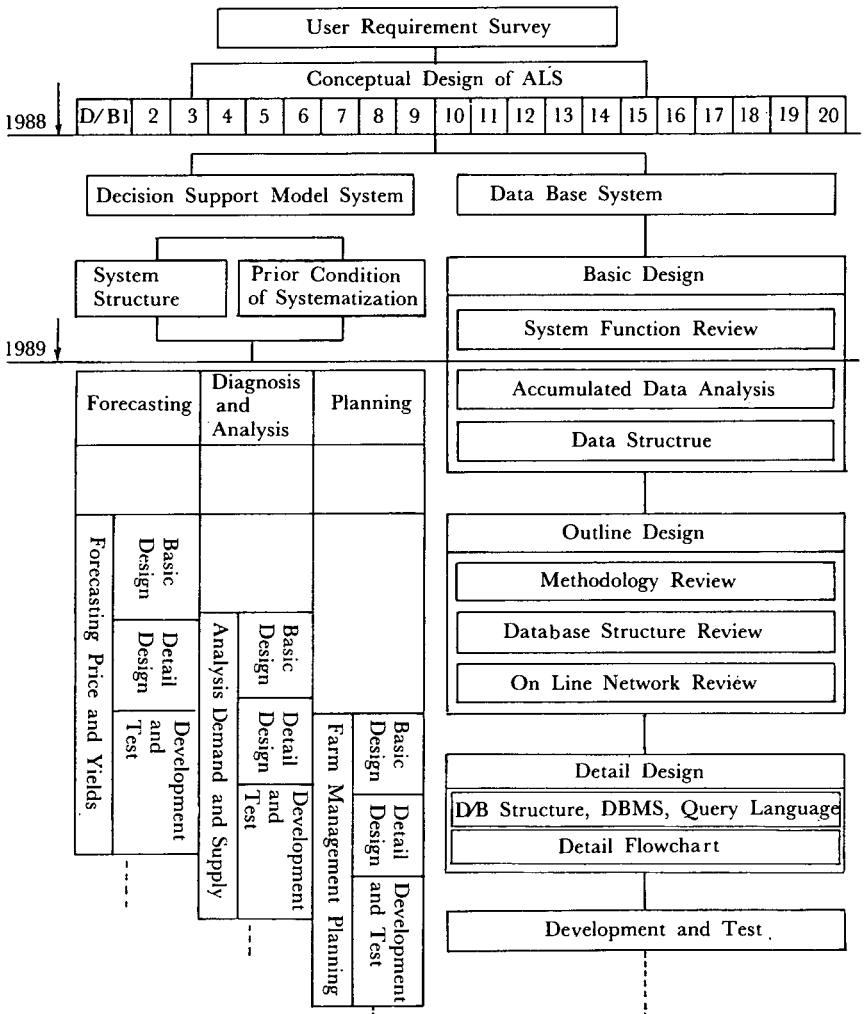
2nd stage(Line OA) ; By the connection between OA machines and computer system and by the interconnections of whole organization by one LAN, the series of automated operations of information collection, processing and distribution would be accomplished.

3rd stage(Surface OA) ; The maximization of administrative work productivity can be achieved by constructing the wideband LAN-like network between organizations and between other national information networks.

5. Software Development Strategy

For the allocation of development resources, the priority order has been assessed to the proposed information systems and the development schedule has been established according to their importance ratio calculated by the grade of complexity, target region, data volume. The aggregated and summarized schedule is shown in Fig. 18.

FIGURE 18. **Development Schedule**



Ⅵ. Conclusion

To relieve the inferiority of agricultural sector as an industry and to solve the so-called problems of transition period. AIS has been proposed. Aiming AIS, the current status and problems of MAFF and its subsidiary organizations were reviewed. Through 2 phase analyses of the operations and the information processings, the direction of the system structure were derived.

Based on the output of the analysis, the functional calssification of information, the conceptual composition of databases, the conceptual composition of decision support models, the design strategies for network, data communication, and OA system were proposed. Finally the development schedule were discussed so as to establish AIS with the minimum resources and within the shortest period.

As a concluding remark, based on the results of the conceptual design phase and the comments about it, the AIS development task force(S/W House) would set to the 2nd phase study for the detailed design of database system and the decision support model system.

By the end of the 2nd phase study period, AIS would reveal its substance, prove the transition from the production oriented data processing system to the user oriented information processing system, and show the possible direction to integrate all the relevant networks into virtually one AIS network.

However, all those good events can not happen one or two years. Therefore, the adjustment of the scope and direction by the change of our environments would be demanded. Until the moment of finish, the comprehensive investment, the extensive understanding and the harmony between task force and agricultural organizations would be vital to the accomplishment of AIS.

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